REVIEW ARTICLE

# Primary Care Approach to Asthma Management

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Asthma is a common heterogeneous syndrome characterized by airflow obstruction, bronchial hyper-responsiveness, and underlying inflammation. It is a major cause of lost work and school, lower quality of life and increased emergency room visits. Treatment involves a comprehensive step-wise approach to patient care, matching symptom severity with appropriate therapeutic intervention and close monitoring of clinical response. Well established guidelines have outlined the diagnosis and management of asthma, however it remains critical that clinicians educate patients and encourage active participation in their own care.

## INTRODUCTION

Asthma is a common heterogeneous syndrome characterized by airflow obstruction, bronchial hyper-responsiveness, and underlying inflammation.[1] It is a major cause of lost work and school, lower quality of life and increased emergency room visits.[2] Treatment involves a comprehensive step-wise approach to patient care, matching symptom severity with appropriate therapeutic intervention and close monitoring of clinical response. Well established guidelines have outlined the diagnosis and management of asthma, however it remains critical that clinicians educate patients and encourage active participation in their own care.

## PREVALENCE

Asthma affects approximately 300 million people worldwide, including 22 million Americans and 6 million children.[1] According to the Center for Disease Control, asthma prevalence has increased from 7.3% in 2001 to 8.4% in 2010.[2] Though asthma can present at any age, peak incidence is from 8-17 years of age. In childhood, males are affected more than girls, but the prevalence reverses by adulthood. With better comprehensive care, the rate of death secondary to asthma decreased by 26% between 1999 and 2009.[3]

## ETIOLOGY AND TRIGGERS

The etiology of the reversible inflammation observed in asthma is multifactorial. Although the exact underlying cause is unknown, it is believed that there is an interplay between geneticand environmental factors. Genetic phenotypes are now emerging which may help guide future approaches to treatment. Major environmental factors include dust mites, viral respiratory infections such as respiratory syncytial virus, tobacco smoke, air pollution and diet.[4] It is the interaction of these features that determines the clinical manifestations and severity of asthma, as well as treatment response.

## DIAGNOSIS

Assessment of asthma begins with a thorough history, as often times, physical exam may appear benign. Patients may report symptoms such as recurrent wheezing or worsening cough. Further history regarding triggers, time of day, and nighttime awakenings characterize asthma and help in initial staging and long-term management. Clinical history and presenting symptoms are reviewed in Table 1. The presence of a reversible obstructive pattern on spirometry is used to confirm the clinical diagnosis of asthma in patients five years or older.[1] Spirometry demonstrates obstruction when the ratio of forced expiratory volume in one second (FEV1) to forced vital capacity (FVC) is less than 70%. Reversibility is confirmed by an increase in FEV1 of >200mLand ≥ 12% from baseline measure after inhalation of a bronchodilator, usually a short-acting beta-2 agonist (SABA).[1]

When spirometry is normal but clinical suspicion remains high, methacholine bronchoprovocation testing can demonstrate airway hyperresponsiveness with a 95% negative predictive value.[4] Provocation testing can be positive in a number of other conditions including chronic obstructive pulmonary disease, congestive heart failure, cystic fibrosis, bronchitis and allergic rhinitis.[5] Absolute contraindications to a methacholine challenge include severe airway obstruction, recent myocardial infarction, stroke, uncontrolled hypertension or aortic aneurysm.[5] Recent

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studies have evaluated the safety and utility of various diagnostic markers such as immunoglobulins, sputum eosinophils, and nitrous oxide levels. Further research is needed to determine their role in the workup and monitoring of asthma.[6,7,8]

## DIFFERENTIAL DIAGNOSIS

The differential diagnosis of asthma remains broad as the signs and symptoms are found in a wide range of conditions. In the uncontrolled asthmatic patient, it is important to investigate untreated comorbidities, such as gastroesophageal reflux disease, obesity/obstructive sleep apnea, sinusitis and vocal cord dysfunction.[9] Diagnostic workup can include but is not limited to chest radiography, trial of proton pump inhibitors, polysomnography, and laryngoscopy. Treating these underlying comorbidities has shown to improve quality of life.[10] A more extensive list of differential diagnosis and comorbidities is found in Table 2 *(page 18)*.

## INITIAL THERAPY

Treatment of asthma is guided by appropriately classifying patients and assessing severity of symptoms. Severity is measured by the level of impairment of symptoms on daily living and the risk of recurrent exacerbations.[1] Impairment has many components, including symptom frequency, nighttime awakenings, SABA usage, interference of daily activity, and lung function measured by spirometry. The number of prior exacerbations requiring oral corticosteroids, severity of exacerbation and lung function correlate with an increased risk of future exacerbations. Based on the various components of severity, patients are classified as either intermittent or persistent asthmatics. See Figure 1 *(page 19)*.

Patients must be educated about symptom recognition, adherence to treatment regimen, proper technique for use of inhaled medication, and environmental trigger control at each severity level. Patient education can improve compliance with asthma management and improve control of the disease. After asthma severity is appropriately classified, therapy may be initiated in a step-wise manner.[11] Each medication class works at different levels of bronchospasm or inflammation and is utilized for either acute or chronic control. Intermittent asthma can be controlled with a SABA as needed, while persistent asthma requires daily medications with longer durations of action. First line therapy for persistent asthma starts with inhaled corticosteroids followed by long-acting beta agonist (LABA). Patients who frequently use SABA despite long acting medications may benefit from a consultation with an asthma specialist. Table 3 and Figure 2 (*page 20*) correlate symptom severity with the indicated therapeutic intervention. Table 4 *(page 21)* gives a detailed summary of the different mechanisms and side effects of each medication class.

## MAINTENANCE & STEP DOWN THERAPY

After initiating therapy, patients generally are followed in two to six week intervals until the disease is controlled. The goal of therapy is for the patient to have minimal symptoms while on therapeutic intervention and be able to participate in activities of daily living.[1] Asthma control can be measured qualitatively using a number of easily accessible clinical tools. The Asthma Control Test and Asthma Therapy Assessment Questionnaire can be used to reliably measure changes in control symptoms.[12] Once control is achieved, patients can follow up at one to six month intervals for monitoring. Spirometry should be measured every one to two years in clinically stable patients.[1] Patients with moderate to severe persistent disease can monitor disease activity with daily peak flows.

Once control of asthma is attained for a period of at least three months, step-down therapy is indicated using the same step-wise approach. Though some debate remains regarding the ideal approach to step-down therapy in asthma, LABA's generally should be used for the shortest duration possible owing to their increased risk of worsening asthma, hospitalization and death.[13] However, some studies suggest that removing inhaled corticosteroids prior to LABA's is associated with better symptom control, improved FEV1, peak expiratory flow (PEF) and quality of life.[14,15]

## PREVENTATIVE CARE

Preventative care is critical in the management of any chronic medical condition. Vaccination for both pneumonia as well as influenza is currently recommended for patients with asthma. There are currently two pneumonia vaccinations available, the pneumococcal polysaccharide vaccine (PPSV23) and the 13-valent conjugate vaccine (PCV13). PPSV23 is indicated for

TABLE 1:

Clinical History

| HISTORY | COMMENTS |
|---|---|
| **Recurrent Symptoms:**<br>Cough, wheeze, dyspnea, chest tightness | • Wheeze more prominent in children<br>• Normal physical exam does not exclude asthma |
| **Worsening Symptoms** | • Induced by exercise, viral infection, weather changes, stress, irritants, and allergies |
| **Timing** | • Occurs or worsens at night.<br>• May report frequent night time awakenings |

Clinical history often shows patterns, which should lead the clinician to consider asthma. Key points include questions regarding recurrence, triggers and the time of day of symptoms. (adapted from [Guideline] Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report October 2007.) [1]

TABLE 2:

Asthma Differential Diagnosis[1]

| ORGAN SYSTEM | DIFFERENTIAL DIAGNOSIS | WORKUP |
|---|---|---|
| **Respiratory** | Vocal Cord Dysfunction | Laryngoscopy |
| | Laryngotracheomalacia, Tracheal Stenosis, and Bronchostenosis | Laryngoscopy |
| | Bronchiolitis | High resolution computed tomography |
| | Recurrent cough secondary to medication | Recurrent cough secondary to medication |
| | Laryngeal Webs | Laryngoscopy |
| | Cystic Fibrosis | Sweat Chloride Testing |
| | Aspiration | Chest x-ray |
| | COPD | Pulmonary Function Testing |
| | Pulmonary Embolism | D-dimer, Ventilation-Perfusion scan, and Computed tomography angiography |
| | Obstructive sleep apnea | Polysomnography |
| | Allergic Rhinitis | Thorough history |
| | Foreign Body | Chest x-ray |
| **Cardiovascular** | Congestive Heart Failure | Clinical history +/- Echo |
| | Coronary Artery Disease | Stress Testing or Catheterization |
| **Gastrointestinal** | GERD | Trial proton pump inhibitor |
| **Miscellaneous** | Enlarged Lymph Nodes/Malignancy | Chest x-ray or computed tomography |

The differential diagnosis for asthma is extensive. Other comorbidities should be considered if patient remains uncontrolled despite optimal medication adherence. (adapted from [Guideline] Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report October 2007.)

all immunocompetent adults with asthma older than 19 years of age with an additional dose after the age of 65. PCV13 is recommended for adults older than 65 years of age. Currently guidelines recommend that unvaccinated patients with an age greater than 65 should receive the PCV13 vaccine followed by the pneumococcal polysaccharide vaccine (PPSV23) in 6-12 months. In children, PCV13 is approved for children 6 weeks to 71 months - especially patients currently taking high dose oral corticosteroids. The inactivated yearly influenza vaccine is recommended for all persons 6 months or older with asthma.[16]

Limiting exposure to environmental triggers is vital in the management of asthma and preventing acute asthmatic attacks. Common triggers include aspirin, NSAIDs, cockroaches, dust mites, pets and sulfites in foods such as shrimp, beer, wine and processed potatoes.[1,17,18] Allergens are prevalent in multiple areas of the house and outside. Patients should be advised to take simple measures to limit exposure if a specific trigger or allergen is suspected. Common preventative measures are listed in Table 5 (*page 22*). One measure that reduces environmental trigger exposure is high efficiency particulate air (HEPA) filters, which can reduce the amount of animal, mold, and tobacco allergens. Data, however, has not shown improvement in lung function.[19,20] HEPA filters provide little benefit for dust-mite and cockroach allergens which are better controlled with extermination and low humidity.[1]

Patient education and active participation is a critical component of the asthma treatment plan. Patients should be aware of the signs of poor control and exacerbations because prompt identification of worsening symptoms and appropriate step up in therapy, as outlined in Figure 2 *(page 20)*, reduces urgent care, emergency room and hospital visits.[21] Their skills using inhalers, spacers, nebulizers and valve holding chambers should be assessed on a regular basis. Poor technique has been associated with worsening asthma control, decreased response to therapy and increased exacerbations requiring systemic steroids.[22] Asthma action plans are an important tool for those with moderate to severe persistent asthma. These plans guide patients and families in the management of asthma, lists important warning signs of clinical decompensation and need for emergent therapy. One study noted that patients and families found action plans useful; unfortunately only 32% of patients reported having such a plan.[23]

FIGURE 1:

Classifying Severity For Patients Not Taking Long-Term Control Medications

| COMPONENTS OF SEVERITY | | CLASSIFICATION OF ASTHMA SEVERITY ( YOUTHS ≥ 12 YEARS OF AGE & ADULTS ) | | | |
|---|---|---|---|---|---|
| | | INTERMITTENT | PERSISTENT | | |
| | | | Mild | Moderate | Severe |
| IMPAIRMENT<br>Normal $FEV_1$ / FVC:<br>8 - 19 years 85%<br>20 - 39 years 80%<br>40 - 59 years 75%<br>60 - 80 years 70% | SYMPTOMS | ≤ 2 days / week | > 2 days / week *(but not daily)* | Daily | Throughout the Day |
| | Nighttime awakenings | ≤ 2x's / month | 3 - 4x's / month | > 1x / week *(but not nightly)* | Often as 7x's / week |
| | Short-acting $beta_2$-agonist use for symptom control *(not prevention of EIB)* | ≤ 2 days / week | > 2 days / week *(but not > 1x / day)* | Daily | Several times per day |
| | Interference with normal activity | None | Minor limitation | Some limitation | Extremely limited |
| | Lung fuction | • Normal $FEV_1$ between exacerbations<br>• $FEV_1$ > 80% predicted<br>• $FEV_1$ / FVC normal | • $FEV_1$ ≥ 80% predicted<br>• $FEV_1$ / FVC normal | • $FEV_1$ > 60% but < 80% perdicted<br>• $FEV_1$ / FVC reduced 5% | • $FEV_1$ < 60% perdicted<br>• $FEV_1$ / FVC reduced > 5% |
| RISK | Exacerbations requiring oral systemic corticosteroids | 0 - 1 / year *(see note)* | ≥ 2 / year *(see note)* | | |
| | | Consider severity and interval since last exacerbation. Frequency and severity may fluctuate over time for patients in any severity category. | | | |
| | | Relative annual risk of exacerbations may be related to $FEV_1$ | | | |

Severity is multifactorial which involves assessing both impairment and risk. Severity worsens with increasing symptoms, medication use and exacerbations. Lung function alone should not determine severity. (Obtained from [Guideline] Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report October 2007.)[1]

## MANAGEMENT OF AN ACUTE EXACERBATION

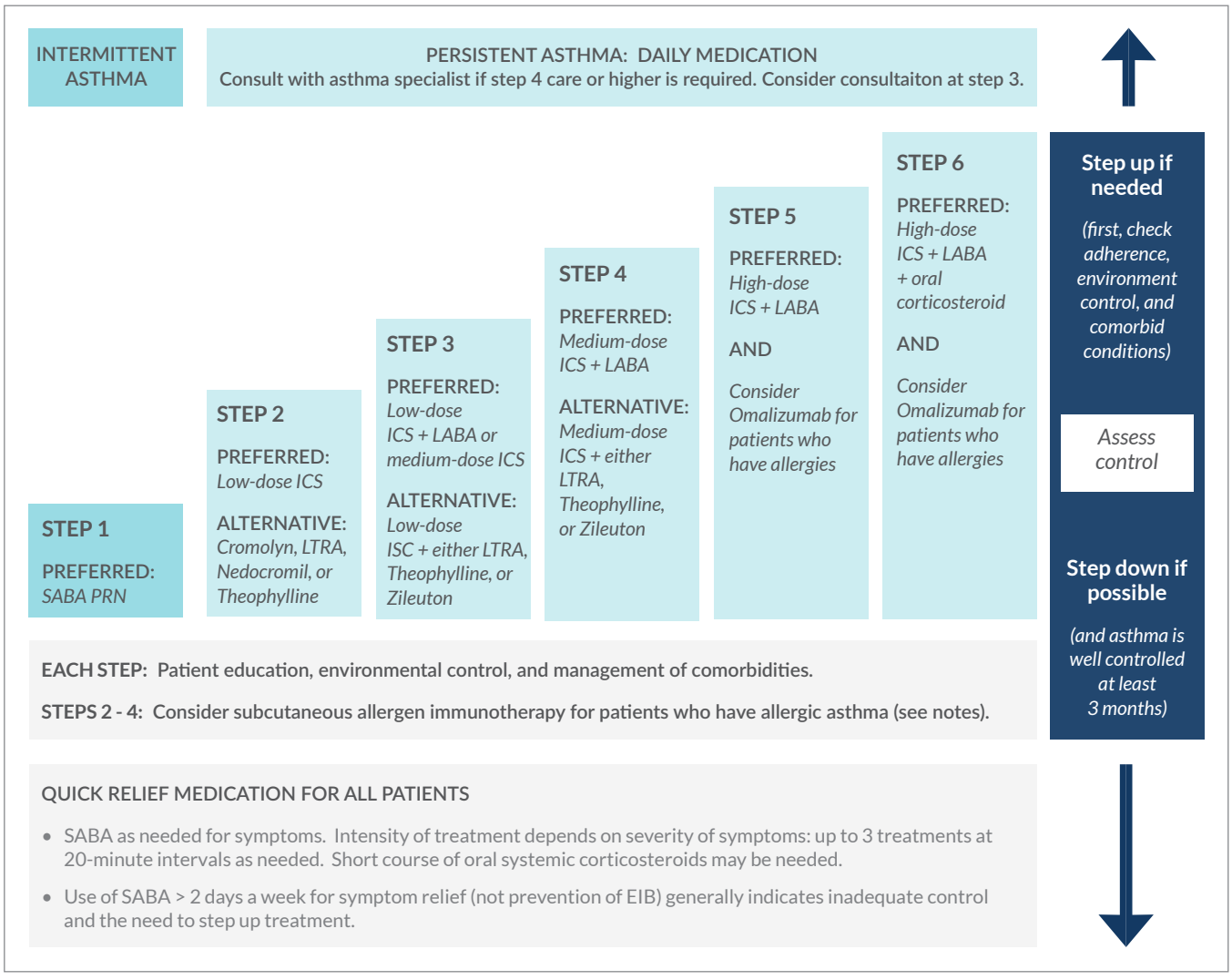
Acute asthma exacerbations are managed by assessing severity and treating appropriately. Severity can be measured clinically by noting worsening dyspnea and cough with daily activities or objectively with a peak expiratory flow (PEF) meter. A PEF ≥40% is considered a mild to moderate exacerbation while <40% is severe.[1]

Patients should refer to their predetermined asthma action plan as soon as they begin to experience signs of an exacerbation. If they are experiencing a mild to moderate exacerbation, they can increase their SABA by taking up to six puffs of a rescue SABA every 20 minutes for up to one hour. Any identified trigger should be removed.[1] Patients who have resolution of their wheezing, no tachypnea and a PEF ≥80% are considered to have a good response and should continue with scheduled SABA every four hours for up to 48 hours. If there is incomplete resolution of symptoms or only a mild increase in PEF to 50-79%, they should be seen urgently by a physician, whether in an urgent care clinic or at the primary care office, to determine the need for additional treatment with oral or inhaled corticosteroids in addition to the SABA.[1] Patients with mild to moderate exacerbations with partial responses can be admitted to the hospital for further observation based on clinical judgment. There, patients can receive scheduled SABA treatments, oral or intravenous glucocorticoids and oxygen.

A patient with a severe exacerbation (PEF < 40%) or no improvement with initial self-management should be evaluated in the emergency room. Patients may require hourly SABA and ipratroprium, oxygen, and oral corticosteroids. The response to treatment is again monitored clinically using PEF measurements. If again there is no improvement, admission to the intensive care unit may be warranted where they can continue nebulized SABA and ipratropium treatments, receive intravenous corticosteroids and be monitored for possible intubation. A $PaCO_2$ that begins to normalize in a previously tachypnic patient is a sign of respiratory fatigue and may warrant mechanical ventilation.[1] Clinicians should be aware of other risk factors for asthma related death listed in Table 6 (*page 23*). Upon discharge, patients should be seen by their primary care physician or asthma specialist within one to four weeks depending on the severity. Patients receiving close follow up, a customized medical regimen, and intensive teaching are three times less likely to have hospital readmissions over the next two years.[25]

FIGURE 2:

Stepwise Approach for Managing Asthma in Youths ≥ 12 Years of Age and Adults




All patients should be screened for adherence to medication regimen, proper technique and control of other comorbidities. Patients taking daily medications for persistent asthma who still require frequent SABA should step up in therapy. An asthma specialist should be considered if uncontrolled at step 3 for further recommendations such as multiple medication management or immunotherapy. (Obtained with permission from [Guideline] Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report October 2007.)[1]

TABLE 3:

Therapeutic Management based on Asthma Severity

| ASTHMA SEVERITY | THERAPEUTIC MANAGEMENT |
|---|---|
| **Intermittent** | Step 1 |
| **Mild Persistent** | Step 2 |
| **Moderate Persistent** | Step 3 - 4 |
| **Severe Persistent** | Step 5 - 6 |

Clinical history often shows patterns, which should lead the clinician to consider asthma. Key points include questions regarding recurrence, triggers and the time of day of symptoms. (adapted from [Guideline] Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report October 2007.) [1]

## TABLE 4:

Common Medications used in Asthma Management[1,11]

| MEDICATION CLASS *(example)* | MECHANISM OF ACTION | RECOMMENDED USAGE | MISC. |
|---|---|---|---|
| **Cortico-steroids** *(inhaled: fluticasone, budesonide, flunisolide, beclomethasone, mometasone, ciclesonide)* | Reduces migration and activation of inflammatory cells such as mast cells and eospinophils | • Inhaled corticosteroids (ICS) are initiated with mild persistent asthma and titrated accordingly.<br>• Oral corticosteroids are used in acute exacerbations. Consider initiation with severe persistent asthma. | Side effects include voice hoarseness and oral thrush. To prevent candidiasis, use spacer and rinse mouth after ICS. Evaluate for cataracts and osteoporosis with increasing steroid usage. Steroids can decrease growth in children. |
| **Short/ Long Acting Beta agonists (LABA)** *(SABA: albuterol, levalbuterol) (LABA: salmeterol, formoterol)* | Bronchodilates through activation of B2 receptors in respiratory smooth muscles. | • SABAs are used as rescue therapy for acute exacerbations<br>• LABAs are initiated in combination with ICS for moderate persistent asthma in patients >5 years old. | • SABAs duration of action is 3-6 hours. Side effects include tremor and palpitations in the elderly.<br>• LABAs duration of action is >12 hours. Increased mortality associated with LABAs may be due to corticosteroid noncompliance. |
| **Anti-Cholinergics** *(tiotropium)* | Inhibits muscarinic cholinergic receptors and reduces intrinsic vagal tone in airways | Can be used in conjunction with SABA in the emergency or hospital setting | Produces less cardiac stimulation than SABA. Side effects include dry mouth, urinary retention and glaucoma |
| **Cromolyn Sodium and Nedocromil** | Mast cell stabilizer | Alternative treatment for persistent asthma | Effective in blocking trigger associated asthma. Short duration of action |
| **Leuktriene Modifiers** *(montelukast, zafirlukast)* | Decreases bronchoconstriction by inhibiting inflammatory leukotriene release | Alternative treatment for persistent asthma | Monitor liver function. |
| **Methyl-Xanthines** *(theophylline)* | Inhibits phosphodiesterase resulting in increasing cAMP levels and bronchodilation | May be used in addition to ICS in patients > 5 years old | Plasma concentrations of 5-10 mg/L help bronchodilation when in combination with ICS. Higher concentrations can cause arrhythmias, seizures and death. |
| **Immuno-modulators** *(omalizumab)* | Prevents binding of IgE to receptors | May be used in addition to regular therapy for severe persistent asthma in patients >12 years old. | Very expensive. Patient should be clinically monitored as anaphylaxis has been seen occasionally. |

Different medication classes work synergistically to decrease bronchoconstriction and inflammation at different molecular levels. Goals of therapy are to decrease symptoms, exacerbations, usage of SABA and control adverse effects of medications. (adapted from [Guideline] Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report October 2007.)

TABLE 5:
Prevention of Common Environmental Triggers

| ALLERGEN | ENVIRONMENT | COMMENTS |
|---|---|---|
| **Dust Mites** | Around the house | Avoid cloth furniture and remove carpets. Wash stuffed toys weekly, or place in freezer or dryer. |
| | Bedroom | Dust-mite covers are available for mattresses and pillows. Wash pillow and bedding in hot water or mixture of detergent, bleach and cold water. |
| | Humidity | Reduce indoor humidity to 30-50% using dehumidifiers or central air conditioning. |
| **Animal Dander** | Around the house | Cats, furry pets, carpets and cloth furniture should be removed. |
| | Bedroom | Keep pet out of bedroom and keep bedroom door closed. |
| **Cockroach** | Around the house | Keep food and garbage in closed containers. Avoid exposure to aerosolized extermination products. Powders, gels, traps are good alternatives. |
| | Bedroom | Keep all food out of the bedroom. |
| **Mold** | Indoor | Fix any leaking source of water; clean moldy surfaces; dehumidify basements. |
| | Outdoor | Spore counts highest in afternoon. Remain indoors at this time. |

Allergen exposure can be controlled by ensuring proper cleaning and removal of objects which attract allergens. Special attention should be given to the bedroom as many hours are spent sleeping in this area. (adapted from NHLBI Figure 26 pg 26-27[1])

## OSTEOPATHIC MANIPULATIVE TREATMENT OF ASTHMA

Osteopathic manipulative treatment (OMT) enhances the interaction between the musculoskeletal and respiratory system improving physiological function. This may lead to decreased utilization of medications.[26,27] OMT treats thoracic cage somatic dysfunction, normalizes autonomic function and improves lymphatic flow.[28] The Osteopathic physician should thoroughly examine the following areas in the asthmatic patient:[27]

| | |
|---|---|
| Skeletal Structures | Upper thoracic and lumbar vertebrae, ribs, sternum |
| Sympathetic Innervation | T2-T7 |
| Parasympathetic Innervation | OA, AA, C2 |
| Diaphragm | C3-C5 |
| Cranial | Extension dysfunction commonly found |
| Chapman's Reflexes | Lung and Sinuses |

A variety of osteopathic treatments are effective in the treatment of asthma. These include but are not limited to muscle energy, HVLA, counterstrain or myofascial release, rib raising, treatment of rib dysfunction, scapula release, and lymphatic drainage techniques.[27] These techniques have been shown to potentially increase vital capacity, improve mobility and function of the rib cage and diaphragm and increase airway secretions clearance.[29]

Absolute contraindications for direct techniques such as HVLA include, but are not limited to: fractures, malignancy and Down's syndrome for manipulation of the OA and AA. Relative contraindications include acute whiplash, osteoporosis and metabolic bone disease. Absolute contraindications to indirect techniques are inability to consent or lack of cooperation. Relative contraindications include cancer, chronic infection and coagulopathies.

## ASTHMA IN THE PEDIATRIC POPULATION

Distinct differences exist in the diagnosis and management of asthma in the pediatric population. Unlike the adult population, impairment in daily activities is less indicative of severity as children tend to be asymptomatic between episodes.[1] Chronic inflammation can start early in children. Up to 80% of children have asthma symptoms before their fifth birthday.[1] Viral upper respiratory infections should be recognized early as it is a common cause for severe exacerbations.

Criteria of severity for younger children, less than four years of age, does not rely on spirometry testing. For those children able to perform spirometry, the normal FEV1/FVC ratio in children is >85% whereas in adults older than 20 years of age, FEV1/FVC is >80%. The criteria for asthma severity in children varies by age as shown in Figure 3 and 4 *(page 24)*. Long term control therapy should be initiated based on severity, however, other factors to consider include parental history of asthma, atopic dermatitis, food allergies, peripheral blood eosinophilia, and wheezing apart from colds.[1] Similar to adult asthma, therapeutic goals are to reduce episodes of acute exacerbations, decrease

TABLE 6:

Risk Factors for Asthma Related Death

| | |
|---|---|
| Past Medical History | Previous ICU admission for exacerbations requiring intubation |
| | Two or more hospitalizations in 1 year or > three ED visits in 1 year |
| | Chronic heart and lung disease |
| Medications | Consuming > 2 SABA canisters in 1 month |
| Social History | Low socioeconomic status, illicit drug use, psychosocial problems |

Peak expiratory flow does not necessarily predict risk for asthma related death. Several historical factors can guide clinical judgment on sending patients earlier to the emergency department for close monitoring. (adapted from NHLBI page 53 and Emerman et al. [1,24])

hospitalizations, minimize medication side effects and participate in physical activity.[1,30] Approved FDA control medications include inhaled corticosteroids such as fluticasone and budesonide, LABA such as salmeterol and leukotriene antagonist such as montelukast.

## EXERCISE INDUCED BRONCHOSPASM

Exercise induced asthma is thought to be a result of mast cell activation due to airway cooling and increased ventilation.[31] Onset of symptoms typically occurs after high intensity exercise and can spontaneously remit.[11] Diagnosis is made by exhibiting a 15% decrease in PEF or FEV1 measured 20-30 minutes after exercise at 5 minute intervals.[1] Treatment typically consists of SABA 2-3 hours prior to exercise, however, leukotrienes, cromolyn, or nedocromil can also be added. LABAs are not recommended as it may mask poorly controlled asthma.[1] Exacerbations can be reduced by decreasing the intensity of activity, warming up prior to exercise and wearing warm, protective clothing in cold weather.[1,31] Patients should be educated about this condition and continue to exercise as tolerated.

## ASTHMA AND PREGNANCY

Asthma control during pregnancy is important for both the mother and developing fetus. Uncontrolled asthma increases a mothers risk for hyperemesis, preeclampsia, pneumonia, complicated labor and caesarean delivery. It is associated with intrauterine growth restriction, neonatal hypoxia, perinatal death, preterm birth, and low birth weight.[1] Treatments with the highest level of clinical benefit and safety during gestation and breastfeeding, include albuterol and budesonide.[1,11] Other treatments have been evaluated, however less data is available.

## ASTHMA AND SURGERY

Asthma related peri-operative complications can be as low as 1.7%.[32] Bronchoconstriction can be caused by multiple factors such as intubation, hypercapnia, hypoxemia, decreased effective cough, or respiratory infection.[1] This complication can lead to anxiety, increased work of breathing, greater sedation and eventual respiratory depression. Risk factors which predispose patients to complications include recent exacerbations requiring hospitalization and systemic steroids, poor disease control and older age.[32] Patients should be medically optimized either by stepping up pharmacological management or giving a short course of oral steroids.[1,33] If patients have recent exacerbations requiring systemic corticosteroids in the last six months or have high dose inhaled steroids dependency, more intensive steroid therapy may be needed during the procedure.

## CONCLUSION

Asthma is a common condition of reversible inflammation where control of symptoms and severity decrease morbidity and mortality. Well established guidelines outline the diagnosis, step-wise management with frequent evaluations assessing the rapeutic response. A comprehensive, patient centered approach emphasizing patient education and participation is critical in the effective management of both acute and chronic asthma.

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## FIGURE 3:

Assessing Severity and Initiating Therapy in Children who are Not Currently Taking Long-Term Control Medication Ages 0-4 years of age

| COMPONENTS OF SEVERITY | | CLASSIFICATION OF ASTHMA SEVERITY ( 0 - 4 YEARS OF AGE ) | | | |
|---|---|---|---|---|---|
| | | INTERMITTENT | PERSISTENT | | |
| | | | Mild | Moderate | Severe |
| IMPAIRMENT | SYMPTOMS | ≤ 2 days / week | > 2 days / week *(but not daily)* | Daily | Throughout the Day |
| | Nighttime awakenings | 0 | 1 - 2x's / month | 3 - 4x's / month | > 1x / week |
| | Short-acting $beta_2$-agonist use for symptom control *(not prevention of EIB)* | ≤ 2 days / week | > 2 days / week *(but not daily)* | Daily | Several times per day |
| | Interference with normal activity | None | Minor limitation | Some limitation | Extremely limited |
| RISK | Exacerbations requiring oral systemic corticosteroids | 0 - 1 / year | ≥ 2 exacerbations in 6 months requiring oral systemic corticosteroids, or ≥ 4 wheezing episodes/1 year lasting > 1 day AND risk factors for persistent asthma | | |
| | | Coniser severity and interval since last exacerbation. Frequency and severity may fluctuate over time. Exacerbations of any severity may occur in patients in any severity category. | | | |
| RECOMMENDED STEP FOR INITIATING THERAPY | | STEP 1 | STEP 2 | STEP 3 & Consider short course of oral systemic corticosteroids | |
| | | In 2 - 6 weeks, depending on severity, evaluate level of asthma control that is achieved. If no clear benefit is observed in 4 - 6 weeks, consider adjusting therapy or alternative diagnoses. | | | |

Severity is not defined by lung function secondary to the difficulty in performing pulmonary function testing in this age group. In younger children, exacerbation frequency is measured every six months whereas children older than four years of age are measured on a yearly basis. The number of exacerbations is associated with higher morbidity as children are often symptom free in between exacerbations. (Obtained with permission from NHLBI page 40).


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## FIGURE 4:

Assessing Severity and Initiating Therapy in Children who are Not Currently Taking Long-Term Control Medication Ages 0-4 years of age

| COMPONENTS OF SEVERITY | | CLASSIFICATION OF ASTHMA SEVERITY ( 5-11 YEARS OF AGE ) | | | |
|---|---|---|---|---|---|
| | | INTERMITTENT | PERSISTENT | | |
| | | | Mild | Moderate | Severe |
| IMPAIRMENT | SYMPTOMS | ≤ 2 days / week | > 2 days / week *(but not daily)* | Daily | Throughout the Day |
| | Nighttime awakenings | ≤ 2x's / month | 3 - 4x's / month | > 1x / week *(but not nightly)* | Often as 7x's / week |
| | Short-acting $beta_2$-agonist use for symptom control *(not prevention of EIB)* | ≤ 2 days / week | > 2 days / week *(but not daily)* | Daily | Several times per day |
| | Interference with normal activity | None | Minor limitation | Some limitation | Extremely limited |
| | Lung fuction | • Normal $FEV_1$ between exacerbations<br>• $FEV_1$ > 80% predicted<br>• $FEV_1$ / FVC > 85% | • $FEV_1$ = > 80% predicted<br>• $FEV_1$ / FVC > 80% | • $FEV_1$ = 60 - 80% perdicted<br>• $FEV_1$ / FVC = 75 - 80% | • $FEV_1$ < 60% perdicted<br>• $FEV_1$ / FVC < 75% |
| RISK | Exacerbations requiring oral systemic corticosteroids | 0 - 1 / year *(see note)* | ≥ 2 / year *(see note)* | | |
| | | Consider severity and interval since last exacerbation. Frequency and severity may fluctuate over time for patients in any severity category. | | | |
| | | Relative annual risk of exacerbations may be related to $FEV_1$ | | | |
| RECOMMENDED STEP FOR INITIATING THERAPY | | STEP 1 | STEP 2 | STEP 3 & 4 medium-dose ICS option AND consider short course of oral systemic corticosteroids | |
| | | In 2 - 6 weeks, evaluate level of asthma control that is achieved, and adjust therapy accordingly. | | | |

Impairment for children older than five years old includes pulmonary function. FEV1/FVC ratio is higher than in adults older than 20 years of age. (Obtained from NHLBI page 40).


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