Acute Asthma Exacerbations in Adults: Emergency Department and Inpatient Management

What You Need to Know

- Short acting bronchodilators and systemic steroids should be started promptly upon recognition of asthma exacerbation
- Utilize RT-directed bronchodilator protocol for asthma exacerbations
- Monitor peak expiratory flow (PEF) at baseline and subsequently to help determine severity of exacerbation and response to therapy
- Patients should be discharged on a controller therapy and asthma action plan with close follow up
- Clinicians can refer to OSUMC Outpatient Asthma guideline

An asthma exacerbation is an acute or subacute episode of worsening shortness of breath, coughing, wheezing, or chest tightness.
Determine risk and severity. Do not delay treatment.

Initial Management

- RT evaluate patient; initiate RT-directed bronchodilator protocol for Asthma
- Start short-acting bronchodilators promptly
  - Albuterol-Ipratropium (DuoNeb) shown to reduce hospital admission in ED and pre-hospital setting
- Recommend Prednisone 40-60 mg
  - Methylprednisolone IV 1 mg/kg (max dose 80 mg) can be used for severe exacerbation or if not tolerating PO
  - No benefit from higher steroid dose
- Administer/wean supplemental oxygen to maintain SpO2 > 90%
- Regularly monitor PEF until clear response to therapy, plateau reached, or clinical change
- ED patients: determine disposition within 4 hours
- Inpatients
  - Continue or step up home controller therapy with appropriate formulary substitutions
  - Consider pulmonary consult for patient with moderate to severe exacerbations or ≥ 2 exacerbations in 12 months

Focused H&P

- Evaluate for complicating factors
  - Anaphylaxis, pneumonia, pneumothorax
- Consider alternate diagnosis
  - Laryngeal obstruction, inhaled foreign body, heart failure, pulmonary embolism
- Determine patient's fluid balance: consider dehydration due to poor oral intake, insensible losses

Factors for Severe Asthma and Risk of Death

- History of severe exacerbations (ICU admission, intubation)
- Frequent ED visits or hospitalizations w/in past 12 months
- Using > 2 canisters of albuterol/month
- Difficulty perceiving asthma symptoms or severity
- Low socioeconomic status
- Concomitant psychiatric illness
- Cardiovascular, other chronic lung comorbidities

Testing

- Recommend measuring peak expiratory flow (PEF)
  - PEF can be regularly monitored until clear response to therapy or plateau reached
- Consider chest x-ray if alternate diagnosis suspected or no response to treatment
- Obtain venous blood gas
  - Consider obtaining arterial blood gas if PEF <50% predicted, no response to routine therapy, or further decompensation

Stratify exacerbation severity (mild, moderate, severe, or life-threatening)

Criteria	Mild[+]	Moderate[+]	Severe[+]	Life-Threatening[+]
Dyspnea	With exertion; can speak sentences	At rest; speaking phrases	At rest; sitting upright; speaking only words	Patient is drowsy or confused
Accessory muscle use	None; increased RR	Retractions may be present; increased RR	Subcostal, intercostal, or suprasternal retractions usually present; increased RR	Paradoxical thoracoabdominal movement
Wheezing	Often only end expiratory	Loud, throughout exhalation	Loud, biphasic wheezing (inhalation and exhalation)	Absence of wheezing/breath sounds (silent chest)
HR/Pulsus paradoxus	Normal/None present	100-120/May be present (10-25 mm Hg)	>120/Often present and >25 mm Hg	Can be significantly tachycardic or bradycardic
PEF % predicted or % personal best	>70%	50-69%	<40%	<25% if obtained
SaO2/SpO2 on baseline O2	>95%	90-95%	<90%	<90%

Mild Asthma Exacerbation†

- **Initiate RT Bronchodilator Protocol at Acuity Level 3**
- Prednisone 40-60 mg daily x 5 days (or IV equivalent)

Good response

- Appears well but history of severe exacerbations or concern for further decline
- Clinically improving but requires albuterol Q4 hours
- Peak flow < 70% but otherwise improving
- Economic barriers requiring SW/CM evaluation

Clinician discretion: Consider admit to ED Obs Unit or Hospital at Home

Good response

Discharge (page 3)

Incomplete response

- Continued need for supplemental oxygen
- Continued increased work of breathing
- Need for albuterol more frequently than Q4 hours
- Failed outpatient systemic steroids

Admit to appropriate level of care (LoC Guidelines)

- Consider for patients with high-risk features or previous near-fatal event.
- Consider PCU if requiring frequent treatments/ assessments, or intermittent NiPPV
- Consider Hospital at Home for patients with improving response

Discharge planning (page 3)

Moderate Asthma Exacerbation†

- **Initiate RT Bronchodilator Protocol at Acuity Level 2**
- Prednisone 40-60 mg daily x 5 days (or IV equivalent)
- IV magnesium 2 g over 20 minutes

Good response

Incomplete response

Condition worsening

Severe/Life-Threatening Asthma Exacerbation†

- **Initiate RT Bronchodilator Protocol Acuity Level 1**
- **Consult Pulmonology and prepare for MICU admission**
- Methylprednisolone 1 mg/kg (max 80 mg) daily x 5 days
- IV magnesium 2 g over 20 minutes

Poor Response / Failure to Improve

- Patients with
  - Persistent respiratory distress
  - Altered mental status, apparent fatigue or exhaustion
  - Continuous albuterol or Heliox
  - Continuous NiPPV, HHFNC or IMV
- Normal PCO2 on blood gas is a sign of impending respiratory failure. Pursue higher level of care
- Discretion of ED, inpatient, and pulmonary/ICU teams

Prepare for ICU Admission

Recommend early discussion with pulmonary consult/ MICU (page pulmonary/MICU fellow on call)

Consider one or more of the following status asthmaticus adjuvant therapies:

- IV magnesium 2 g over 20 minutes
- Administer albuterol 10-15 mg/h continuously
- Use NiPPV if intubation not imminently required
  - Avoid if patient altered, encephalopathic, agitated, or vomiting
- Administer Heliox continuously (only in patient on < 30% FiO2)
  - Give albuterol in line with Heliox
  - Can be given through NRB, HHFNC, or critical care (e.g., Avea) ventilator via NiPPV or IMV
- Consider epinephrine 0.3-0.5 mg SQ or IM
- Methylxanthines (e.g., aminophylline) not recommended
- Consider intubation for the following:
  - Do not respond to adjuvant therapies or NiPPV
  - Develop altered mental status or hemodynamic instability
- Consider ketamine for induction and post intubation sedation
- **CAUTION:** maintain a **HIGH** threshold for intubation; involve Pulm/CC **EARLY**

Patient Admitted to ICU

NOTES

- When evaluating "Good response", can consider:
  - PEF increase by >20%
  - Ability to lie flat
  - Decrease in respiratory rate by 10% - 20%
  - Improvement in work of breathing/decreased accessory muscle use
  - Decreased in modified BORG dyspnea score
  - Room air SpO2 >94%
- Antibiotics not routinely recommended unless concomitant infection suspected
- Therapies can lead to further tachycardia and hypotension; consider hypovolemia; give IV fluid resuscitation
- Avoid sedative, anxiolytic and hypnotic drugs: associated with avoidable death
- Monitor electrolytes, especially K+; replace as needed
- Lactate may be elevated in setting of beta agonist use
- Consider inpatient pulmonary consultation for patients with slower than expected clinical improvement, multiple admissions, risk factors for life-threatening asthma, or clinician concerns

Discharge	
Discharge criteria – per physician's discretion	**Upon discharge**
• Peak flow > 70% • Tolerating q4 self MDI with spacer • Off supplemental oxygen • Able to tolerate oral steroids • Improvement in pulmonary exam, respiratory rate, and work of breathing • Able to demonstrate appropriate technique, asthma action plan completed • Access to controller inhaler, reliever inhaler, and oral steroids	• Discharge from ED/CDU or LOS <24 hours: Continue albuterol MDI with spacer scheduled q4h while awake for the next 24-48 hours, and resume PRN afterwards • Continue prednisone course for total of 5-7 days ○ Consider prednisone taper over 2 weeks for patients with severe or frequent exacerbations • For those not on long-term controller therapy, recommend initiation of inhaled corticosteroid (refer to Outpatient Asthma guideline). • For those on long term therapy, consider symptom frequency and step-up therapy (refer to Outpatient Asthma guideline) • Recommend patient education including asthma education, inhaler technique, and environmental control measures • Asthma action plan*** dot phrase in discharge instructions and reviewed with MD/RN/RT • If deemed high risk for readmission and delayed outpatient follow-up or no primary care provider, consider scheduled follow-up in 24-48 hours in Advanced Urgent Care Center • Close follow up with asthma provider within 4-6 weeks • Consider pulmonary referral if frequent exacerbations or uncontrolled symptoms • If deemed appropriate for Hospital at Home program, consider consult to initiate assessment

Medications / Treatment			
Medication	**Dosing**	**Adverse Effects**	**Comments**
Corticosteroids • Prednisone (PO) • Methylprednisolone (IV)	Based on severity (see guideline above) Equivalent doses • Prednisone: 5 mg • Methylprednisolone: 4 mg • Dexamethasone: 0.75 mg	• Agitation/Delirium • Hyperglycemia* • Insomnia • Infection risk	• Steroid therapy should be continued until patient achieves substantial symptom improvement or resolution • Steroid doses greater than those listed above have not been associated with improved outcomes in patients with acute asthma exacerbations • Early administration of steroids (<1 hour of ED presentation) is associated with a decreased need for hospital admission
Magnesium (IV)	2 g over 20 minutes May repeat dose once after 30 minutes	• Nausea • Headache • Hypotension	• No need to check magnesium levels • Caution in patients with severe renal dysfunction
Epinephrine (IM or SQ)	0.3 – 0.5 mg May repeat dose every 20 minutes for three doses	• Tachycardia • Hypertension • Arrhythmias	• Rarely, inhaled beta agonists may not be effective in patients with severe bronchospasm; consider systemic therapy
Ketamine (IV)	See OSUWMC Pharmacy Ketamine IV Guidelines	• Sedation • Increased secretions • Psychosis • Hypertension	• Pulmonology/critical care does not recommend the use of IV ketamine in non-intubated patients with acute asthma exacerbations • Consider ketamine for induction and post-intubation sedation
Methylxanthines	Discuss with clinical pharmacy specialist	• Vomiting • Arrhythmias • Seizures	• Literature does not support the use of methylxanthines in acute asthma exacerbations • Initiation should be done in conjunction with pulmonology/critical care
Notes: See Outpatient Asthma Evaluation and Management guideline for guidance on OSUWMC formulary-approved inhaler equivalency medications. See Steroid-Induced Hyperglycemia Management guideline for assistance.			

References

- Manser R, Reid D, Abramson M. Corticosteroids for acute severe asthma in hospitalised patients. Cochrane Database Syst Rev. 2001;1:CD001740
- McFadden ER. Acute severe asthma. Am J Respir Crit Care Med. 2003;168(7):740-759.
- Rowe BH, Spooner C, Ducharme FM, Bretzlaff JA, Bota GW. Early emergency department treatment of acute asthma with systemic corticosteroids. Cochrane Database Syst Rev. 2001;(1):CD002178.
- Nair P, Milan SJ, Rowe BH. Addition of intravenous aminophylline to inhaled beta(2)-agonists in adults with acute asthma. Cochrane Database Syst Rev. 2012;12(12):CD002742.
- GINA: https://ginasthma.org/wp-content/uploads/2022/07/GINA-Main-Report-2022-FINAL-22-07-01-WMS.pdf
- National Asthma Education and Prevention Program. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. J Allergy Clin Immunol. 2007 Nov;120(5 Suppl):S94-138. doi: 10.1016/j.jaci.2007.09.043. Erratum in: J Allergy Clin Immunol. 2008 Jun;121(6):1330. PMID: 17983880.
- Fanta CH, Rossing TH, McFadden ER Jr. Glucocorticoids in acute asthma. A critical controlled trial. Am J Med. 1983 May;74(5):845-51. doi: 10.1016/0002-9343(83)91076-8. PMID: 6340496.
- Krishnan JA, Davis SQ, Naureckas ET, Gibson P, Rowe BH. An umbrella review: corticosteroid therapy for adults with acute asthma. Am J Med. 2009;122(11):977-991. doi:10.1016/j.amjmed.2009.02.013
- McFadden ER Jr. Acute severe asthma. Am J Respir Crit Care Med. 2003 Oct 1;168(7):740-59. doi: 10.1164/rccm.200208-902SO. PMID: 14522812.
- Kew KM, Kirtchuk L, Michell CI. Intravenous magnesium sulfate for treating adults with acute asthma in the emergency department. Cochrane Database Syst Rev. 2014 May 28;(5):CD010909. doi: 10.1002/14651858.CD010909.pub2. PMID: 24865567.
- Self TH, Redmond AM, Nguyen WT. Reassessment of theophylline use for severe asthma exacerbation: is it justified in critically ill hospitalized patients? J Asthma. 2002 Dec;39(8):677-86. doi: 10.1081/jas-120015790. PMID: 12507187.
- Goyal S, Agrawal A. Ketamine in status asthmaticus: A review. Indian J Crit Care Med. 2013;17(3):154-161. doi:10.4103/0972-5229.117048
- Global Initiative for Asthma. Global strategy for asthma management and prevention. www.ginasthma.org. Date last updated: 2021
- Kress JP, Noth I, Gehlbach BK, et al. The utility of albuterol nebulized with heliox during acute asthma exacerbations. Am J Respir Crit Care Med. 2002;165(9):1317-1321.
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4166064/
- https://www.atsjournals.org/doi/full/10.1164/rccm.9907035

OSUWMC Resources

- Outpatient Asthma Clinical Practice Guideline
- Advanced Noninvasive Respiratory Support Guideline
- Asthma Assessment and scoring tool
- Respiratory Therapy-Directed Asthma and COPD Inhaler Protocol
- Heliox Policy
- Non-invasive Mechanical Ventilation (NIMV) Policy
- Peak flow calculator male
- Peak flow calculator female
- Level of Care Guidelines

Quality Measures

- All patients with asthma discharged with rescue inhaler included on medication list
- All patients with persistent asthma discharged with controller therapy included on medication list
- PCP or Pulmonary follow-up arranged within 2-6 weeks of an asthma related hospitalization

Order Sets

- In development

Authors

- Megan Conroy, MD, MA(Ed), FCCP
- Allison Rossetti, MD, FACP, FAAP
- Eric Adkins, MD
- Josh Arnold, PharmD, BCCCP
- Ryan Bellomy, RRT, RCP
- Matthew Curtis, RRT, RCP
- Scott Hazelwood, RRT, RCP, MRT
- Akshay Vijayaraman, MD
- Angad Sodhi, PharmD
- Tiffany Moore-Shook, MRT, RRT, RCP
- Michael Purcell, MD
- Jamie Zimmer, RRT, RCP

Guideline reviewed by: Critical Care Quality Management Committee

Guideline Approved

June 31, 2024. First Edition.

Disclaimer: *Clinical practice guidelines and algorithms at The Ohio State University Wexner Medical Center (OSUWMC) are standards that are intended to provide general guidance to clinicians. Patient choice and clinician judgment must remain central to the selection of diagnostic tests and therapy. OSUWMC's guidelines and algorithms are reviewed periodically for consistency with new evidence; however, new developments may not be represented.*