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Guidelines for the Diagnosis and Management of Pediatric Acute Asthma Exacerbation

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

MedStar Pediatrics, MedStar PromptCare and MedStar Family Choice accept and endorse the clinical guidelines set forth by the Nation Heart Lung and Blood Institute Guidelines for the Diagnosis and Management of Asthma (EPR-3) and the Global Initiative for Asthma GINA

The complete online version of this article/guideline is available at:
http://www.nhlbi.nih.gov/health-pro/guidelines/current/asthma-guidelines
The guideline below is a summary of the above article/guideline adapted for our Outpatient and Urgent Care settings for acute exacerbation. For chronic management of asthma, see Guidelines for Diagnosis and Management of Asthma.

Diagnosis

Asthma exacerbations are acute or subacute episodes of progressively worsening shortness of breath, cough, wheezing, and/or chest tightness. Exacerbations are characterized by decreases in expiratory airflow that can be measured by spirometry or peak expiratory flow (PEF). These objective measures in conjunction with physical finding more reliably indicate the severity of an exacerbation than does the severity of symptoms alone. In general, milder exacerbations may be managed "at home" (i.e., outside the health care system), whereas more serious exacerbations may require an unscheduled ("urgent") office visit, an ED visit, or a hospital admission.

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ASTHMA EXACERBATION SEVERITY CLASSIFICATION IN THE OUTPATIENT OR URGENT CARE SETTING			
	Signs and Symptoms	PEF, SaO_2	Clinical Course
Mild	Dyspnea only with activity, end expiratory wheezes, intermittent cough	PEF ≥70% predicted SaO_2 >95%	• Usually care for at home • Prompt relief with SABA • Consider short course of oral corticosteroids
Moderate	Dyspnea limits activity, accessory muscle use/retractions common, expiratory wheezes, tachycardia, persistent cough, abdominal breathing/paradoxical breathing	PEF 40-69% predicted SaO_2 90-95%	• Requires office or ED visit • Relief from frequent SABA • Oral corticosteroids
Severe	Dyspnea at rest, accessory muscle use/retractions, nasal flaring, inspiratory and expiratory wheezes, tachycardia, persistent cough abdominal breathing/paradoxical breathing	PEF <40% predicted SaO_2<90%	• Requires ED visit • Partial relief from SABA • Oral corticosteroids • Adjunctive therapies
Life Threatening	Too dyspneic to speak, perspiring, drowsy, grunting, absence of wheeze, tachycardia/bradycardia, cough may be absent	PEF <25% predicted SaO_2<90%	• Requires ED/Hospitalization • Minimal relief from SABA • IV corticosteroids • Adjunctive therapies
Key: PEF, peak expiratory flow; ED, emergency department; SABA, short acting beta$_2$-agonist; SaO_2, oxygen saturation Normal respiratory rate per minute: 0-6 months:30-60, 6-12 months: 24-30, 1-5 years: 20-30, > 6 years: 12-20			

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Diagnostic Considerations

1) Assess the severity of the exacerbation, as indicated by the findings listed in the above table

2) Assess overall patient status, including level of alertness, fluid status, presence of cyanosis, respiratory distress, and wheezing. Wheezing can be an unreliable indicator of obstruction; in rare cases, extremely severe obstruction may be accompanied by a "silent chest"-with little or no air movement.

3) Rule out possible complications such as pneumonia, pneumothorax, or pneumomediastinum

4) Rule out upper airway obstruction from foreign bodies, epiglottitis, organic diseases of the larynx, vocal cord dysfunction, and extrinsic and intrinsic tracheal

5) Chest radiography is not recommended for routine assessment but should be obtained for patients suspected of a complicating cardiopulmonary process

Special considerations

1) Assessment depends on physical examination. Signs of serious distress requiring evaluation in the ED include accessory muscle use, inspiratory and expiratory wheezing, paradoxical breathing, grunting and cyanosis (see Table above)

- No single measure is best for assessing severity or predicting hospital admission
- Lung function measures (FEV_1 or PEF) may be useful for children ≥5 years of age, but these measures may not be obtainable during an exacerbation
- Pulse oximetry may be useful for assessing the initial severity; a repeated measure of pulse oximetry of <92-94 percent after 1 hour is predictive of the need for further medical care.
- Signs and symptoms scores may be helpful. Children who have signs and symptoms after 1-2 hours of initial treatment and who continue to meet the criteria for a moderate or severe exacerbation have a >84% chance of requiring hospitalization.

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Treatment

Treatment Considerations

1) Rapid reversal of airflow obstruction by repetitive administration of a short acting beta agonist (SABA) (Albuterol) with or without ipratropium bromide in a continuous or repeated treatment. Systemic corticosteroids (e.g. Prednisolone or Prednisone 2mg/kg up to a maximum of 60mg/dose) should be added for children with **mild** exacerbations who fail to respond to the first dose of a SABA. For patients who have **moderate to severe** exacerbations systemic corticosteroids should be administered immediately.
2) Nebulized ipratropium, shown to reduce the risk of hospitalization, should be added with each of the first three albuterol treatments for children with **moderate to severe** asthma exacerbations.
3) For **severely** ill patients who are aerating poorly, administer subcutaneous or intramuscular epinephine concurrent with nebulized albuterol/ipratropium therapy and obtaining intravenous access. Activate EMS for emergency transfer to the ED and place these patients on continuous monitor until the ambulance arrives.
4) Correction of hypoxemia ($SaO_2 \leq 92\%$) with supplemental oxygen delivered by face mask. Nebulized medications should also be delivered with oxygen in hypoxyemic patients. A patient requiring supplement oxygen should be transferred to the ED by ambulance. Monitor closely for respiratory depression after initiating treatment.

Reassessment

Every 10 to 20 minutes, patients should be reassessed for response to treatment and repeat vital signs. Children with moderate exacerbations are typically given up to three doses of SABA/ipratropium over one hour and reassessed after each dose. This should include physical examination and repeat measurement of SaO_2. Serial lung function measures using either FEV1 or PEF are useful for children 5 years of age or older.

Indications for Emergency Department Transfer

1. Children with severe exacerbations
2. Children with $SaO_2 \leq 92\%$ that does not resolve with albuterol and unable to remove from supplemental Oxygen delivery.
3. Children with persistent exacerbation symptoms after three SABA/ipratropium treatments and oral steroids.

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Medications for Asthma Exacerbation in Outpatient Setting

	How Supplied	Pediatric Dose	Comments
Albuterol (preferred)			
(AccuNeb) (generics available)	nebulizer solution (0.63 mg/3 ml, 1.25 mg/3 ml, 2.5 mg/3ml, 5.0 mg/ml)	0.15 mg/kg (min dose 2.5 mg) every 20 minutes for 3 doses then 0.15-0.3 mg/kg up to 10 mg every 1-4 hours as needed, or 0.5 mg/kg/hour by continuous nebulization	Only selective beta2 agonists are recommended. May mix with ipratropium nebulizer solution.
(ProAir, Proventil, Ventolin)	HFA, MDI (90 mcg/puff)	<12 years: 4-8 puffs every 20 minutes for 3 doses, then every 1-4 hours inhalation, maneuver as needed. Use valved holding chamber (VHC); add mask in children <6 years. >12 years: 4-8 puffs every 20 minutes for 4 hours then every 1-4 hours as needed.	In mild –to-moderate exacerbations, MDI plus VHC is as effective as nebulized therapy with appropriate administration technique and coaching by trained personnel.
Levalbuterol			
Xopenex (currently not available in outpatient clinics)	Nebulizer solution (0.31 mg/3 ml, 0.63 mg/3 ml, 1.25 mg/0.5 ml, 1.25 mg/3 ml)	0.075 mg/ kg (minimum dose 1.25 mg) every 20 minutes for 3 doses, then 0.075 – 0.15 mg/kg up to 5 mg every 1-4 hours as needed.	Levalbuterol administered in one-half the mg dose of albuterol provides comparable efficacy and safety. Has not been evaluated by continuous nebulization.
Xopenex HFA (currently not available in outpatient clinics)	HFA, MDI (45 mcg/puff)	<12 years: 4-8 puffs every 20 minutes for 3 doses, then every 1-4 hours inhalation, maneuver as needed. Use valved holding chamber; add mask in children <6 years. >12 years: 4-8 puffs every 20 minutes for 4 hours then every 1-4 hours as needed.	
Epinephrine			
Epinephrine (1 mg/ml)	Injection solution 1 mg/ml	0.01 mg/kg up to 0.3-0.5 mg every 20 minutes for 3 doses subcut	No proven advantage of systemic therapy over aerosol. Generally reserved for cases where nebulized therapy is either unavailable or clinically ineffective.

Ipratropium			
Ipratropium (available generic only)	Nebulizer solution (with or without preservative) 0.5 mg/2.5 ml	0.25 – 0.5 mg every 20 minutes for 3 doses, then as needed	Do not use as first treatment without albuterol. May mix in same nebulizer with albuterol. Should be used for moderate to severe exacerbations to prevent hospitalization. **Do not continue ipratropium at home for asthma.**
Atrovent	HFA MDI (17 mcg/puff)	4-8 puffs every 20 minutes as needed up to 3 hours	For use with acute exacerbation only. **Do not continue ipratropium at home for asthma.** Should use with valved holding chamber.
Combination Products			
Ipratropium with albuterol (DuoNeb)	Nebulizer solution (each 3 ml contains 0.5 mg ipratropium bromide and 2.5 mg albuterol)	1.5 – 3 ml every 20 minutes for 3 doses, then as needed	May be used for up to 3 hours in the initial management of severe exacerbations.
Ipratropium with albuterol (Combivent Respimat Inhaler)	MDI / respimat inhaler (each puff contains 20 mcg ipratropium bromide and 100 mcg of albuterol	4-8 puffs every 20 minutes as needed up to 3 hours	Should be used with VHC and face mask for children <6 years
Prednisone prednisone 5 mg = prenisolone 5 mg = methyprednisolone 4 mg however same dosing recommended for all 3 agents for simplicity per NHLBI guidelines	Regular release tablets available in 1 mg, 2.5 mg. 5 mg, 10 mg, 20 mg, and 50 mg strengths. Oral solution available in 5mg/ 5ml concentration and 5 mg/ml concentrate	First dose of 2mg/kg up to maximum of 60mg	Children 2 mg/kg/day maximum 60 mg/day for 3-10 days) GINA guidelines recommend max dose of 40 mg per day. NHLBI recommends 40 to 60 mg max. Minimal added benefit when going from 40 mg to 60 mg in clinical trials.

Methylprednisolone	Tablet available in 2 mg, 4 mg, 8 mg, 16 mg, 32 mg strengths. Injection solution as sodium succinate available in 40 mg, 125 mg (and other) strengths		
Prednisolone	Available 5 mg tablet; 10 mg, 15 mg, 30 mg oral dispersible tablet; Oral solutions (varied concentrations); oral syrup 15 mg/5 ml		

Discharge

Provide patients with the following:
1)necessary medications and education using teach-back/demonstration on effective use and when to return to see a medical provider.
2) Recommend follow-up appointment to primary care provider, and
3) instruction in an asthma discharge plan for recognizing and managing relapse of the exacerbation or recurrence of airflow obstruction.

Criteria for Discharge

1) Discharge is appropriate if FEV1 or PEF has returned to ≥70 % of predicted or personal best and symptoms are minimal or absent for at least one hour after the most recent albuterol dose
2) Patients who have a rapid response should be observed for 30–60 minutes after the most recent dose of bronchodilator to ensure their stability of response before discharge to home.

Discharge Medications

1) Prescribe sufficient medications for the patient to continue treatment after discharge at least until follow-up is scheduled.
2) Patients given systemic corticosteroids should continue oral systemic corticosteroids for a total of 5 days. For more complicated asthmatics, oral steroids may provided as a burst for up to 10 days without a need to taper the dose. If more than 10 days of treatment with oral steroids is required, the dose needs to be tapered before stopping.

3) Consider initiating an inhaled corticosteroid (ICS) at discharge for persistent asthmatics (e.g., providing a one month supply), in addition to oral systemic corticosteroids. Patients already taking ICS therapy should continue it following discharge.

4) Review discharge medications and provide patient education on correct use of inhaler and spacer/holding chamber with or without a mask.

FIGURE 5–7b. EMERGENCY DEPARTMENT—ASTHMA DISCHARGE PLAN: HOW TO USE YOUR METERED-DOSE INHALER

Using an inhaler seems simple, but most patients do not use it the right way. When you use your inhaler the wrong way, less medicine gets to your lungs.

For the next few days, read these steps aloud as you do them or ask someone to read them to you. Ask your doctor, nurse, other health care provider, or pharmacist to check how well you are using your inhaler.

Use your inhaler in one of the three ways pictured below. A or B are best, but C can be used if you have trouble with A and B. Your doctor may give you other types of inhalers.

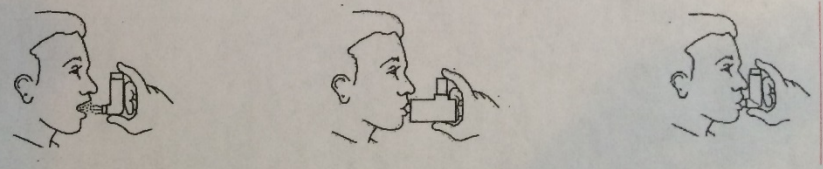
Steps for Using Your Inhaler

Getting ready	1. Take off the cap and shake the inhaler. 2. Breathe out all the way. 3. Hold your inhaler the way your doctor said (A, B, or C below).
Breathe in slowly	4. As you start breathing in slowly through your mouth, press down on the inhaler one time. (If you use a holding chamber, first press down on the inhaler. Within 5 seconds, begin to breathe in slowly.) 5. Keep breathing in slowly, as deeply as you can.
Hold your breath	6. Hold your breath as you count to 10 slowly, if you can. 7. For inhaled quick-relief medicine (short-acting beta$_2$-agonists), wait about 15–30 seconds between puffs. There is no need to wait between puffs for other medicines.

A. Hold inhaler 1 to inches in front of your mouth (about the width of two fingers).

B. Use a spacer/holding chamber. These come in many shapes and can be useful to any patient.

C. Put the inhaler in your mouth. Do not use for steroids.



Clean your inhaler as needed, and know when to replace your inhaler. For instructions, read the package insert or talk to your doctor, other health care provider, or pharmacist.

5) Ensure that patient/parent has the resources to fill prescriptions not provided on-site.

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Follow-up Care and Home Care

1) Emphasize the need for continual, regular care in an outpatient setting, and refer the patient for a follow-up asthma care appointment with the primary care provider, ideally prior to stopping oral steroids. If appropriate, consider referral to an asthma self-management education program. If an asthma specialist seems appropriate, encourage patient to discuss with their primary care provider.
2) Consider issuing a peak flow meter and giving appropriate education on how to measure and record PEF to patients who have difficulty perceiving airflow obstruction or symptoms of worsening asthma.
3) Give the patient an asthma discharge plan with instruction for medications prescribed and for increasing medications or seeking medical care should symptoms worsen.

FIGURE 5–7. EMERGENCY DEPARTMENT—ASTHMA DISCHARGE PLAN

EMERGENCY DEPARTMENT—ASTHMA DISCHARGE PLAN

Name: _____ was seen by **Dr.** _____ on ___/___/___

- Take your prescribed medications as directed—do not delay!
- Asthma attacks like this one can be prevented with a long-term treatment plan.
- Even when you feel well, you may need daily medicine to keep your asthma in good control and prevent attacks.
- Visit your doctor or other health care provider as soon as you can to discuss how to control your asthma and to develop *your own* action plan.

Your followup appointment with _____ is on: ___/___/___. **Tel:** _____

YOUR MEDICINE FOR THIS ASTHMA ATTACK IS:

Medication	Amount	Doses per day, for # days
Prednisone/prednisolone (oral corticosteroid)		_____ a day for _____ days Take the entire prescription, even when you start to feel better.
Inhaled albuterol		_____ puffs every 4 to 6 hours if you have symptoms, for _____days

YOUR DAILY MEDICINE FOR LONG-TERM CONTROL AND PREVENTING ATTACKS IS:

Medication	Amount	Doses per day
Inhaled corticosteroids		

YOUR QUICK-RELIEF MEDICINE WHEN YOU HAVE SYMPTOMS IS:

Medication	Amount	Number of doses/day
Inhaled albuterol		

ASK YOURSELF 2 TO 3 TIMES PER DAY, EVERY DAY, FOR AT LEAST 1 WEEK:

"How good is my asthma compared to when I left the hospital?"

If you feel much better:	**If you feel better, but still need your quick-relief inhaler often:**	**If you feel about the same:**	**If you feel worse:**
• Take your daily long-term control medicine.	• Take your daily long-term-control medicine. • See your doctor as soon as possible.	• Use your quick-relief inhaler. • Take your daily long-term control medicine. • See your doctor as soon as possible—don't delay.	• Use your quick-relief inhaler. • Take your daily long-term control medicine. • Immediately go to the emergency department or call 9–1–1.

YOUR ASTHMA IS UNDER CONTROL WHEN YOU:

① Can be active daily and sleep through the night.	② Need fewer than 4 doses of quick-relief medicine in a week.	③ Are free of shortness of breath, wheeze, and cough.	④ Achieve an acceptable "peak flow" (discuss with your health care provider).

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Source: Camargo CA Jr, Emond SD, Boulet L, Gibson PG, Kolbe J, Wagner CW, Brenner BE. Emergency Department—Asthma Discharge Plan. Developed at "Asthma Education in the Adult Emergency Department: A Multidisciplinary Consensus Conference," New York Academy of Medicine, New York, NY; 2001 April 1–5. Boston, MA: Massachusetts General Hospital, 2001. 2 pp.

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Initial Approval Date and Reviews:	*Most Recent Revision and Approval Date:*	*Next Scheduled Review Date:*
April 2017 *by Ambulatory Best Practice Committee*	April 2019	April 2021 *Ambulatory Best Practice* Condition: Pediatric Acute Asthma Treatment