TEXAS CHILDREN'S HOSPITAL
EVIDENCE-BASED OUTCOMES CENTER
Asthma/Recurrent Wheezing Clinical Guideline
Evidence-Based Guideline

Definition: [1] Acute asthma exacerbations or "asthma attacks" are episodes of progressive increase in shortness of breath, cough, wheezing, or chest tightness, or some combination of these symptoms. Respiratory distress is common. Exacerbations are characterized by decreases in expiratory airflow that can be quantified by measurement of lung function (PEF or FEV_1).

Pathophysiology: [2] Asthma is a complex process that depends on the interaction of:

- Bronchoconstriction
- Airway hyperresponsiveness
- Airway inflammation, resulting in edema and mucus plugging

Epidemiology: A wide global variation exists in the prevalence of asthma, with higher rates typically seen in higher-income countries. Asthma is the most common chronic disease in childhood in resource-rich countries. In the United States, asthma affects more than 26 million persons. Approximately 6.2 percent of US children had asthma in 2022.[3] which is a decline from the past decade. Approximately one-half of children with asthma present with symptoms before 3 years of age. Hospitalization rates are also higher among young children 0–4 years of age. [4] Before the onset of puberty, boys have a higher current prevalence of asthma than girls; however, this trend reverses in adolescence.
Disparities in prevalence remain, with a higher prevalence seen in poor children and those living in the Southern US and the highest prevalence still seen in Puerto Rican and non-Hispanic Black American children.[5] particularly for those living in urban environments.
The pattern of disease persistence is determined in part by early, recognizable risk factors including atopic disease, recurrent wheezing, and a parental history of asthma. The modified asthma predictive index provides a method for predicting the likelihood for preschool wheezers to develop persistent asthma during school age. Although only approximately 30% of children who wheeze before 3 years of age will have persistent asthma by school age, studies suggest that deficits in lung function growth occur more often in children whose asthma symptoms begin during the first 3 years of life as opposed to those with an onset of symptoms after 3 years of age.

Etiology: Asthma is a complex, interactive disease process that depends on the interplay between two major factors—host factors (particularly genetics) and environmental exposures that occur at a crucial time in the development of the immune system. Gene-by-environmental interactions are important to the development and expression of asthma. It is well recognized that asthma has an inheritable component to its expression, but the genetics involved in the eventual development of asthma remain a complex and incomplete picture. A number of other factors continue to be explored asthma risks largely through association studies such as various dietary factors, obesity, and medication use.

Several major environmental factors have emerged as being particularly important in the development, persistence, and possibly severity of asthma: airborne allergens, viral respiratory infections and secondhand smoke (SHS)/air pollution.

Allergens and Atopy
Allergen exposure, allergic sensitization, and respiratory infections also may function interactively in the eventual development of asthma. Atopy, the genetic predisposition for the development of an immunoglobulin E (IgE)-mediated response to common aeroallergens, is the strongest identifiable predisposing factor for developing asthma. The "atopic march" usually starts with atopic dermatitis in early life and progresses to the addition of other allergic diseases, including food allergy, asthma, and allergic rhinoconjunctivitis. Early age of onset of atopic dermatitis and allergic sensitization is associated with an increased risk of childhood asthma in several studies.

Infection
Viral respiratory infections are one of the most important causes of asthma exacerbation and may also contribute to the development of asthma. Some infections seem to decrease the risk of developing asthma, whereas viral infections, such as respiratory syncytial virus (RSV), may increase the risk. There is considerable interest in the role of innate and adaptive immune responses associated with both the development and regulation of inflammation. In particular, research has focused on an imbalance between Th1 and Th2 cytokine profiles and evidence that allergic diseases, and possibly asthma, are characterized by a shift toward a Th2 cytokine-like disease, either as overexpression of Th2 or underexpression of Th1.

Environmental Exposure Risks
Prenatal and postnatal SHS exposures are potentially avoidable and can contribute to the burden of asthma in children. Exposure to SHS is associated with increased prevalence and severity of asthma and wheezing. Pre- and/or postnatal exposure to SHS was associated with an increased risk for asthma. A significant excess of childhood asthma occurs if both parents or the mother smoke. In utero exposures from maternal smoking can adversely affect lung development and function and increase the risk for asthma in early childhood. In addition, smoking during gestation is associated with higher rates of premature delivery, which is another risk factor for asthma.
A dose-response relationship exists between SHS and childhood asthma, and no defined threshold level of exposure is without risk. SHS may increase the frequency of lower respiratory infection in early childhood and promote allergic sensitization. Exposure to SHS also appears to worsen the severity of asthma in children.

Outdoor Air Pollution
A growing body of evidence suggests that early-life exposure to air pollution increases the risk of pediatric asthma including outdoor air pollutants including sulfur dioxide and nitrogen dioxide. Exposure to high ozone levels may worsen asthma

control as well. Studies have shown that residence near a major roadway even at relatively low levels of traffic-related pollution increased the risk of early childhood asthma.

Asthma Phenotypes
A number of cohort studies have explored the occurrence and natural history of asthma in children.
The Tucson Children's Respiratory Study prospective longitudinal study of a cohort of 1246 newborns based upon the presence of wheezing symptoms during the first three years of life and again at six years.
Subsequent analyses of data from this cohort led to a revised definition of three groups of wheezers:

- *Transient wheeze in infancy* – Begins in infancy (the first year of life) and resolves by the preschool years; associated with decreased lung function, narrower intrapulmonary airways, maternal tobacco use during pregnancy, having siblings, and daycare attendance.
- *Nonatopic persistent wheezing phenotype* – Begins in infancy and resolves in mid-childhood; associated with lack of both allergic sensitization and methacholine hyperresponsiveness.
- *Immunoglobulin E (IgE)-associated/atopic persistent wheezing phenotype* – Can begin in infancy but increases in prevalence with age; associated with personal and family history of atopy, methacholine hyperresponsiveness, and poor growth of lung function. This phenotype may represent a classic allergic asthma phenotype, but it is unknown if children with this phenotype will have symptoms that persist into adulthood.

Asthma Endotypes
Greater understanding of the heterogeneity associated with pathophysiology of asthma has led to the identification of distinct asthma endotypes. Two distinct endotypes have been identified based on identifiable triggers, the inflammatory cell milieu, and the presence or absence of clinical features such as atopy, nasal polyposis and clinical response to steroids.

Th2 high, or atopic asthma is characterized by the presence of inflammatory markers associated with Th2 cells, including IL-4, IL-5, and IL-13, and predominantly eosinophilic inflammation. Patients typically have allergic sensitization and are most often steroid responsive. Th2 low or non-atopic asthma is characterized by the absence of Th2 markers of activation and predominantly neutrophilic or pauci-granulocytic inflammation. In contrast to atopic asthma, patients may be less responsive to steroid treatments. Identifying these endotypes becomes important in optimizing treatment whereby patients with Th2 high asthma are more likely to respond to corticosteroid therapy and may be candidates for emerging biologic therapies targeting specific inflammatory pathways (see below).

Inclusion Criteria
- Patients ≥2 years with a diagnosis of asthma/recurrent wheezing in whom foreign body or vocal cord dysfunction have been ruled out

Exclusion Criteria
- Other chronic lung disease, bronchiolitis, bacterial pneumonia, neurological disorders, immunodeficiency diseases, and cardiac patients

Differential Diagnosis [1,2]
- Foreign body
- Croup
- Heart failure
- Vocal cord dysfunction
- GERD

Diagnostic Evaluation
History of Exacerbation: Assess for [1-2,6,7]
- Severity and duration of symptoms, including exercise limitation and sleep disturbance
- All current medications, including dose (and device) prescribed, dose usually taken, frequency, dose taken in response to the deterioration, and the patient's response (or lack thereof) to this therapy
- Time of onset and cause of the present exacerbation
- Risk factors for asthma-related death
- Level of control

History of Disease: Assess for [2]
- Patient/Family history of asthma, eczema, and/or smoking
- Patient history of allergic rhinitis, sinusitis, nasal polyps, eczema, or BPD
- Recurrent cough, bronchitis, or bronchiolitis
- Use or exposure to secondhand smoke and vaping
- Cough, wheeze, shortness of breath, and/or chest tightening that occurs in an "episodic" fashion. These symptoms may occur or worsen with:
  - Exercise
  - Weather change
  - Nighttime hours
  - Viral infection
  - Inhalant exposure (e.g., smoke, fur, dust mites, mold, pollen)
  - Irritant exposure (e.g., airborne chemicals, smoke)
  - Strong emotions (e.g., laughing, crying)
  - Menstrual cycle

Physical Examination [2]
- Evaluate patient's ability to complete a sentence
- Pulse rate
- Respiratory rate
- Use of accessory muscles
- Severity of respiratory symptoms using the Clinical Respiratory Score (CRS)
- Rhinitis, increased nasal secretions, mucosal swelling, or nasal polyps

Exacerbation Severity Assessment Tool

Clinical Respiratory Score (CRS)			
Assess	**Score 0**	**Score 1**	**Score 2**
Respiratory Rate	<2 mos: <50 2-12 mos: <40 1-5 yrs: <30 >5 yrs: <20	<2 mos: 50-60 2-12 mos: 40-50 >1-5 yrs: 30-40 >5 yrs: 20-30	<2 mos: >60 2-12 mos: >50 >1-5 yrs: >40 >5 yrs: >30
Auscultation	Good air movement, scattered expiratory wheezing, loose rales/crackles	Depressed air movement, inspiratory and expiratory wheezes or rales/crackles	Diminished or absent breath sounds, severe wheezing, or rales/crackles, or marked prolonged expiration
Use of Accessory Muscles	Mild to no use of accessory muscles, mild to no retractions, no nasal flaring on inspiration	Moderate intercostal retractions, mild to moderate use of accessory muscles, nasal flaring	Severe intercostal and substernal retractions, nasal flaring
Mental Status	Normal to mildly irritable	Irritable, agitated, restless	Lethargic
Room Air SpO_2	>95%	90-95%	<90%
Color	Normal	Pale to normal	Cyanotic, dusky

(Add score from all rows to calculate total CRS score)

Risk factors for asthma-related death include:

- Comorbid conditions such as heart or lung disease
- Previous severe exacerbation (e.g., intubation or ICU admission)
- ≥2 hospitalizations or >3 EC visits within the past year
- Use of >2 canisters of short-acting beta-agonist (SABA) per month
- Difficulty perceiving airway obstruction or the severity of worsening asthma (parent and/or child)
- Low socioeconomic status or inner-city residence
- Illicit drug use
- Major psychosocial problems or psychiatric disease

Life-threatening asthma *involves a constellation of symptoms, including:*

- Marked chest tightness
- Wheezing, severe shortness of breath
- Retractions
- Cyanosis
- Inability to speak or speak in sentences due to dyspnea
- Hunched posture
- Altered mental status (agitation, anxiety, lethargy)

Laboratory Tests

- Chest radiographs should not be used to determine the level of exacerbation severity
- Serum potassium levels should not be checked routinely in patients with no other underlying conditions that would worsen the effect of hypokalemia

Critical Points of Evidence*

TCH Evidence-Based Recommendations

Evidence Supports

- The Clinical Respiratory Score (CRS) should be used to determine the level of exacerbation severity. [8-11, Unpublished TCH data] – Strong recommendation, moderate quality evidence
- Pulse oximetry should be used as part of the CRS to determine the level of exacerbation severity. [1,12,13] – Strong recommendation, low quality evidence
- Blood gases should be used in the critical care setting to determine the level of exacerbation severity. [1,2,6,14-16] – Weak recommendation, low quality evidence
- Dexamethasone should be administered immediately during a moderate to severe exacerbation, and given orally in the ambulatory setting, Emergency Department (ED), urgent care, and in the inpatient setting if the patient is able to tolerate oral medication. [1,6,17-36] – Weak recommendation, moderate quality evidence
  Remarks: For children with a recent (within 1-2 weeks) course of steroids, history of ICU admission, or severe persistent asthma, consider a longer course of oral steroids for asthma exacerbations.
  Dexamethasone tablets are easily dissolvable, up to 16 mg in 1 mL of liquid (e.g., juice, water, sports drink). IV for PO solution is not available in outpatient pharmacies.
- Immediately administer SABA via metered-dose inhaler (MDI) for children with mild to severe asthma, reserving continuous SABA only for children requiring administration more than every 1 hour and for children with life-threatening asthma. [2,6,37-40] – Strong recommendation, moderate quality evidence
- Either albuterol or levalbuterol should be used for SABA administration via MDI. [1,6,41-46] – Strong recommendation, moderate quality evidence
- Albuterol should be used for SABA administration via nebulizer when co-administrated with Atrovent due to cost effectiveness or when utilized continuously, otherwise MDI is preferred. Nebulized levalbuterol is an equally effective alternative but is much more expensive than nebulized albuterol. [41-46] – Strong recommendation, moderate quality evidence
- Ipratropium bromide should be used with beta-agonist for three doses as adjunct therapy in children with moderate to severe asthma exacerbations. [1,2,6,47-50] – Strong recommendation, high quality evidence
- IV magnesium sulfate should be used as adjunct therapy when there is inadequate response to conventional therapy within the first hour in children with moderate to severe asthma exacerbations. [51-54] – Strong recommendation, moderate quality evidence

- IV terbutaline should be used in a monitored care setting for the treatment of children with severe asthma exacerbations. [55] – Weak recommendation, low quality evidence
- Non-invasive positive pressure ventilation should be considered prior to intubation in children with severe asthma exacerbations. [56-60]
  – Strong recommendation, low quality evidence
- Tailored educational interventions should be delivered to all patients seen at TCH. [59-70] – Strong recommendation, high quality evidence
- All patients seen at TCH should be given a written asthma action plan. [6,69-72] – Strong recommendation, high quality evidence
- Discharge patients from the IP setting once the child has successfully completed every three-hour SABA X 2. [6,73-75] – Strong recommendation, low quality evidence
- Refer any patient with an asthma exacerbation and high ED usage (≥4 visits/year), severe asthma, or previous ICU admission to an asthma specialist, if not already done. [1,76,78] – Strong recommendation, low quality evidence
- ***Consider*** referring any patient admitted to the hospital for an asthma exacerbation to an asthma specialist (to be seen within 4-6 weeks of discharge), if not already done. [1,76,78] – Weak recommendation, low quality evidence
- Refer any patient admitted to the ICU for an asthma exacerbation to an asthma specialist (to be seen within 4-6 weeks of discharge), if not already done. [1,76,78] – Strong recommendation, low quality evidence

Evidence Against

- Spirometry should not be used routinely to determine the level of exacerbation severity, except in select cases (obesity and vocal cord dysfunction). Spirometry may have a role in the management of the patient later in the hospital course. [79,80] – Strong recommendation, low quality evidence
- Peak expiratory flow measurements should not be used to determine the level of exacerbation severity, except in patients with established use. [81,82] – Strong recommendation, low quality evidence
- Chest radiographs should not be used to determine the level of exacerbation severity. [1,2,6,83-85] – Strong recommendation, moderate quality evidence
- End tidal carbon dioxide ($ETCO_2$) measurements should not be used to determine the level of exacerbation severity. [86,87] – Strong recommendation, low quality evidence
- Heliox should not be used in the treatment of children with asthma exacerbations. [6,88,89] – Strong recommendation, low quality evidence
- Serum potassium levels should not be checked routinely in patients with no other underlying conditions that would worsen the effect of hypokalemia. [14,16,97-101] – Strong recommendation, moderate quality evidence

Evidence Lacking/Inconclusive

- Utilize high-dose (50 mg/kg/dose) magnesium infusion (vs. low-dose (40 mg/kg)) when magnesium infusion is required. [2,6,16-19,100-107] – Consensus recommendation
- Administer oxygen to maintain SpO_2 ≥90%; however, transiently lower levels may be acceptable in patients who are otherwise ready for discharge. – Consensus recommendation
- Hold long-acting beta-agonists-when short-acting beta-agonists are required more often than four-hourly. [6] – Consensus recommendation
- Send all patients admitted to the hospital for an asthma exacerbation for a follow-up with their PCP within 1 week of discharge. – Consensus recommendation
- In patients with severe asthma exacerbation with impending respiratory failure, may consider administering intramuscular epinephrine. – Consensus recommendation
- High-flow nasal cannula is not recommended for routine use in the treatment of children with asthma exacerbations. [108-115] – Consensus recommendation
- Viral testing should be performed as determined by the medical provider based on clinical presentation, epidemiologic factors, and current public health guidelines – Consensus recommendation
- There is insufficient evidence to address the following topics: Continuation or no continuation of LABA for patients admitted to observation or inpatient status, impact of cohorting asthma inpatients or having an asthma unit, [92],doubling the dose of inhaled corticosteroid at the first signs of an exacerbation (prehospital) [118,119], administration of 1 dose of dexamethasone vs. 2 doses for an asthma exacerbation [21,24,28,34,35,120,123,124,125], administering dexamethasone IV vs orally, administering dexamethasone vs. prednisone vs. prednisolone in an ambulatory setting, administering dexamethasone IV vs methylprednisolone IV in acute setting [134], administering albuterol every 3 hours x 2 vs albuterol every 3 hours x 1, the time frame for administering magnesium sulfate, use of high-flow nasal cannula for treatment of acute asthma exacerbation, use of ipratropium in the primary care setting, or the standard practice of administering IV fluids along with magnesium sulfate to prevent hypotension. [18,19]
- There is no definitive recommendation on whether pulse oximeters systematically overestimate oxygen saturation in patients with darker skin tones and the impact on clinical outcomes. [126- 133] – Evidence Lacking (Recommendation adopted from TCH Bronchiolitis Guideline)

  Remarks: Recent studies concluded that overestimation of saturation by pulse oximetry may be associated with darker skin tones [132]; however, there is a paucity of pediatric evidence on the clinical impact of this occurrence. The studies reviewed for this topic have significant limitations due to the methodological procedures. There is ongoing research at Texas Children's Hospital to explore this topic. Guidelines will be updated as new research is published.

*NOTE: The references cited represent the entire body of evidence reviewed to make each recommendation.

Condition-Specific Elements of Clinical Management

General: The child's age and severity of illness are important factors to consider in diagnosing and managing an acute asthma exacerbation.

Treatment Recommendations:
Exacerbation Management (see Respiratory Assessment and Management Protocol [RAMP], p. 7):

Emergency Center
1. Obtain brief history, perform physical exam, and assess exacerbation severity using the CRS (p. 1). [8-11]
2. Administer oxygen to maintain SpO_2 ≥90%. Transiently lower levels may be acceptable in patients who are otherwise ready for discharge.
3. Initiate SABA (levalbuterol or albuterol via MDI or albuterol via nebulizer, depending on severity). [1,2,6,37-46]
4. Consider/Administer dexamethasone. [1,2,6,21-36]
5. If severity warrants, consider/add ipratropium bromide (up to 3 doses). [1,2,6,47-50]
6. If there is inadequate response within the first hour of conventional therapy, consider/administer IV magnesium sulfate. [51-54]
7. If condition unchanged or worsening, consider initiation of adjunct therapies, including IV terbutaline and non-invasive positive pressure ventilation (NPPV), and admit to PICU. [55-60]
8. If condition unchanged or slightly improving but continued close monitoring is required, consider IP admission.
9. If condition has improved greatly, wean SABA, complete Asthma Action Plan (see Table 1 on p. 6 for additional guidance), and discharge home. [6,69-72]
10. Consider initiation of inhaled corticosteroids if persistent asthma.
11. Order asthma education
12. Administer seasonal flu vaccination.
13. Recommend PCP follow-up within one week.

PICU
1. Continue above and consider adjunct therapies yet to be initiated.
2. Consider intubation and mechanical ventilation as needed.
3. Continue to reassess. When improving, refer to RAMP and follow to discharge.

Inpatient
1. Begin discharge process upon admission.
2. Continue therapies and wean as appropriate according to RAMP.
3. Administer flu shot, if not already given. [121]
4. Complete Asthma Action Plan (see Table 1 on p. 6 for additional guidance) and discharge home once discharge criteria are met. [6,69-72]

Admission Criteria
- Oxygen saturation consistently <90%
- Inability to wean albuterol
- Unsafe to send home/poor follow-up

Discharge Criteria
- No oxygen requirement
- CRS ≤3
- Response sustained at least 1-3 h after last SABA (EC) OR SABA q3h X 2 (Inpatient)
- Asthma Action Plan given
- Asthma Education complete
- Appropriate support system (e.g., PCP, caregivers)

Referrals/Follow-Up Care
- Patients admitted to the hospital for an asthma exacerbation should be seen by their PCP within 1 week of discharge.
- If a child has seen an asthma specialist in the past encourage contacting the specialist and getting a follow-up appointment. [76,78]
- Consider referring patients admitted to the hospital to an asthma specialist for the following reasons [76,77,78]:
  - required admission to the ICU for an asthma exacerbation
  - has had frequent ED/urgent care usage (≥4 visits/year) for asthma
  - has severe persistent asthma
  - has a history of prior intubation or ICU admission
  - has a history of pneumothorax/pneumomediastinum
- Criteria for referral to the Life-Threatening Asthma (LTA) Clinic:
  - age generally 2 years and older
  - PICU admission for primary asthma exacerbation
  - on ventilator at any time for treatment of primary asthma exacerbation
  - very high ED/urgent care usage without admission (≥5 visits/year)
  - admission to the acute care floor/TICU >2 times in past 18 months
  - history of severe asthma complication (e.g., loss of consciousness, seizure, cardiopulmonary arrest)
- Consider addition of recommendation to refer to resources for stopping smoking or vaping (electronic cigarette use) if close family member or patient smoke or vapes. These resources include:
  - 1-800-QUIT-NOW (1-800-784-8669) (state quitline)
  - 1-877-YES-QUIT (Texas tobacco quitline)
  - 1-877-44U-QUIT (1-877-448-7848) (National Cancer Institute counselors)
  - Smokefree.gov
  - QuitSTART app for cell phone

Measures

Process
- Time from ED arrival to delivery of beta-agonist
- Proportion of patients with chest x-ray obtained
- Proportion of patients who received an Asthma Action Plan
- Proportion of persistent patients prescribed controller medications
- Proportion of patients receiving asthma education
- Time to steroid administration
- Time to magnesium sulfate administration

Outcome
- Readmission rate to the ED and inpatient
- Hospitalization
- PCP follow-up

Table 1. Classifying Asthma Severity and Initiating Therapy [2]

	Intermittent	Mild Persistent	Moderate Persistent	Severe Persistent
Symptoms	≤2 days/week	>2 days/week	Daily	Throughout the day
Nighttime awakenings	0 (≤4 years) ≤2x/month (≥5 years)	1-2x/month (≤4 years) 3-4x/month (≥5 years)	3-4x/month (≤4 years) >1x/week (≥5 years)	> 1x/week (≤4 years) Often 7x/week (≥5 years)
SABA use	≤2 days/week	>2 days/week	Daily	Several times/day
Activity limitation	None	Minor	Some	Extreme
Oral steroid usage	0-1x/year	≥2x in 6 months or ≥4x/year (≤4 years) ≥2x/year (≥5 years)		
Recommended therapy	SABA PRN	Low-dose ICS	Medium-dose ICS or Low-dose ICS + LTRA or Low-dose ICS + LABA* *only if already prescribed by PCP or pulmonologist	Previous medications plus Subspecialist referral

For recommendations on controller medications, please refer to the Asthma: Chronic Management Guideline (Table 1 and Table 3)

Table 2. Mini Pediatric Asthma Control Test [122]

Mini Pediatric Asthma Control Tool
(M-PACT)

Please take time to fill out this checklist. This checklist can help doctors and nurses (and you!) to know how to best help your child manage his or her asthma.

- **Children may have different *signs* of asthma.**
- **Signs of asthma get worse during an asthma *flare* (also known as an attack or exacerbation)**

What are the signs of asthma for your child? (check all that apply)

- ☐ Coughs
- ☐ Gets mucus in his or her chest
- ☐ Feels chest pain or tightness
- ☐ Wheezes (a whistling in the chest)
- ☐ Gets short of breath
- ☐ Breathes fast

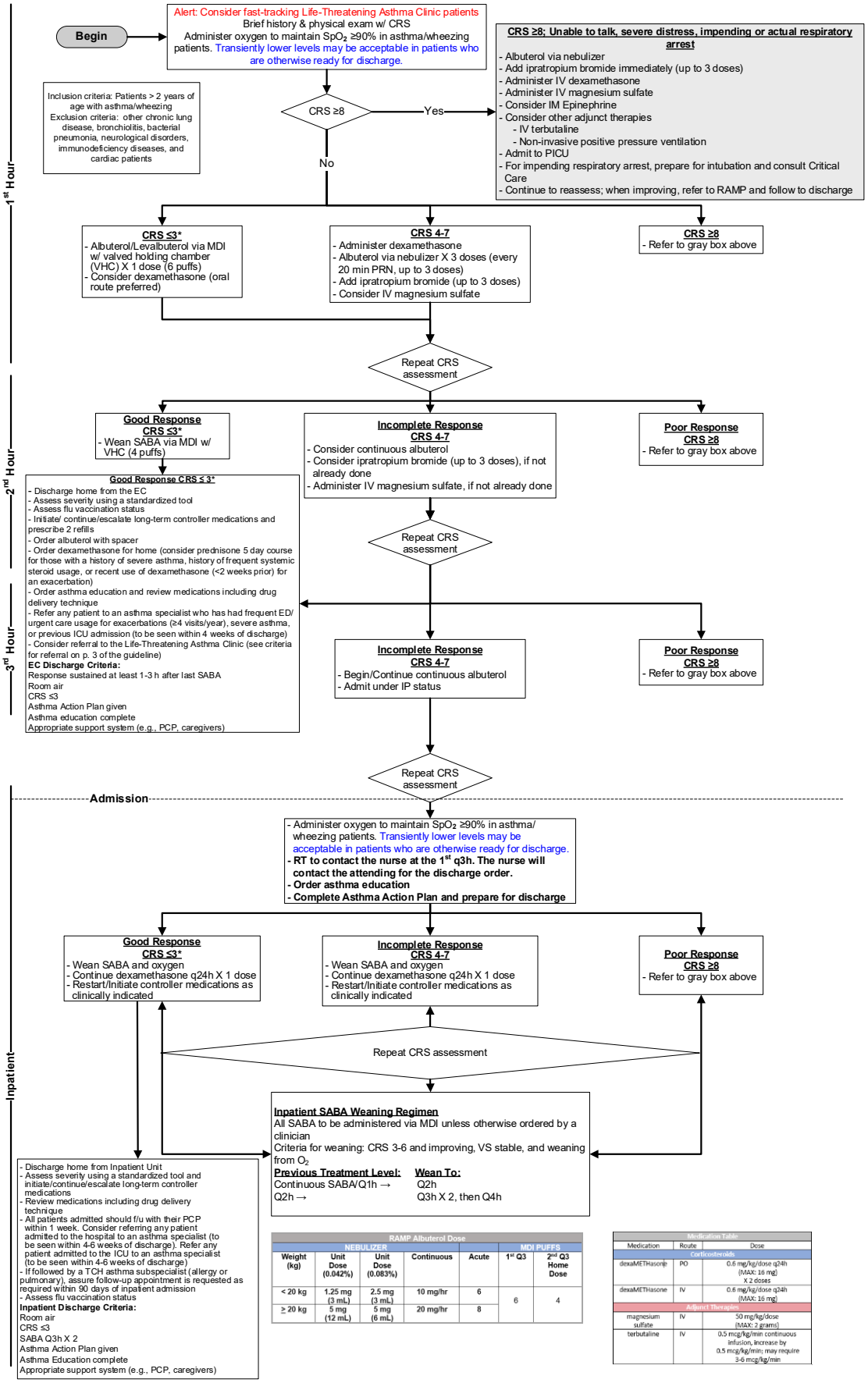
Think about the past 3 months

- **How often did these things happen when your child was feeling his or her best and not having an asthma flare? (check one)**

	Never	Once or twice a month	Once or twice a week	Every other day	Every day	More than once a day
1. Asthma symptoms with running or sports	☐	☐	☐	☐	☐	☐
2. Asthma symptoms while asleep at night	☐	☐	☐	☐	☐	☐
3. He or she needed to take albuterol or other quick-relief medicine for asthma symptoms	☐	☐	☐	☐	☐	☐

Responses in the shaded area above indicate the presence of *persistent asthma* symptoms

RESPIRATORY ASSESSMENT AND MANAGEMENT PROTOCOL (RAMP) for Asthma Patients



Clinical standards are developed for 80% of the patient population with a particular disease. Each practitioner must use his/her clinical judgment in the management of any specific patient.

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Asthma Action Plan

@NAME@'s ASTHMA ACTION PLAN

Know your triggers: Avoid irritants like smoke, infections, and things that you are allergic to.
Remember: WASH MY HANDS and get a FLU SHOT EVERY YEAR in the fall to help avoid infections.
Always use a SPACER with inhalers and rinse your mouth out after using any controller inhaler.
Asthma visits: Even if feeling healthy, I should follow-up at least every six months with my provider.

Green Zone – Medications I should take EVERY DAY to stay healthy:

 **Symptoms** No cough No wheeze No chest tightness	{Green Zone Meds:24665} Call my provider if having regular symptoms or need quick relief medicine more frequently.

Yellow Zone – Take QUICK Relief Medications:

 **Symptoms** Slight cough or wheeze Starting a cold Chest tightness Difficulty breathing	**Inhaler:** albuterol (ProAir/Ventolin/Proventil) or levalbuterol (Xopenex) inhaler with a spacer 4 puffs every 4 hours **Continue taking my controller medication(s).** **CALL MY PROVIDER** if I don't get to the GREEN ZONE after 24 hours.

Red Zone – Take QUICK Relief Medications NOW:

 **Symptoms** Increasing cough Continued wheezing Worsening wheezing Fast breathing	**Inhaler:** albuterol (ProAir/Ventolin/Proventil) or levalbuterol (Xopenex) inhaler with a spacer 6 puffs every 2-3 hours as needed for 9-12 hours **Oral steroid** (if prescribed). **Continue taking my controller medication(s).** **CALL MY PROVIDER NOW OR GO TO THE HOSPITAL.**
 **Symptoms** Breathing very hard/fast Breathing so hard I can't walk or talk Lips or fingertips are blue	**DANGER ZONE – I NEED IMMEDIATE HELP!** QUICK RELIEF medications are not working. CALL 911 or go to nearest Emergency Room. Continue my QUICK RELIEF medicine in the RED ZONE.

My primary care provider is: @PCP@. **Phone number:** @PCPPH@.
Completed by: @ME@.

The Asthma Action Plan is available via Epic in English and Spanish and can be found in Patient Goals, under Clinical Tools (or with the filter through Snapshot). It is accessible by parents and caregivers in MyChart and should be reviewed and refreshed each visit, even if there are no changes to update.

Appendix B. Recommendations for Children <2 Years [3]

The assessment of acute asthma exacerbations in children <2 years can be difficult. The differential diagnosis of symptoms includes aspiration pneumonitis, pneumonia, bronchiolitis, tracheomalacia, and complications of underlying conditions such as congenital anomalies and cystic fibrosis. These children may not respond to the treatment recommendations made in this guideline.

Clinical Standards Preparation

This clinical standard was prepared by the Evidence-Based Outcomes Center (EBOC) team in collaboration with content experts at Texas Children's Hospital. Development of this clinical standard supports the TCH Quality and Patient Safety Program initiative to promote clinical standards and outcomes that build a culture of quality and safety within the organization.

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No relevant financial or intellectual conflicts to report.

Development Process

This clinical standard was developed using the process outlined in the EBOC Manual. The literature appraisal documents the following steps:

1. Review Preparation
   - PICO questions established
   - Evidence search confirmed with content experts

2. Review of Existing External Guidelines
- British Guideline on the Management of Asthma
- GINA Global Strategy for Asthma Management and Prevention
- NAEPP Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma

3. Literature Review of Relevant Evidence
   - Searched: PubMed, Cochrane, Google Scholar

4. Critically Analyze the Evidence
   - 13 systematic reviews/meta-analyses, 36 randomized controlled trials, and 63 nonrandomized studies

5. Summarize the Evidence
   - Materials used in the development of the clinical standard, literature appraisal, and any order sets are maintained in an Acute Asthma Exacerbation evidence-based review manual within EBOC.

Evaluating the Quality of the Evidence

Published clinical guidelines were evaluated for this review using the **AGREE II** criteria. The summary of these guidelines is included in the literature appraisal. AGREE II criteria evaluate Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial Independence using a 4-point Likert scale. The higher the score, the more comprehensive the guideline.
This clinical standard specifically summarizes the evidence *in support of* or *against* specific interventions and identifies where evidence is *lacking/inconclusive*. The following categories describe how research findings provide support for treatment interventions.
"Evidence Supports" provides evidence to support an intervention.
"Evidence Against" provides evidence against an intervention.
"Evidence Lacking/Inconclusive" indicates there is insufficient evidence to support or refute an intervention, and no conclusion can be drawn *from the evidence.*
The **GRADE** criteria were utilized to evaluate the body of evidence used to make practice recommendations. The table below defines how the quality of the evidence is rated and how a strong versus weak recommendation is established. The literature appraisal reflects the critical points of evidence.

Recommendation	
STRONG	Desirable effects clearly outweigh undesirable effects or vice versa
WEAK	Desirable effects closely balanced with undesirable effects
Quality	**Type of Evidence**
High	Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies
Moderate	Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies
Low	Evidence for at least 1 critical outcome from observational studies, RCTs with serious flaws or indirect evidence
Very Low	Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence

Recommendations

Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible. The Content Expert Team and EBOC team remain aware of the controversies in the diagnosis/management of Acute Asthma Exacerbation in children. When evidence is lacking, options in care are provided in the clinical standard and the accompanying order sets (if applicable).

Approval Process

Clinical standards are reviewed and approved by hospital committees as deemed appropriate for its intended use. Clinical standards are reviewed as necessary within EBOC at Texas Children's Hospital. Content experts are involved with every review and update.

Disclaimer

Practice recommendations are based upon the evidence available at the time the clinical standard was developed. Clinical standards (guidelines, summaries, or pathways) do not set out the standard of care and are not intended to be used to dictate a course of care. Each physician/practitioner should use his or her independent judgment in the management of any specific patient and is

responsible, in consultation with the patient and/or the patient's family, to make the ultimate judgment regarding care.

Permission of Use

Version History

Date	Comments
Nov 2009	Originally completed
Jan 2014	Updated
Jan 2017	Revised
Jan 2019	Updated recommendations on steroids, revised verbiage for referrals, and added recommendation on magnesium dosing. Revised RAMP to reflect a 'maximum' wean of q4h albuterol dosing versus PRN albuterol dosing. Reaffirmed all other practice recommendations.
Dec 2025	Updated recommendation regarding magnesium sulfate, added PICO question regarding use of high flow nasal cannula, archived PICO questions during literature review phase, added RAMP albuterol dosing to algorithm, revised inpatient SABA weaning regimen, reaffirmed practice recommendations, and adopted recommendation from the Bronchiolitis Guideline on pulse oximetry accuracy.