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Evidence-Based Best Practices For the Management of Asthma in Pediatric Primary Care in South Carolina

The SCORxE best practices for the management of asthma offers South Carolina providers unbiased, evidence-based clinical information to assist in making optimal treatment decisions.

Assess and document initial severity and follow-up control to select optimal medications.

- Provide a rescue inhaler for all patients with asthma and a controller medication for those with persistent asthma.
- An inhaled corticosteroid (ICS) is the controller of choice.
- Step medication treatment up or down as needed based on level of control.
- Rule out non-adherence to asthma medications or improper inhaler technique before stepping up if asthma is not well controlled.

Environmental control includes a smoke-free home and car and avoiding or minimizing exposure to triggers.

- Ask parents, caregivers and patients about tobacco use; advise smokers to quit and offer assistance (e.g., refer to SC Tobacco Quitline 1-800-QUIT-NOW).
- Educate families on how to best manage the patient's asthma when exposure to triggers is unavoidable (e.g., exercise, viral infections).
- Administer the flu vaccine annually.

Develop a written asthma action plan for patient self-management and provide copies for use at home, school and daycare.

- Engage patients and parents in monitoring asthma control based on symptoms, peak flow readings or a combination of both.
- Educate families on how to monitor for overuse of rescue inhaler (> 1 canister/month) and why it is important.
- Review individualized asthma action plan at every visit and modify as needed.
- Discuss plan for acute exacerbations, including detailed contact information and how to get timely access to oral corticosteroids.

Instruct patients and parents on the proper use of each of their inhalers.

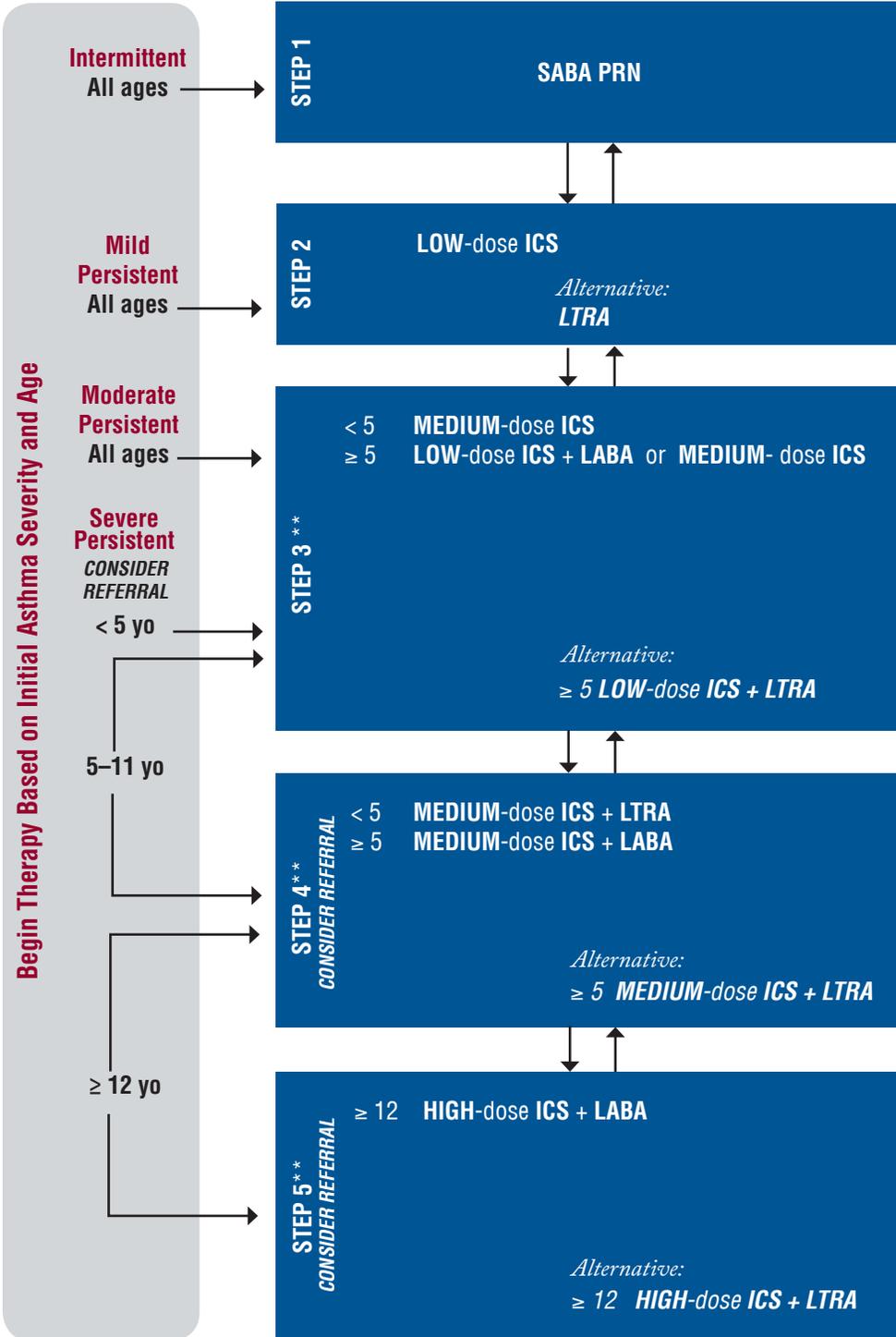
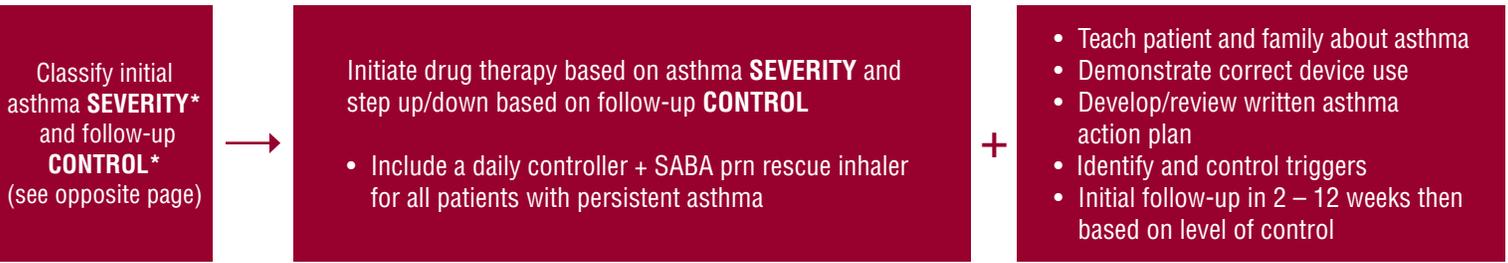
- Demonstrate proper administration technique of all prescribed asthma devices and provide instruction sheets for future reference.
- Have patients demonstrate inhaler technique at each visit and provide feedback.
- Make sure patients can distinguish between rescue and controller inhalers.

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The information contained in this summary is intended to supplement the knowledge of clinicians regarding best practices and drug therapy to treat asthma in children and adolescents in a primary care setting. This information is advisory only and is not intended to replace sound clinical judgment, nor should it be regarded as a substitute for individualized diagnosis and treatment. Special considerations are needed when treating some populations with certain conditions (e.g., pregnancy/breast-feeding, cardiac disease, liver and renal impairment).

References: Available in Clinical Topics – Treatment of Asthma in Pediatrics at: <http://www.sccp.sc.edu/SCORxE>.

Algorithm for Treatment of Asthma



Important Considerations for Ongoing Management

Assess Level of Control at Every Follow-up Visit (see opposite page)

Adjust Drug Therapy Based on Level of Control

- Before stepping up therapy, consider
 - Non-adherence***
 - Improper inhalation technique
 - Lack of trigger control

If Well Controlled

- Maintain current medication(s)
 - Consider step down if well controlled for at least 3–6 months
- Review written action plan
- Follow-up every 3–12 months****

If Not Well Controlled

- Step up therapy
 - Or can first try different medication(s) on same step
- Modify written action plan
- Follow-up in 2–6 weeks

If Very Poorly Controlled

- Step up therapy
- Consider burst of oral steroids
- Modify written action plan
- Re-evaluate in 2 weeks

Consider referral to specialist if difficulty achieving control of asthma after 3–6 months of therapy or 2 bursts of oral steroids in the previous 12 months

Abbreviation Key

ICS Inhaled corticosteroid
 LABA Long-acting inhaled beta₂-agonist
 LTRA Leukotriene receptor antagonist
 PRN As needed
 SABA Short-acting inhaled beta₂-agonist

* Assess impairment criteria of previous 2 – 4 weeks; ask about respiratory emergency department visits and hospitalizations.
 ** Consider burst of oral steroids if initiating therapy at Steps 3, 4 or 5.
 *** Obtain accurate medication refill history.
 **** Consider follow-up every 3 – 6 months for patients on a daily controller.

Initial Classification of Asthma Severity

NOTE: Severity is based on the worst criterion that occurs (even if it is just one).

SEVERITY CRITERIA		INTERMITTENT	MILD PERSISTENT	MODERATE PERSISTENT	SEVERE PERSISTENT
Impairment	Symptoms	≤ 2 days/week	> 2 days/week, not daily	Daily	Throughout the day
	Nighttime awakening	< 5 yo: 0 ≥ 5 yo: ≤ 2 /month	< 5 yo: 1-2 /month ≥ 5 yo: 3-4 /month	< 5 yo: 3-4 /month ≥ 5 yo: > 1 /week	< 5 yo: > 1 /week ≥ 5 yo: Often 7 /week
	SABA use*	≤ 2 days/week	> 2 days/week, not daily	Daily	Several times/day
	Interference with activities/normal play	None	Minor	Some	Extreme
	Lung function** (≥ 5 years old) • FEV ₁ or PEF	Normal FEV ₁ between flare-ups > 80% predicted	> 80% predicted	60-80% predicted	< 60% predicted
Risk***	Exacerbations requiring oral steroids	0-1 /year	< 5 yo: ≥ 2 /6 months ≥ 5 yo: ≥ 2 /year	< 5 yo: ≥ 2 /6 months ≥ 5 yo: ≥ 2 /year	< 5 yo: ≥ 2 /6 months ≥ 5 yo: ≥ 2 /year

KEY FEV₁: forced expiratory volume in 1 second PEF: peak expiratory flow SABA: short-acting inhaled beta₂-agonist

* Criterion applies to symptom control, not prevention of exercise-induced bronchospasm. ** Spirometry is the preferred objective measure for assessing lung function. Peak flow meters can be used as an alternative when spirometry is not available. *** In general, more frequent and intense exacerbations requiring urgent care, hospitalization, or ICU admission indicate greater underlying disease severity. Additionally, children less than 5 with ≥ 4 wheezing episodes in the past year, and with risk factors for persistent asthma, may be considered the same as patients who have persistent asthma, regardless of impairment level.

Classification of Asthma Control at Follow-up

NOTE: Level of control is based on the worst criterion that occurs (even if it is just one).

CONTROL CRITERIA		WELL CONTROLLED	NOT WELL CONTROLLED	VERY POORLY CONTROLLED
Impairment	Symptoms	≤ 2 days/week	> 2 days/week	Throughout the day
	Nighttime awakening	< 12 yo: ≤ 1 /month ≥ 12 yo: ≤ 2 /month	< 12 yo: ≥ 2 /month ≥ 12 yo: 1-3 /week	< 12 yo: ≥ 2 /week ≥ 12 yo: ≥ 4 /week
	SABA use*	≤ 2 days/week	> 2 days/week	Several times per day
	Interference with activities/normal play	None	Some	Extreme
	Lung function** (≥ 5 years old) • FEV ₁ or PEF	> 80% personal best/predicted	60-80% personal best/ predicted	< 60% personal best/predicted
Risk****	Questionnaires • ACT*** (≥ 4 years old)	≥ 20	16-19	≤ 15
	Exacerbations requiring oral steroids	0-1 /year	< 5 yo: 2-3 /year ≥ 5 yo: ≥ 2 /year	< 5 yo: > 3 /year ≥ 5 yo: ≥ 2 /year

KEY ACT: Asthma Control Test™ FEV₁: forced expiratory volume in 1 second PEF: peak expiratory flow SABA: short-acting inhaled beta₂-agonist

* Criterion applies to symptom control, not prevention of exercise-induced bronchospasm. ** Spirometry is the preferred objective measure for assessing lung function. Peak flow meters can be used as an alternative when spirometry is not available. *** Minimal change in ACT score indicating a clinically meaningful difference has not been established in pediatrics. **** In general, more frequent and intense exacerbations requiring urgent care, hospitalization, or ICU admission indicate greater underlying disease severity or poorer disease control.

Inhaled Asthma Controller Dosing Guidelines

Medication (Brand Name) Strengths/Dosage Form	Delivery System	Age (Years)	Low TOTAL Daily Dose (mcg/day)	Medium TOTAL Daily Dose (mcg/day)	High TOTAL Daily Dose (mcg/day)	FDA Maximum TOTAL Daily Dose (mcg/day)	FDA Minimum Age (Years)	Recommended Administration
Inhaled Corticosteroids (ICS)								
Budesonide (Pulmicort™ Flexhaler) 90 and 180 mcg/puff	DPI	5–11	180–360	> 360–720	> 720	720	6	BID
		≥ 12	180–540	> 540–1,080	> 1,080	720		
Fluticasone Furoate (Arnuity™ Ellipta) 100 and 200 mcg/puff	DPI	≥ 12	100 (i)			200	12	Once daily
Fluticasone Propionate (Flovent® Diskus®) 50, 100 and 250 mcg/puff	DPI	5–11	100–200	> 200–400	> 400	200	4	BID
		≥ 12	100–300	> 300–500	> 500	2,000		
Mometasone (Asmanex® Twisthaler®) 110 and 220 mcg/puff	DPI	5–11	110	220–440	> 440	110	4	Once daily (evening) or BID
		≥ 12	220	440	> 440	880		
Beclomethasone (QVAR® HFA) 40 and 80 mcg/puff	MDI	5–11	80–160	> 160–320	> 320	160	5	BID
		≥ 12	80–240	> 240–480	> 480	640		
Ciclesonide (Alvesco®) 80 and 160 mcg/puff	MDI	5–11	80–160	> 160–320	> 320	NA	12	BID
		≥ 12	160–320	> 320–640	> 640	640		
Flunisolide (Aerospan™) 80 mcg/puff	MDI	5–11	160	320	≥ 640	320	6	BID
		≥ 12	320	> 320–640	> 640	640		
Fluticasone (Flovent® HFA) 44, 110 and 220 mcg/puff	MDI	0–4	176	> 176–352	> 352	176	4	BID
		5–11	88–176	> 176–352	> 352	176		
		≥ 12	88–264	> 264–440	> 440	1,760		
Mometasone (Asmanex® HFA) 100 and 200 mcg/puff	MDI	≥ 12	200	400	> 400	800	12	BID
Budesonide (Pulmicort® Respules)	Neb	0–4	250–500	> 500–1,000	> 1,000	1,000	1	Once daily or BID
		5–11	500	1,000	2,000	1,000		
Medication (Brand Name) Strengths/Dosage Form	Delivery System	Age (Years)	Low Dose	Medium Dose	High Dose	FDA Maximum Daily Dose	FDA Minimum Age (Years)	
Combination ICS + Long-Acting Beta₂-Agonists (LABA) (ii)								
Fluticasone/salmeterol (Advair Diskus®) 100/50, 250/50 and 500/50 mcg/puff	DPI	5–11	100/50 mcg 1 puff BID			100/50 mcg 1 puff BID	4	
		≥ 12	100/50 mcg 1 puff BID	250/50 mcg 1 puff BID	500/50 mcg 1 puff BID	500/50 mcg 1 puff BID		
Budesonide/formoterol (Symbicort®) 80/4.5 and 160/4.5 mcg/puff	MDI	5–11	80/4.5 mcg 2 puffs BID			NA	12	
		≥ 12	80/4.5 mcg 2 puffs BID	160/4.5 mcg 2 puffs BID		160/4.5 mcg 2 puffs BID		
Fluticasone/salmeterol (Advair® HFA) 45/21, 115/21 and 230/21 mcg/puff	MDI	≥ 12	45/21 mcg 2 puffs BID	115/21 mcg 2 puffs BID	230/21 mcg 2 puffs BID	230/21 mcg 2 puffs BID	12	
Mometasone/formoterol (Dulera®) 100/5 and 200/5 mcg/puff	MDI	≥ 12	100/5 mcg 2 puffs BID	200/5 mcg 2 puffs BID		200/5 mcg 2 puffs BID	12	

Oral Asthma Controller Dosing Guidelines

Medication (Brand Name)	Delivery System	Age (Years)	Usual Daily Dose	Other Dosing Information	FDA Maximum Daily Dose	FDA Minimum Age (years)
Leukotriene Antagonists (LTRA)						
Montelukast (Singulair®)	Oral	1–5	4 mg HS	10 mg 2 hours before exercise for prevention of EIB	4 mg HS	1
		6–14	5 mg HS		5 mg HS	
		≥ 15	10 mg HS		10 mg HS	
Zafirlukast (Accolate®)	Oral	5–11	10 mg BID	Take 1 hour before or 2 hours after eating	10 mg BID	5
		≥ 12	20 mg BID		20 mg BID	

Asthma Rescue Medication Dosing Guidelines

Medication (Brand Name) Strengths/Dosage Form	Delivery System	Age (Years)	Short-Term Rescue Dosing	Other Dosing Information	FDA Maximum TOTAL Daily Dose	FDA Minimum Age (years)
Short-Acting Inhaled Beta₂-Agonists (SABA)						
Albuterol (ProAir® RespiClick) 90 mcg/puff	DPI	≥ 12	2 puffs Q4–6H prn (Higher doses may be needed)	2 puffs 15 minutes before exercise for prevention of EIB (iii)		12
Albuterol (Ventolin® HFA, ProAir® HFA, Proventil® HFA) 90 mcg/puff	MDI	≥ 0	2 puffs Q4–6H prn (Higher doses may be needed)	2 puffs 15 minutes before exercise for prevention of EIB (iii)		4
Levalbuterol (Xopenex® HFA) 45 mcg/puff	MDI	≥ 5	2 puffs Q4–6H prn	≥ 12 years: 2 puffs 15 minutes before exercise for prevention of EIB (i)		4
Albuterol (iv) (AccuNeb®)	Neb	≥ 0	2.5–5 mg Q4-8H prn			2
Levalbuterol (v) (Xopenex®)	Neb	≥ 0	0.31–1.25 mg Q4-8H prn			6
Oral Corticosteroids (vi)						
Methylprednisolone (Medrol®) Prednisolone (Orapred®, Pediapred®) Prednisone	Oral	0–11	1–2 mg/kg/day (maximum 60 mg/day) for 3-10 days (vii)			
		≥ 12	40–60 mg AM or in divided doses for 3-10 days (vii)			

KEY DPI: dry powder inhaler EIB: exercise-induced bronchospasm HFA: hydrofluoroalkane MDI: metered dose inhaler NA: not applicable Neb: nebulizer

- (i) Low TOTAL daily dose is based on the FDA usual recommended starting dose; Low/Medium/High TOTAL daily dosing is derived from asthma guidelines and pharmacotherapy textbook for all other ICS products.
- (ii) Although single ingredient LABA products are FDA-indicated for asthma, they are not listed in this table to avoid inadvertent use without ICS.
- (iii) Recommended time of administration ranges from 5 to 30 minutes before exercise.
- (iv) Albuterol nebulizer 2.5 mg clinically compares to 4 puffs of albuterol MDI 90 mcg.
- (v) Levalbuterol nebulizer 1.25 mg clinically compares to 4 puffs of levalbuterol MDI 45 mcg (extrapolated from albuterol data).
- (vi) Oral corticosteroids may be used as long-term controller for severe persistent asthma: 0-11 years old, 0.25-2 mg/kg AM or every other day; ≥ 12 years old, 7.5-60 mg AM or every other day.
- (vii) Tapering at the end of a short-course treatment is not necessary.

Select Asthma Medication Side Effects

Medication	Side Effects/Cautions/Warnings	Management Strategies/Comments
Inhaled Corticosteroids (ICS)		
Beclomethasone Budesonide Ciclesonide Flunisolide Fluticasone Mometasone	Local effects: hoarseness, thrush, steroid rash.	Instruct patient to brush teeth, rinse mouth with water and spit out after each use. Instruct patient to use a spacer.
	Low-medium doses: minor growth delay during first year of treatment (average 1 cm).	Monitor height and weight annually on growth chart with percentiles; final adult height does not appear to be affected.
	High doses: skin thinning, easy bruising, HPA axis suppression (rare), reduced bone mineral density (rare).*	Consider referral to specialist.
Oral Corticosteroids		
Methylprednisolone Prednisolone Prednisone	Single burst: behavioral and mood-related changes, increased appetite.	Monitor behavior and mood.
	Frequent bursts (≥ 4/year) or long-term daily use: bone growth retardation, decreased bone mineralization, HPA axis suppression, hypertension, hyperglycemia, ocular toxicity (cataracts and glaucoma), weight gain.	Monitor height and weight on growth chart with percentiles, bone mineral density,* cataracts, blood pressure, and glucose. Anticipate need for steroid replacement in the event of severe intercurrent illness or surgery. Consider every other day dosing for long-term use.
Combination ICS + Long-Acting Beta₂-Agonists (LABA)		
Budesonide/formoterol Fluticasone/salmeterol Mometasone/formoterol	ICS ingredient: same as above.	
	LABA ingredient: increased risk (rare) of severe asthma exacerbations and death.	Black box warning: use ONLY in combination with ICS; monotherapy is contraindicated.
Leukotriene Antagonists		
Montelukast	Behavior and mood-related changes (rare).	Monitor behavior and mood.
Zafirlukast	Behavior and mood-related changes (rare), hepatic dysfunction (rare).	Monitor behavior and mood. Monitor for signs and symptoms of hepatotoxicity; check liver function tests periodically.
Short-Acting Inhaled Beta₂-Agonists (SABA)		
Albuterol Levalbuterol	Usual doses: tachycardia, tremor, headache, irritability, sleep difficulties.	Reassess daily controller therapy if SABA use exceeds 2 days/week (not counting use for EIB prevention).**
	Very high doses: hyperglycemia, hypokalemia.	

KEY **EIB:** exercise-induced bronchospasm **HPA:** hypothalamic-pituitary-adrenal

* The American Academy of Pediatrics recommends assessing bone mineral density using dual-energy x-ray absorptiometry (DXA) scans in children and adolescents (not infants) on a yearly basis, or less frequently, based on clinical presentation and risk factors.

** Step up therapy after ruling out non-adherence, improper inhaler technique, and lack of trigger control.

Environmental Control

Avoidance measures that improve control of asthma	
Tobacco	Provide smoke free environment (home, car, child care, public areas). Encourage patients and parents not to smoke and support smoking cessation. Pregnant women should not smoke.
Reasonable avoidance measures to improve asthma with limited evidence of clinical benefit	
Allergens	
Outdoors	Close windows and remain indoors when pollen counts of known allergens are high.
Indoors	Individualized, home-based, multi-trigger, multi-component approach may help sensitized patients.*
Pets with fur	Remove pet from home. Keep pet outside or at least out of bedroom. Use HEPA filter air cleaner. Bathe pet 2 times/week.
Cockroaches	Clean up food/spills immediately. Clean countertops daily. Keep food and trash in closed containers. Fix water leaks. Seal openings to outside. Use boric acid, baits/gels, or consider hiring a licensed exterminator.
Mold	Remove moldy items. Clean with chlorine solution diluted 1:10 (do NOT mix with ammonia). Hire professional if area larger than 3 x 3 feet. Control moisture: use central air conditioning or dehumidifiers; vent clothes dryers and kitchen/bath fans outside; repair faucets/pipes/ductwork quickly.
Pollutants	
Outdoors	Monitor air quality and remain indoors when pollutant levels are high. Avoid strenuous physical activity (especially with poor asthma control) in cold weather, low humidity, or high air pollution.
Indoors	Eliminate tobacco smoke. Use non-polluting heating system. Install exhaust fan close to source and vent outside. Avoid strong odors and irritant products.
Additional resources	Environmental history form: www.neefusa.org/resource/asthma-environmental-history-form Fact sheets with questions and intervention solutions: www.neefusa.org/resource/environmental-intervention-guidelines-and-patient-handouts

* Current guidelines do not recommend physical and chemical measures to reduce dust mites. It is unknown if lack of benefit is due to inadequate reduction in house dust mites or exposure in other settings. If house dust mite reduction is a consideration, steps include: putting pillow and mattress in impermeable casing; washing bedding weekly in hot water (130° F); vacuuming with a HEPA filter or double-layer bag 1-2 times weekly; and removing soft bed toys, carpets and/or upholstered furniture from bedroom.

Selected Features of Suggested Asthma Resources

	Patient Education	Information for School	Parent Coaching	Counseling	Questionnaires	Action Plans	Predicted Peak Flow Table	Medication Picture Charts	Device Instructions	Spanish
Allergy & Asthma Network Mothers of Asthmatics https://aanma.site-ym.com/store/ListProducts.aspx?catid=410345&ftr=								Poster (\$)		
American Academy of Allergy Asthma and Immunology www.aaaai.org/conditions-and-treatments/treatments/drug-guide.aspx								X		
American College of Chest Physicians http://www.chestnet.org/Foundation/Patient-Education-Resources/Asthma/Other-Resources									V	X
Palo Alto Medical Foundation www.pamf.org/asthma/education/handouts.html	V	X			X	X			V	X
Family Connection Project Breathe Easy 1-800-578-8750 http://www.familyconnections.org/project-breathe-easy.html	X		X							X
KidsHealth from Nemours http://kidshealth.org/parent/centers/asthma_center.html	H/R	H/R	H/R			H/R				H/R
National Heart Lung Blood Institute www.nhlbi.nih.gov/health/public/lung/index.htm#asthma	X	X				X			X	X
Regional Asthma Management and Prevention Initiative www.rampasthma.org/info-resources/asthma-action-plans/						H/F				X
S.C. Tobacco Quitline 1-800-QUIT-NOW www.scdhec.gov/quitforkeeps				X						
St. Louis Children's Hospital www.stlouischildrens.org/content/medservices/livingwithasthma.htm	H/V								V	
University of Michigan www.med.umich.edu/1info/fhp/practiceguides/asthma.html	X						X	X	P	

KEY F: fillable pdf H: hardcopy P: with pictures R: recorded V: video \$: available for purchase

Basic Steps for Use of Inhalers*

1. Prime MDI if new, unused for 1 week, or as directed in package insert (not needed with DPI). **
2. Remove cap and shake for 5-10 seconds (do not shake DPI).
3. If using DPI, activate device to prepare to inhale the powder.
4. Breathe out normally and completely (common mistake) (do not breathe into DPI mouthpiece).
5. Tilt head back slightly, place mouthpiece in mouth and seal your lips around mouthpiece (keep DPI level and do not breathe into mouthpiece).
6. MDI: Begin to inhale slowly...press down ONE time on inhaler as you continue breathing in slowly until your lungs are full.
DPI: Breathe in fast and deeply until your lungs are full.
MDI + Spacer: Press down ONE time on inhaler and take 1 slow deep breath OR 3-6 normal breaths (If using facemask, take 3-6 normal breaths). ***
7. HOLD your breath and slowly count to 10 or as long as you can (common mistake).
8. Exhale slowly, and wait one minute before repeating if you need 2 puffs (do not breathe into DPI mouthpiece).
9. For a steroid inhaler, brush teeth, rinse mouth well with water and spit water out to decrease the risk of a mouth infection (if using a facemask, also wash area around the mouth).
10. Clean MDI weekly. Wash spacer with gentle soap and warm water then air dry (gently wipe DPI with dry cloth - do not use water).

KEY **DPI:** dry powder inhaler **MDI:** metered dose inhaler

* Always check use instructions for specific devices.

** Budesonide DPI requires priming before first use only.

*** No need to hold breath and exhale slowly if taking 3-6 breaths with a spacer/facemask.

Tips for Optimal Selection and Use of Inhalers

- **CONSIDER** devices available for selected drug.
- **SELECT** inhaler patient is capable of using properly.
- **TEACH** patient and caregiver proper technique then have them teach you back.
- **REPEAT** at follow-up; have patient bring device(s) and demonstrate use at every visit.

(Most common patient errors: does not exhale before actuating inhaler, or does not hold breath after inhaling dose.)

Device	General Age for Correct Use	General Advantages	General Disadvantages
Dry powder inhaler (DPI)	> 8 years	<ul style="list-style-type: none"> • Compact and portable • Priming or shaking of device not necessary • Breath-actuated, less coordination needed • Many have dose counters 	<ul style="list-style-type: none"> • Requires fairly rapid inhalation (may be difficult in young child) • Must be careful not to lose powder once activated
Metered dose inhaler (MDI)	> 8 years* > 4 years (with spacer)** ≤ 4 years (with spacer & mask)	<ul style="list-style-type: none"> • Compact and portable • Can use with spacer • Less coordination needed with spacer • Reduced pharyngeal drug deposition with spacer 	<ul style="list-style-type: none"> • Coordination of breath and actuation by hand needed • Requires priming and shaking • Cannot place > 1 puff in spacer or wait too long to inhale • Spacer is less portable, less compact
Small-volume nebulizer	All ages	<ul style="list-style-type: none"> • Coordination not needed 	<ul style="list-style-type: none"> • Less portable, less compact • Slower to administer • An additional expense • Requires power source • Need to clean and disinfect

* MDI with spacer is preferred over MDI without spacer in children and adolescents.

** Spacers available today are valved-holding chambers. Anti-static chambers are preferred.