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Evidence Based Practice Guideline:

February 2024

Treatment of Pediatric Acute Asthma Exacerbation/Status Asthmaticus

Rationale & Scope

Asthma is a chronic inflammatory disorder that affects 8.4% of all children less than 18 years old in the United States. Asthma is a complex process that is characterized by bronchoconstriction, bronchial hyper-responsiveness, increased mucus secretion, and airway inflammation leading to obstruction and air trapping. While many children with asthma respond well to standard therapies such as short-acting bronchodilators and daily inhaled corticosteroids (ICS), a substantial minority do not, and this places them at risk for emergency room visits and hospitalizations. Asthma exacerbations are common, with approximately half of U.S. children with asthma reporting at least one exacerbation per year. Severe exacerbations requiring emergency department (ED) or hospital admission for care occur frequently in children, with rates reported as 10.7% and 2.1% respectively. Preventing and managing exacerbations is important due to effects of missed school and work, quality of life, and potential long-term impact on lung function. Asthma exacerbations are also an important public health issue due to the high direct and indirect costs associated with exacerbations[7]. Viral infections are the most common trigger for exacerbations in children, with a seasonal peak typically in the fall although other peaks may exist due to seasonal allergens or after schools start.

The scope of this guideline includes the assessment of asthma severity and recommended pharmacologic treatment interventions based on presentation and response to therapy during a hospital based or outpatient encounter for an asthma exacerbation. The guideline also includes self-management education and non-pharmacologic interventions to reduce future exacerbations. It does not take into consideration all adjunctive pharmacologic and respiratory support therapies that may be considered for patients with severe asthma exacerbations, impending respiratory failure, and/or requiring ICU level care as this care is often individualized.

Treatment Algorithm for Pediatric Acute Asthma Exacerbation – Primary Care/Urgent Care
Treatment Algorithm for Pediatric Acute Asthma Exacerbation/Status Asthmaticus – Emergency Department
Treatment Algorithm for Pediatric Status Asthmaticus - Hospitalized

Inclusion and Exclusion Criteria

- This guideline is intended for physicians, advanced practice practitioners, respiratory therapists, clinical pharmacists, and nurses caring for pediatric patients with asthma.
- This guideline may also be a resource for patients and families

INCLUSION CRITERIA

a. Patients ≥ 2 years of age with a diagnosis of asthma or history of episodic wheezing that is responsive to bronchodilator therapy

EXCLUSION CRITERIA

a. Patients with other underlying chronic lung disease, bronchiolitis, bacterial pneumonia, cardiac conditions, or complex neurological disorders

Definitions

- **Acute asthma exacerbation:** defined as episodes of progressive shortness of breath, characterized by coughing, wheezing, and/or chest tightness which may result in respiratory distress
- **Status Asthmaticus:** medical emergency in which asthma doesn't respond to ambulatory standard care

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Assessing Asthma Severity – Clinical Asthma Score

- There is currently no widely accepted gold standard for asthma scoring tools across the continuum of care although the Pediatric Respiratory Assessment Measure (PRAM) has been validated in some treatment settings. The use of simpler asthma scoring tools can be used to determine the severity of asthma exacerbation. (Recommendation strength, low level of evidence)
- The Clinical Asthma Score (CAS) was developed locally to assess disease severity; assist staff in objectively assessing patient readiness for weaning or intensification of treatment; and recognize clinical deterioration that may warrant escalation of care. Validating the CAS across the continuum of care is an area of future study.
- Patients that require respiratory support beyond low flow oxygen are taken off the asthma clinical pathway and no longer assessed with the CAS. Resume the asthma clinical pathway and CAS scoring once additional respiratory support is discontinued.

	0 – None/Mild	1 – Moderate	2 – Severe
Wheeze	None or end expiratory wheezes	Inspiratory and/or expiratory wheezes	Breath sounds becoming inaudible
Accessory Muscle Usage	None	Intercostal and/or tracheosternal	Intercostal and/or tracheosternal muscles **PLUS** use of sternocleidomastoid muscles
Air Exchange	Equal all lobes	Decreased in some lobes	Decreased in all lobes
Oxygenation	SpO2 ≥94% on room air	SaO2 < 94% on room air OR SaO2 ≥ 94% on supplemental O2	SaO2 <94% on supplemental O2
Respiratory Rate	1-5 yrs: <30 bpm 6-14 yrs: <25 bpm ≥15 yrs: <20 bpm	1-5 yrs: 30-35 bpm 6-14 yrs: 25-30 bpm ≥15 yrs: 20-25 bpm	1-5 yrs: >35 bpm 6-14 yrs: >30 bpm ≥15 yrs: >25 bpm

Initial Diagnostic Evaluation and Treatment Recommendations

(See "How was this guideline developed?")

Assessment

- Perform full history of present illness (HPI):
  - Time of onset of exacerbation and trigger (if known)
  - Treatment given for asthma exacerbation prior to arrival to ED/hospital setting including time of last dose
  - Daily asthma controller medications prescribed and last taken
  - Severity of underlying asthma
  - Presence of environmental or viral triggers and/or exposures
  - Asthma exacerbation and admission history
    - History of intubation for asthma (ever)
    - Number of ED visits in the last year
    - Number of hospitalizations in the last year
- Assess the patient for signs of impending respiratory failure
- Initial CAS assessment is recommended to be performed in conjunction with the physician for accurate placement on asthma clinical pathway. After pathway placement, subsequent scoring and advancements are performed by the RN or RT.
- Screening for social determinants of health (SDoH) at admission is recommended to identify patients that are at greater risk for future asthma exacerbations.
- Routine laboratory studies are not recommended.
  - Consider a renal function panel (RFP) if the patient has known renal insufficiency and magnesium sulfate infusion is ordered
  - Consider blood gas when exam findings are concerning for impending respiratory failure
- Chest radiograph is not recommended to be routinely obtained during the initial management of acute asthma exacerbation.
- Consider chest radiograph in limited situations, such as: hypoxemia (SpO2 < 92%) and focal pulmonary exam findings not responsive to asthma therapy OR concern for pneumothorax, pneumomediastinum, or cardiac abnormalities. (Weak recommendation, low level evidence [expert consensus])

Steroid Treatment

- In the Emergency Department, for mild-moderate acute asthma exacerbations, dexamethasone is recommended over prednisolone due to no difference in outcomes, improved tolerability, and cost-effectiveness. (Strong recommendation, high level of evidence)

- For inpatient status asthmaticus that does not require ICU level care, a 2-day course of dexamethasone is a non-inferior alternative to prednisolone and is associated with decreased length of stay, improved tolerability/compliance, and cost-effectiveness. (Strong recommendation, low level of evidence)

Bronchodilator Treatment

- The use of short-acting bronchodilators by MDI with a spacer/VHD is recommended over nebulizer in patients with mild-moderate exacerbations due to efficacy and decreased ED LOS. (Strong recommendation, high level of evidence)
- Evidence does not support routine use of ipratropium for mild or moderate asthma exacerbation. (Strong recommendation, low level of evidence)
- Continuous nebulized short-acting bronchodilators for status asthmaticus is safe in the ED and ICU setting (Strong recommendation, low level of evidence)

Adjunct Treatment

- Intravenous magnesium sulfate is recommended for status asthmaticus treated in the Emergency Department due to decreased odds of hospital admission and improvement in respiratory function. (Strong recommendation, high level of evidence)
- Evidence to support improved outcomes with the use of adjunct therapies such as terbutaline and aminophylline is inconclusive and not recommended for routine use. These adjuncts may be considered in patients that are not improving on standard therapies and with concern for escalation of respiratory support. (Weak recommendation, low level of evidence)

Oxygen Delivery

- Administer supplemental oxygen to achieve SpO2 $\geq$ 93%. Modality to be determined by patient preference, asthma severity and care level setting.

Discharge

- Discharge planning is recommended to begin as soon as admission, but no later than Phase 2 to allow for coordination of care. Outpatient medication orders are to be placed as soon as determined.
- Recommend that patients are discharged once tolerating q4h short-acting bronchodilator treatments. Physicians may consider a q3h discharge on a case-by-case basis. (Strong recommendation, low level of evidence)
- Patients and families can be discharged after an asthma home management plan has been completed and the family expresses understanding of the plan (Strong recommendation, high level of evidence)
- The use of consistent scripting for asthma teaching at discharge is recommended across inpatient and ED that is consistent with care plan (Strong recommendation, very low level [expert consensus])
- The use of teach back method with inhalers and spacers is recommended. If possible, allow family to administer one dose of beta-agonist via MDI prior to discharge (Strong recommendation, very low level evidence [expert consensus]).
- Patients with positive SDoH screens are recommended to be seen by social work prior to discharge. Patients may follow up with social work as an outpatient only at the discretion and approval of the medical attending.

Exam findings concerning for impending respiratory failure

- Single word dyspnea
- Acute change in mental status
- Significant accessory muscle use
- Silent chest
- Oxygen saturation < 92%

Risk Factors for Severe Exacerbations

- Hospitalization or ED visit for asthma in the last year
- Use of 2 or more canisters of short acting bronchodilator in the last 12 months
- Low socioeconomic status
- Comorbidities including food allergy, cardiovascular disease, and obesity
- Poor adherence to controller medications
- History of psychiatric condition
- Poor perception of wheezing

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Social Work Consults for Admitted Asthma Patients

- The following healthcare utilization indicators place a patient at a greater risk for uncontrolled asthma or asthma exacerbations. Healthcare provider are recommended to order a social work consult prior to discharge when these indicators are noted:
  - 2 or more previous no-shows to pulmonary appointments
  - Previous no-show to routine well-child appointments in the last 12 months
  - Previous admission in the past 30 days
  - Admission in the last year without pulmonary or asthma specialist follow-up

- A focused SDoH screening is recommended to be completed by the patient's caregiver at admission and documented in the admission navigator. Patients that screen positive based on this focused screening are at risk for re-admission and/or severe exacerbation as these factors may lead to poor medication adherence and/or poor health and well-being.
  - Nursing should order a social work consult for all positive screenings.
  - Focused SDoH screening includes questions specific to financial stress or strain, housing stability, transportation, ability to pay and maintain utilities at home, and food insecurity.

Discharge Criteria and Discharge Education

- At minimum, every asthma discharge is recommended to include the following elements:
  - Outpatient medications are reviewed and new orders placed if applicable
  - Referrals are made or follow-up with asthma specialist is scheduled
  - Asthma Home Management Plan is updated or marked as reviewed in EPIC
  - Asthma Home Management Plan is reviewed with patient caregiver with teach back
  - Device training and teach back is performed with patient caregiver

- Social work consult completed if order placed
- Meds to Beds Pharmacy Delivery Program is offered to all patients
- Patients that required ICU level care for asthma exacerbation must be seen by pulmonary service prior to discharge

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Major References

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6. Bohannon K, Machen R, Ragsdale C, Padilla-Tolentino E, Cervenka P. Dexamethasone Associated With Significantly Shorter Length of Hospital Stay Compared With a Prednisolone-Based Regimen in Pediatric Patients With Mild to Moderate Acute Asthma Exacerbations. Clin Pediatr (Phila). 2019; 58(5):521-527.
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8. Abaya R, Delgado EM, Scarfone RJ, Reardon AM, Rodio B, Simpkins D, Mehta V, Hayes K, Zorc JJ. Improving efficiency of pediatric emergency asthma treatment by using metered dose inhaler. J Asthma. 2019 Oct;56(10):1079-1086. doi: 10.1080/02770903.2018.1514629.

How was this Guideline Developed?

- This guidance document was developed by a multi-disciplinary group of caregivers involved in the Asthma Clinical Effectiveness Team (CET) led by pulmonary services and asthma experts. The final recommendations in this document reflect the consensus from the Asthma CET based on review of the guidelines referenced below with consideration of application to local community.
- This guideline is a revision of the original guideline approved in 2020. For this revision, the team focused on review of literature related to adjunct therapies in severe asthma, ipratropium use in moderate asthma exacerbation, and social factors that affect asthma management.
- Local consensus statements (i.e. expert opinion) that are not graded should be interpreted as low-level evidence.

Acronyms and Abbreviations

AHMP	Asthma Home Management Plan
CAS	Clinical Asthma Score
ED	Emergency Department
MDI	Metered Dose Inhaler
PICU	Pediatric Intensive Care Unit
SDoH	Social Determinants of Health

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