Asthma Clinical Pathway
Emergency Department

Nationwide Children's — When your child needs a hospital, everything matters.

Center for Clinical Excellence

Phase 1
1st hour

(LPIP) or provider order

Use ED Asthma Order Set

If transfer or already received 3 duoneb treatments skip to Phase 2 / 2nd hour

Age ≥ 2 years?

No → **See Algorithm for age 12-23 months**

Yes

Document Pretreatment
Asthma Clinical Score (ACS)

ACS 2-4

Albuterol MDI
+
Steroid PO

ACS 5-7

Duoneb aerosol q 20 minutes x 3 PRN via Aerogen until ACS ≤ 2
+
Steroid PO

Consider duoneb burst if SpO2 < 92%

ACS 8-13

- Raise head of bed
- Steroid PO/IV
- Duoneb aerosol q 20 min x 3 PRN via Aerogen until ACS ≤ 2 **(or** Duoneb burst if SpO2 < 92%)
- Consider IM epinephrine
- Consider IV Magnesium sulfate
- Consider NIPPV

Repeat ACS

Phase 2
2nd hour

ACS ≤ 2

SpO2 > 90% on room air

Discharge home with prescription for steroids and albuterol home pack

ACS 3-4

Albuterol aerosol q 20 minutes x 3 PRN via Aerogen until ACS ≤ 2

Consider albuterol burst if SpO2 < 92%

ACS ≥ 5

Albuterol aerosol q 20 minutes x 3 PRN via Aerogen until ACS ≤ 2 (or Albuterol burst if SpO2 < 92%)

+ IV Magnesium sulfate

Repeat ACS

Phase 3
3rd hour

ACS ≤ 2

SpO2 > 90% on room air

Consider 45-60 minutes of observation

ACS 3-5

45-60 minutes observation

ACS ≥ 6

Continuous Albuterol
Determine Floor Eligibility
Admission to PICU
Consider NiPPV

Repeat ACS

Phase 4
4th hour

ACS ≤ 2

SpO2 > 90% on room air

Discharge home with prescription for steroids and albuterol home pack

ACS 3-5

Admit to Hospital Pediatrics **or** Pulmonary for q 2 Albuterol

ACS ≥ 6

Continuous Albuterol
Determine Floor Eligibility
Admission to PICU
Consider NiPPV

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Emergency Department

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1st hour

Use ED Asthma Order Set

If transfer or already received 3 duoneb treatments skip to Phase 2 / 2nd hour

Age 12-23 months

No → **See Algorithm for age ≥ 2 years**

Yes

Document Pretreatment
Asthma Clinical Score (ACS)

Aerogen not approved for patients < 2 years of age

ACS 2-4

Albuterol inhaler
+
Steroid PO

ACS 5-7

High dose Albuterol inhaler OR
Duoneb burst
+
Steroid PO

ACS 8-13

- Raise head of bed
- Steroid PO/IV
- Duoneb burst
- Consider IM Epinephrine
- Consider IV Magnesium sulfate
- Consider NIPPV

2nd hour

Repeat ACS with up to 1 hour of observation

ACS ≤ 2

SpO2 > 90% on room air

Discharge home with prescription for steroids and albuterol home pack

ACS 3-4

High dose Albuterol inhaler
OR Albuterol burst
OR Duoneb burst

ACS ≥ 5

Albuterol burst
+
IV Magnesium sulfate

3rd hour

Repeat ACS with up to 1 hour of observation

ACS ≤ 2

SpO2 > 90% on room air

Consider 45-60 minutes of observation

ACS 3-5

45-60 minutes observation

ACS ≥ 6

Continuous Albuterol
Admission to PICU
Consider NiPPV

4th hour

Repeat ACS

ACS ≤ 2

SpO2 > 90% on room air

Discharge home with prescription for steroids and albuterol home pack

ACS 3-5

Admit to Hospital Pediatrics **or** Pulmonary for
q 2 Albuterol

ACS ≥ 6

Continuous Albuterol
Admission to PICU
Consider NiPPV

Inclusion and Exclusion Criteria

Inclusion criteria

- Patient 1-18 years of age with acute exacerbation of known asthma or with a presentation for which asthma is the most likely diagnosis

Exclusion criteria

- Patients with another primary diagnosis including bronchiolitis or croup
- Patient with a chronic lung disease other than asthma including cystic fibrosis or restrictive lung disease
- Patients diagnosed with congenital or acquired heart disease
- Patients requiring chronic invasive or non-invasive airway support
- Immunocompromised patients
- Patients diagnosed with sickle cell anemia

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Definition & Diagnosis

- Clinicians should diagnose an asthma exacerbation on the basis of history and physical examination.
- A typical presentation of an asthma exacerbation is characterized by acute or subacute episodes of progressively worsening shortness of breath, cough, wheezing, chest tightness, or some combination of these symptoms caused by decreases in expiratory airflow in a patient with known asthma
- In a patient without a previous diagnosis of asthma, an asthma exacerbation is more likely in a patient with:
  - Recurrent wheezing and/or chronic cough
  - Prior bronchodilator or corticosteroid use
  - Past medical history of eczema or food/environmental allergies
  - Family history of asthma, eczema or allergies

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Differential Diagnoses

Acute

- Bronchiolitis
- Pneumonia
- Foreign body

Chronic

- Vocal cord dysfunction
- Anatomic anomalies such as: vascular rings, laryngeal web
- Laryngotracheomalacia
- CF

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Asthma Clinical Score

Scoring Key (Maximum score is “13”)	0	1	2	3	4
Tachypnea *(see reference)*	No	Yes			
O2 Requirement to keep SaO2 ≥ 92%	RA	≤ 2 liters/31%	> 2 liters/31% ≤ 4 liters/50%	> 4 liters/50%	
Wheezing	None	End expiratory or scattered wheeze	Expiratory wheeze throughout	Inspiratory and expiratory wheeze	“Silent chest” (no air movement)
Air Movement	Normal/Good	Fair	Tight	Silent	
Retractions *(see references)*	None	One type of retraction	Two or more types of retractions		

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Bronchodilator Options

	Meter Dose Inhaler (MDI)	High Dose MDI (patients <2 yo)	3 BTB Duoneb/ Albuterol (Aerogen)	Duoneb Burst	Albuterol Burst
< 15 kg	4 puffs	4 puff q20 min x3 (max dose = 12 puffs)	1 neb q20 min PRN x3 doses (max dose = 9mL)	3 duoneb + 1 albuterol neb	4 albuterol neb
≥ 15 kg	8 puffs	8 puff q20 min x3 (max dose = 24 puffs)	1 neb q20 min PRN x3 doses (max dose = 9mL)	3 duoneb + 3 albuterol neb	6 albuterol neb

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Recommended Treatments

Oxygen is recommended for most patients.
Administer supplemental oxygen (by nasal cannula or mask, whichever is best tolerated) to maintain an SaO2 >92 percent *(1,2)*

Short-acting-beta-agonist (SABA) treatment is recommended for all patients.
In the emergency department (ED), three treatments of SABA spaced every 20 minutes or continuously over 1 hour can be given safely as initial therapy. Thereafter, the frequency of administration varies according to the improvement in airflow obstruction, associated symptoms, and the occurrence of side effects. Continuous administration of SABA may be more effective in more severely obstructed patients. Continuous albuterol can be given as a 1-hour albuterol (15mg if >15kg, 10mg if <15kg) burst in the ED followed by reassessment and repeat ACS scoring. In mild or moderate exacerbations, equivalent bronchodilation can be achieved either by high doses (4–12 puffs) of a SABA by MDI and spacer in infants, children, and adults under the supervision of trained personnel or by nebulizer therapy. However, nebulizer therapy may be preferred for patients who are unable to cooperate effectively in using an MDI because of their age, agitation, or severity of the exacerbation (1, 2).

Short-acting-beta-agonist (SABA) via Vibrating Mesh Nebulizer (i.e., Aerogen)
The Vibrating Mesh Nebulizer (VMN) is an alternative method of administering nebulized SABA and has been approved for use in patients who are ≥ 2 years of age. The VMN delivers better particle size for increased medication deposition into the lungs (3). Previous studies have shown that use of the VMN in acute asthma exacerbations are associated with decreased dosage of albuterol to reach mild asthma score, decrease ED length of stay and decrease relative admission rates (4,5). Three treatments of SABA can be administered every 20 min PRN for a max of 3 doses each hour for moderate to severe exacerbations. Burst treatments or continuous albuterol cannot be administered via the VMN.

Ipratropium bromide
In the emergency department, adding 3 doses of ipratropium bromide (0.5 mg nebulizer solution or 8 puffs by MDI in adults; 0.25–0.5 mg nebulizer solution or 4–8 puffs by MDI in children) to a selective SABA produces additional bronchodilation, and results in fewer hospital admissions, particularly in patients who have severe airflow obstruction (2).

Systemic corticosteroids are recommended for most patients in the emergency department (ED)
Administration of steroids within the first hour has shown to reduce hospitalization rates in children with acute asthma (6). Give Prednisone/prednisolone 2 mg/kg PO q day, Max: 60 mg for 5 days or Dexamethasone 0.6mg/kg PO x Q day x 2 doses. There is no difference in relapse rate between dexamethasone and prednisone/prednisolone. Dexamethasone has some advantages over prednisone/prednisolone including palatability, cost, and decreased frequency of administration. Oral administration of prednisone has been shown to have effects equivalent to those of intravenous methylprednisolone and is usually preferred because it is less invasive. Give a total of 5 day course of prednisone/prednisolone or a total of 2 day course of dexamethasone following ED discharge to prevent early relapse. Give supplemental doses of oral corticosteroids to patients who take them regularly, even if the exacerbation is mild (1,2,7).

Intravenous Magnesium Sulfate
Give magnesium sulfate 2 grams in adults and 25–75 mg/kg x 1(max: 2 grams) IV to children with a moderate or severe asthma exacerbation not adequately responding to albuterol and a systemic steroid. Studies of both children and adults show magnesium sulfate IV added to conventional therapy is safe and may reduce symptoms and hospital admission rates (8). *The efficacy of IV magnesium sulfate in asthma has not been studied in children <2 years of age and the number of children <2 years of age with wheezing in the safety study is very low.*

Heliox
Consider heliox-driven albuterol nebulization for patients who have life-threatening exacerbations and for those patients whose exacerbations remain in the severe category after 1 hour of intensive conventional therapy (1,2).

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Treatments Not Recommended

Antibiotics are not generally recommended for the treatment of acute asthma exacerbations except as needed for comorbid conditions. Bacterial, Chlamydia, or Mycoplasma infections infrequently contribute to exacerbations of asthma therefore, the use of antibiotics is generally reserved for patients who have fever and purulent sputum and for patients who have evidence of pneumonia. When the presence of bacterial sinusitis is strongly suspected, treat with antibiotics (1).

Aggressive hydration is not recommended for older children and adults but may be indicated for some infants and young children with increased respiratory rate and decreased oral intake. In these patients, clinicians should make an assessment of fluid status (urine output, urine specific gravity, mucus membrane moisture, electrolytes) and provide appropriate corrections. Oral routes of hydration are preferable except in very severe exacerbations with the possibility of endotracheal intubation (1).

Chest physiotherapy is not generally recommended. For most exacerbations, chest physiotherapy is not beneficial and is unnecessarily stressful for the breathless asthma patient. Because mucus plugging is a major contributing cause of fatal asthma further studies are needed on the role of improved airway clearance in near-fatal exacerbations (1).

Mucolytics are not recommended because they may worsen cough or airflow obstruction (1).

Aerogen administration of albuterol in patients < 2 years of age is not recommended. Additionally, burst treatments or continuous albuterol cannot be administered via the VMN.

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Discharge

- Prescription for steroids
- Albuterol home pack
- Follow-up with Primary Care Physician within the next week

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References

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Metrics

Goal:
To appropriately determine asthma severity and provide optimal treatments while minimizing emergency department length of stay.

Process measure:
- Order set utilization
- Discharge smart set utilization

Outcome measures:
- Percent of patients presenting with asthma exacerbations who receive steroids in the ED
- Percent of patients who receive steroids within 60 min
- Time to disposition
- ED Length of Stay

Balancing Measure:
- 48 hour return to ED rate

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Team & Process

Content Development Team:

Leaders:

Emergency Medicine:
Adjoa Andoh, MD

Members:

Emergency Medicine:
Gregory Stewart, MD
Berkeley Bennet, MD, MS
Laura Rust, MD, MPH
Amberly Masa, RN
Vicky Smeltzer, RN
Barb Abdalla, RN

Pulmonary:
Lisa Ulrich, MD

Hospital Pediatrics:
Cara Harasaki, MD
Hilary Lin, MD
Gerd McGwire, MD
Mathew Suer, MD
Gabriella Gonzales, MD
Rachel Thompson, MD
Guillermo Yepes Junquera, MD

Respiratory Care:
Gloria Ayres, RN
Laura Evans, RRT
Courtney Whitcare, RRT

Pharmacy:
Kimberly Jones, PharmD

Quality Consultant:
Charles Hardy, MHA, CPHQ- QIS

Clinical Pathways Program:

Medical Director – Emergency Medicine:
Berkeley Bennett, MD, MS

Medical Director – Clinical Informatics & Emergency Medicine:
Laura Rust, MD, MPH

Physician Informatics:
Kathy Nuss, MD
Juan D. Chaparro, MD

Business & Development Manager:
Rekha Voruganti, MBOE, LSSBB

Program Coordinators:
Tahje Brown, MBA
Tara Dinh, BS

Clinical Pathway Approved:

Medical Director – Associate Chief Quality Officer, Center for Clinical Excellence:
Ryan Bode, MD, MBOE

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Clinical Pathway Development

This clinical pathway was developed using the process described in the NCH Clinical Pathway Development Manual Version 6, 2022. Clinical Pathways at Nationwide Children's Hospital (NCH) are standards which provide general guidance to clinicians. Patient choice, clinician judgment, and other relevant factors in diagnosing and treating patients remain central to the selection of diagnostic tests and therapy. The ordering provider assumes all risks associates with care decisions. NCH assumes no responsibility for any adverse consequences, errors, or omissions that may arise from the use or reliance on these guidelines. NCH's clinical pathways are reviewed periodically for consistency with new evidence; however, new developments may not be represented, and NCH makes no guarantees, representations, or warranties with respect to the information provided in this clinical pathway.

For more information about our pathways and program please contact:
ClinicalPathways@NationwideChildrens.org

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MCED Continuous Albuterol
Process for Bedside Handover to Hospital Pediatrics

ED Asthma Clinical Pathway

Main Campus Emergency Department (MCED) patient with asthma exacerbation who requires continuous albuterol

Patient meets Criteria for Floor Continuous Albuterol Protocol ?

No → Consider admission to PICU

Yes

ED pages the Safety Officer of the Day (SOD) or Pulmonologist on call to request admission to Hospital Pediatrics or Pulmonary Service on Asthma Clinical Pathway and Continuous Albuterol (Max 6 patients on continuous albuterol (4 on H8A and 2 on H9A))

ED to place **bed request** for Hospital Pediatrics or Pulmonary

Bed assigned by PCTC or Patient Placement in conjunction with H8A or H9A Charge RN

H8A or H9A Charge RN notifies **Senior Resident/APN**

In person evaluation by charge RN and/or charge RT & senior resident/attending +/- SOD **within 30 minutes** of receiving the admission notification

Senior Resident/APN calls for sign-out **and** arranges to meet ED team for direct handoff

Any concerns over stability or suitability for the floor must be reconciled by the Primary Attending or SOD along with ED Attending.

"Care Complete" if the following criteria are met:

- Patient demonstrates >90 minutes of improvement/stability after Continuous albuterol initiation **AND**
- The floor physician and RN have completed bedside evaluation and communicated acceptance to ED physician team.

Continuous Albuterol Floor Protocol

(aka Level 3 care)

Asthma Pathway - Continuous Albuterol Floor Protocol

Hospital Pediatrics and Pulmonary Service, H8A and H9A units

Inclusion Criteria

- Patient must have primary condition of asthma exacerbation with no exclusion criteria as below
- Patient must be between 2 - 18 years of age
- No more than 4 patients on H8A and 2 on H9A on continuous albuterol. “Safety Officer of the Day”(SOD) or Pulmonologist on call, along with Respiratory Therapy, will ensure that no more than 6 patients are on continuous albuterol at any one time.
- **Admission from MCED** of stable or improving asthma pathway patient on continuous albuterol for >45 minutes and with ACS stable or decreasing at time of bedside handover

Exclusion Criteria

- Age <2 or >18 yrs
- Patients in severe respiratory failure (PPV requirement, altered mental status, bradycardia, poor perfusion)
- FiO_2 requirement ≥50%
- MCED patient that received epinephrine, ketamine or continuous magnesium.
- Known concurrent bacterial pneumonia
- Patients with significant comorbidities (cardiac, pulmonary, or neuromuscular disease, craniofacial abnormalities, immunodeficiency)

Continuous Albuterol Floor Protocol

Initiation

- **Admission from MCED**
    - The following criteria should be followed as closely as possible when accepting potential ED Admission:
        - > 45 minutes stability on continuous albuterol per ED provider assessment
        - ACS stable or decreasing at time of bedside handover
        - Meeting all other inclusion/exclusion criteria including:
            - No magnesium drip
            - No active sedation
            - Did not receive Epinephrine or Ketamine
        - Communication/agreement by Safety Officer/Hospital Pediatrics attending or Pulmonologist on call, admit senior resident/APN, accepting unit charge nurse and RT.