MedStar Health

Guidelines for the Diagnosis and Management of Asthma in Adults

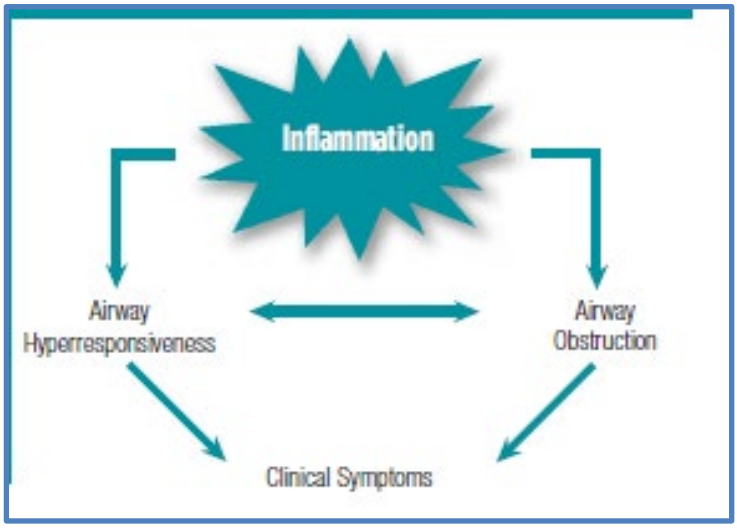
Clinical Practice Guideline

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".

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 2019, 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.

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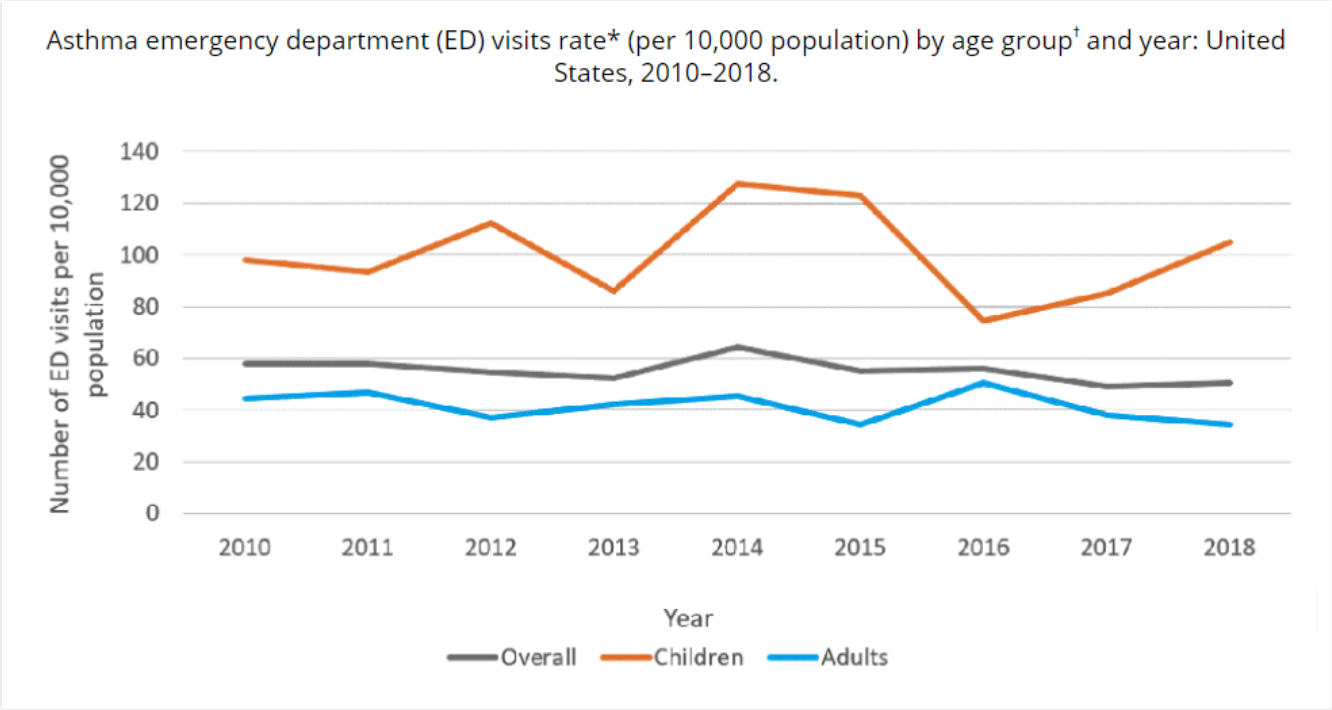
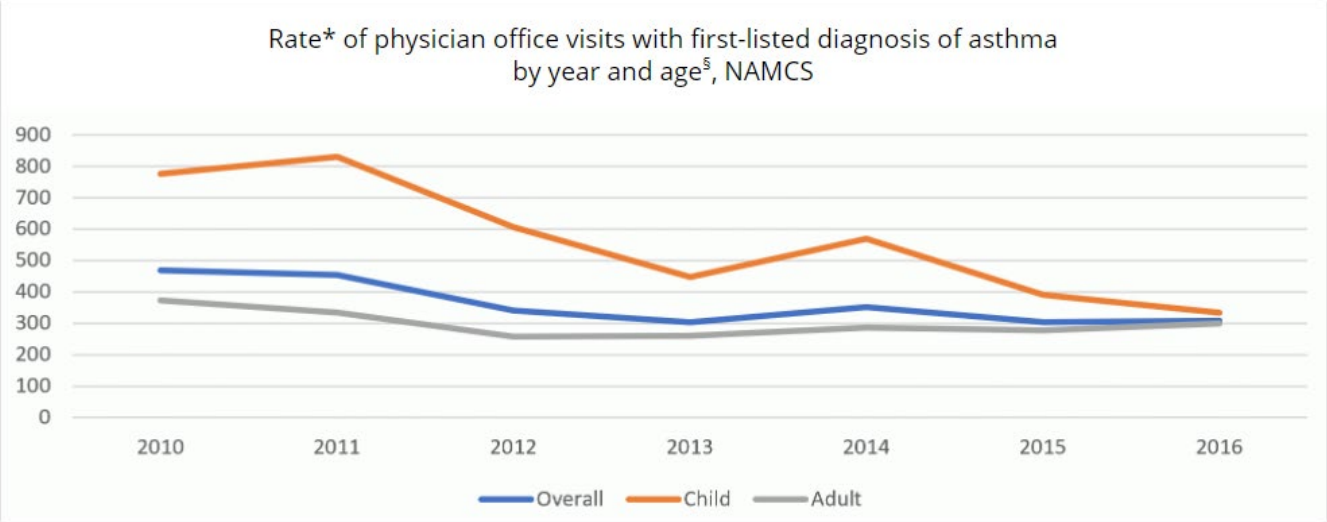
Effective 1997, 6/13, 7/15(adult), 8/15 (pediatric) 7/17 (separated adult and ped guideline), 7/19, 7/21	© Copyright MedStar Health, 2015	July 2023



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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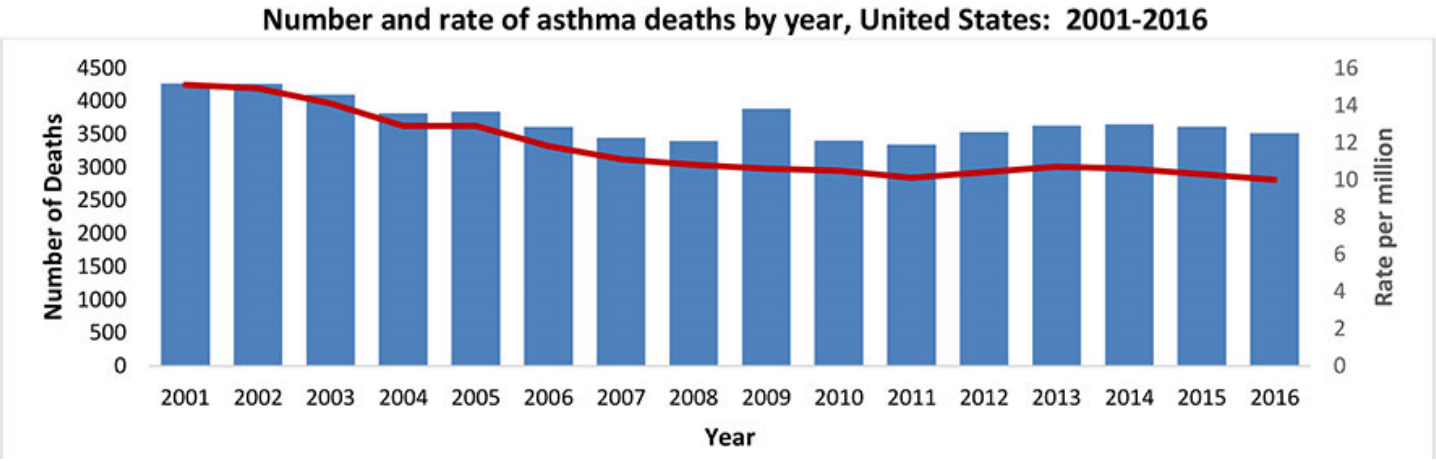

https://www.cdc.gov/asthma/asthma_stats/asthma_underlying_death.html

Diagnosis of asthma

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. For patients not meeting these criteria in whom the diagnosis continues to be suspected, a repeat spirometry test on a different day or a methacholine (bronchoprovocation) challenge test can be performed.

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.

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

Asthma severity is staged based on the level of asthma impairment and risk. Impairment is assessed based on severity of airway obstruction, symptoms, frequency of short acting beta agonist inhaler use, and interference with normal activity. Risk is related to the number of exacerbations per year requiring oral corticosteroid use. Intermittent asthma is characterized by symptoms no more than twice a week, nighttime awakenings no more than twice a month, and short acting beta agonist medication use nor more often than two days a week. There is no impact on daily activities, and lung function between attacks is normal. Persistent asthma is divided into mild, moderate and severe categories with symptoms and exacerbations being progressively more often and severe. The greatest degree of impairment or risk governs the severity classification. Asthma severity should drive treatment choice.

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

INITIAL VISIT: CLASSIFYING ASTHMA SEVERITY AND INITIATING THERAPY

(in patients who are not currently taking long-term control medications)

Level of severity (Columns 2-5) is determined by events listed in Column 1 for both impairment (frequency and intensity of symptoms and functional limitations) and risk (of exacerbations). Assess impairment by patient's or caregiver's recall of events during the previous 2-4 weeks; assess risk over the last year. Recommendations for initiating therapy based on level of severity are presented in the last row.

Components of Severity		Intermittent			Persistent								
					Mild			Moderate			Severe		
		Ages 0–4 years	Ages 5–11 years	Ages ≥12 years	Ages 0–4 years	Ages 5–11 years	Ages ≥12 years	Ages 0–4 years	Ages 5–11 years	Ages ≥12 years	Ages 0–4 years	Ages 5–11 years	Ages ≥12 years
Impairment	Symptoms	≤2 days/week			>2 days/week but not daily			Daily			Throughout the day		
	Nighttime awakenings	0	≤2x/month		1–2x/month	3–4x/month		3–4x/month	>1x/week but not nightly		>1x/week	Often 7x/week	
	SABA* use for symptom control (not to prevent EIB*)	≤2 days/week			>2 days/week but not daily	>2 days/week but not daily and not more than once on any day		Daily			Several times per day		
	Interference with normal activity	None			Minor limitation			Some limitation			Extremely limited		
	Lung function		Normal FEV_1 between exacerbations	Normal FEV_1 between exacerbations									
	→ FEV_1* (% predicted)	Not applicable	>80%	>80%	Not applicable	>80%	>80%	Not applicable	60–80%	60–80%	Not applicable	<60%	<60%
	→ FEV_1/FVC*		>85%	Normal†		>80%	Normal†		75–80%	Reduced 5%†		<75%	Reduced >5%†
Risk	Asthma exacerbations requiring oral systemic corticosteroids‡	0–1/year			≥2 exacerb. in 6 months, or wheezing ≥4x per year lasting >1 day AND risk factors for persistent asthma	≥2/year		Generally, more frequent and intense events indicate greater severity.					
		Consider severity and interval since last asthma 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 *(See "Stepwise Approach for Managing Asthma Long Term," page 7)* *The stepwise approach is meant to help, not replace, the clinical decisionmaking needed to meet individual patient needs.*		Step 1			Step 2			Step 3	Step 3 medium-dose ICS* option	Step 3	Step 3	Step 3 medium-dose ICS* option or Step 4	Step 4 or 5
								Consider short course of oral systemic corticosteroids.					
		In 2–6 weeks, depending on severity, assess level of asthma control achieved and adjust therapy as needed. For children 0–4 years old, if no clear benefit is observed in 4–6 weeks, consider adjusting therapy or alternate diagnoses.											

* **Abbreviations:** EIB, exercise-induced bronchospasm; FEV_1, forced expiratory volume in 1 second; FVC, forced vital capacity; ICS, inhaled corticosteroid; SABA, short-acting $beta_2$-agonist.

† Normal FEV_1/FVC by age: 8–19 years, 85%; 20–39 years, 80%; 40–59 years, 75%; 60–80 years, 70%.

‡ Data are insufficient to link frequencies of exacerbations with different levels of asthma severity. Generally, more frequent and intense exacerbations (e.g., requiring urgent care, hospital or intensive care admission, and/or oral corticosteroids) indicate greater underlying disease severity. For treatment purposes, patients with ≥2 exacerbations may be considered to have persistent asthma, even in the absence of impairment levels consistent with persistent asthma.

National Asthma Education and Prevention Program

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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 use (≤ 2 days per week) of SABA 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.
2. Reduce Risk
   - Prevent recurrent exacerbations of asthma and minimize the need for ED visits or hospitalizations
   - Prevent progressive loss of lung function; for children, prevent reduced lung growth
   - Provide optimal pharmacotherapy with minimal or no adverse effects

Components of Asthma Management

- **Routine assessment and monitoring:**
  Assess asthma severity to initiate therapy using the severity classification chart
  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.

Box 2-2. GINA assessment of asthma control in adults, adolescents and children 6–11 years

A. Asthma symptom control		Level of asthma symptom control		
In the past 4 weeks, has the patient had:		**Well controlled**	**Partly controlled**	**Uncontrolled**
• Daytime asthma symptoms more than twice/week?	Yes☐ No☐	None of these	1–2 of these	3–4 of these
• Any night waking due to asthma?	Yes☐ No☐			
• SABA reliever for symptoms more than twice/week?*	Yes☐ No☐			
• Any activity limitation due to asthma?	Yes☐ No☐			

- **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

Low dose ICS-formoteraol—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 2021 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)—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.

Long acting beta agonists (LABAs)—Can be added to inhaled corticosteroids in order 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.

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

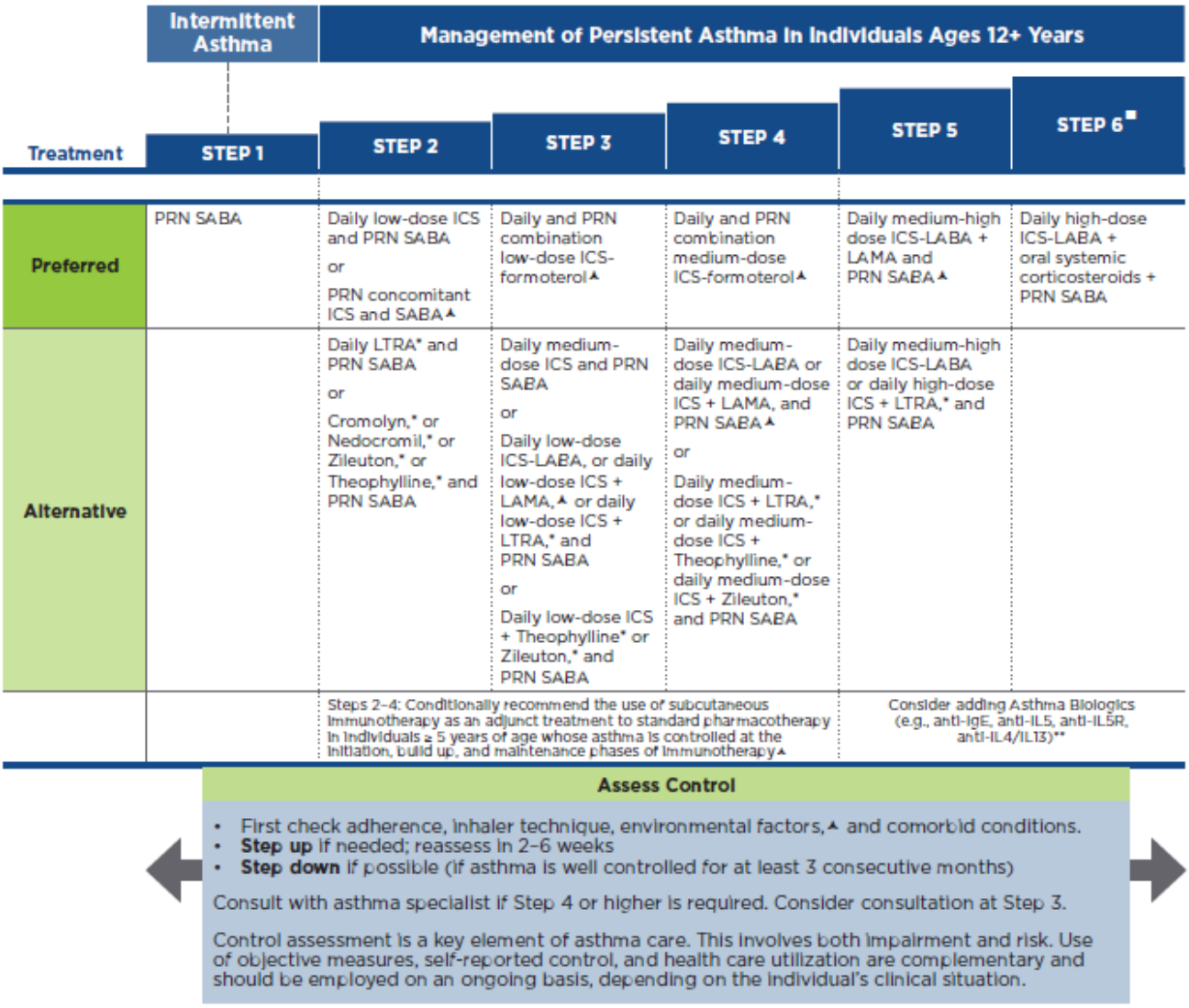
Methylxanthines—inexpensive and can be considered for patients unable to use inhalers. Drug levels need to be monitored to avoid toxicity. Rarely used.

Other biologics—Mepolizumab and Reslizumab are anti-IL-5 agents, given parenterally, usually by asthma specialists.

- **Immunizations:** annual influenza vaccine for all and pneumococcal 23 vaccine for patients with persistent asthma
- **Smoking cessation:** all patients with asthma who smoke should be advised to stop smoking and assisted in efforts to quit.

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

Figure I.d: Stepwise Approach for Management of Asthma in Individuals Ages 12 Years and Older



National Asthma Education and Prevention Program 2020 Focused Update

The Global Initiative for Asthma (GINA) differs in recommending that all adults and adolescents should receive ICS containing controller treatment and that combined ICS-formoterol be used as the preferred reliver 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.

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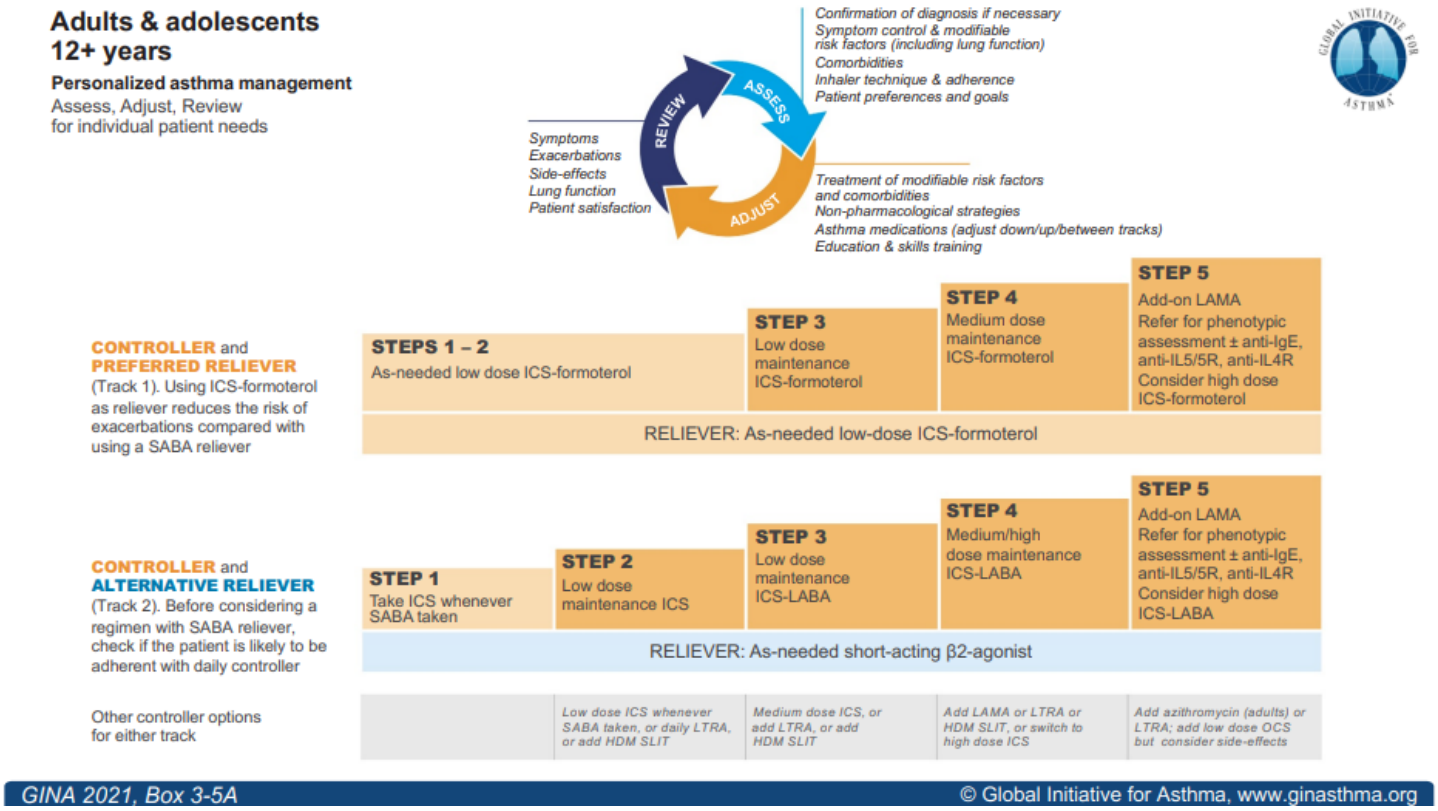

In addition to the choice of specific medication, thought should be given to which type of delivery device is best for the patient. Education on the inhaler chosen, using whatever method works best for the patient (video, handout, demonstration) is crucial to successful use. Spacer devices can improve delivery to the lung and reduce delivery to the mouth and pharynx.

Ease of use of Some Bronchodilator Inhalers

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 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
- 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. Asthma is treated the same in pregnancy as in the non-pregnant patient. Albuterol is the SABA of choice; salmeterol is the LABA of choice; budesonide is the ICS of choice.

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 parenteral biologic agents such as omalizumab

Asthma and COVID-19

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.

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

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:

https://foundation.chestnet.org/patient-education-resources/asthma/
Patient education information on asthma symptoms, diagnosis, inhalers and peak flow use
https://www.acponline.org/practice-resources/patient-education/online-resources/asthma-and-allergies-asthma-and-immunology
Patient education on asthma (in English and Spanish) as well as four videos demonstrating use of different inhaler types with and without spacers
http://www.aafa.org/page/programs-for-patients-and-caregivers.aspx
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
https://www.nhlbi.nih.gov/health/health-topics/topics/asthma
Comprehensive patient information on asthma from the National Heart, Lung, and Blood Institute
https://www.nhlbi.nih.gov/health-spanish/health-topics/temas/asthma
Comprehensive patient information on asthma from the National Heart, Lung, and Blood Institute in Spanish

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Medication Tables (from National Asthma Education and Prevention Program)

Medication	<5 Years of age	5-11 Years of age	≥12 Years of age and adults	Potential adverse effects	Comments (not all inclusive)
Inhaled SABAs					
	Dose applies to albuterol	**Dose applies to albuterol and levalbuterol**	**Does applies to all 4 SABAs**		**(Apply to all 4 SABAs)**
MDI					
Albuterol CFC 90 mcg/puff, 200 puffs/canister	1-2 puffs 5 minutes before exercise 2 puffs every 4-6 hours, as needed for symptoms	2 puffs 5 minutes before exercise 2 puffs every 4-6 hours, as needed for symptoms	2 puffs 5 minutes before exercise 2 puffs every 4-6 hours, as needed for symptoms	▪ Tachycardia, skeletal muscle tremor, hypokalemia, increased lactic acid, headache, hyperglycemia. Inhaled route, in general, causes few systemic adverse effects. Patients with pre-existing cardiovascular disease, especially the elderly, may have adverse cardiovascular reactions with inhaled therapy.	▪ Drugs of choice for acute bronchospasm. ▪ Differences in potencies exist, but all products are essentially comparable on a puff-per-puff basis. ▪ An increasing use or lack of expected effect indicates diminished control of asthma. ▪ Not recommended for long-term daily treatment. Regular use exceeding 2 d/wk for symptom control (not prevention of EIB) indicates the need for additional long-term control therapy. ▪ May double usual dose for mild exacerbations. ▪ For levalbuterol, prime the inhaler by releasing 4 actuations before use. ▪ For HFA: periodically clean HFA actuator, because drug may plug orifice. ▪ For autohaler: children <4 years of age may not generate sufficient inspiratory flow to activate an autoinhaler. ▪ Nonselective agents (ie, epinephrine, isoproterenol, metaproterenol) are not recommended because of their potential for excessive cardiac stimulation, especially in high doses.
Albuterol HFA 90 mcg/puff, 200 puffs/canister					
Levalbuterol HFA 45 mcg/puff, 200 puffs/canister	NA <4 years of age				
Pirbuterol CFC Autohaler 200 mcg/puff, 400 puffs/canister	NA	NA			

CFC, Chlorofluorocarbon; *HFA*, hydrofluoroalkane; *IM*, intramuscular; *NA*, not available (not approved, no data available, or safety and efficacy not established for this age group);

*Dosages are provided for those products that have been approved by the FDA or have sufficient clinical trial safety and efficacy data in the appropriate age ranges to support their use.

Medication	<5 Years of age	5-11 Years of age	≥12 Years of age and adults	Potential adverse effects	Comments (not all inclusive)
Inhaled SABAs (continued)					
Nebulizer solution					
Albuterol					
0.63 mg/3 mL 1.25 mg/3 mL 2.5 mg/3 mL 5 mg/mL (0.5%)	0.63-2.5 mg in 3 cc of saline q 4-6 hours, as needed	1.25-5 mg in 3 cc of saline q 4-8 hours, as needed	1.25-5 mg in 3 cc of saline q 4-8 hours, as needed	(Same as with MDI)	▪ May mix with cromolyn solution, budesonide inhalant suspension, or ipratropium solution for nebulization. May double dose for severe exacerbations.
Levalbuterol (R-albuterol)					
0.31 mg/3 mL 0.63 mg/3 mL 1.25 mg/0.5 mL 1.25 mg/3 mL	0.31-1.25 mg in 3 cc q 4-6 hours, as needed for symptoms	0.31-0.63 mg, q 8 hours, as needed for symptoms	0.63 mg-1.25 mg q 8 hours, as needed for symptoms	(Same as with MDI)	▪ Does not have FDA-approved labeling for children <6 years of age. ▪ Compatible with budesonide inhalant suspension. The product is a sterile-filled preservative-free unit dose vial.
Anticholinergics					
Ipratropium HFA					
MDI				▪ Drying of mouth and respiratory secretions, increased wheezing in some individuals, blurred vision if sprayed in eyes. If used in the ED, produces less cardiac stimulation than SABAs.	▪ Multiple doses in the ED (not hospital) setting provide additive benefit to SABA. ▪ Treatment of choice for bronchospasm because of β-blocker medication. ▪ Does not block EIB. ▪ Reverses only cholinergically mediated bronchospasm; does not modify reaction to antigen. ▪ May be an alternative for patients who do not tolerate SABA. ▪ Has not proven to be efficacious as long-term control therapy for asthma.
17 mcg/puff, 200 puffs/canister	NA	NA	2-3 puffs q 6 hours		
Nebulizer solution					
0.25 mg/mL (0.025%)	NA	NA	0.25 mg q 6 hours		
Ipratropium with albuterol					
MDI					
18 mcg/puff of ipratropium bromide and 90 mcg/puff of albuterol 200 puffs/canister	NA	NA	2-3 puffs q 6 hours		
Nebulizer solution					
0.5 mg/3 mL ipratropium bromide and 2.5 mg/3 mL albuterol	NA	NA	3 mL q 4-6 hours		▪ Contains EDTA to prevent discoloration of the solution. This additive does not induce bronchospasm.

Medication	<5 Years of age	5-11 Years of age	≥12 Years of age and adults	Potential adverse effects	Comments (not all inclusive)
Systemic corticosteroids					
	Dosages apply to first 3 corticosteroids				***(Apply to the first 3 corticosteroids)***
Methylprednisolone 2, 4, 6, 8, 16, 32-mg tablets	Short course burst: 1-2 mg/kg/d, maximum 60 mg/d, for 3-10 days	Short course burst: 40-60 mg/d as single or 2 divided doses for 3-10 days	Short course burst: 40-60 mg/d as single or 2 divided doses for 3-10 days	■ Short-term use: reversible abnormalities in glucose metabolism, increased appetite, fluid retention, weight gain, facial flushing, mood alteration, hypertension, peptic ulcer, and rarely aseptic necrosis. ■ Consideration should be given to coexisting conditions that could be worsened by systemic corticosteroids, such as herpes virus infections, varicella, tuberculosis, hypertension, peptic ulcer, diabetes mellitus, osteoporosis, and *Strongyloides*.	■ Short courses or bursts are effective for establishing control when initiating therapy or during a period of gradual deterioration. Action may begin within an hour. ■ The burst should be continued until patient achieves 80% PEF personal best or symptoms resolve. This usually requires 3-10 days but may require longer. There is no evidence that tapering the dose after improvement prevents relapse in asthma exacerbations. ■ Other systemic corticosteroids such as hydrocortisone and dexamethasone given in equipotent daily doses are likely to be as effective as prednisolone.
Prednisolone 5-mg tablets, 5 mg/5 cc, 15 mg/5 cc					
Prednisone 1, 2.5, 5, 10, 20, 50-mg tablets; 5 mg/cc, 5 mg/5 cc					
Repository injection (Methylprednisolone acetate) 40 mg/mL 80 mg/mL	7.5 mg/kg IM once	240 mg IM once	240 mg IM once		■ May be used in place of a short burst of oral steroids in patients who are vomiting or if adherence is a problem.

Long-Term Control Medications for Adults

Drug Name	Dosing Range	Other Information	AWP (brand/generic)
Inhaled Corticosteroids (ICS)			
Beclomethasone (QVAR RediHaler)	Patients previously on bronchodilators: 40-80mcg twice daily Patients previously on ICS: 40-320mcg twice daily Maximum dose: 320mcg twice daily "Low" dose: 80-240mcg/day "Medium" dose: 240-480mcg/day "High" dose: >480mcg/day * all in two divided doses daily	Does not need to be shaken before using Rinse mouth after use to prevent *Candida* infection	Brand only (price/inhaler): 40mcg/puff: $240 80mcg/puff: $321
Budesonide (Pulmicort Flexhaler)	Initial dose: 360mcg twice daily • May increase dose after 1-2 weeks if inadequate control Maximum dose: 720mcg twice daily "Low" dose: 180-400mcg/day "Medium" dose: 400-800mcg/day "High" dose: >800mcg/day * all in two divided doses daily	Do **not** shake before use Do **not** use with a spacer Rinse mouth after use to prevent *Candida* infection Interaction with CYP3A4 inhibitors – may increase systemic concentration of ICS	Brand only (price/inhaler) 90mcg/puff: $230 180mcg/puff: $308
Fluticasone (Arnuity Ellipta, Flovent Diskus, Flovent HFA, ArmonAir Digihaler)	**Arnuity Ellipta:** Prior use with ICS: 100-200mcg once daily; max 200mcg day No prior ICS use: 100mcg once daily; max 200mcg day "Low" dose: 100mcg/day "High" dose: 200mcg/day **Flovent HFA:** No prior ICS use: 88mcg twice daily; max 880mcg twice daily	May increase dose after 2 weeks if inadequate control Rinse mouth after use to prevent *Candida* infection Interaction with CYP3A4 inhibitors – may increase systemic concentration of ICS	Brand only (price/inhaler) **Arnuity Ellipta:** 50mcg/puff: $221 100mcg/puff: $221 200mcg/puff: $296 **Flovent HFA:** 44mcg/puff: $238 110mcg/puff: $319 220mcg/puff: $495 **Flovent Diskus:** 50mcg/blister: $226 100mcg/blister: $238

Drug Name	Dosing Range	Other Information	AWP (brand/generic)
	"Low" dose: 88-250mcg/day "Medium" dose: 250-500mcg/day "High" dose: >500mcg/day * all in two divided doses daily **Flovent Diskus:** No prior ICS use: 100mcg twice daily; max 1000mcg twice daily "Low" dose: 100-250mcg/day "Medium" dose: 250-500mcg/day "High" dose: >500mcg/day * all in two divided doses daily **ArmonAir Digihaler:** Prior ICS use: 55-232 mcg twice daily; max 232 mcg twice daily No prior ICS use: 55 mcg twice daily; max 232 mcg twice daily	**Flovent Diskus:** do **not** use with a spacer **Arnuity Ellipta:** do **not** shake **Flovent HFA**: must be shaken before use	250mcg/blister: $398 **ArmonAir Digihaler:** 55mcg/puff: $287 113mcg/puff: $287 232mcg/puff: $359
Mometasone (Asmanex Twisthaler, Asmanex HFA)	**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 **Asmanex HFA:** No prior ICS use:200mcg twice daily; max 400mcg twice daily Prior oral corticosteroid use: 400mcg twice daily "Low" dose:110-220mcg daily	If on oral corticosteroids, taper slowly (max reduction of 2.5mg/day on a weekly basis) beginning at least 1 week after starting mometasone. Rinse mouth after use to prevent *Candida* infection HFA should be shaken before use For every 110mcg delivered by Twisthaler, 100mcg of	Brand only (price/inhaler) **Asmanex HFA:** 50mcg/puff: $213 100mcg/puff: $230 200mcg/puff: $270 **Asmanex Twisthaler (30 doses)** 110mcg/puff: $213 220mcg/puff: $230

Drug Name	Dosing Range	Other Information	AWP (brand/generic)
	"Medium" dose: 220-4400mcg daily "High" dose: >440mcg daily	mometasone is delivered 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 3-10 days ("burst") • Used to achieve control	Alternate day therapy may produce less adrenal suppression Short course "bursts" may be useful when initiating therapy Tapering will not prevent relapse	2mg $60/-- 4mg $11/$67 8mg $64/$60 16mg $103/$106 32mg $358/$155
Prednisolone (Millipred) Prednisolone ODT (Orapred ODT)			5mg $556/-- ODT: 10mg $783/$431 15mg $1017/$719 30mg $1290/$924
Long-Acting Beta$_2$-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: $493
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: 500mcg fluticasone/50mcg salmeterol twice daily **Advair HFA:**	Starting dose depends on asthma severity May increase dose after 2 weeks if inadequate control Rinse mouth after use to prevent *Candida* infection	Brand name (price/inhaler) **Advair Diskus:** 100-50mcg/dose: $781 250-50mcg/dose: $781 500-50mcg/dose: $1272 **Advair HFA:** 45-21mcg/dose: $394 115-21mcg/dose: $394 230-21mcg/dose: $584

Drug Name	Dosing Range	Other Information	AWP (brand/generic)
	Initial: 2 inhalations of 45mcg fluticasone/21mcg salmeterol twice daily Max: 2 inhalations of 230mcg fluticasone/21mcg salmeterol twice daily **AirDuo RespiClick and AirDuo Digihaler:** 55mcg fluticasone/14mcg salmeterol twice daily; max 232mcg fluticasone/14mcg salmeterol twice daily	See also: individual agents - LABAs vilanterol and formoterol not available as monotherapy	**AirDuo RespiClick:** 55-14mcg/dose: $420 113-14mcg/dose: $420 232-14mcg/dose: $420 **AirDuo Digihaler:** 55-14mcg/dose: $479 113-14mcg/dose: $479 232-14mcg/dose: $479 **Wixela Inhub:** 100-50mcg/dose: $361 250-50mcg/dose: $449 500-50mcg/dose: $590 Generic (price/inhaler) 55-14mcg/dose: $119 113-14mcg/dose: $119 232-14mcg/dose: $119
Budesonide/Formoterol (Symbicort)	Initial: 80mcg budesonide/4.5mcg formoterol as two inhalations twice daily Max: 160mcg budesonide/4.5mcg formoterol as two inhalations twice daily		(price/inhaler) 80-4.5mcg/puff: $353 160-4.5mcg/puff: $403
Fluticasone/Vilanterol (Breo Ellipta)	100mcg fluticasone/25mcg vilanterol or 200mcg fluticasone/25mcg vilanterol once daily Max: 200mcg fluticasone/25mcg vilanterol once daily		Brand only (price/inhaler) 100-25mcg/dose: $369 200-25mcg/dose: $369
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 *Candida* infection See also: individual agents	Brand only (price/inhaler) 100-5mcg/puff: $374 200-5mcg/puff: $374
Fluticasone/Umeclidinium/ Vilanterol (Trelegy Ellipta)	100mcg fluticasone/ 62.5mcg umeclidinium/ 25mcg vilanterol one inhalation daily or 200mcg	Rinse mouth after use to prevent *Candida* infection	Brand only (price/inhaler) 100-62.5-25mcg/puff: $721

Drug Name	Dosing Range	Other Information	AWP (brand/generic)
	fluticasone/62.5mcg umeclidinium/ 25mcg vilanterol one inhalation daily	See also: individual agents	200-62.5-25mcg/puff: $721
Leukotriene Receptor Antagonists			
Montelukast (Singulair)	10mg nightly	**Boxed Warning:** Risk of serious neuropsychiatric events Increasing the dose does **not** increase response	$274/$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/$62 20mg: $137/$62
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			
Theophyline (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	**Theo-24 (**brand only): 100mg: $95.4 200mg: $142 300mg: $174 400mg: $245

Drug Name	Dosing Range	Other Information	AWP (brand/generic)
		Recheck serum levels every 6-12 months once dose is stable Extended release formulations must be taken with full glass of water and 1 hour before or 2 hours after meals • Capsule forms may be opened and sprinkled on soft foods, but beads should **not** be chewed	**Theophylline ER** (generic only)**:** 400mg: $41 600mg: $59
Immunomodulator			
Omalizumab (Xolair)	Based on pre-treatment IgE serum level and body weight: IgE 30-100: 30-90kg: 150mg every 4 weeks 90-150kg: 300mg every 4 weeks IgE 100-200: 30-90kg: 300mg every 4 weeks 90-150kg: 225mg every 2 weeks IgE 200-300: 30-60kg: 300mg every 4 weeks 60-90 kg: 225mg every 2 weeks 90-150kg: 300mg every 2 weeks IgE 300-400: 30-70kg: 225mg every 2 weeks 70-90kg: 300mg every 2 weeks	Maximum 150mg per injection site Adjust dose for significant changes in body weight. Only adjust dose for IgE levels if therapy is interrupted for over 1 year. Monitor for anaphylaxis for 2 hours following at least the first 3 injections; discontinue if anaphylaxis occurs (boxed warning) Discontinue if fever, arthralgia, and rash occur after use.	Brand only: $1395 per 150mg dose

Drug Name	Dosing Range	Other Information	AWP (brand/generic)
	>90kg: do not use IgE 400-500: 30-70kg: 300mg every 2 weeks 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: $1164 for 100mg/10mL vial
Mepolizumab (Nucala)	100mg IV every 4 weeks	Common side effects: Headache, injection site reactions, fatigue, back pain	Brand only: $3744 for 100mg/mL injector, syringe, or solution