

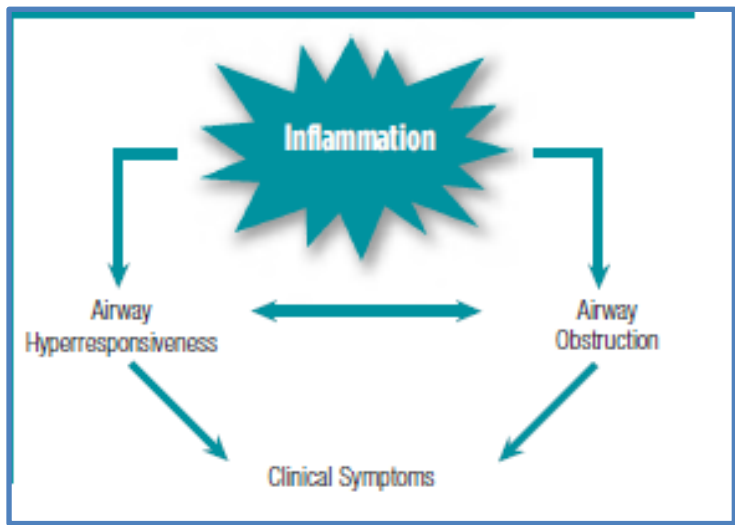
Guidelines for the Diagnosis and Management of Asthma in Adults
 Clinical Practice Guideline
 MedStar Health

“These guidelines are provided to assist physicians and other clinicians in making decisions regarding the care of their patients. They are not a substitute for individual judgment brought to each clinical situation by the patient’s primary care provider-in collaboration with the patient. As with all clinical reference resources, they reflect the best understanding of the science of medicine at the time of publication but should be used with the clear understanding that continued research may result in new knowledge and recommendations”.

MedStar Health Ambulatory Best Practices Committee endorses Global Strategy for Asthma Management and Prevention. Global Initiative for Asthma 2023 report.
<https://ginasthma.org/>

Definition and Prevalence of asthma

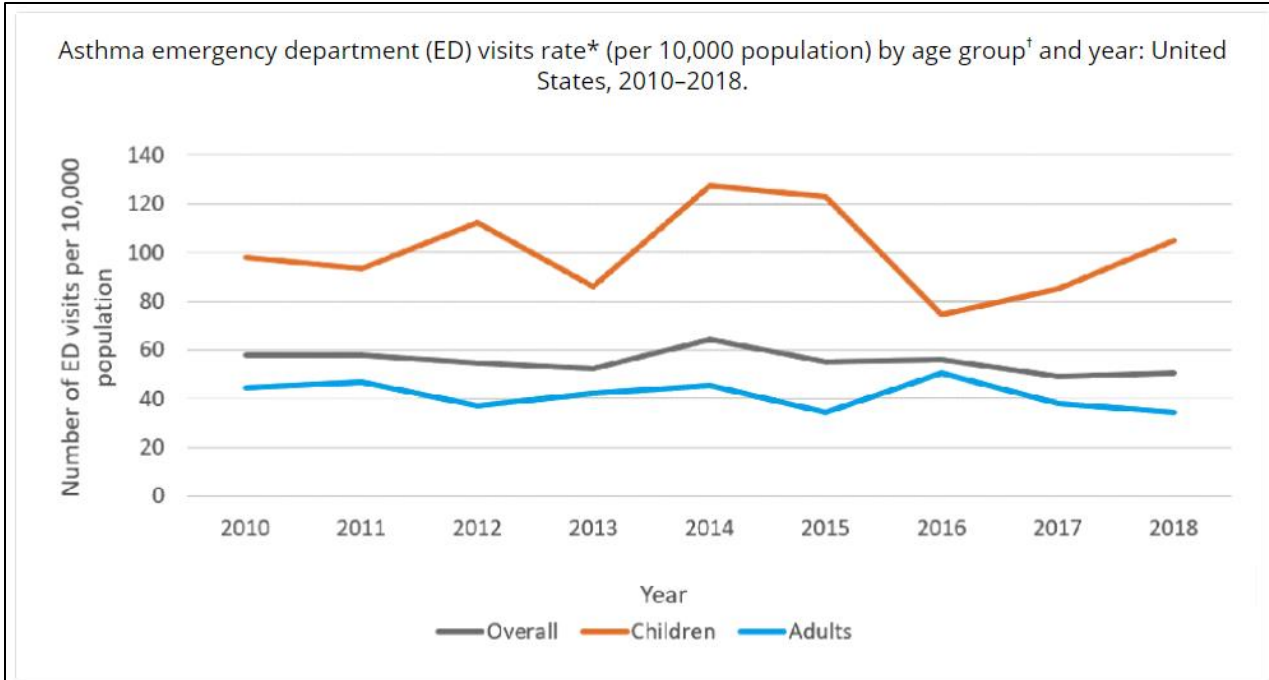
Asthma is a chronic respiratory illness characterized by the interplay of variable airway obstruction, airway hyperresponsiveness, and airway inflammation.



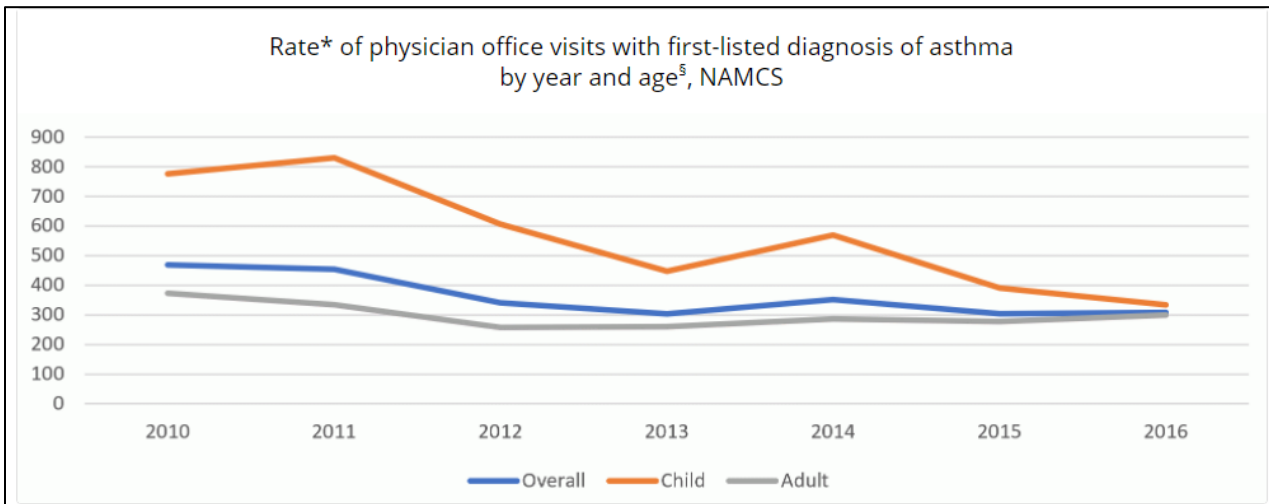
National Asthma Education and Prevention Program

Asthma most often develops in children and adolescents but may begin at any time in a person’s life. Risk factors for the development of asthma include family history, exposure to tobacco smoke, viral infections in the first 3 years of life and exposure to cockroaches or rodents in the home. As of 2020, asthma afflicts 25 million people in the United States. The rate of ED visits for asthma per 10,000 has not changed significantly from 2010-2018.

<p><u>Initial Approval Date and Reviews:</u> Effective 1997, 6/13, 7/15(adult), 8/15 (pediatric) 7/17 (separated adult and ped guideline), 7/19, 7/21, 7/23</p>	<p><u>Most Recent Revision and Approval Date:</u> <u>July 2023-full review; September 2023-GINA slides were removed and replaced with weblink.</u> © Copyright MedStar Health, 2015</p>	<p><u>Next Scheduled Review Date:</u> July 2025</p>
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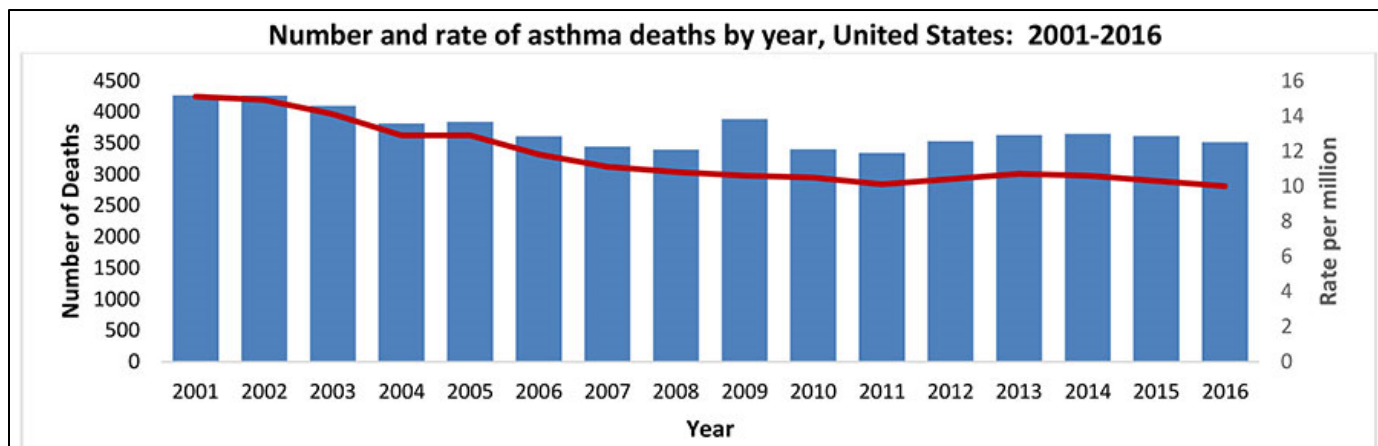


While the rate of office visits for children has declined, that for adults has remained relatively stable.



While mortality from asthma has decreased over time, black Americans are 2-3 times more likely to die from asthma than any other racial or ethnic group.

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https://www.cdc.gov/asthma/asthma_stats/asthma_underlying_death.html

Diagnosis of asthma

Diagnosis of asthma is based on history of respiratory symptoms and variable expiratory airflow limitation.

Clinical features

The typical clinical features of asthma include shortness of breath, wheezing, cough, and chest tightness. Symptoms may be intermittent or persistent. Physical findings may include wheezing or rhonchi, tachypnea, and tachycardia. Triggers include allergens, irritants, viral upper respiratory infections, cold air, acid reflux and sinusitis. Some patients may present with cough only (often called cough variant asthma). Patients are usually symptom free between attacks. Many patients have concomitant allergic rhinitis and atopic dermatitis. Some patients have symptoms only with exercise (exercise induced asthma). A subset of asthmatics has the triad of asthma, nasal polyps and aspirin sensitivity.

Spirometry/Bronchoprovocation

Patients suspected of having asthma should undergo spirometry, looking for evidence of reversible airway obstruction defined as FEV_1/FVC below lower limit of normal (usually less than 0.7 in adults) with a post-bronchodilator increase in $FEV_1 \geq 200$ mL AND $\geq 12\%$ from baseline, a cutoff of 10% change in % predicted is also used. For patients not meeting these criteria in whom the diagnosis continues to be suspected, a repeat spirometry test on a different day, early in the morning, or a methacholine (bronchoprovocation) challenge test can be performed. Peak Expiratory Flow (PEF) can be monitored, and a variation of more than 10% for adults and 13% for children is also indicative of variable flow limitation suggesting asthma.

Fractional Exhaled Nitric Oxide Testing

Nitric oxide can be measured in exhaled breath and can serve as a measure of the level of airway inflammation. FeNO testing requires expiration into a device designed for this purpose. In individuals ages 5 years and older for whom the diagnosis of asthma is uncertain using history, clinical findings, clinical course, and spirometry, including bronchodilator responsiveness testing, or in whom spirometry cannot be performed, the Expert Panel conditionally recommends the addition of FeNO measurement as an adjunct to the evaluation process.

Differential diagnosis

The differential diagnosis of asthma is wide and includes diseases of the upper respiratory tract, lower respiratory tract, and cardiovascular system. Chest x-ray, chest CT and echocardiogram may be appropriate if one of these other diagnoses is seriously possible.

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Differential Diagnosis of Asthma	
Upper Respiratory Tract	Vocal cord dysfunction
	Congestive rhinopathy
	Obstructive sleep apnea syndrome
Lower Respiratory Tract	Chronic obstructive pulmonary disease
	Occupational bronchitis
	Cystic fibrosis
	Bronchiectasis
	Pneumonia
Gastrointestinal Tract	GERD
Cardiovascular System	Congestive Heart Failure
	Pulmonary Hypertension
	Chronic Thromboembolic Pulmonary Disease
Central Nervous System	Habitual Cough

Adapted from Diagnosis and Management of Asthma in Adults JAMA July 18, 2019

Asthma severity

The guidelines emphasize that asthma severity can change over time and differs among individuals and by age groups. Thus, it is important to regularly monitor the patient's level of **asthma control** so that treatment can be adjusted as needed.

Per Global Initiative for Asthma (GINA) severity should be assessed **retrospectively** from the level of treatment required to **control** the patient's symptoms and exacerbations, i.e., after at least several months of treatment.

Mild asthma is defined as asthma that is well controlled with as-needed ICS-formoterol, or with low dose ICS plus as-needed SABA.

Moderate asthma is defined as asthma that is well controlled with Step 3 or Step 4 treatment e.g., with low or medium dose ICS-LABA in either treatment track. (See below)

Severe asthma is defined as asthma that remains uncontrolled despite optimized treatment with high dose ICS-LABA, or that requires high dose ICS-LABA to prevent it from becoming uncontrolled. (See below)

Per GINA the older National Asthma Education and Prevention Program 2007 classification which distinguishes between 'intermittent', and 'mild persistent' asthma is "not evidence-based, was arbitrary and was based on an untested assumption that patients with symptoms ≤ 2 days/week were not at risk, would not benefit from ICS, and should be treated with SABA alone. However, it is now known that patients with so-called 'intermittent' asthma can have severe or fatal exacerbations, and that their risk is substantially reduced by ICS-containing treatment compared with SABA alone."

Asthma Management

Goals of asthma treatment

1. Reduce impairment.
 - Prevent chronic and troublesome symptoms (e.g., coughing or breathlessness in the night, in the early morning, or after exertion).
 - Require infrequent need for quick relief of symptoms.
 - Maintain (near) "normal" pulmonary function.
 - Maintain normal activity levels including exercise and other physical activity and attendance at work or school).
 - Meet patients' and families' expectations of and satisfaction with asthma care.

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2. Reduce Risk

- Prevent recurrent exacerbations of asthma and minimize the need for ED visits or hospitalizations.
- Prevent progressive loss of lung function.
- Provide optimal pharmacotherapy with minimal or no adverse effects.
- Prevent asthma-related death.

Components of Asthma Management

- **Routine assessment and monitoring:**

Assess asthma presenting symptoms to initiate therapy using the presenting symptoms/symptom control chart (see below)

Assess asthma control to adjust therapy (step up or step down)

Schedule regular follow up visits since asthma is variable over time. Assess symptom control, medication adherence, inhaler technique, and concerns at every visit.

A. Level of asthma symptom control					
In the past 4 weeks, has the patient had:			Well controlled	Partly controlled	Uncontrolled
Daytime symptoms more than twice/week?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	None of these	1 to 2 of these	3 to 4 of these
Any night waking due to asthma?	<input type="checkbox"/> Yes	<input type="checkbox"/> No			
Reliever needed more than twice/week?	<input type="checkbox"/> Yes	<input type="checkbox"/> No			
Any activity limitation due to asthma?	<input type="checkbox"/> Yes	<input type="checkbox"/> No			

Up To Date <https://www.uptodate.com/contents/an-overview-of-asthma-management>

- **Patient Education:** Patients should be taught the skills to self-monitor and manage asthma. Key elements of optimal asthma education include symptom recognition, appropriate inhaler technique, use of a peak flow meter, and using a **written asthma action plan (asthma management plan)**, which should include instructions for daily treatment and ways to recognize and handle worsening asthma. Educational opportunities should reach patients in a variety of settings, such as pharmacies, schools, community centers, and patients' homes. A strong clinician-patient relationship is optimal.
- **Control of environmental factors and other conditions that can affect asthma:** Multiple approaches should be used to limit exposure to allergens and other substances that can worsen asthma; research shows that single steps are rarely sufficient. Other common conditions that asthma patients can have such as rhinitis and sinusitis, gastroesophageal reflux, overweight or obesity, obstructive sleep apnea, stress, and depression should be treated. Treatment may help improve asthma control.
- **Medications:** The mainstay of treatment is a stepwise approach to control asthma, in which medication types and doses are chosen based on asthma severity and stepped up as needed or stepped down when possible. Treatment is adjusted based on the level of asthma control. Major classes of medications and their role are as follows:

Reliever medications:

Short acting beta agonists (SABAs)—serve as “reliever” inhalers when patients experience acute bronchospasm.

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Low dose ICS-formoterol—serves as “reliever medication” when patients experience acute bronchospasm.

Short acting anti-cholinergics—may be additive to beta agonists or used as a substitute for patients who are intolerant.

Systemic Corticosteroids—useful to achieve control of disease, prescribed in short term bursts.

Note that the 2023 GINA guidelines recommend ICS-formoterol as the reliever of choice, noting that the addition of an inhaled corticosteroid to the short acting beta agonist reduces the risk of exacerbation.

Controller medications:

Inhaled corticosteroids (ICS) and medications containing ICS—Mainstay of treatment for patients needing long term controller medications. May be associated with oral thrush (rinse mouth after inhaler use) and, in high doses, bone loss and cataracts. In patients with mild asthma, controller treatment may be delivered through as-needed low dose ICS-formoterol, taken when symptoms occur and before exercise.

Long-acting beta agonists (LABAs)—Can be added to inhaled corticosteroids to intensify treatment effect but should not be used without inhaled corticosteroids (black box warning for adverse outcomes and death).

Cromolyn/Nedocromil—Most useful in allergic asthma and in exercise induced asthma

Leukotriene modifiers—May be helpful in exercise induced asthma (though less effective than ICS) and in aspirin induced asthma.

Long-acting muscarinic antagonists (LAMAs)—Used in severe asthma when ICS-LABA combination has not controlled symptoms.

Oral corticosteroids—Indicated only in severe persistent asthma when other medications have not been effective.

Biologics: for use with elevated eosinophils, IgE level, frequent or persistent oral steroid need, consider Pulmonary or Allergy evaluation.

anti-IgE monoclonal antibody (omalizumab)- given by subcutaneous injection, in patients with allergic asthma, elevated IgE level, and documented sensitivity to aeroallergens.

anti-IL-5 agents (benralizumab, mepolizumab and reslizumab)- given parenterally, usually by asthma specialists.

anti-IL-4 subunit alpha agents (dupilumab) given SQ

anti-thymic stromal lymphopoietin (TSLP) (tezepelumab)- given SQ

Methylxanthines—inexpensive and can be considered for patients unable to use inhalers. Drug levels need to be monitored to avoid toxicity. Rarely used.

- **Immunizations:** ACIP 2023 recommends annual influenza vaccine for all and pneumococcal vaccine for patients with asthma age 65 or older; per GINA 2023 report, there is currently insufficient evidence to recommend routine pneumococcal vaccination for all adults with asthma; Covid -19 vaccine – see Covid-19 and Asthma section below.
- **Smoking cessation:** all patients with asthma who smoke should be advised to stop smoking and assisted in efforts to quit. Assess patients with a >10 pack-year smoking history for COPD or asthma–COPD overlap, as additional treatment strategies may be required.

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See the medication tables at the end of the guideline for specific medication doses, costs, and side effects.

The Global Initiative for Asthma (GINA) recommends that all adults and adolescents should receive ICS containing controller treatment and that combined ICS-formoterol be used as the preferred reliever medication (with SABA plus and ICS as an alternative reliever combination). GINA also does not distinguish between intermittent and mild persistent asthma, considering the distinction arbitrary. GINA recommends initiation of treatment at Step 1-2 if patient has symptoms less than 4-5 days a week; Step 3 if symptoms are most days or waking with asthma once a week or more; Step 4 if daily symptoms or waking with asthma once a week or more, and low lung function. [See 2023 GINA Main Report Box 3-7 <https://ginasthma.org/> for selecting initial treatment and Box 3-12 for continuous personalized management; [What's New in the 2023 GINA slide set](#) has good practical advice on how to prescribe ICS-formoterol (slides 21, 27 and 28)].

There is a suggested asthma action plan: Single inhaler Maintenance and reliever therapy from Asthma Council of Australia/ modified with permission by Allergy & Asthma Network

[SMART Asthma Action Plan](#)

Ref: DOI: [10.1016/j.jaip.2021.10.011](https://doi.org/10.1016/j.jaip.2021.10.011)

In addition to the choice of specific medication, thought should be given to which type of delivery device is best for the patient. **Education on the inhaler chosen, using whatever method works best for the patient (video, handout, demonstration) is crucial to successful use.** Spacer devices can improve delivery to the lung and reduce delivery to the mouth and pharynx. Acknowledgement of costs of inhalers and working with patients to find the inhaler best covered by their insurance is also key to improving adherence.

Resources:

- ❖ [American Lung Association: Using Asthma Medication Devices](#)
- ❖ [Asthma Patient Assistance](#) (Allergy & Asthma Network)
- ❖ [Asthma & Allergy Foundation of America: Drug Assistance Programs](#)

<u>Ease of use of Some Bronchodilator Inhalers</u>				
Inhaler Type	Assembly	Indicator showing remaining doses	Breath-Hand Coordination Needed	Dependence on Strength of breath intake
Aerosphere Inhaler	Easy	Yes	Yes	No
Ellipta Inhalers	None	Yes		Yes
Respimat Inhalers	Difficult for some	Yes		No
Neohaler Inhalers	Difficult for some to remove capsules from packaging			Yes
Pressair Inhaler	None			Yes
Handihaler Inhaler	Inserting capsules into device may be difficult			Yes
Diskus Inhalers	None	Yes		Yes

When the patient has refractory or difficult-to-treat asthma symptoms

- Consider alternative diagnoses or contributors to symptoms, e.g., upper airway dysfunction, COPD, recurrent respiratory infections.
- Investigate for co-morbidities such as chronic sinusitis, obesity, GERD, obstructive sleep apnea, psychologic or psychiatric disorders.

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- Review inhaler technique and medication adherence
- Investigate for persistent environmental exposure such as allergens or toxic substances (domestic or occupational)

Asthma-COPD overlap

Many patients, particularly older smokers, have clinical features of both asthma and COPD in the setting of persistent airflow limitation. These patients tend to have higher mortality, more exacerbations, higher health care costs and poorer quality of life.

Asthma in pregnancy

Poorly controlled asthma in pregnancy presents a threat to the mother as well as the fetus. In general, 1/3 of pregnant asthmatics get worse, 1/3 improve, and 1/3 stay the same. Achieving asthma control during pregnancy outweighs concerns about any medication use.

Exercise-induced bronchoconstriction (EIB)

Physical activity is an important stimulus for asthma symptoms for many patients. Regular treatment with ICS as well as sufficient warm-up significantly reduces EIB. Breakthrough EIB often indicates poorly controlled asthma and stepping up ICS containing treatment is warranted.

Aspirin-exacerbated respiratory disease (AERD) or previously called aspirin-induced asthma.

It starts with nasal congestion and anosmia and progresses to chronic rhinosinusitis with nasal polyps that re-grow rapidly after surgery. Asthma and hypersensitivity to aspirin and NSAIDs develop subsequently. Diagnosis is made by history and confirmed by aspirin challenge. Oral aspirin challenge tests must only be conducted in a specialized center with cardiopulmonary resuscitation capabilities. Bronchial (inhalational) and nasal challenges with lysine aspirin are safer than oral challenges and may be safely performed in allergy centers. Cornerstone of management is avoidance of aspirin and NSAID's, especially COX-1 inhibitors. When NSAIDs are indicated for other medical conditions COX-2 inhibitors may be considered with a health care provider observation for at least 2 hours after administration. Aspirin desensitization may be considered in severe cases and conducted by a specialist. ICS is the mainstay of pharmacological management.

Referral to an asthma specialist

Referral to the appropriate specialist (allergist or pulmonologist) should be considered in the following situations:

- Life threatening exacerbation
- Patient has required hospitalization or more than two bursts of oral steroids in a year.
- Patient requires step 4 care or higher.
- Poor response to therapy
- Occupational triggers
- Atypical presentation or uncertain diagnosis
- Need for specialized testing.
- Allergen immunotherapy
- Consideration of treatment with biologic agents

Asthma and COVID-19

Research regarding relationship between asthma and COVID-19 infection is still evolving. Per GINA guidance regarding COVID-19 and asthma updated April 30, 2022, current evidence suggests that patients with asthma are no more likely to acquire COVID-19 or severe COVID. There is evidence, however, that the risk of death from COVID-19 is increased in asthmatics who have recently needed oral corticosteroids. Consequently, maintaining good symptom control is important. CDC has identified asthma as a risk factor for severe coronavirus disease. Based on the CDC designation, patients with asthma may be prioritized for antiviral therapies if they develop COVID-19. Note that the antiviral tablets

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nirmatrelvir and ritonavir (Paxlovid) interact with the long-acting beta-agonist bronchodilator salmeterol, which should be held for the five days of oral antiviral therapy and three additional days thereafter. Alternative bronchodilator therapy may be needed during this time in some patients. Treatment options include prescribing alternative antiviral therapy or switching to ICS or ICS-formoterol for duration of therapy plus 5 days. Remember to teach correct technique if prescribing a new inhaler.

Nebulizer use (rather than metered-dose inhalers) should be avoided to minimize spread of virus. Likewise, spirometry should be avoided in confirmed or suspected COVID 19.

When using pulse oximetry for estimation of oxygenation status, FDA safety communication for potential overestimation of oxygenation status in people with dark skin color. Overestimation is an issue of major concern since patients may seem healthier than they are with the corresponding risk of adverse health effects from diseases like COVID-19.

COVID 19 vaccination is recommended for patients with asthma. Patients should not receive biologic therapies and COVID-19 vaccination on the same day.

Patient education:

- 1) Patient education information on asthma symptoms, diagnosis, inhalers, and peak flow use: <https://foundation.chestnet.org/patient-education-resources/asthma/>
- 2) Patient education on asthma (in English and Spanish) as well as four videos demonstrating use of different inhaler types with and without spacers <https://www.acponline.org/practice-resources/patient-education/online-resources/asthma-and-allergies-asthma-and-immunology>
- 3) Patient education from the Asthma and Allergy Foundation of America including downloadable asthma action plans, and handouts on spacers, peak flow meters, inhalers, and nebulizers. <http://www.aafa.org/page/programs-for-patients-and-caregivers.aspx>
- 4) An information guide for patients and their families. Reflects the focus on achieving asthma control in the current GINA guideline documents. <https://ginasthma.org/gina-patient-guide-you-can-control-your-asthma/>
- 5) America Lung Association. How to Use Asthma Medicine Devices; Patient education on asthma as well as videos demonstrating use of different inhaler types as well as financial resources. <https://www.lung.org/lung-health-diseases/lung-disease-lookup/asthma/treatment/devices>

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Long-Term Control Medications for Adults

Drug Name	Dosing Range	Other Information	AWP (brand/generic)
Inhaled Corticosteroids (ICS)			
Beclomethasone (QVAR RediHaler)	<p>Patients previously on bronchodilators: 40-80mcg twice daily</p> <p>Patients previously on ICS: 40-320mcg twice daily</p> <p>Maximum dose: 320mcg twice daily</p> <p>“Low” dose: 100-200mcg/day</p> <p>“Medium” dose: >200-400mcg/day</p> <p>“High” dose: >400mcg/day</p> <p>*All in two divided doses daily</p>	<p>Does not need to be shaken before using</p> <p>Rinse mouth after use to prevent <i>Candida</i> infection</p>	<p>Brand only (price/inhaler):</p> <p>40mcg/puff: \$251</p> <p>80mcg/puff: \$337</p>
Budesonide (Pulmicort Flexhaler)	<p>Initial dose: 360mcg twice daily</p> <ul style="list-style-type: none"> • May increase dose after 1-2 weeks if inadequate control. <p>Maximum dose: 720mcg twice daily</p> <p>“Low” dose: 200-400mcg/day</p> <p>“Medium” dose: >400-800mcg/day</p> <p>“High” dose: >800mcg/day</p> <p>* all in two divided doses daily</p>	<p>Do not shake before use.</p> <p>Do not use with a spacer.</p> <p>Rinse mouth after use to prevent <i>Candida</i> infection.</p> <p>Interaction with CYP3A4 inhibitors – may increase systemic concentration of ICS.</p>	<p>Brand only (price/inhaler)</p> <p>90mcg/puff: \$237</p> <p>180mcg/puff: \$318</p>

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Drug Name	Dosing Range	Other Information	AWP (brand/generic)
Fluticasone (Arnuity Ellipta, Flovent Diskus, Flovent HFA, Armon Air Digihaler)	<p>Fluticasone Furoate: “Low”- “Medium” dose: 100mcg/day “High” dose: 200mcg/day</p> <p>Fluticasone Propionate: “Low” dose: 100-250mcg/day “Medium” dose: >250-500mcg/day “High” dose: >500mcg/day</p>	<p>May increase dose after 2 weeks if inadequate control.</p> <p>Rinse mouth after use to prevent <i>Candida</i> infection.</p> <p>Interaction with CYP3A4 inhibitors – may increase systemic concentration of ICS.</p> <p>Flovent Diskus: do not use with a spacer.</p> <p>Arnuity Ellipta: do not shake.</p> <p>Flovent HFA: must be shaken before use</p>	<p>(price/inhaler) Arnuity Ellipta (Brand Only): 50mcg/puff: \$250 100mcg/puff: \$250 200mcg/puff: \$335</p> <p>Flovent HFA: 44mcg/puff: \$233 110mcg/puff: \$312 220mcg/puff: \$485</p> <p>Flovent Diskus (Brand Only): 50mcg/blister: \$232 100mcg/blister: \$245 250mcg/blister: \$329</p> <p>ArmonAir Digihaler (Brand Only): 55mcg/puff: \$316 113mcg/puff: \$316 232mcg/puff: \$395</p>
Mometasone (Asmanex Twisthaler, Asmanex HFA)	<p>Asmanex Twisthaler: Prior ICS use: 220mcg daily in the evening; max 440mcg/day Prior bronchodilator use: 220mcg daily in the evening; max 440mcg/day Prior oral corticosteroid use: 440mcg twice daily</p> <p>Asmanex HFA: No prior ICS use: 200mcg twice daily; max 800mcg twice daily Prior oral corticosteroid use: 800mcg twice daily</p> <p>“Low” – “Medium” dose: 200-400mcg daily “High” dose: >400mcg daily</p>	<p>If on oral corticosteroids, taper slowly (max reduction of 2.5mg/day on a weekly basis) beginning at least 1 week after starting mometasone.</p> <p>Rinse mouth after use to prevent <i>Candida</i> infection.</p> <p>HFA should be shaken before use.</p> <p>For every 110mcg delivered by Twisthaler, 100mcg of mometasone is delivered.</p>	<p>Brand only (price/inhaler) Asmanex HFA: 50mcg/puff: \$223 100mcg/puff: \$241 200mcg/puff: \$283</p> <p>Asmanex Twisthaler (30 doses) 110mcg/puff: \$223 220mcg/puff: \$241</p>

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Drug Name	Dosing Range	Other Information	AWP (brand/generic)
		Use Twisthaler in the evening if only given once daily. Interaction with CYP3A4 inhibitors – may increase systemic concentration of ICS.	
Systemic Corticosteroids			
Methylprednisolone (Medrol)	40-60mg/day as 1-2 doses for 5-7 days (“burst”) <ul style="list-style-type: none"> Used to achieve control. 	Alternate day therapy may produce less adrenal suppression. Short course “bursts” may be useful when initiating therapy.	2mg \$414/-- 4mg \$26/\$156 8mg \$104/\$99 16mg \$97/\$99 32mg \$--/\$73
Prednisolone (Millipred)			5mg \$1557/\$1411
Prednisolone ODT (Orapred ODT)		Tapering will not prevent relapse	ODT: 10mg \$1096/\$604 15mg \$949/\$672 30mg \$602/\$432
Long-Acting Beta₂-Agonists (LABA)			
Salmeterol (Serevent Diskus)	50mcg every 12 hours	Should never be used alone – always in combination with ICS.	Brand only (price/inhaler) 50mcg/puff: \$508
Combination medications			
Fluticasone/Salmeterol (Advair Diskus, Advair HFA, AirDuo RespiClick, AirDuo Digihaler, Wixela Inhub)	Advair Diskus and Wixela Inhub: Initial: 100mcg fluticasone/50mcg salmeterol twice daily Max: 1000mcg fluticasone/100mcg salmeterol per day Advair HFA: Initial: 2 inhalations of 45mcg fluticasone/21mcg salmeterol twice daily Max: 920mcg fluticasone/84mcg salmeterol per day	Starting dose depends on asthma severity. May increase dose after 2 weeks if inadequate control. Rinse mouth after use to prevent <i>Candida</i> infection. See also: individual agents. - LABAs vilanterol and formoterol	Brand name (price/inhaler) Advair Diskus: 100-50mcg/dose: \$781 250-50mcg/dose: \$781 500-50mcg/dose: \$1272 Advair HFA: 45-21mcg/dose: \$394/\$372 115-21mcg/dose: \$394/\$463 230-21mcg/dose: \$584/\$608 AirDuo RespiClick:

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Drug Name	Dosing Range	Other Information	AWP (brand/generic)
	AirDuo RespiClick and AirDuo Digihaler: 55mcg fluticasone/14mcg salmeterol twice daily; max 464mcg fluticasone/28mcg salmeterol per day	not available as monotherapy	55-14mcg/dose: \$483 113-14mcg/dose: \$483 232-14mcg/dose: \$483 AirDuo Digihaler: 55-14mcg/dose: \$527 113-14mcg/dose: \$527 232-14mcg/dose: \$593 Wixela Inhub: 100-50mcg/dose: \$361 250-50mcg/dose: \$449 500-50mcg/dose: \$590 Generic (price/inhaler) 55-14mcg/dose: \$147 113-14mcg/dose: \$147 232-14mcg/dose: \$147
Budesonide/Formoterol (Symbicort)	Initial: 80mcg budesonide/4.5mcg formoterol as two inhalations twice daily Max: 12 inhalations per day		(price/inhaler) 80-4.5mcg/puff: \$409/\$353 160-4.5mcg/puff: \$541/\$403
Fluticasone/Vilanterol (Breo Ellipta)	100mcg fluticasone/25mcg vilanterol or 200mcg fluticasone/25mcg vilanterol once daily Max: 200mcg fluticasone/25mcg vilanterol once daily		(price/inhaler) 100-25mcg/dose: \$392/\$437 200-25mcg/dose: \$392/\$437
Mometasone/Formoterol (Dulera)	100mcg mometasone/5mcg formoterol 2 inhalations twice daily; max 200mcg mometasone/5mcg formoterol 2 inhalations twice daily	Rinse mouth after use to prevent <i>Candida</i> infection. See also: individual agents.	Brand only (price/inhaler) 100-5mcg/puff: \$411 200-5mcg/puff: \$411
Fluticasone/Umeclidinium/Vilanterol (Trelegy Ellipta)	100mcg fluticasone/62.5mcg umeclidinium/25mcg vilanterol one inhalation daily or 200mcg fluticasone/62.5mcg umeclidinium/25mcg	Rinse mouth after use to prevent <i>Candida</i> infection. See also: individual agents.	Brand only (price/inhaler) 100-62.5-25mcg/puff: \$765 200-62.5-25mcg/puff: \$765

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Drug Name	Dosing Range	Other Information	AWP (brand/generic)
	vilanterol one inhalation daily		
Leukotriene Receptor Antagonists			
Montelukast (Singulair)	10mg nightly	Boxed Warning: Risk of serious neuropsychiatric events Increasing the dose does not increase response	\$305/\$170
Zafirlukast (Accolate)	20mg twice daily	Take at least 1 hour before meals or at least 2 hours after Hepatic dysfunction possible, especially in female patients; monitor liver function periodically	10mg: \$137/\$123 20mg: \$137/\$123
5-Lipoxygenase Inhibitor			
Zileuton (Zyflo)	Immediate Release: 600mg 4 times/day Extended Release: 1200mg twice daily	Extended-release tab should be administered within 1 hour of morning and evening meals Hepatic dysfunction possible, monitor liver function periodically.	Extended-release product (generic only): \$4060 Immediate release (brand only): \$4511
Methylxanthine			
Theophylline (Elixophyllin, Theo-24,)	Initial: 10mg/kg/day; max 300mg dose Max: 600mg/day Geriatric dosing (>60yo): max 400mg/day	Goal serum concentration 5-15mcg/mL after at least 48 hours on the same dosage Recheck serum levels every 6-12 months once dose is stable. Extended-release formulations must be	Theo-24 (brand only): 100mg: \$95.4 200mg: \$142 300mg: \$174 400mg: \$245 Theophylline ER (generic only): 400mg: \$41 600mg: \$59

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Drug Name	Dosing Range	Other Information	AWP (brand/generic)
		<p>taken with full glass of water and 1 hour before or 2 hours after meals.</p> <ul style="list-style-type: none"> • Capsule forms may be opened and sprinkled on soft foods, but beads should not be chewed. 	
Immunomodulator			
Omalizumab (Xolair)	<p>Based on pre-treatment IgE serum level and body weight:</p> <p>IgE 30-100: 30-90kg: 150mg every 4 weeks 90-150kg: 300mg every 4 weeks</p> <p>IgE 100-200: 30-90kg: 300mg every 4 weeks 90-150kg: 225mg every 2 weeks</p> <p>IgE 200-300: 30-60kg: 300mg every 4 weeks 60-90 kg: 225mg every 2 weeks 90-150kg: 300mg every 2 weeks</p> <p>IgE 300-400: 30-70kg: 225mg every 2 weeks 70-90kg: 300mg every 2 weeks >90kg: do not use</p> <p>IgE 400-500: 30-70kg: 300mg every 2 weeks</p>	<p>Maximum 150mg per injection site</p> <p>Adjust dose for significant changes in body weight. Only adjust dose for IgE levels if therapy is interrupted for over 1 year.</p> <p>Monitor for anaphylaxis for 2 hours following at least the first 3 injections; discontinue if anaphylaxis occurs (boxed warning)</p> <p>Discontinue if fever, arthralgia, and rash occur after use.</p>	Brand only: \$1539 per 150mg dose

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Drug Name	Dosing Range	Other Information	AWP (brand/generic)
	70-90kg: 375mg every 2 weeks >90kg: do not use IgE 500-600: 30-60kg: 300mg every 2 weeks 60-70kg: 375mg every 2 weeks >70kg: do not use IgE 600-700: 30-60kg: 375mg every 2 weeks >60kg: do not use.		
Reslizumab (Cinqair)	3mg/kg IV every 4 weeks	Boxed Warning: Anaphylaxis – monitor after infusion. Common side effects: increased creatine phosphokinase, myalgia, oropharyngeal pain	Brand only: \$1260 for 100mg/10mL vial
Mepolizumab (Nucala)	100mg SubQ every 4 weeks	Common side effects: Headache, injection site reactions, fatigue, back pain	Brand only: \$4298 for 100mg/mL injector or syringe and \$3974 for 100mg/mL solution vial
Benralizumab (Fasenra)	30mg SubQ every 4 weeks for first 3 doses, then every 8 weeks	Common side effects: headache, fever, pharyngitis	Brand only: \$6614 for 30mg dose
Dupilumab (Dupixent)	Two 200mg SubQ injections once, then 200mg SubQ every other week or two 300mg SubQ injections once followed by 300mg SubQ every other week.	Common side effects: injection site reactions, conjunctivitis, keratitis, upper respiratory tract infections	Brand only: \$1888 for 200mg dose \$1076 for 300mg dose

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Drug Name	Dosing Range	Other Information	AWP (brand/generic)
Tezepelumab (Tezspire)	210mg SubQ every 4 weeks	Common side effects: arthralgia, back pain, pharyngitis	Brand only: \$2587 for 210mg autoinjector \$2418 for prefilled for 210mg syringe.

Short-Acting Beta 2 Agonists

	How Supplied	Adult Dose	Comments	Cost*
Albuterol				
AccuNeb (Only generics available)	nebulizer solution: 0.63mg/3mL 2.5mg/3mL 100mg/20mL Preservative free also available as 1.25mg/3mL in addition to above	2.5 – 5 mg every 20 minutes for 3 doses, then taper to 2.5 – 10 mg every 1-4 hours as tolerated, or 10-15 mg over 1 hour continuously for critically ill patients	May mix with ipratropium nebulizer solution.	\$1.65/each
ProAir, Proventil, Ventolin, and generics	HFA, MDI (90 mcg/puff)	4-10 inhalations every 20 minutes up to 3 doses, then taper to 2-4 inhalations every 1-4 hours as tolerated.	In mild –to-moderate exacerbations, MDI plus VHC is as effective as nebulized therapy with appropriate administration technique and coaching by trained personnel.	Proventil HFA: \$122 ProAir RespiClick: \$82 ProAir Digihaler: \$108 Ventolin HFA: \$27 Generic albuterol HFA: \$115 200 puffs/ container
Levalbuterol				
Xopenex (Only generics available)	nebulizer solution: 0.31 mg/3ml 0.63 mg/3 ml 1.25 mg/3 ml 1.25 mg/ 0.5 ml (Same strengths available as preservative free)	1.25-2.5 mg every 20 minutes for 3 doses, then 1.25 -5 mg every 1-4 hours as needed	1mg levalbuterol is equivalent to 2mg albuterol. Has not been evaluated by continuous nebulization.	\$2-7 each (generic)
Xopenex HFA	HFA, MDI (45 mcg/puff)	4-8 inhalations every 20 minutes up to 3 doses,	1mg levalbuterol is equivalent to 2mg albuterol	\$74 (generic) \$82 (brand)

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		then taper based on response to therapy.		200 puffs/container
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