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Asthma Care Quick Reference

DIAGNOSING AND MANAGING ASTHMA

Guidelines from the National Asthma Education and Prevention Program

EXPERT PANEL REPORT 3

The goal of this asthma care quick reference guide is to help clinicians provide quality care to people who have asthma.

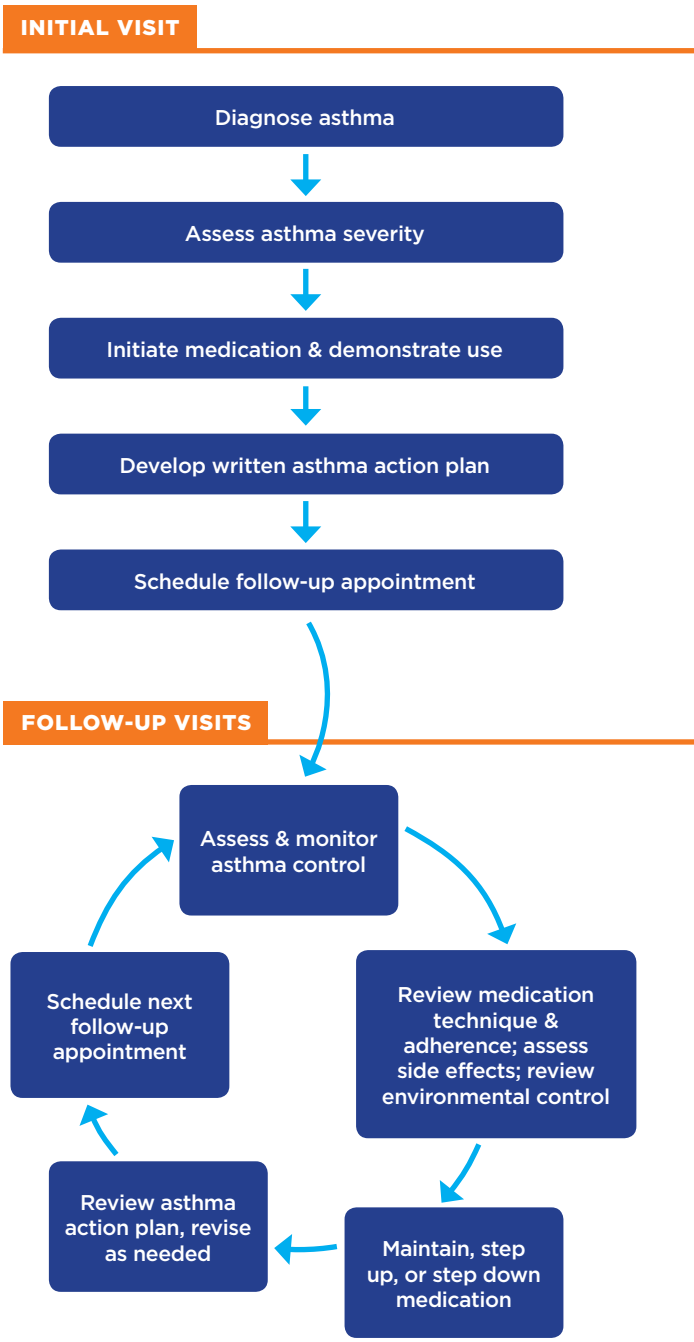
Quality asthma care involves not only initial diagnosis and treatment to achieve asthma control, but also long-term, regular follow-up care to maintain control.

Asthma control focuses on two domains: (1) **reducing impairment**—the frequency and intensity of symptoms and functional limitations currently or recently experienced by a patient; and (2) **reducing risk**—the likelihood of future asthma attacks, progressive decline in lung function (or, for children, reduced lung growth), or medication side effects.

Achieving and maintaining asthma control requires providing appropriate medication, addressing environmental factors that cause worsening symptoms, helping patients learn self-management skills, and monitoring over the long term to assess control and adjust therapy accordingly.

The diagram (right) illustrates the steps involved in providing quality asthma care.

This guide summarizes recommendations developed by the National Asthma Education and Prevention Program's expert panel after conducting a systematic review of the scientific literature on asthma care. See **www.nhlbi.nih.gov/guidelines/asthma** for the full report and references. Medications and dosages were updated in September 2011 for the purposes of this quick reference guide to reflect currently available asthma medications.



U.S. Department of Health and Human Services
National Institutes of Health
National Heart, Lung, and Blood Institute

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KEY CLINICAL ACTIVITIES FOR QUALITY ASTHMA CARE

(See complete table in *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma* [EPR-3])

Clinical Issue	Key Clinical Activities and Action Steps
➡ ASTHMA DIAGNOSIS	
	Establish asthma diagnosis. ▪ Determine that symptoms of recurrent airway obstruction are present, based on history and exam. • History of cough, recurrent wheezing, recurrent difficulty breathing, recurrent chest tightness • Symptoms occur or worsen at night or with exercise, viral infection, exposure to allergens and irritants, changes in weather, hard laughing or crying, stress, or other factors ▪ In all patients ≥5 years of age, use spirometry to determine that airway obstruction is at least partially reversible. ▪ Consider other causes of obstruction.
➡ LONG-TERM ASTHMA MANAGEMENT	
GOAL: Asthma Control	**Reduce Impairment** ▪ Prevent chronic symptoms. ▪ Require infrequent use of short-acting beta$_2$-agonist (SABA). ▪ Maintain (near) normal lung function and normal activity levels. **Reduce Risk** ▪ Prevent exacerbations. ▪ Minimize need for emergency care, hospitalization. ▪ Prevent loss of lung function (or, for children, prevent reduced lung growth). ▪ Minimize adverse effects of therapy.
Assessment and Monitoring	**INITIAL VISIT: Assess asthma severity to initiate treatment** (see page 5)**.** **FOLLOW-UP VISITS: Assess asthma control to determine if therapy should be adjusted** (see page 6)**.** ▪ Assess at each visit: asthma control, proper medication technique, written asthma action plan, patient adherence, patient concerns. ▪ Obtain lung function measures by spirometry at least every 1–2 years; more frequently for asthma that is not well controlled. ▪ Determine if therapy should be adjusted: Maintain treatment; step up, if needed; step down, if possible. **Schedule follow-up care.** ▪ Asthma is highly variable over time. See patients: • Every 2–6 weeks while gaining control • Every 1–6 months to monitor control • Every 3 months if step down in therapy is anticipated
Use of Medications	**Select medication and delivery devices that meet patient's needs and circumstances.** ▪ Use stepwise approach to identify appropriate treatment options (see page 7). ▪ Inhaled corticosteroids (ICSs) are the most effective long-term control therapy. ▪ When choosing treatment, consider domain of relevance to the patient (risk, impairment, or both), patient's history of response to the medication, and willingness and ability to use the medication. **Review medications, technique, and adherence at each follow-up visit.**

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KEY CLINICAL ACTIVITIES FOR QUALITY ASTHMA CARE *(continued)*

Clinical Issue	Key Clinical Activities and Action Steps
Patient Education for Self-Management	**Teach patients how to manage their asthma.** ▪ Teach and reinforce at each visit: • Self-monitoring to assess level of asthma control and recognize signs of worsening asthma (either symptom or peak flow monitoring) • Taking medication correctly (inhaler technique, use of devices, understanding difference between long-term control and quick-relief medications) - ***Long-term control medications*** (such as inhaled corticosteroids, which reduce inflammation) prevent symptoms. Should be taken daily; will not give quick relief. - ***Quick-relief medications*** (short-acting beta$_2$-agonists or SABAs) relax airway muscles to provide fast relief of symptoms. Will not provide long-term asthma control. If used >2 days/week (except as needed for exercise-induced asthma), the patient may need to start or increase long-term control medications. • Avoiding environmental factors that worsen asthma **Develop a written asthma action plan** in partnership with patient/family (sample plan available at *www.nhlbi.nih.gov/health/public/lung/asthma/asthma_actplan.pdf*). ▪ Agree on treatment goals. ▪ Teach patients how to use the asthma action plan to: • Take daily actions to control asthma • Adjust medications in response to worsening asthma • Seek medical care as appropriate ▪ Encourage adherence to the asthma action plan. • Choose treatment that achieves outcomes and addresses preferences important to the patient/family. • Review at each visit any success in achieving control, any concerns about treatment, any difficulties following the plan, and any possible actions to improve adherence. • Provide encouragement and praise, which builds patient confidence. Encourage family involvement to provide support. **Integrate education into all points of care involving interactions with patients.** ▪ Include members of all health care disciplines (e.g., physicians, pharmacists, nurses, respiratory therapists, and asthma educators) in providing and reinforcing education at all points of care.
Control of Environmental Factors and Comorbid Conditions	**Recommend ways to control exposures to allergens, irritants, and pollutants that make asthma worse.** ▪ Determine exposures, history of symptoms after exposures, and sensitivities. (In patients with persistent asthma, use skin or in vitro testing to assess sensitivity to perennial indoor allergens to which the patient is exposed.) • Recommend multifaceted approaches to control exposures to which the patient is sensitive; single steps alone are generally ineffective. • Advise all asthma patients and all pregnant women to avoid exposure to tobacco smoke. • Consider allergen immunotherapy by trained personnel for patients with persistent asthma when there is a clear connection between symptoms and exposure to an allergen to which the patient is sensitive. **Treat comorbid conditions.** ▪ Consider allergic bronchopulmonary aspergillosis, gastroesophageal reflux, obesity, obstructive sleep apnea, rhinitis and sinusitis, and stress or depression. Treatment of these conditions may improve asthma control. ▪ Consider inactivated flu vaccine for all patients >6 months of age.

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ASTHMA CARE FOR SPECIAL CIRCUMSTANCES

Clinical Issue	Key Clinical Activities and Action Steps
Exercise-Induced Bronchospasm	**Prevent EIB.*** ▪ Physical activity should be encouraged. For most patients, EIB should not limit participation in any activity they choose. ▪ Teach patients to take treatment before exercise. SABAs* will prevent EIB in most patients; LTRAs,* cromolyn, or LABAs* also are protective. Frequent or chronic use of LABA to prevent EIB is discouraged, as it may disguise poorly controlled persistent asthma. ▪ Consider long-term control medication. EIB often is a marker of inadequate asthma control and responds well to regular anti-inflammatory therapy. ▪ Encourage a warm-up period or mask or scarf over the mouth for cold-induced EIB.
Pregnancy	**Maintain asthma control through pregnancy.** ▪ Check asthma control at all prenatal visits. Asthma can worsen or improve during pregnancy; adjust medications as needed. ▪ Treating asthma with medications is safer for the mother and fetus than having poorly controlled asthma. Maintaining lung function is important to ensure oxygen supply to the fetus. ▪ ICSs* are the preferred long-term control medication. ▪ Remind patients to avoid exposure to tobacco smoke.

MANAGING EXACERBATIONS

Clinical Issue	Key Clinical Activities and Action Steps
Home Care	**Develop a written asthma action plan** (see Patient Education for Self-Management, page 3)**.** **Teach patients how to:** ▪ Recognize early signs, symptoms, and PEF* measures that indicate worsening asthma. ▪ Adjust medications (increase SABA* and, in some cases, add oral systemic corticosteroids) and remove or withdraw from environmental factors contributing to the exacerbation. ▪ Monitor response. ▪ Seek medical care if there is serious deterioration or lack of response to treatment. Give specific instructions on who and when to call.
Urgent or Emergency Care	**Assess severity by lung function measures (for ages ≥5 years), physical examination, and signs and symptoms.** **Treat to relieve hypoxemia and airflow obstruction; reduce airway inflammation.** ▪ Use supplemental oxygen as appropriate to correct hypoxemia. ▪ Treat with repetitive or continuous SABA,* with the addition of inhaled ipratropium bromide in severe exacerbations. ▪ Give oral systemic corticosteroids in moderate or severe exacerbations or for patients who fail to respond promptly and completely to SABA. ▪ Consider adjunctive treatments, such as intravenous magnesium sulfate or heliox, in severe exacerbations unresponsive to treatment. **Monitor response with repeat assessment of lung function measures, physical examination, and signs and symptoms, and, in emergency department, pulse oximetry.** **Discharge with medication and patient education:** ▪ Medications: SABA, oral systemic corticosteroids; consider starting ICS* ▪ Referral to follow-up care ▪ Asthma discharge plan ▪ Review of inhaler technique and, whenever possible, environmental control measures

***Abbreviations:** EIB, exercise-induced bronchospasm; ICS, inhaled corticosteroid; LABA, long-acting beta$_2$-agonist; LTRA, leukotriene receptor antagonist; PEF, peak expiratory flow; SABA, short-acting beta$_2$-agonist.

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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	*Generally, more frequent and intense events indicate greater severity.*							
						≥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 bronchospam; 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.

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FOLLOW-UP VISITS: ASSESSING ASTHMA CONTROL AND ADJUSTING THERAPY

Level of control (Columns 2–4) is based on the most severe component of impairment (symptoms and functional limitations) or risk (exacerbations). Assess impairment by patient's or caregiver's recall of events listed in Column 1 during the previous 2–4 weeks and by spirometry and/or peak flow measures. Symptom assessment for longer periods should reflect a global assessment, such as inquiring whether the patient's asthma is better or worse since the last visit. Assess risk by recall of exacerbations during the previous year and since the last visit. Recommendations for adjusting therapy based on level of control are presented in the last row.

Components of Control		Well Controlled			Not Well Controlled			Very Poorly Controlled		
		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 more than once on each day	≤2 days/week	>2 days/week	>2 days/week or multiple times on ≤2 days/week	>2 days/week	Throughout the day		
	Nighttime awakenings	≤1x/month		≤2x/month	>1x/month	≥2x/month	1–3x/week	>1x/week	≥2x/week	≥4x/week
	Interference with normal activity	None			Some limitation			Extremely limited		
	SABA* use for symptom control (not to prevent EIB*)	≤2 days/week			>2 days/week			Several times per day		
	Lung function									
	➔ FEV_1* (% *predicted*) or peak flow (% *personal best*)	Not applicable	>80%	>80%	Not applicable	60–80%	60–80%	Not applicable	<60%	<60%
	➔ FEV_1/FVC*		>80%	Not applicable		75–80%	Not applicable		<75%	Not applicable
	Validated questionnaires†									
	➔ ATAQ*	Not applicable	Not applicable	0	Not applicable	Not applicable	1–2	Not applicable	Not applicable	3–4
	➔ ACQ*			≤0.75‡			≥1.5			Not applicable
	➔ ACT*			≥20			16–19			≤15
Risk	Asthma exacerbations requiring oral systemic corticosteroids§	0–1/year			2–3/year	≥2/year		>3/year	≥2/year	
		Consider severity and interval since last asthma exacerbation.								
	Reduction in lung growth/Progressive loss of lung function	Not applicable	Evaluation requires long-term follow-up care.		Not applicable	Evaluation requires long-term follow-up care.		Not applicable	Evaluation requires long-term follow-up care.	
	Treatment-related adverse effects	*Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.*								
Recommended Action for Treatment *(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.*		*Maintain current step.* *Regular follow-up every 1–6 months.* *Consider step down if well controlled for at least 3 months.*			Step up 1 step	Step up at least 1 step	Step up 1 step	*Consider short course of oral systemic corticosteroids.* *Step up 1–2 steps.* *Reevaluate in 2 weeks to achieve control.*		
					Reevaluate in 2–6 weeks to achieve control. *For children 0–4 years, if no clear benefit observed in 4–6 weeks, consider adjusting therapy or alternative diagnoses.*					
					Before step up in treatment: Review adherence to medication, inhaler technique, and environmental control. If alternative treatment was used, discontinue and use preferred treatment for that step. For side effects, consider alternative treatment options.					

* **Abbreviations:** ACQ, Asthma Control Questionnaire®; ACT, Asthma Control Test™; ATAQ, Asthma Therapy Assessment Questionnaire®; EIB, exercise-induced bronchospasm; FVC, forced vital capacity; FEV_1, forced expiratory volume in 1 second; SABA, short-acting $beta_2$-agonist.

† Minimal important difference: 1.0 for the ATAQ; 0.5 for the ACQ; not determined for the ACT.

‡ ACQ values of 0.76–1.4 are indeterminate regarding well-controlled asthma.

§ Data are insufficient to link frequencies of exacerbations with different levels of asthma control. Generally, more frequent and intense exacerbations (e.g., requiring urgent care, hospital or intensive care admission, and/or oral corticosteroids) indicate poorer asthma control.

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STEPWISE APPROACH FOR MANAGING ASTHMA LONG TERM

The stepwise approach tailors the selection of medication to the level of asthma severity (see page 5) or asthma control (see page 6). The stepwise approach is meant to help, not replace, the clinical decisionmaking needed to meet individual patient needs.

ASSESS CONTROL:

STEP UP IF NEEDED (first, check medication adherence, inhaler technique, environmental control, and comorbidities)

STEP DOWN IF POSSIBLE (and asthma is well controlled for at least 3 months)

At each step: Patient education, environmental control, and management of comorbidities

		STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6
0–4 years of age		**Intermittent Asthma**	**Persistent Asthma: Daily Medication** Consult with asthma specialist if step 3 care or higher is required. Consider consultation at step 2.				
	Preferred Treatment†	SABA* as needed	low-dose ICS*	medium-dose ICS*	medium-dose ICS* + either LABA* or montelukast	high-dose ICS* + either LABA* or montelukast	high-dose ICS* + either LABA* or montelukast + oral corticosteroids
	Alternative Treatment†,‡		cromolyn or montelukast				
	If clear benefit is not observed in 4–6 weeks, and medication technique and adherence are satisfactory, consider adjusting therapy or alternate diagnoses.						
	Quick-Relief Medication	▪ SABA* as needed for symptoms; intensity of treatment depends on severity of symptoms. ▪ With viral respiratory symptoms: SABA every 4–6 hours up to 24 hours (longer with physician consult). Consider short course of oral systemic corticosteroids if asthma exacerbation is severe or patient has history of severe exacerbations. ▪ Caution: Frequent use of SABA may indicate the need to step up treatment.					
5–11 years of age		**Intermittent Asthma**	**Persistent Asthma: Daily Medication** Consult with asthma specialist if step 4 care or higher is required. Consider consultation at step 3.				
	Preferred Treatment†	SABA* as needed	low-dose ICS*	low-dose ICS* + either LABA,* LTRA,* or theophylline(b) **OR** medium-dose ICS	medium-dose ICS* + LABA*	high-dose ICS* + LABA*	high-dose ICS* + LABA* + oral corticosteroids
	Alternative Treatment†,‡		cromolyn, LTRA,* or theophylline§		medium-dose ICS* + either LTRA* or theophylline§	high-dose ICS* + either LTRA* or theophylline§	high-dose ICS* + either LTRA* or theophylline§ + oral corticosteroids
			Consider subcutaneous allergen immunotherapy for patients who have persistent, allergic asthma.**				
	Quick-Relief Medication	▪ SABA* as needed for symptoms. The intensity of treatment depends on severity of symptoms: up to 3 treatments every 20 minutes as needed. Short course of oral systemic corticosteroids may be needed. ▪ Caution: Increasing use of SABA or use >2 days/week for symptom relief (not to prevent EIB*) generally indicates inadequate control and the need to step up treatment.					
≥12 years of age		**Intermittent Asthma**	**Persistent Asthma: Daily Medication** Consult with asthma specialist if step 4 care or higher is required. Consider consultation at step 3.				
	Preferred Treatment†	SABA* as needed	low-dose ICS*	low-dose ICS* + LABA* **OR** medium-dose ICS*	medium-dose ICS* + LABA*	high-dose ICS* + LABA* **AND** consider omalizumab for patients who have allergies††	high-dose ICS* + LABA* + oral corticosteroid§§ **AND** consider omalizumab for patients who have allergies††
	Alternative Treatment†,‡		cromolyn, LTRA,* or theophylline§	low-dose ICS* + either LTRA,* theophylline,§ or zileuton‡‡	medium-dose ICS* + either LTRA,* theophylline,§ or zileuton‡‡		
			Consider subcutaneous allergen immunotherapy for patients who have persistent, allergic asthma.**				
	Quick-Relief Medication	▪ SABA* as needed for symptoms. The intensity of treatment depends on severity of symptoms: up to 3 treatments every 20 minutes as needed. Short course of oral systemic corticosteroids may be needed. ▪ Caution: Use of SABA >2 days/week for symptom relief (not to prevent EIB*) generally indicates inadequate control and the need to step up treatment.					

* **Abbreviations:** EIB, exercise-induced bronchospasm; ICS, inhaled corticosteroid; LABA, inhaled long-acting beta$_2$-agonist; LTRA, leukotriene receptor antagonist; SABA, inhaled short-acting beta$_2$-agonist.

† Treatment options are listed in alphabetical order, if more than one.

‡ If alternative treatment is used and response is inadequate, discontinue and use preferred treatment before stepping up.

§ Theophylline is a less desirable alternative because of the need to monitor serum concentration levels.

** Based on evidence for dust mites, animal dander, and pollen; evidence is weak or lacking for molds and cockroaches. Evidence is strongest for immunotherapy with single allergens. The role of allergy in asthma is greater in children than in adults.

†† Clinicians who administer immunotherapy or omalizumab should be prepared to treat anaphylaxis that may occur.

‡‡ Zileuton is less desirable because of limited studies as adjunctive therapy and the need to monitor liver function.

§§ Before oral corticosteroids are introduced, a trial of high-dose ICS + LABA + either LTRA, theophylline, or zileuton, may be considered, although this approach has not been studied in clinical trials.

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ESTIMATED COMPARATIVE DAILY DOSAGES: INHALED CORTICOSTEROIDS FOR LONG-TERM ASTHMA CONTROL

	0–4 years of age			5–11 years of age			≥12 years of age		
Daily Dose	**Low**	**Medium***	**High***	**Low**	**Medium***	**High***	**Low**	**Medium***	**High***
MEDICATION									
Beclomethasone MDI†	N/A	N/A	N/A	80–160 mcg	>160–320 mcg	>320 mcg	80–240 mcg	>240–480 mcg	>480 mcg
40 mcg/puff				1–2 puffs 2x/day	3–4 puffs 2x/day		1–3 puffs 2x/day	4–6 puffs 2x/day	
80 mcg/puff				1 puff 2x/day	2 puffs 2x/day	≥3 puffs 2x/day	1 puff am, 2 puffs pm	2–3 puffs 2x/day	≥4 puffs 2x/day
Budesonide DPI†	N/A	N/A	N/A	180–360 mcg	>360–720 mcg	>720 mcg	180–540 mcg	>540–1,080 mcg	>1,080 mcg
90 mcg/inhalation				1–2 inhs† 2x/day	3–4 inhs† 2x/day		1–3 inhs† 2x/day		
180 mcg/ inhalation					2 inhs† 2x/day	≥3 inhs† 2x/day	1 inh† am, 2 inhs† pm	2–3 inhs† 2x/day	≥4 inhs† 2x/day
Budesonide Nebules	0.25–0.5 mg	>0.5–1.0 mg	>1.0 mg	0.5 mg	1.0 mg	2.0 mg	N/A	N/A	N/A
0.25 mg	1–2 nebs†/day			1 neb† 2x/day					
0.5 mg	1 neb†/day	2 nebs†/day	3 nebs†/day	1 neb†/day	1 neb† 2x/day				
1.0 mg		1 neb†/day	2 nebs†/day		1 neb†/day	1 neb† 2x/day			
Ciclesonide MDI†	N/A	N/A	N/A	80–160 mcg	>160–320 mcg	>320 mcg	160–320 mcg	>320–640 mcg	>640 mcg
80 mcg/puff				1–2 puffs/day	1 puff am, 2 puffs pm–2 puffs 2x/day	≥3 puffs 2x/day	1–2 puffs 2x/day	3–4 puffs 2x/day	
160 mcg/puff				1 puff/day	1 puff 2x/day	≥2 puffs 2x/day		2 puffs 2x/day	≥3 puffs 2x/day
Flunisolide MDI†	N/A	N/A	N/A	160 mcg	320–480 mcg	≥480 mcg	320 mcg	>320–640 mcg	>640 mcg
80 mcg/puff				1 puff 2x/day	2–3 puffs 2x/day	≥4 puffs 2x/day	2 puffs 2x/day	3–4 puffs 2x/day	≥5 puffs 2x/day

* It is preferable to use a higher mcg/puff or mcg/inhalation formulation to achieve as low a number of puffs or inhalations as possible.

† **Abbreviations:** DPI, dry powder inhaler (requires deep, fast inhalation); inh, inhalation; MDI, metered dose inhaler (releases a puff of medication); neb, nebule.

ESTIMATED COMPARATIVE DAILY DOSAGES: INHALED CORTICOSTEROIDS FOR LONG-TERM ASTHMA CONTROL *(continued)*

	0–4 years of age			5–11 years of age			≥12 years of age		
Daily Dose	**Low**	**Medium***	**High***	**Low**	**Medium***	**High***	**Low**	**Medium***	**High***
MEDICATION									
Fluticasone MDI†	176 mcg	>176–352 mcg	>352 mcg	88–176 mcg	>176–352 mcg	>352 mcg	88–264 mcg	>264–440 mcg	>440 mcg
44 mcg/puff	2 puffs 2x/day	3–4 puffs 2x/day		1–2 puffs 2x/day	3–4 puffs 2x/day		1–3 puffs 2x/day		
110 mcg/puff		1 puff 2x/day	≥2 puffs 2x/day		1 puff 2x/day	≥2 puffs 2x/day		2 puffs 2x/day	3 puffs 2x/day
220 mcg/puff								1 puffs 2x/day	≥2 puffs 2x/day
Fluticasone DPI†	N/A	N/A	N/A	100–200 mcg	>200–400 mcg	>400 mcg	100–300 mcg	>300–500 mcg	>500 mcg
50 mcg/inhalation				1–2 inhs† 2x/day	3–4 inhs† 2x/day		1–3 inhs† 2x/day		
100 mcg/inhalation				1 inh† 2x/day	2 inhs† 2x/day	>2 inhs† 2x/day		2 inhs† 2x/day	≥3 inhs† 2x/day
250 mcg/inhalation						1 inh† 2x/day		1 inh† 2x/day	≥2 inhs† 2x/day
Mometasone DPI†	N/A	N/A	N/A	110 mcg	220–440 mcg	>440 mcg	110–220 mcg	>220–440 mcg	>440 mcg
110 mcg/inhalation				1 inh†/day	1–2 inhs† 2x/day	≥3 inhs† 2x/day	1–2 inhs† pm	3–4 inhs† pm or 2 inhs† 2x/day	≥3 inhs† 2x/day
220 mcg/inhalation					1–2 inhs†/day	≥3 inhs† divided in 2 doses	1 inh† pm	1 inh† 2x/day or 2 inhs† pm	≥3 inhs† divided in 2 doses

* It is preferable to use a higher mcg/puff or mcg/inhalation formulation to achieve as low a number of puffs or inhalations as possible.
† **Abbreviations:** DPI, dry powder inhaler (requires deep, fast inhalation); inh, inhalation; MDI, metered dose inhaler (releases a puff of medication); neb, nebule.

Therapeutic Issues Pertaining to Inhaled Corticosteroids (ICSs) for Long-Term Asthma Control

- **The most important determinant of appropriate dosing is the clinician's judgment of the patient's response to therapy.** The clinician must monitor the patient's response on several clinical parameters (e.g., symptoms; activity level; measures of lung function) and adjust the dose accordingly. Once asthma control is achieved and sustained at least 3 months, the dose should be carefully titrated down to the minimum dose necessary to maintain control.
- Some doses may be outside package labeling, especially in the high-dose range. Budesonide nebulizer suspension is the only inhaled corticosteroid (ICS) with FDA-approved labeling for children <4 years of age.
- Metered-dose inhaler (MDI) dosages are expressed as the actuator dose (amount leaving the actuator and delivered to the patient), which is the labeling required in the United States. This is different from the dosage expressed as the valve dose (amount of drug leaving the valve, not all of which is available to the patient), which is used in many European countries and in some scientific literature. Dry powder inhaler (DPI) doses are expressed as the amount of drug in the inhaler following activation.
- For children <4 years of age: The safety and efficacy of ICSs in children <1 year of age has not been established. Children <4 years of age generally require delivery of ICS (budesonide and fluticasone MDI) through a face mask that fits snugly over nose and mouth to avoid nebulizing in the eyes. Face should be washed after treatment to prevent local corticosteroid side effects. For budesonide, the dose may be given 1–3 times daily. Budesonide suspension is compatible with albuterol, ipratropium, and levalbuterol nebulizer solutions in the same nebulizer. Use only jet nebulizers, as ultrasonic nebulizers are ineffective for suspensions. For fluticasone MDI, the dose should be divided 2 times daily; the low dose for children <4 years of age is higher than for children 5–11 years of age because of lower dose delivered with face mask and data on efficacy in young children.

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USUAL DOSAGES FOR OTHER LONG-TERM CONTROL MEDICATIONS*

Medication	0–4 years of age	5–11 years of age	≥12 years of age
Combined Medication (inhaled corticosteroid + long-acting beta$_2$-agonist)			
Fluticasone/Salmeterol — DPI† 100 mcg/50 mcg, 250 mcg/50 mcg, or 500 mcg/50 mcg MDI† 45 mcg/21 mcg, 115 mcg/21 mcg, or 230 mcg/21 mcg	N/A†	1 inhalation 2x/day; dose depends on level of severity or control	1 inhalation 2x/day; dose depends on level of severity or control
Budesonide/Formoterol — MDI† 80 mcg/4.5 mcg or 160 mcg/4.5 mcg	N/A†	2 puffs 2x/day; dose depends on level of severity or control	2 puffs 2x/day; dose depends on level of severity or control
Mometasone/Formoterol — MDI† 100 mcg/5 mcg	N/A†	N/A†	2 inhalations 2x/day; dose depends on severity of asthma
Leukotriene Modifiers			
Leukotriene Receptor Antagonists (LTRAs) Montelukast — 4 mg or 5 mg chewable tablet, 4 mg granule packets, 10 mg tablet	4 mg every night at bedtime (1–5 years of age)	5 mg every night at bedtime (6–14 years of age)	10 mg every night at bedtime
Zafirlukast — 10 mg or 20 mg tablet *Take at least 1 hour before or 2 hours after a meal. Monitor liver function.*	N/A†	10 mg 2x/day (7–11 years of age)	40 mg daily (20 mg tablet 2x/day)
5-Lipoxygenase Inhibitor Zileuton — 600 mg tablet *Monitor liver function.*	N/A†	N/A†	2,400 mg daily (give 1 tablet 4x/day)
Immunomodulators			
Omalizumab (Anti IgE†) — Subcutaneous injection, 150 mg/1.2 mL following reconstitution with 1.4 mL sterile water for injection *Monitor patients after injections; be prepared to treat anaphylaxis that may occur.*	N/A†	N/A†	150–375 mg subcutaneous every 2–4 weeks, depending on body weight and pretreatment serum IgE level
Cromolyn			
Cromolyn — Nebulizer: 20 mg/ampule	1 ampule 4x/day, N/A† <2 years of age	1 ampule 4x/day	1 ampule 4x/day
Methylxanthines			
Theophylline — Liquids, sustained-release tablets, and capsules *Monitor serum concentration levels.*	Starting dose 10 mg/kg/day; usual maximum: ▪ <1 year of age: 0.2 (age in weeks) + 5 = mg/kg/day ▪ ≥1 year of age: 16 mg/kg/day	Starting dose 10 mg/kg/day; usual maximum: 16 mg/kg/day	Starting dose 10 mg/kg/day up to 300 mg maximum; usual maximum: 800 mg/day
Inhaled Long-Acting Beta$_2$-Agonists (LABAs) – used in conjunction with ICS† for long-term control; LABA is NOT to be used as monotherapy			
Salmeterol — DPI† 50 mcg/blister	N/A†	1 blister every 12 hours	1 blister every 12 hours
Formoterol —DPI† 12 mcg/single-use capsule	N/A†	1 capsule every 12 hours	1 capsule every 12 hours
Oral Systemic Corticosteroids			
Methylprednisolone — 2, 4, 8, 16, 32 mg tablets **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	▪ 0.25–2 mg/kg daily in single dose in a.m. or every other day as needed for control ▪ Short course "burst": 1–2 mg/kg/day, max 60 mg/d for 3–10 days	▪ 0.25–2 mg/kg daily in single dose in a.m. or every other day as needed for control ▪ Short course "burst": 1–2 mg/kg/day, max 60 mg/d for 3–10 days	▪ 7.5–60 mg daily in single dose in a.m. or every other day as needed for control ▪ Short course "burst": to achieve control, 40–60 mg/day as single or 2 divided doses for 3–10 days

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

† **Abbreviations:** DPI, dry powder inhaler; IgE, immunoglobulin E; MDI, metered-dose inhaler; N/A, not available (not approved, no data available, or safety and efficacy not established for this age group).

The most important determinant of appropriate dosing is the clinician's judgment of the patient's response to therapy. The clinician must monitor the patient's response on several clinical parameters (e.g., symptoms; activity level; measures of lung function) and adjust the dose accordingly. Once asthma control is achieved and sustained at least 3 months, the dose should be carefully titrated down to the minimum dose necessary to maintain control.

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RESPONDING TO PATIENT QUESTIONS ABOUT INHALED CORTICOSTEROIDS

Questions and varying beliefs about inhaled corticosteroids (ICSs) are common and may affect adherence to treatment. Following are some key points to share with patients and families.

- ICSs are the most effective medications for long-term control of persistent asthma. Because ICSs are inhaled, they go right to the lungs to reduce chronic airway inflammation. In general, ICSs should be taken every day to prevent asthma symptoms and attacks.
- The potential risks of ICSs are well balanced by their benefits. To reduce the risk of side effects, patients should work with their doctor to use the lowest dose that maintains asthma control, and be sure to take the medication correctly.
  - Mouth irritation and thrush (yeast infection), which may be associated with ICSs at higher doses, can be avoided by rinsing the mouth and spitting after ICS use and, if appropriate for the inhaler device, by using a valved holding chamber or spacer.
  - ICS use may slow a child's growth rate slightly. This effect on linear growth is not predictable and is generally small (about 1 cm), appears to occur in the first several months of treatment, and is not progressive. The clinical significance of this potential effect has yet to be determined. Growth rates are highly variable in children, and poorly controlled asthma can slow a child's growth.
- ICSs are generally safe for pregnant women. Controlling asthma is important for pregnant women to be sure the fetus receives enough oxygen.
- ICSs are not addictive.
- ICSs are not the same as anabolic steroids that some athletes use illegally to increase sports performance.

RESPONDING TO PATIENT QUESTIONS ABOUT LONG-ACTING BETA$_2$-AGONISTS

Keep the following key points in mind when educating patients and families about long-acting beta$_2$-agonists (LABAs).

- The addition of LABA (salmeterol or formoterol) to the treatment of patients who require more than low-dose inhaled corticosteroid (ICS) alone to control asthma improves lung function, decreases symptoms, and reduces exacerbations and use of short-acting beta$_2$-agonists (SABA) for quick relief in most patients to a greater extent than doubling the dose of ICS.
- A large clinical trial found that slightly more deaths occurred in patients taking salmeterol in a single inhaler every day in addition to usual asthma therapy* (13 out of about 13,000) compared with patients taking a placebo in addition to usual asthma therapy (3 out of about 13,000). Trials for formoterol in a single inhaler every day in addition to usual therapy* found more severe asthma exacerbations in patients taking formoterol, especially at higher doses, compared with those taking a placebo added to usual therapy. Therefore, the Food and Drug Administration placed a Black Box warning on all drugs containing a LABA.
- The established benefits of LABAs added to ICS for the great majority of patients who require more than low-dose ICS alone to control asthma should be weighed against the risk of severe exacerbations, although uncommon, associated with daily use of LABAs.
- LABAs should not be used as monotherapy for long-term control. Even though symptoms may improve significantly, it is important to keep taking ICS while taking LABA.
- Daily use should generally not exceed 100 mcg salmeterol or 24 mcg formoterol.
- It is not currently recommended that LABAs be used to treat acute symptoms or exacerbations.

* Usual therapy included a wide range of regimens, from those in which no other daily therapy was taken to those in which varying doses of other daily medications were taken.

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EDUCATIONAL RESOURCES

National Heart, Lung, and Blood Institute

- Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma (EPR-3) www.nhlbi.nih.gov/guidelines/asthma
- Physician Asthma Care Education (PACE): www.nhlbi.nih.gov/health/prof/lung/asthma/pace/
- National Asthma Control Initiative (NACI): http://naci.nhlbi.nih.gov

Allergy & Asthma Network Mothers of Asthmatics
800-878-4403
www.aanma.org

American Academy of Allergy, Asthma, and Immunology
414-272-6071
www.aaaai.org

American Academy of Pediatrics
847-434-4000
www.aap.org

American Association of Respiratory Care
972-243-2272
www.aarc.org

American College of Chest Physicians
847-498-1400
www.chestnet.org

American College of Allergy, Asthma & Immunology
847-427-1200
www.acaai.org

American Lung Association
800-LUNG-USA (800-586-4872)
www.lungusa.org

American School Health Association
800-445-2742
www.ashaweb.org

Asthma and Allergy Foundation of America
800-7-ASTHMA (800-727-8462)
http://aafa.org

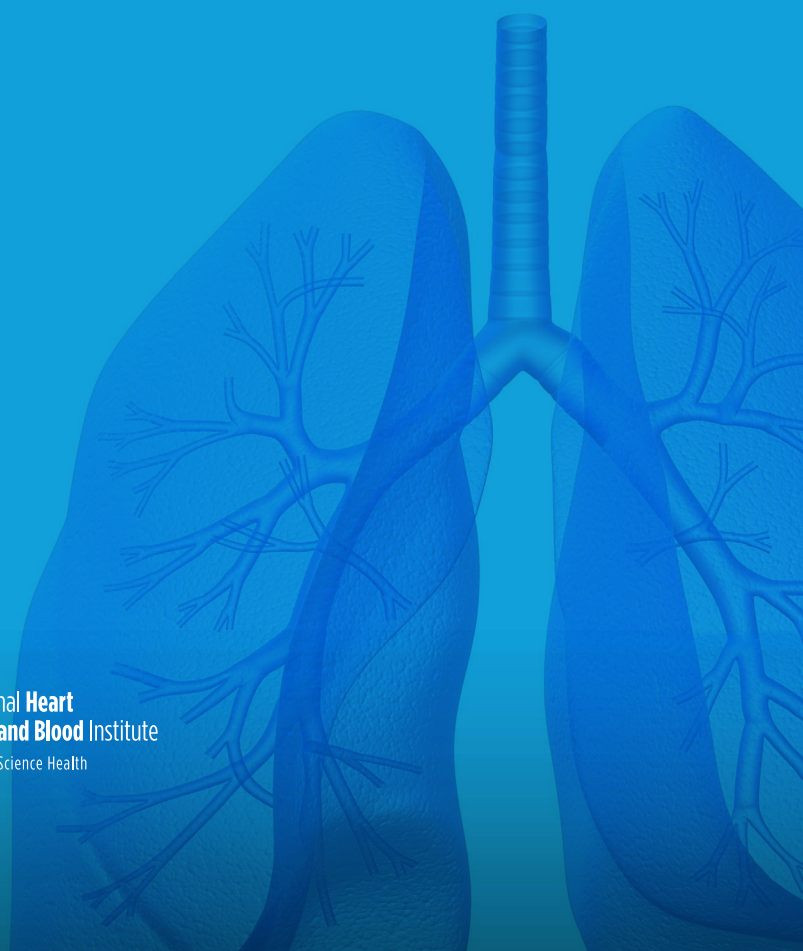
Centers for Disease Control and Prevention
800-CDC-INFO (800-232-4636)
www.cdc.gov/asthma

Environmental Protection Agency/ Asthma Community Network
www.asthmacommunitynetwork.org
800-490-9198 (to order EPA publications)
www.epa.gov/asthma/publications.html

National Association of School Nurses
240-821-1130
www.nasn.org

For more information contact:

NHLBI Information Center
P.O. Box 30105
Bethesda, MD 20824-0105
Phone: 301-592-8573
Fax: 301-592-8563
Web site: www.nhlbi.nih.gov



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