



2011 CLINICAL PRACTICE GUIDELINES FOR ASTHMA

Updated guidelines for the diagnosis and management of asthma developed by the National Asthma Education and Prevention Program (NAEPP) were released in October 2007. The “Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma” (available at: <http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm>) represents an update to the 1997 EPR-2 (itself updated in 2002) and contains detailed recommendations, the levels of scientific evidence upon which these are based, citations from the published scientific literature, discussion of the Expert Panel’s rationale for the recommendations, and description of methods used in developing the report. The EPR-3 Guidelines on Asthma report was developed by an expert panel commissioned by the NAEPP Coordinating Committee, the project coordinated by the National Heart, Lung, and Blood Institute of the National Institutes of Health.

The 2007 EPR-3 contains a number of major changes made to the previous NAEPP EPR-2 guidelines. These include:

1. **New Focus on Monitoring Asthma Control as The Goal for Asthma Therapy and Distinguishing Between Classifying Asthma Severity and Monitoring Asthma Control.**
 - Severity = the intrinsic intensity of the disease process.
Guidelines use assessment of asthma severity as guide to initiation of therapy.
 - Control = the degree to which the manifestations of asthma are minimized by therapeutic interventions and goals of therapy are met.
Guidelines use assessment and monitoring of asthma control as guide to adjustment of therapy.
2. **New Focus on Impairment and Risk as the Two Key Domains of Severity and Control, and Multiple Measures For Assessment.**
 - Impairment = frequency and intensity of symptoms and functional limitations the patient is experiencing currently or has recently experienced.
 - Risk = the likelihood of either asthma exacerbations, progressive decline in lung function (or, for children, lung growth), or risk of adverse effects from medication.

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

3. Modifications in The Stepwise Approach to Managing Asthma Long Term.

- The report further presents modifications to the previous EPR-2 stepwise approach to managing asthma long term, treatment recommendations now presented in Expert Panel Report 3 (EPR-3) for three age groups: 0-4 years; 5-11 years; and those ≥ 12 years and adults. This was done in recognition that the course of the disease may change over time; that the relevance of different measures of impairment of risk and the potential short-term and long-term impact of medications may be age related; and the presence of varied levels of scientific evidence available for these three age groups.
- The stepwise approach was further expanded to six steps to simplify progressive actions by separating recommendations into different steps.
- Medications have likewise been repositioned within the six steps of care in EPR-3. With respect to medications recommended for use:
 - (1) Inhaled corticosteroids (ICS) continue as preferred long-term control therapy for all ages.
 - (2) Combination of a long-acting beta₂-agonist (LABA) and ICS is presented as an equally preferred option, with an increase in the dose of ICS in step 3 care, in patients 5 years of age and older. This approach balances the established beneficial effects of combination therapy in older children and adults with the increased risk for severe exacerbations, although uncommon, associated with daily use of a LABA.
 - (3) Omalizumab is recommended for consideration for those ≥ 12 years of age or for adults who require step 5 or 6 care. Clinicians who administer omalizumab should be prepared and equipped to identify and treat anaphylaxis that may occur.

4. New Emphasis on Multifaceted Approaches to Patient Education and to The Control of Environmental Factors or Comorbid Conditions That Affect Asthma.

- Patient education for a partnership is encouraged in expanded settings.
 - (1) Patient education should occur at all points of care: clinic settings (offering separate self-management programs as well as integrating education into every patient visit); emergency departments and hospitals; pharmacies; schools and other community settings; and patients' homes.
 - (2) Provider education should encourage clinician and health care systems support of the partnership (e.g., through interactive continuing medical education, communication skills training, clinical pathways, and information system supports for clinical decision making).
- Environmental control includes several strategies:
 - (1) Multifaceted approaches to reduce exposures are necessary; single interventions are generally ineffective.

Reference for guidelines: "Expert Panel Report 3: Guidelines for the diagnosis and management of asthma" Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

- (2) Consideration of subcutaneous immunotherapy for patients who have allergies at steps 2-4 of care (mild or moderate persistent asthma) when there is a clear relationship between symptoms and exposure to an allergen to which the patient is sensitive. Clinicians should be prepared to treat anaphylaxis that may occur.
- (3) Potential benefits to asthma control by treating comorbid conditions that affect asthma.

5. **Modifications to Treatment Strategies for Managing Asthma Exacerbations.**

- Simplify the classification of severity of exacerbations. For the urgent or emergency care setting: <40 percent predicted forced expiratory volume in 1 second (FEV₁) or peak expiratory flow (PEF) indicates severe exacerbation and potential benefit from use of adjunctive therapies; ≥70 percent predicted FEV₁ or PEF is a goal for discharge from the emergency care setting.
- Encourage development of prehospital protocols for emergency medical services to allow administration of albuterol, oxygen, and, with medical oversight, anticholinergics and oral systemic corticosteroids.
- Modify recommendations on medications:
 - (1) Add levabuterol.
 - (2) Add magnesium sulfate or heliox for severe exacerbations unresponsive to initial treatments.
 - (3) Emphasize use of oral corticosteroids. Doubling the dose of ICS for home management is not effective.
 - (4) Emphasize that anticholinergics are used in emergency care, not hospital care.
 - (5) Add consideration of initiating ICS at discharge.

To reiterate the above, the EPR-3 presents a program of asthma care and set of recommendations intended to lead to: (a) initiation of therapy on the basis of assessment of severity; (b) assessment of control and monitoring to adjust therapy; (c) reduction of impairment; and (d) reduction of risk.

As noted above, recommendations for treatments are specified for the three different age groups (0-4 years, 5-11 years, and 12 years and older) given that the course of the disease may change over time, the relevance of measures of impairment or risk and the potential short- and long-term impact of medications may be age related, and varied levels of scientific evidence are available for the different ages.

This Community Health Network of Connecticut clinical practice guideline incorporates the 2007 NAEPP EPR-3 guidelines into summaries for three age groups: 0-4 years; 5-11 years; those ≥12 years of age and older.

Treatment recommendations for each age group are based on asthma severity and level of control achieved with initiated treatment. A number of charts are presented for use in classifying severity of asthma, initiating and maintaining treatment programs, and assessing control.

See the following as these relate to the first two age groups:

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

Figure 1, “Classifying Asthma Severity and Initiating Therapy in Children”

Figure 2, “Assessing Asthma Control and Adjusting Therapy in Children”

Figure 3, “Stepwise Approach for Managing Asthma Long Term in Children, 0-4 Years of Age And 5-11 Years of Age”

See the following as these relate to the age group ≥ 12 years of age and older:

Figure 4, “Classifying Asthma Severity and Initiating Treatment in Youths 12 years of Age And Adults”

Figure 5, “Assessing Asthma Control and Adjusting Therapy in Youths 12 years of Age And Adults”

Figure 6, “Stepwise Approach for Managing Asthma in Youths 12 years of Age And Adults”

STEPS FOR CHILDREN 0-4 YEARS OF AGE

See Figure 3, for recommended treatments in the different steps and Figures 7-9 for recommended medication dosages. In addition to the general principles of the stepwise approach, special considerations for this age group include initiating therapy, selecting among treatment options, and monitoring response to therapy.

The initiation of daily long-term control therapy in children ages 0-4 years is recommended as follows:

- Recommended for reducing impairment and risk of exacerbations in infants and young children who had four or more episodes of wheezing in the past year that lasted more than 1 day and affected sleep AND who have a positive *asthma predictive index* (either (1) one of the following: a parental history of asthma, a physician’s diagnosis of atopic dermatitis, or evidence of sensitization to aeroallergens; OR (2) two of the following: evidence of sensitization to foods, >4 percent peripheral blood eosinophilia, or wheezing apart from colds).
- Should be considered for reducing impairment in infants and young children who consistently require symptomatic treatment >2 days per week for a period of more than 4 weeks.
- Should be considered for reducing risk in infants and young children who have two exacerbations requiring corticosteroids within 6 months.
- May be considered for use only during periods, or seasons, of previously documented risk, e.g., during seasons of viral respiratory infections.

Note: Initiating long-term control therapy will depend on consideration of issues regarding diagnosis and prognosis.

See complete EPR-3 Guidelines for expanded and detailed recommendations and additional information relating to medications and monitoring for this age group.

STEPS FOR CHILDREN 5-11 YEARS OF AGE

See **Figure 3**, for recommended treatments in the different steps and **Figures 7-9** for recommended medication dosages. In addition to the general principles of the stepwise approach, special considerations for this age group include the following:

- Promotion of active participation in physical activities, exercise, and sports because physical activity is an essential part of a child's life. Treatment immediately before vigorous activity usually prevents exercise-induced bronchospasm.
- Directly involve children ≥ 10 years of age (and younger as appropriate) in developing their written asthma action plans and reviewing adherence.
- Encourage the parents to take a copy of the written asthma action plan to the student's school, or childcare or extended care setting, or camp.

See complete EPR-3 Guidelines for expanded and detailed recommendations and additional information relating to medications and monitoring for this age group.

STEPS FOR THOSE ≥ 12 YEARS OF AGE AND OLDER

See **Figure 6**, for recommended treatments in the different steps and **Figures 7-9** for recommended medication dosages. In addition to the general principles of the stepwise approach, special considerations for this age group include initiating therapy, selecting among treatment options, and monitoring response to therapy.

For youths:

- Involve adolescents in the development of their written asthma plans and reviewing adherence.
- Encourage students to take a copy of their plans to school, after school programs, and camps.
- Encourage adolescents to be physically active.

For older adults:

- Consider a short course of oral systemic corticosteroids to establish reversibility and the extent of possible benefit from asthma treatment.
- Adjust medications as necessary to address coexisting medical conditions.
- Review patient's technique and adherence in using medications, and make necessary adjustments. Physical or cognitive impairments may make proper technique difficult.

See complete EPR-3 Guidelines for expanded and detailed recommendations and additional information relating to medications and monitoring for this age group.

Figure 1. Classifying Asthma Severity and Initiating Therapy in Children

Components of Severity		Classifying Asthma Severity and Initiating Therapy in Children							
		Intermittent		Persistent					
				Mild		Moderate		Severe	
		Ages 0-4	Ages 5-11	Ages 0-4	Ages 5-11	Ages 0-4	Ages 5-11	Ages 0-4	Ages 5-11
Impairment	Symptoms	≤ 2 days/wk		≥ 2 days/wk		Daily		Throughout the day	
	Nighttime awakenings	0	<2x/ month	0	3-4x/ month		>1x/week but not nightly		Often 7x/week
	Short-acting Beta ₂ agonist use for symptom control	≤ 2 days/wk		>2 days/wk but not daily		Daily		Several times per day	
	Interference with normal activity	None		Minor limitation		Some limitation		Extremely limited	
	Lung Function • FEV ₁ (predicted) or peak flow (personal best) • FEV ₁ /FVC	N/A	Normal FEV ₁ between exacerbations >80%	N/A	>80%	N/A	60-80%	N/A	<60%
Risk	Exacerbations requiring oral systemic corticosteroids (consider severity and interval since last exacerbation)	0-1/year (see notes)		≥2 exacerbations in 6 months requiring oral systemic corticosteroids, or >4 wheezing episodes/1 year lasting > day AND risk factors for persistent asthma	>2x/year (see notes) Relative annual risk may be related to FEV ₁				

Key:
FEV₁ forced expiratory volume in 1 second;
FVC, forced vital capacity;
ICS, inhaled corticosteroids;
ICU, intensive care unit;
N/A not applicable

- Notes:
- Level of severity is determined by both impairment and risk. Assess impairment domain by caregiver's recall of previous 2-4 weeks. Assign severity to the most severe category in which any feature occurs.
 - Frequency and severity of exacerbations may fluctuate over time for patients in any severity category. At present, there are inadequate data to correspond frequencies of exacerbations with different levels of asthma severity. In general, more frequent and severe exacerbations (e.g., requiring urgent, unscheduled care, hospitalization or ICU admissions) indicate greater underlying disease

Reference for guidelines: "Expert Panel Report 3: Guidelines for the diagnosis and management of asthma" Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

Recommended Step for Initiating Therapy (See “Stepwise Approach for Managing Asthma” for treatment steps.) The stepwise approach is to assist, not replace, the clinical decision-making required to meet individual patient needs	Step 1 (for both age groups)	Step 2 (for both age groups)	Step 3 and consider short course of oral systemic corticosteroids	Step 3: medium-dose ICS option and consider short course of oral systemic corticosteroids	Step 3 and consider short course of oral systemic corticosteroids	Step 3: medium-dose ICS option OR step 4 and consider short course of oral systemic corticosteroids	severity. For treatment purposed, patients with ≥ 2 exacerbations described above may be considered the same as patients who have persistent asthma, even in the absence of impairment levels consistent with persistent asthma.
	In 2-6 weeks, depending of severity, evaluate level of asthma control that is achieved. <ul style="list-style-type: none"> Children 0-4 years old: If no clear benefit is observed in 4-6 weeks, stop treatment and consider alternative diagnoses or adjusting therapy Children 5-11 years old: Adjust therapy accordingly. 						

Figure 2. Assessing Asthma Control and Adjusting Therapy in Children

Components of Control		Assessing Asthma Control and Adjusting Therapy in Children						Key: EIB, exercise induced bronchospasm FEV ₁ , forced expiratory volume in 1 second; FVC, forced vital capacity; ICU, intensive care unit; N/A not applicable
		Well Controlled		Not Well Controlled		Very Poorly Controlled		
		Ages 0-4	Ages 5-11	Ages 0-4	Ages 5-11	Ages 0-4	Ages 5-11	
Impairment	Symptoms	≤ 2 days/week about not more than once on each day		>2 days/week or multiple times on ≤ 2 days/week		Throughout the day		Notes: <ul style="list-style-type: none"> The level of control is based on the most severe impairment or risk category. Assess impairment domain by caregiver’s recall of previous 2-4 weeks. Symptom assessment for longer periods should reflect a global assessment, such as whether the patient’s asthma is better or worse since the last visit. At present, there are inadequate data to correspond frequencies of exacerbations with different levels of asthma control. In general, more frequent and severe exacerbations (e.g., requiring urgent, unscheduled care, hospitalization or ICU admissions) indicate poorer
	Nighttime awakenings	≤ 1 x/month		>1 x/month	≥ 2 x/month	>1 x/week	≥ 2 x/week	
	Interference with normal activity	None		Some limitation		Extremely limited		
	Short-acting beta ₂ agonist use for symptom control (not prevention of EIB)	≤ 2 days/week		>2 days/week		Several times per day		
	Lung Function <ul style="list-style-type: none"> FEV₁ (predicted) or peak flow personal best FEV₁/FVC 	N/A	$>80\%$ $>80\%$	N/A	60-80% 75-80%	N/A	$<60\%$ $<75\%$	
Risk	Exacerbations requiring oral systemic corticosteroids	0-1x/year		2-3x/yr	≥ 2 x/yr	> 3 x/yr	≥ 2 x/yr	
	Reduction in lung growth	N/A	Requires long-term follow-up	N/A		N/A		
	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.						

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

<p>Recommended Action for Treatment</p> <p>(See “Stepwise Approach for Managing Asthma” for treatment steps.)</p> <p>The stepwise approach is to assist, not replace, the clinical decision making required to meet individual patient needs.</p>	<ul style="list-style-type: none"> Maintain current step. Regular follow-up every 1-6 months Consider step down if well controlled for at least 3 months. 	Sep up 1 step	Step up at least 1 step	<ul style="list-style-type: none"> Consider short course oaf oral systemic corticosteroids, Step up 1-2 steps
		<ul style="list-style-type: none"> Before step up: Review adherence to medication, inhaler technique, and environmental control. If alternative treatment was used, discontinue it and use preferred treatment for that step. Reevaluate the level of asthma control in 2-6 weeks to achieve control; every 1-6 months to maintain control. Children 0-4 years old: If no clear benefit is observed in 4-6 weeks, consider alternative diagnoses or adjusting therapy. Children 5-11 years old: Adjust therapy accordingly. For side effects, consider alternative treatment options. 		

disease control.

FIGURE 3. STEPWISE APPROACH FOR MANAGING ASTHMA LONG TERM IN CHILDREN, 0-4 YEAR OF AGE AND 5-11 YEARS OF AGE

		<p>Step up if needed (first check Inhaler technique, adherence, environmental control, and comorbid conditions)</p> <p style="text-align: center;">Assess control</p> <p>Step down if possible (and asthma is well controlled at least 3 months)</p>					
		Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Children 0-4 years of Age		Intermittent Asthma	Persistent Asthma: Daily Medication				<p>Notes</p> <ul style="list-style-type: none"> The stepwise approach is meant to assist, not replace, the clinical decision-making required to meet individual patient needs. If an alternative treatment is used and response is inadequate, discontinue it and use the preferred treatment before stepping up. If clear benefit is not observed within 4-6 weeks, and patient's /family's medication technique and adherence are satisfactory, consider adjusting therapy or an alternative diagnosis. Studies on children 0-4 years of age are limited. Step 2 preferred therapy is based on Evidence A. All other recommendations are based on expert opinion and extrapolation from studies in older children. Clinicians who administer immunotherapy should be prepared and equipped to identify and treat anaphylaxis that may occur. <p>Key: Alphabetical listing is used when more than one treatment option is listed within either preferred or alternative therapy. ICS, inhaled corticosteroid; LABA, inhaled long-acting beta₂ agonist; LTRA, leukotriene receptor antagonist; oral corticosteroids, oral systemic corticosteroids; SABA, inhaled short acting beta₂ agonist.</p>
	Preferred	SABA PRN	Consult with asthma specialist if step 3 care or higher is required. Consider consultation at step 2.				
	Alternative		Low-dose ICS	Medium-dose ICS	Medium-dose ICS + LABA or Montelukast	High-dose ICS + LABA or Montelukast	
		Cromolyn or Montelukast					
		Each Step: Patient Education and Environmental Control					
	Quick-Relief Medication	<ul style="list-style-type: none"> SABA as needed for symptoms. Intensity of treatment depends on severity of symptoms. With viral respiratory symptoms: SABA q 4-6 hours up to 24 hours (longer with physician consult). Consider short course of oral systemic corticosteroids of exacerbation is severe or patient has history of previous severe exacerbations. <p>Caution: Frequent use of SAGA may indicate the need to step up treatment. See text for recommendations on initiating daily long-term control therapy.</p>					
C		Intermittent Asthma	Persistent Asthma: Daily Medication				<ul style="list-style-type: none"> The stepwise approach is meant to assist, not replace, the clinical decision-making
			Consult with asthma specialist if step 4 care or higher is required. Consider consultation at step 3.				

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

Preferred	SABA PRN	Low-dose ICS	Low-dose ICS + LABA, LTRA or Theophylline	Medium-dose ICS + LABA	High-dose ICS + LABA	High-dose ICS + LABA + Oral corticosteroids	<p>required to meet individual patient needs.</p> <ul style="list-style-type: none"> • If an alternative treatment is used and response is inadequate, discontinue it and use the preferred treatment before stepping up. • Theophylline is a less desirable alternative due to the need to monitor serum concentration levels. • Steps 1 and 2 medications are based on Evidence A. Step 3 ICS and ICS plus adjunctive therapy are based on Evidence B for efficacy of each treatment and extrapolation from comparator trials in older children and adults – comparator trials are not available for this age group; steps 4-6 are based on extrapolation from studies in older children and adults. • Immunotherapy for steps 2-4 is based on Evidence B for house-dust mites, animal danders, and pollens; 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 and adults. • Clinicians who administer immunotherapy should be prepared and equipped to identify and treat anaphylaxis that may occur. <p>Key: Alphabetical listing is used when more than one treatment option is listed within either preferred or alternative therapy. ICS, inhaled corticosteroid; LABA, inhaled long-acting beta₂ agonist; LTRA, leukotriene receptor antagonist; SABA, inhaled short acting beta₂ agonist.</p>
Alternative		Cromolyn, LTRA, Nedocromil or Theophylline	OR Medium-dose ICS	Medium-dose ICS + LTRA or Theophylline	High-dose ICS + LTRA or Theophylline	High-dose ICS + LTRA or Theophylline + Oral corticosteroids	
	<p>Each Step: Patient Education and Environmental Control, and Management of Comorbidities Steps 2-4: Consider subcutaneous allergen immunotherapy for patients who have persistent, allergic asthma.</p>						
Quick-Relief Medication	<ul style="list-style-type: none"> • SABA as needed for symptoms. Intensity of treatment depends on severity of symptoms: up to 3 treatments at 20-minute intervals as needed. Short course of oral systemic corticosteroids may be needed. <p>Caution: Frequent use of SABA or use >2 days a week for symptom relief (not prevention of EIB) generally indicates inadequate control and the need to step up treatment.</p>						

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

FIGURE 4. CLASSIFYING ASHTMA SEVERITY AND INITIATING TREATMENT IN YOUTHS 12 YEARS OF AGE AND ADULTS

Assessing severity and initiating treatment for patients who are not currently taking long-term control medications

Components of Severity		Classification of Asthma Severity			
		≥ 12 years of age			
		Intermittent	Persistent		
Mild	Moderate		Severe		
Impairment Normal FEV₁/FVC: 8-9 yr 85% 20-39 yr 80% 40-59 yr 75% 60-80yr 70%	Symptoms	≤ 2 days/week	>2 days/week but not daily	Daily	Throughout the day
	Nighttime awakenings	≤ 2 x/month	3-4x/month	>1x/week but not nightly	Often 7x/week
	Short-acting beta ₂ agonist use for symptom control (not prevention of EIB)	≤ 2 days/week	>2 days/week but not daily, and \ not more than 1x on any day	Daily	Several times per day
	Interference with normal activity	None	Minor limitation	Some limitation	Extremely limited
	Lung Function	<ul style="list-style-type: none"> Normal FEV₁ between exacerbations FEV₁ >80% predicted FEV₁/FVC normal 	<ul style="list-style-type: none"> FEV₁ >80% predicted FEV₁/FVC normal 	<ul style="list-style-type: none"> FEV₁ >60% but <80% predicted FEV₁/FVC reduced 5% 	<ul style="list-style-type: none"> FEV <60% predicted FEV₁/FVC reduced >5%
Risk	Exacerbations requiring oral systemic corticosteroids	0-1/year (see note)	≥ 2/year (see note)		
		Consider severity and interval since last exacerbation. Frequency and severity may fluctuate over time for patients in any severity category. Relative annual risk of exacerbations may be related to FEV ₁			
Recommended Step for Initiating Treatment (See “Stepwise Approach for Managing Asthma” for treatment steps.)		Step 1	Step 2	Step 3	Step 4 or 5
		and consider short course of oral systemic corticosteroids In 2-6 weeks, evaluate level of asthma control that is achieved and adjust therapy accordingly.			

Key:
 EIB, exercise induced bronchospasm;
 FEV₁ forced expiratory volume in 1 second;
 FVC, forced vital capacity;
 ICU, intensive care unit;

NOTES:

- The stepwise approach is meant to assist, not replace, the clinical decision-making required to meet individual patient needs.
- Level of severity is determined by assessment of both impairment and risk. Assess impairment domain by patient’s/ caregiver’s recall of previous 2-4 weeks and spirometry. Assign severity to the most severe category in which any feature occurs.
- At present, there are inadequate data to correspond frequencies of exacerbations with different levels of asthma severity. In general, more frequent and intense exacerbations (e.g. requiring urgent, unscheduled care, hospitalization, or ICU admission) indicate greater underlying disease severity. For treatment purposes, patients who had ≥ 2 exacerbations requiring oral systemic corticosteroids in the past year may be considered the same as patients who have persistent asthma, even in the absence of impairment levels consistent with persistent asthma.

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

FIGURE 5. ASSESSING ASTHMA CONTROL AND ADJUSTING THERAPY IN YOUTHS ≥ 12 YEARS OF AGE AND ADULTS

Components of Control		Classification Asthma Control		
		≥ 12 years of age		
		Well Controlled	Not Well Controlled	Very Poorly Controlled
Impairment	Symptoms	≤ 2 days/week	>2 days/week	Throughout the day
	Nighttime awakenings	≤ 2 x/month	1-3 x/week	≥ 4 x/week
	Interference with normal activity	None	Some limitation	Extremely limited
	Short-acting Beta ₂ agonist use for symptom control (not prevention of EIB)	≤ 2 days/week	>2 days/week	Several times per day
	FEV ₁ or peak flow	$>80\%$ predicted/personal best	60-80% predicted/personal best	$<60\%$ predicted/personal best
	Validated questionnaires			
	ATAQ	0	1-2	3-4
	ACQ	$\leq 7.5^*$	≥ 1.5	N/A
	ACT	≥ 20	16-19	≥ 15
Risk	Exacerbations requiring oral systemic corticosteroids	0-1/year	≥ 2 x/yr (see note)	
	Progressive loss of lung function	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” for treatment steps.)		<ul style="list-style-type: none"> Maintain current step. Regular follow-up every 1-6 months to maintain control. Consider step down if well controlled for at least 3 months. 	<ul style="list-style-type: none"> Step up 1 step. Reevaluate in 2-6 weeks. For side effects, consider alternative treatment options. 	<ul style="list-style-type: none"> Consider short course of oral systemic corticosteroids. Step up 1-2 steps. Reevaluate in 2 weeks. For side effects, consider alternative treatment options.

*ACQ values of 0.76-1.4 are indeterminate regarding well-controlled asthma.
Key:
EIB, exercise induced bronchospasm
ICU, intensive care unit;

Notes:

- The stepwise approach is meant to assist, not replace, the clinical decision-making required to meet individual needs.
- Level of control is based on the most severe impairment or risk category. Assess impairment domain by patient’s recall of previous 2-4 weeks and by spirometry/or peak flow measures. Symptom assessment for longer periods should reflect a global assessment, such as whether the patient’s asthma is better or worse since the last visit.
- At present, there are inadequate data to correspond frequencies of exacerbations with different levels of asthma control. In general, more frequent and severe exacerbations (e.g., requiring urgent, unscheduled care, hospitalization or ICU admissions) indicate poorer disease control. For treatment purposes, patients who had ≥ 2 exacerbations requiring oral systemic corticosteroids in the past year may be considered the same as patients who have not-well controlled asthma, even in the absence of impairment levels consistent with not-well-controlled asthma.

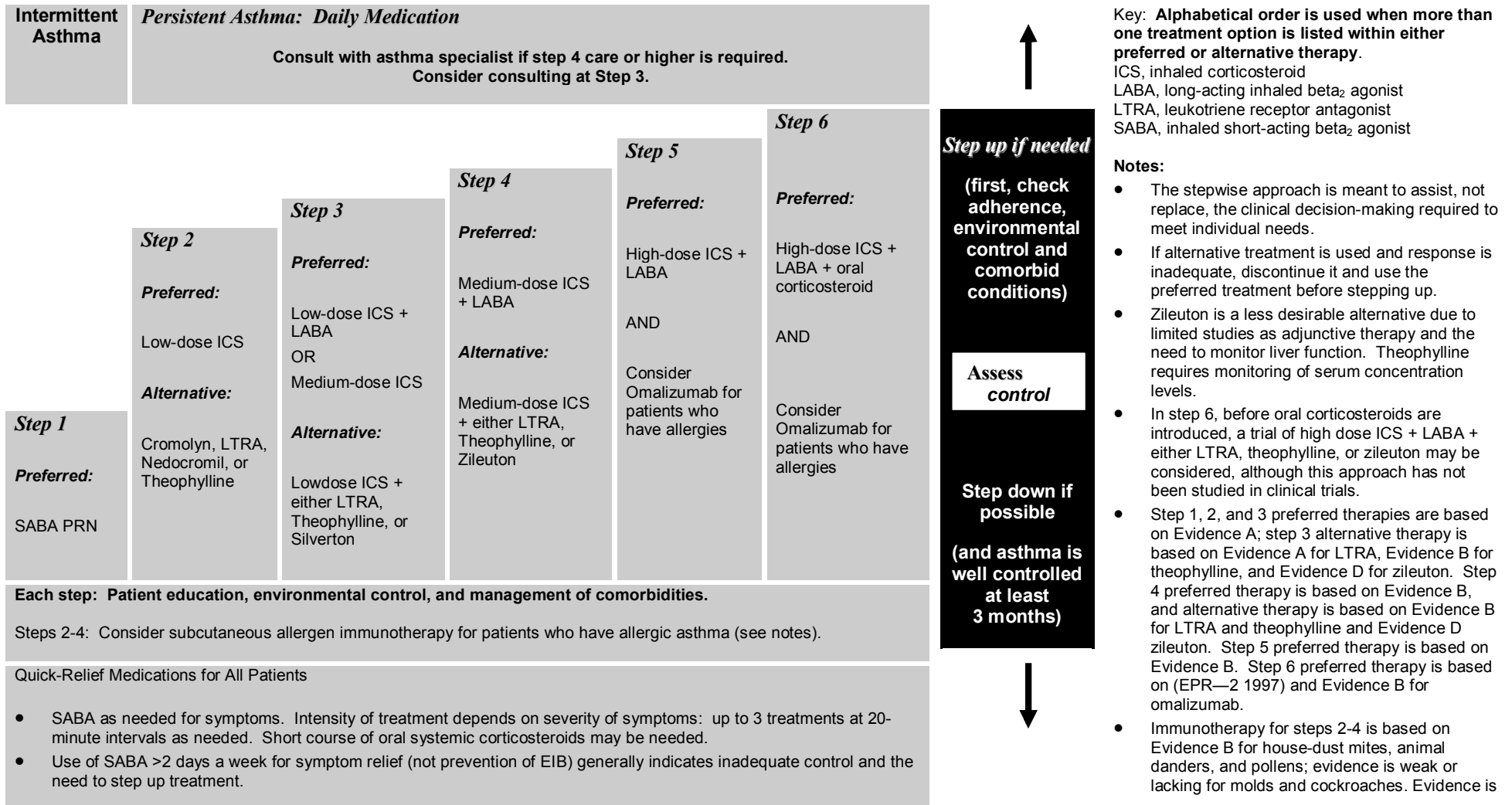
ATAQ = Asthma Therapy Assessment Questionnaire
ACQ = Asthma Control Questionnaire
ACT = Asthma Control Test™.
Minimal Important Difference: 1.0 for the ATAQ; 0.5 for the ACQ; not determined for the ACT.

Before step up in therapy:

- Review adherence to medication, inhaler technique, environmental control, and comorbid conditions.
- If an alternative treatment option was used in a step, discontinue and use the preferred treatment for that step.

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

FIGURE 6. STEPWISE APPROACH FOR MANAGING ASTHMA IN YOUTHS ≥ 12 YEARS OF AGE AND ADULTS



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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 and equipped to identify and treat anaphylaxis that may occur.

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

Figure 7. USUAL DOSAGES FOR LONG-TERM CONTROL MEDICATIONS*

Medication	0-4 Years of Age	5-11 Years of Age	≥ 12 Years of Age and Adults	Potential Adverse Effects	Comments (not all inclusive)
Inhaled Corticosteroids (See figure 18, “Estimated Comparative Daily Dosages for ICSs.”)					
Oral Systemic Corticosteroids					
<p>Methylprednisolone</p> <p>2, 4, 8, 16, 32 mg tablets</p> <p>Prednisolone</p> <p>5 mg tablets, 5 mg/5 cc, 15 mg/5 cc</p> <p>Prednisone</p> <p>1, 2.5, 5, 10, 20, 50 mg tablets; 5 mg/cc, 5 mg/5 cc,</p>	<p>0.25-2 mg/kg daily in single dose in a.m., or qod as needed for control</p> <p>Short-course “burst”: 1-2 mg/kg/day, maximum 30 mg/day for 3-10 days</p>	<p>0.25-2 mg/kg daily in single dose in a.m., or qod as needed for control</p> <p>Short-course “burst”: 1-2 mg/kg/day, maximum 60 mg/day for 3-10 days</p>	<p>7.5-60 mg daily in a single dose in a.m. or qod as needed for control</p> <p>Short-course “burst”: to achieve control, 40-60 mg per day as single or 2 divided doses for 3-10 days</p>	<ul style="list-style-type: none"> ▪ Short-term use: reversible abnormalities in glucose metabolism, increased appetite, fluid retention, weight gain, mood alteration, hypertension, peptic ulcer, and rarely aseptic necrosis. ▪ Long-term use: adrenal axis suppression, growth suppression, dermal thinning, hypertension, diabetes, Cushing’s syndrome, cataracts, muscle weakness, and – in rare instances – impaired immune function. ▪ 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. 	<ul style="list-style-type: none"> ▪ For long-term treatment of severe persistent asthma, administer single dose in a.m. either daily or on alternate days (alternate-day therapy may produce less adrenal suppression). ▪ Short courses or “bursts” are effective for establishing control when initiating therapy or during a period of gradual deterioration. ▪ There is no evidence that tapering the dose following improvement in symptom control and pulmonary function prevents relapse. ▪ Children receiving the lower dose (1 mg/kg/day) experience fewer behavioral side effects, and it appears to be equally efficacious. ▪ For patients unable to tolerate the liquid preparation, dexamethasone syrup at 0.4 mg/kg/day may be an alternative. Studies are limited, however, and the longer duration of activity increases the risk of adrenal suppression.
Inhaled Long-Acting Beta₂-Agonists (LABAs)					
<p>Salmeterol</p> <p>DPI 50 mcg/ blister</p> <p>Formoterol</p> <p>DPI 12 mcg/ single-use capsule</p>	<p>NA</p> <p>NA</p>	<p>1 blister q 12 hours</p> <p>1 capsule q 12 hours</p>	<p>1 blister q 12 hours</p> <p>1 capsule q 12 hours</p>	<ul style="list-style-type: none"> ▪ Tachycardia, skeletal muscle tremor, hypokalemia, prolongation of QTc interval in overdose. ▪ A diminished bronchoprotective effect may occur within 1 week of chronic therapy. Clinical significance has not been established. 	<ul style="list-style-type: none"> ▪ Should not be used for acute symptom relief or exacerbations. Use only with ICSs. ▪ Decreased duration of protection against EIB may occur with regular use. ▪ Most children <4 years of age cannot provide sufficient inspiratory flow for adequate lung delivery.

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

				Potential risk of uncommon, severe, life-threatening or fatal exacerbation; see text for additional discussion regarding safety of LABAs.	<ul style="list-style-type: none"> Do not blow into inhaler after dose is activated. Each capsule is for single use only; additional doses should not be administered for at least 12 hours. Capsules should be used only with the inhaler and should not be taken orally.
<p>Key: DPI, dry power inhaler; EIB, exercise-induced broncospasm; HFA, hydrofluoroalkane; ICS inhaled corticosteroids; IgE, immunoglobulin E; MDI, metered-dose inhaler; NA, not available (either not approved, no data available, or safety and efficacy not established for this age group); SABA, short-acting beta₂-agonist</p> <p>*Note: Dosages are not 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.</p>					

Figure 7. USUAL DOSAGES FOR LONG-TERM CONTROL MEDICATIONS* (continued)					
	0-4 Years of Age	5-11 Years of Age	≥ 12 Years of Age and Adults	Potential Adverse Effects	Comments (not all inclusive)
Combined Medication					
Fluticasone/Salmeterol DPI 100 mcg/50 mcg, 250 mcg/50 mcg, or 500 mcg HFA 45 mcg/21 mcg 115 mcg/21 mcg 230 mcg/21 mcg Budesonide/ Formoterol HFA MDI 80 mcg/4.5 mcg 160 mcg/4.5 mcg	NA NA	1 inhalation bid, dose depends on level of severity or control 2 puffs bid, dose depends on level of severity or control	1 inhalation bid, dose depends on level of severity or control 2 puffs bid, dose depends on level of severity or control	<ul style="list-style-type: none"> See notes for ICS and LABA. See notes for ICS and LABA. 	<ul style="list-style-type: none"> There have been no clinical trials in children <4 years of age. Most children <4 years of age cannot provide sufficient inspiratory flow for adequate lung delivery. Do not blow into inhaler after dose is activated. 100/50 DPI or 45/21 HFA for patients who have asthma not controlled on low- to medium-dose ICS 250/50 DPI or 115/21 HFA for patients who have asthma not controlled on medium- to high-dose ICS There have been no clinical trials in children <4 years of age. Currently approved for use in youths ≥12 years of age. Dose for children 5-12 years of age based on clinical trials using DPI with slightly different delivery characteristics. 80/4.5 for patients who have asthma not controlled on low- to medium-dose ICS.

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

					<ul style="list-style-type: none"> 160/4.5 for patients who have asthma not controlled on medium- to high-dose ICS.
<i>Cromlyn/Nedocromil</i>					
Cromolyn					
MDI 0.8 mg/puff	NA	2 puffs qid	2 puffs qid	<ul style="list-style-type: none"> Cough and irritation. 15-20 percent of patients complaint of an unpleasant taste from nedocromil 	<ul style="list-style-type: none"> One dose of cromolyn before exercise or allergen exposure provides effective prophylaxis for 1-2 hours. Not as effective as inhaled beta2-agonists for EIB as SABA.
Nebulizer 20 mg/ampule	1 ampule qid NA <2 years of age	1 ampule qid	1 ampule qid	<ul style="list-style-type: none"> Safety is the primary advantage of these 	<ul style="list-style-type: none"> 4- to 6-week trial of cromolyn or nedocromil may be needed to determine maximum benefit.
Nedocromil					
MDI 1.75 mg/puff	NA <6 years of age	2 puffs qid	2 puffs qid		<ul style="list-style-type: none"> Dose by MDI may be inadequate to affect hyperresponsiveness. Once control is achieved, the frequency of dosing may be reduced.
<i>Immunomodulators</i>					
Omaliuzumab (anti IgE)					
Subcutaneous injection, 150 mg/12 mL following reconstitution with 1.4 mL sterile water for injection	NA	NA	150-375 mg SC q 2-4 weeks, depending on body weight and pretreatment serum IgE level	<ul style="list-style-type: none"> Pain and bruising of injection sites in 2-20 percent of patients. Anaphylaxis has been reported in 0.2% of treated patients. Malignant neoplasms were reported in 0.5 percent of patients compared to 0.2 percent receiving placebo; relationship to drug is unclear. 	<ul style="list-style-type: none"> Do not administer more than 150 mg per injection site. Monitor patients following injections; be prepared and equipped to identify and treat anaphylaxis that may occur. Whether patients will develop significant antibody titers to the drug with long-term administration is unknown.
<i>Leukotriene Modifiers</i>					
Leukotriene Receptor Antagonists (LTRAs)					
Montelukast					
4 mg or 5 mg chewable tablet					
4 mg granule packets	4 mg qhs (1-5 years of age)	5 mg qhs (6-14 years of age)	10 mg qhs	<ul style="list-style-type: none"> No specific adverse effects have been identified. Rare cases of Churg-Strauss have occurred, but the association is unclear. 	<ul style="list-style-type: none"> Montelukast exhibits a flat dose-response curve. Doses > 10 mg will not product a greater response in adults. No more efficacious than placebo in infants ages 6-24 months. As long-term therapy may attenuate exercise-induced bronchospasm in some patients, but less effective than
10 mg tablet					

Reference for guidelines: "Expert Panel Report 3: Guidelines for the diagnosis and management of asthma" Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

Zafirlukast 10 mg tablet 20 mg tablet	NA	10 mg bid (7-11 years of age)	40 mg daily (20 mg tablet bid)	<ul style="list-style-type: none"> Post marketing surveillance has reported cases of reversible hepatitis and, rarely, irreversible hepatic failure resulting in death and liver transplantation. 	<p>ICS therapy.</p> <ul style="list-style-type: none"> For zafirlukast, administration with meals decreases bioavailability; take at least 1 hour before or 2 hours after meals. Zafirlukast is a microsomal P450 enzyme inhibitor that can inhibit the metabolism of warfarin. Doses of these drugs should be monitored accordingly. Monitor hepatic enzymes (ALT). Warn patients to discontinue use if they experience signs and symptoms of liver dysfunction.
5-Lipoxygenase inhibitor Silverton 600 mg tablet	NA	NA	2,400 mg daily (give tablets qid)	<ul style="list-style-type: none"> Elevation of liver enzymes has been reported. Limited case reports of reversible hepatitis and hyperbilirubinemia. 	<ul style="list-style-type: none"> For zileuton, monitor hepatic enzymes (ALT). Silverton is a microsomal P450 enzyme inhibitor that can inhibit the metabolism of warfarin and theophylline. Doses of these drugs should be monitored accordingly.
<i>Methylxanthines</i>					
Theophylline Liquid, sustained-release tablets, and capsules	<p>Starting dose, 10 mg/kg/day; usual maximum:</p> <ul style="list-style-type: none"> <1 year of age: 0.2 (age in weeks) +5 = mg/kg/day ≥ 1 year of age: 16 mg/kg/day 	<p>Starting dose, 10 mg/kg/day; Usual maximum:</p> <p>16 mg/kg/day</p>	<p>Starting dose, 10 mg/kg/day up to 300 mg maximum; usual maximum:</p> <p>800 mg/day</p>	<ul style="list-style-type: none"> Dose-related acute toxicities include tachycardia, nausea and vomiting, tachyarrhythmias (SVT), central nervous system stimulation, headache, seizures, hematemesis, hyperglycemia, and hypokalemia. Adverse effects at usual doses include insomnia, gastric upset, aggravation of ulcer or reflux, increase in hyperactivity in some children, difficulty in urination in elderly males who have prostratism. 	<ul style="list-style-type: none"> Adjust dosage to achieve serum concentration of 5-15 mcg/mL at steady state (at least 48 hours on same dosage). Due to wide interpatient variability in theophylline metabolic clearance, routine serum Theophylline monitoring is essential. Patients should be told to discontinue if they experience toxicity. Various factors (diet, food, febrile illness, age, smoking and other medications) can affect serum concentrations. See EPR – 3 Full Report 2007 and package insert for details.

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

Figure 8. ESTIMATED COMPARATIVE DAILY DOSAGES FOR INHALED CORTICOSTEROIDS

Drug	Low Daily Dose			Medium Daily Dose			High Daily Dose		
	Child 0–4 Years of Age	Child 5–11 Years of Age	≥12 Years of Age and Adults	Child 0–4 Years of Age	Child 5–11 Years of Age	≥12 Years of Age and Adults	Child 0–4 Years of Age	Child 5–11 Years of Age	≥12 Years of Age and Adults
Beclomethasone HFA 40 or 80 mcg/puff	NA	80-160 mcg	80-240 mcg	NA	160-320 mcg	240-480 mcg	NA	>320 mcg	>480 mcg
Budesonide DPI 90, 180, or 200 mcg/inhalation	NA	180-400 mcg	180-600 mcg	NA	400-800 mcg	600-1,200 mcg	NA	>800 mcg	>1,200 mcg
Budesonide Inhaled Inhalation suspension for nebulization	0.25-0.5 mg	0.5 mg	NA	>0.5-1. mg	1.0 mg	NA	>1.0 mg	2.0 mg	NA
Flunisolide 250 mcg/puff	NA	50-750 mcg	50-1,000 mcg	NA	1,000-1,250 mcg	>1,000-2,000mcg	NA	>1,250 mcg	>2,000 mcg
Flunisolide HFA 80 mcg/puff	NA	160 mcg	320 mcg	NA	320 mcg	>320-640 mcg	NA	≥640 mcg	>640 mcg
Fluticasone HFA/MDI: 44, 110, or 250 mcg/puff	176 mcg	88-176 mcg	88-264 mcg	>176-352 mcg	>176-352 mcg	>264-440 mcg	>35 mcg	>35 2mcg	>440 mcg
DPI: 50, 100, or 250 mcg/inhalation	NA	100-200 mcg	100-300 mcg	NA	>200-400 mcg	>300-500 mcg	NA	>400 mcg	>500 mcg
Mometasone DPI 200 mcg/inhalation	NA	NA	200 mcg	NA	NA	400 mcg	NA	NA	>400 mcg
Triamcinolone acetonide 75 mcg/puff	NA	300-60 mcg	300-750 mcg	NA	600-900 mcg	>750-1,500 mcg	NA	>900 mcg	>1,500 mcg

Key: DPI, dry powder inhaler; FHA, hydrofluoroalkane; MDI, metered-dose inhaler; NA, not available (either not approved, no data available, or safety and efficacy not established for this age group)

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

Therapeutic Issues:

- 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 and adjust the dose accordingly. Once control of asthma is achieved, the dose should be carefully titrated to the minimum dose required to maintain control.
- Preparations are not interchangeable on a mcg or per puff basis. This figure presents estimated comparable daily doses. See ERP-3 Full Report 2007 for full discussion.
- 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.
- For children <4 years of age: The safety and efficacy of ICSs in children <1 year has not been established. Children <4 years of age generally require delivery of ICS (budesonide and fluticasone HFA) through a face mask that should fit snugly over nose and mouth and avoid nebulizing in the eyes. Wash face after each treatment to prevent local corticosteroid side effects. For budesonide, the dose may be administered 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 HFA, 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 due to lower dose delivered with face mask and data on efficacy in young children.

Potential Adverse Effects of Inhaled Corticosteroids:

- Cough, dysphonia, oral thrush (candidiasis).
- Spacer or valved holding chamber with non-breath-actuated MDIs and mouth washing and spitting after inhalation decreases local side effects.
- A number of the ICSs, including fluticasone, budesonide, and mometasone, are metabolized in the gastrointestinal tract and liver by CYP 3A4 isoenzymes. Potent inhibitors of CYP 3A4, such as ritonavir and ketoconazole, have the potential for increasing systemic concentrations of these ICSs by increasing oral availability and decreasing systemic clearance. Some cases of clinically significant Cushing syndrome and secondary adrenal insufficiency have been reported.
- In high doses, system effects may occur, although studies are not conclusive, and clinical significance of these effects has not been established (e.g., adrenal suppression, osteoporosis, skin thinning, and easy bruising). In low-to-medium doses, suppression of growth velocity has been observed in children, but this effect may be transient, and the clinical significance has not been established.

Reference for guidelines: "Expert Panel Report 3: Guidelines for the diagnosis and management of asthma" Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

Figure 9. USUAL DOSAGES FOR LONG-TERM CONTROL MEDICATIONS*

Medication	<5 Years of Age	5-11 Years of Age	≥ 12 Years of Age and Adults	Potential Adverse Effects	Comments (not all inclusive)
Inhaled Long-Acting Beta₂-Agonists					
MDI	<i>Dose applies to Albuterol</i>	<i>Dose applies to Albuterol/and Levalbuterol</i>	<i>Dose applies to all four SABAs</i>		<i>Apply to all four (SABAs)</i>
Albuterol CFC 90 mcg/puff, 200 puffs/canister	1-2 puffs 5 minutes before exercise	2 puffs 5 minutes before exercise	2 puffs 5 minutes before exercise	<ul style="list-style-type: none"> Tachycardia, skeletal muscle tremor, hypokalemia increased lactic acid, headache, hyperglycemia. Inhaled route, in general, causes few systemic adverse effects. Patients with preexisting cardiovascular disease, especially the elderly, may have adverse cardiovascular reactions with inhaled therapy. 	<ul style="list-style-type: none"> Drugs of choice for acute bronchospasm. Differences in potencies exist, but all products are essentially comparable on a 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 days/week 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 prior to use. For HFA: periodically clean HFA actuator, as drug may plug orifice For autohaler: children <4 years of age may not generate sufficient inspiratory flow to activate an auto-inhaler Nonselective agents (i.e., epinephrine, isoproterenol, metaproterenol) are not recommended due to their potential for excessive cardiac stimulation, especially in high doses. May mix with cromolyn solution, budesonide inhalant suspension, or ipratropium solution for nebulization. May double dose for severe exacerbations.
Albuterol HFA 90 mcg/puff, 200 puffs/canister	2 puffs every 4-6 hours, as needed for symptoms	2 puffs every 4-6 hours, as needed for symptoms	2 puffs every 4-6 hours, as needed for symptoms		
Levalbuterol HFA 45 mcg/puff, 200 puffs/canister	NA <4 years of age				
Pributerol CFC Autohaler 200 mcg/puff, 400 puffs/canister	NA	NA			
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)	<ul style="list-style-type: none"> 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.
Levalbuterol (R-albuterol)	0.31-1.25 mg in 3 cc	0.31-0.63 mg q 8 hours,	0.63- 1.25 mg	(Same as with MDI)	

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0.31 mg/3 mL 0.63 mg/3 mL 1.25 mg/0.5 mL 1.25 mg/3 mL	q 4-6 hours, as needed for symptoms	as needed for symptoms	q 8 hours, as needed for symptoms		
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Key: CFC, chlorofluorocarbon; ED, emergency department; EIB, exercise-induced bronchospasm; HFA, hydrofluoroalkane; IM intramuscular
MDI, metered-dose inhaler; NA, not available (either not approved, no data available, or safety and efficacy not established for this age group);
PEF, peak expiratory flow; SABA, short-acting beta₂-agonist

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

Figure 9. USUAL DOSAGES FOR LONG-TERM CONTROL MEDICATIONS* (continued)

Medication	<5 Years of Age	5-11 Years of Age	≥ 12 Years of Age and Adults	Potential Adverse Effects	Comments (not all inclusive)
Anticholinergics					
Ipratropium HFA MDI 17 mcg/puff, 200 puffs/canister Nebulizer solution 0.25 mg/mL (0.025%) Ipratropium with albuterol MDI 18 mcg/puff of ipratropium	N/A N/A N/A	N/A N/A N/A	2-3 puffs q 6 hours 0.25 mg q 6 hours 2-3 puffs q 6 hours	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Multiple doses in the emergency department (not hospital) setting provide additive benefit to SABA Treatment of choice for bronchospasm due to beta-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.

Reference for guidelines: “Expert Panel Report 3: Guidelines for the diagnosis and management of asthma” Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

bromide and 90 mcg/pub of albuterol 200 puffs/canister Nebulizer solution 0.5 mg/3 mL ipratropium bromide and 2.5 mg/3 mL albuterol	N/A	N/A	3 mL q 4-6 hours	<ul style="list-style-type: none"> Contains EDTA to prevent discoloration of the solution. This additive does not induce bronchospasm.
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Systemic Corticosteroids

Methylprednisolone 2, 4, 6, 8, 16, 32 mg tablets Prednisolone 5 mg tablets, 5 mg/5 cc, 15mg/5 cc Predinsone 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	Dosages apply to first three corticosteroids.			<ul style="list-style-type: none"> 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. 	(Applies to the first three corticosteroids.)	
Short Course "burst:" 1-2 mg/kg/ day, maximum 60mg/day, for 3-10 days	Short Course "burst:" 40-60 mg/day, as single or 2 divided doses for 3-10 days	Short Course "burst:" 40-60 mg/day, as single or 2 divided doses for 3-10 days	7.5 mg/kg IM once			240 mg IM once
				<ul style="list-style-type: none"> May be used in place of a short burst of oral steroids in patients who are vomiting or if adherence is a problem. 		

Reference for guidelines: "Expert Panel Report 3: Guidelines for the diagnosis and management of asthma" Bethesda, MD: U.S. Dept of Health and Human Service, National Institutes of Health, National Heart, Lung and Blood Institute; NIH Publication Number 08-5846; October 2007.

