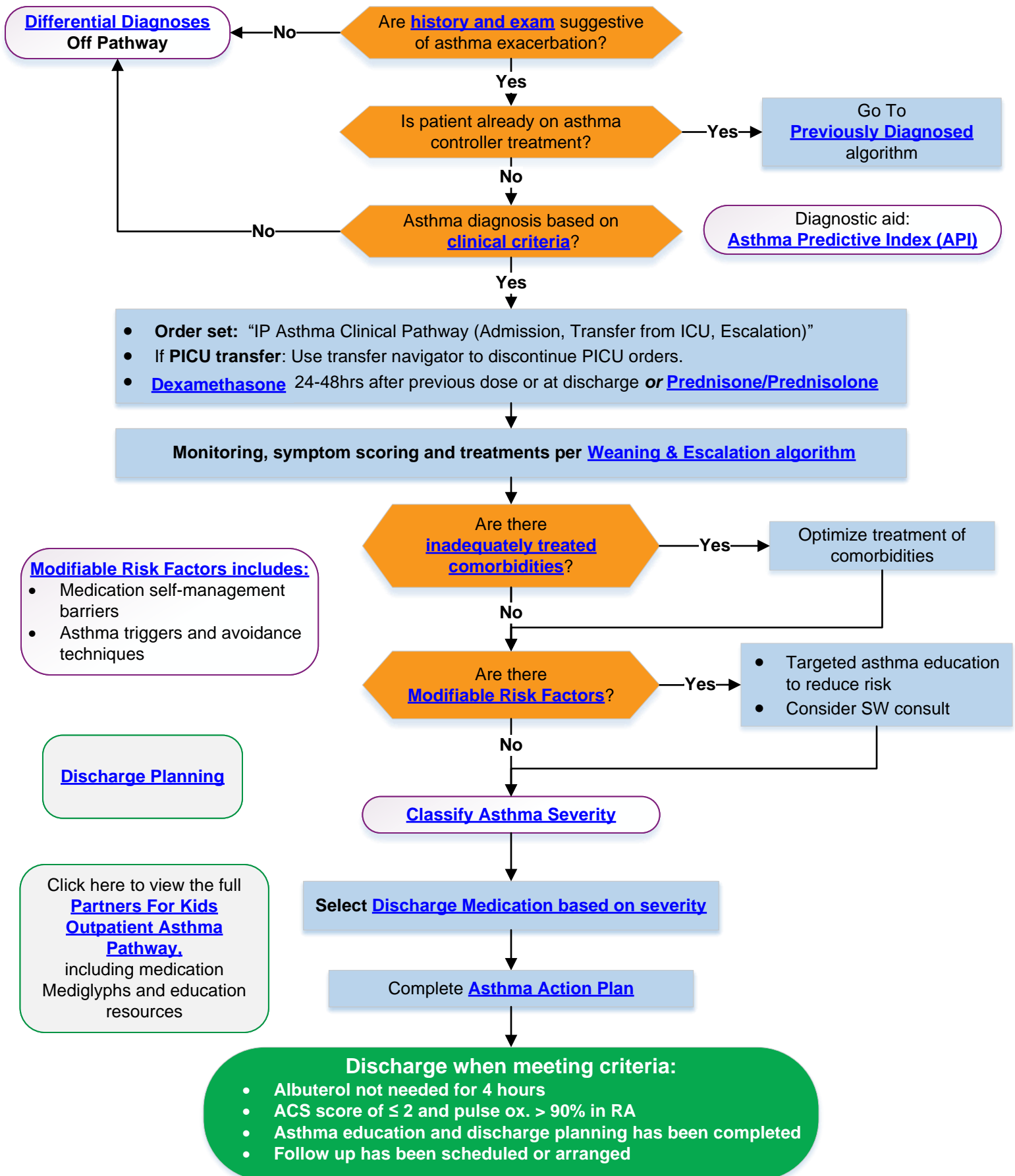


# Asthma Exacerbation

## New asthma diagnosis

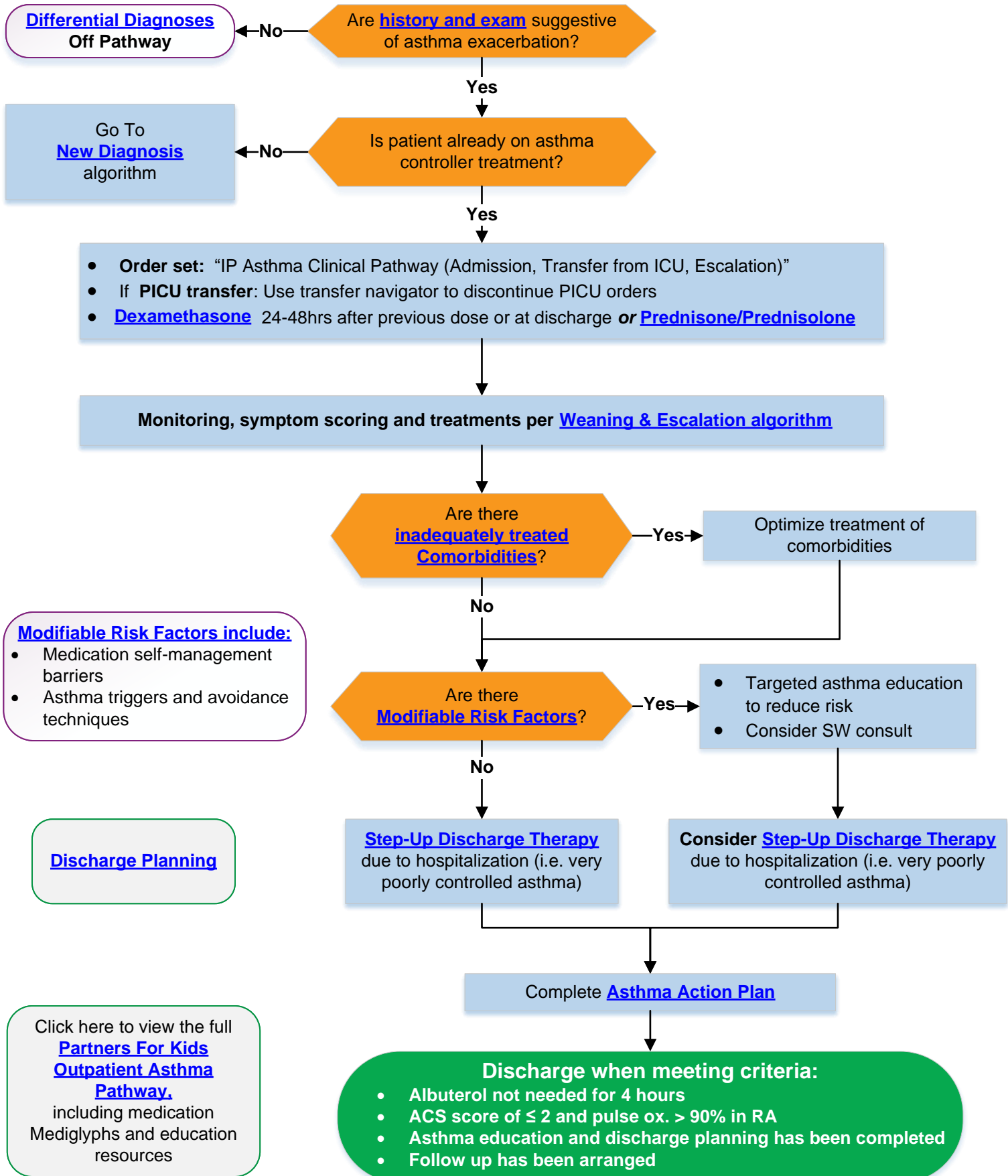
### Inpatient



# Asthma Exacerbation

## Previous asthma diagnosis

### Inpatient





**NATIONWIDE  
CHILDREN'S**

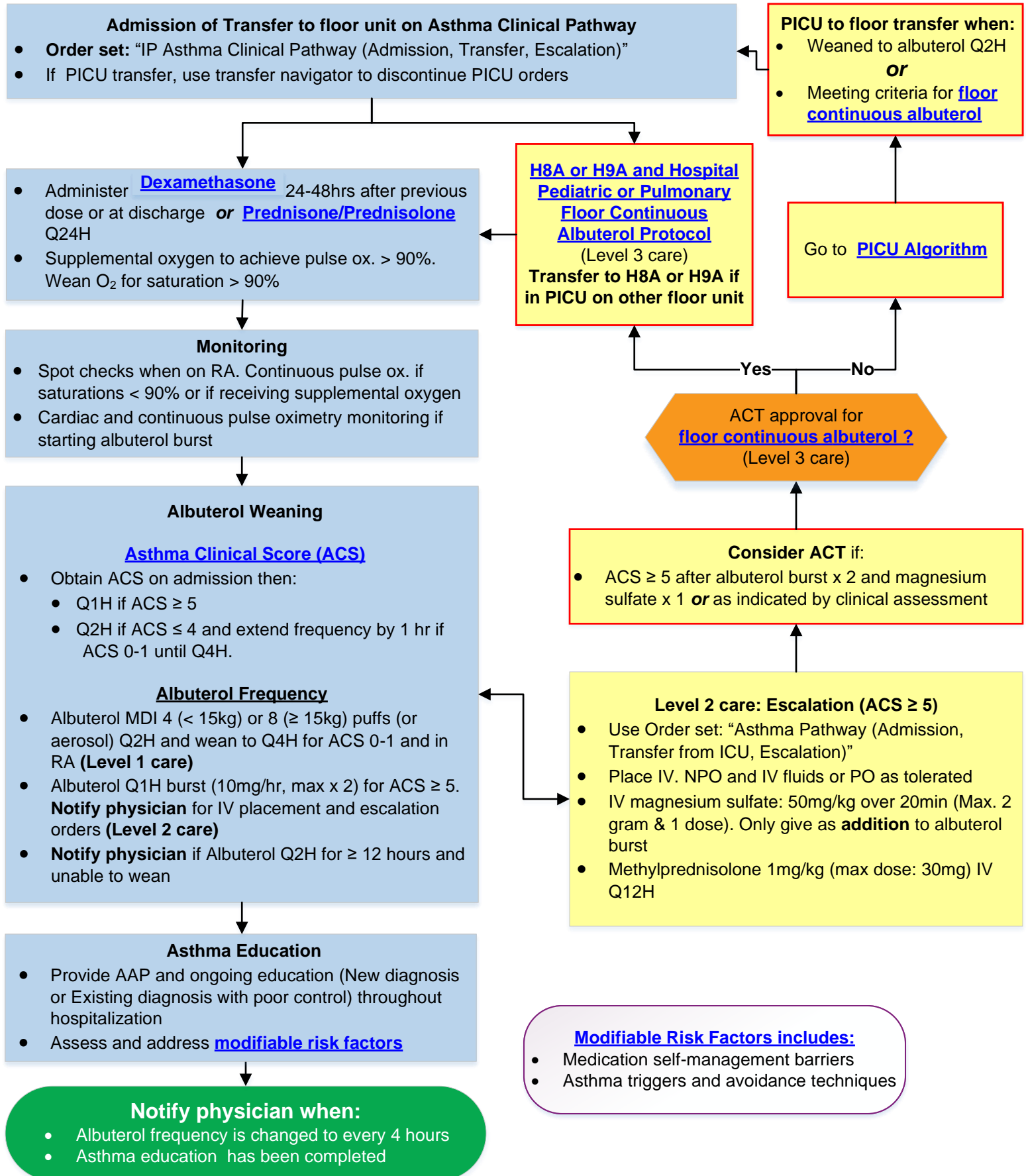
*When your child needs a hospital, everything matters.*

# Asthma Exacerbation

## Weaning & Escalation

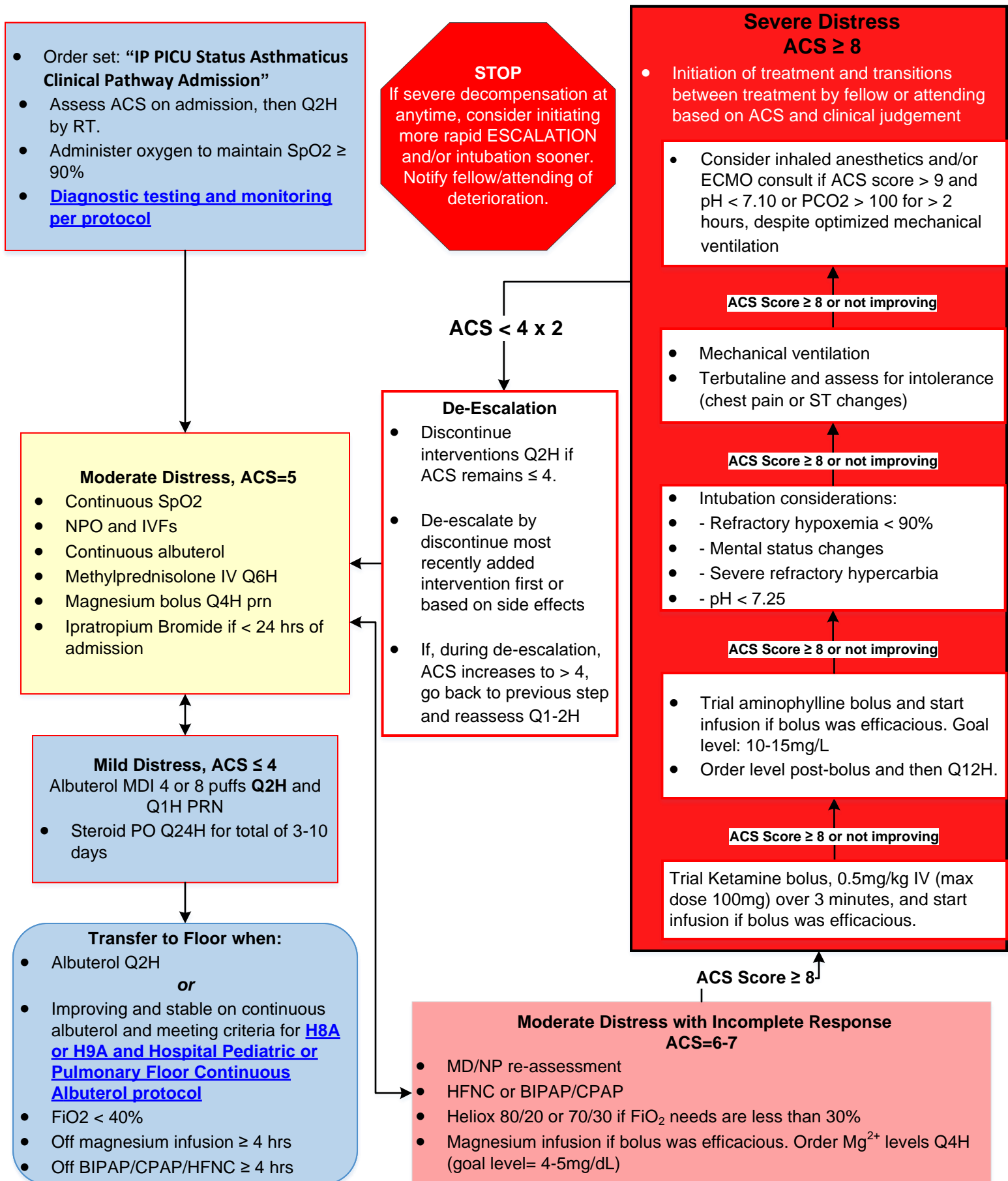
### Inpatient

**Center for  
Clinical Excellence**



# Asthma Exacerbation

## PICU



# Inclusion & Exclusion Criteria

## Inclusion Criteria

- Patient  $\geq 1$  year 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 pneumonia, bronchiolitis, or croup
- Patient with a chronic lung disease other than asthma including cystic fibrosis, restrictive lung disease or bronchopulmonary dysplasia
- 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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# Asthma Exacerbation

## Symptoms & Physical Exam

### Symptoms

- Acute or subacute decrease in expiratory airflow, presenting as progressively worsening:
  - Shortness of breath
  - Cough
  - Wheezing
  - Chest tightness
  - Sputum production

Or some combination of these symptoms

### Physical Exam

- **Upper respiratory tract:**
  - Increased nasal secretion, mucosal swelling, and/or nasal polyp
- **Chest**
  - Wheezing during normal breathing or prolonged phase of forced exhalation
  - Hyper-expansion of the thorax
  - Use of accessory muscles
  - Appearance of hunched shoulders, chest deformity
- **Skin**
  - Atopic dermatitis
  - Eczema

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# Asthma Clinical Score (ACS)

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

## Asthma Exacerbation Severity

- Mild Respiratory distress (ACS ≤ 4)
- Moderate Respiratory distress (ACS 5 – 9)
- Severe Respiratory distress (ACS ≥ 10)

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# Diagnosis Clinical Criteria

## To establish a diagnosis of asthma, the following should be determined:

- **Episodic symptoms** of airflow obstruction or airway hyper-responsiveness are present.
- Airflow obstruction is at least partially **reversible**.
- Alternative diagnoses are excluded.

- [\*\*Asthma Predictive Index \(API and mAPI\):\*\*](#)

- **Major criteria:** Parental history of asthma, MD diagnosed eczema, aeroallergen sensitization
- **Minor criteria:** wheezing without colds, food allergy (egg/peanut/milk) or eosinophilia

## History

- Frequency of early wheeze ( $\leq 3$  yrs) is the most important predictor of asthma (at school age)
- Symptoms worse at night
- Symptoms triggered by exercise, viral infection, animals with fur, house-dust mites (in mattresses, pillows, upholstered furniture, carpets), mold, smoke (tobacco, wood), pollen, changes in weather, strong emotional expression (laughing or crying hard), airborne chemicals or dusts, menstrual cycles

## Physical Exam

- Lung exam with airflow obstruction, commonly expiratory wheezing
- Signs of atopy including eczema

## Spirometry

- To demonstrate obstruction and assess reversibility (5 years of age or older).

(EPR-2 1997 and EPR-3 2008)

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# New Diagnosis - Asthma Predictive Index (API)

## How to use:

- Clinicians may be more aggressive with **trials of asthma medications** in patients who are likely to be diagnosed with asthma later in life.
- The [Asthma Predictive Index \(API\)](#) provides a method for predicting likelihood of a later diagnosis of asthma.
- Applies to children  $\leq 3$  years old
- [Modified Asthma Predictive Index \(mAPI\)](#) applies to children  $\leq 3$  years with 4 or more wheezing episodes

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# Differential Diagnoses

## **Acute:**

- Bronchiolitis
- Pneumonia
- Foreign body

## **Chronic:**

- Vocal cord dysfunction
- Anatomic anomalies such as: vascular rings, laryngeal web
- Laryngotracheomalacia
- Cystic fibrosis
- Aspiration

## **Upper airway disease**

- Allergic rhinitis and sinusitis

## **Obstruction involving large airways**

- Foreign body in trachea or bronchus
- Vocal cord dysfunction
- Vascular ring or laryngeal web
- Laryngotracheomalacia, tracheal stenosis, or bronchostenosis
- Enlarged lymph nodes or tumor

## **Obstruction involving small airways**

- Viral bronchiolitis or obliterative bronchiolitis
- Cystic fibrosis
- Bronchopulmonary dysplasia
- Heart disease

## **Other Causes**

- Recurrent cough not due to asthma
- Aspiration from swallowing mechanism dysfunction or gastroesophageal reflux

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# Oral Corticosteroids

Drug	Strength	Dose, Frequency and Duration*	Maximum Daily Dose	Clinical Considerations
<b>Dexamethasone</b>	Tablets: 0.5mg, 0.75mg, 1mg, 1.5mg, 2mg, 4mg, 6mg	0.6 mg/kg Once, then repeat in 24-48 hrs	16 mg/day	Tablets can be crushed and mixed in liquid/ semisolid foods
	Oral Liquid: <b>IV for oral use:</b> 1mg/mL, 4mg/mL, 10mg/mL			IV for oral is product used at NCH
	<b>Elixir/oral</b> solution: 0.5mg/mL, 1mg/mL			Most Commercial products contain alcohol
	IV/IM: 4mg/mL, 10mg/mL			
<b>Orapred® Prednisone</b>	Liquid: 15mg/5mL	2 mg/kg <b>Daily</b> for 5 days	60 mg/day	Take with food  Solution does NOT contain alcohol
	ODT: 10mg, 15mg, 30mg			
	Tablet: 5mg			
<b>Delatasone® Prednisone</b>	Liquid: 5mg/mL	2 mg/kg <b>Daily</b> for 5 days	60 mg/day	Take with food  Solution contains alcohol (5%)
	Tablets: 1mg, 2.5mg, 5mg, 10mg, 20mg, 50mg			

\* Duration of 5 days is average and typical duration. Treatment may be shorter or longer depending on patient.  
Range 3-10 days of treatment. Do not need to taper due to short course.

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# New Diagnosis - Asthma Severity

## Classification of Asthma Severity: Clinical Features **before** Treatment (Modeled after NHLBI Guidelines)

	Intermittent	Mild Persistent	Moderate Persistent	Severe Persistent
<b>Daytime symptoms</b>	≤ 2 days/week	> 2 days/week	Daily	Throughout the day
<b>Nighttime symptoms*</b>	≤ 2 times/month	3 – 4 times/month	> 1 time/week	Nightly
<b>Rescue inhaler use</b>	≤ 2 days/week	> 2 days/week	Daily	Several times a day
<b>Exercise or Physical Activity Limitation</b>	None	Minor	Some	Extremely
<b>FEV1</b>	>80%	>80%	60 – 80%	<60%
<b>FEV1/FVC</b>	>85%	>80%	75 – 80%	<75%
<b>“Risk”</b>	0 – 1 oral steroids/year	> 2 oral steroids per year ( <i>can be any persistent severity</i> )		

\*Frequency of nighttime symptoms for **0-4 year olds** are classified differently compared to older patients:  
Intermittent: 0/month | Mild Persistent: 1-2/month | Moderate Persistent: 3-4/month | Severe Persistent: >1x/week

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# Modifiable Risk Factors

## Medication self-management barriers

- Poor controller adherence
- Lack of understanding of inhaler technique
- Poor understanding of asthma action plan
- Unable to access medication at the pharmacy
- Unable to obtain spacer

## Asthma triggers

- Seasonal/environmental allergens
- [Tobacco smoke](#) (including vaping, second or third hand exposure)
- Mold
- Cockroaches
- Rodents
- Chemical exposures (e.g. incense)

[Consider referral to asthma express](#)

[Consider referral to school based asthma therapy \(SBAT\)](#)

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# Tobacco Smoke

## Smoking makes asthma worse!

- Studies show caregivers are more likely to make a change if tobacco cessation counseling occurs during an inpatient hospitalization
- Document smoke exposure for all patients with asthma
- Provide the phone number for the Ohio Tobacco Quit Line in the AVS where parents can receive additional counseling and nicotine replacement therapy

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# Asthma Comorbidities

## **Allergic Bronchopulmonary Aspergillosis**

- Consider Pulmonary consult or referral

## **Allergic Conditions (ex Allergic rhinitis)**

- Consider referral to Allergy

## **Gastroesophageal reflux**

- Consider PPI
- Consider GI or Pulmonary referral

## **Obesity**

- Consider nutrition consult
- Consider referral to Healthy Weight & Nutrition Clinic

## **Obstructive Sleep Apnea**

- Consider ENT referral

## **Rhinitis/sinusitis**

- Consider nasal steroid
- Consider ENT referral

## **Chronic stress/depression**

- Consider SW or psychiatry consult
- Consider referral to outpatient BH resources and follow up

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# Testing

- Laboratory studies are not recommended in patients with an uncomplicated asthma exacerbation
- Chest x ray is not recommended in patients with an uncomplicated asthma exacerbation

*EPR-3 2008)*

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# PICU

## Testing & Monitoring

### Monitoring:

- Continuous pulse oximetry, cardiac monitoring
- Oxygen to maintain SpO2 > 92%

### Diet:

- NPO and IVFs, Strict I/O, Bedrest

### Labs:

- ABG, BMP, Mg level, lactate. Troponin if chest pain.
- Order gases Q1H until pH > 7.25

### Imaging:

- Order CXR qam and prn if clinical change concerning for pneumothorax

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# Recommended Treatments

- **Oxygen** (by nasal cannula or mask, whichever is best tolerated) to maintain an SaO<sub>2</sub> > 90 percent.
- **SABA** treatment is recommended for all patients. In the ED, three treatments of SABA spaced every 20–30 minutes can be given safely as initial therapy. Thereafter, the frequency of administration varies according to the improvement in airflow obstruction and 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 hr albuterol (15mg if > 15kg, 10mg if < 15kg) Burst in the ED or on the Med/Surg floor, 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.

- **Systemic corticosteroids** are recommended for most patients.

**In the hospital:** Give Prednisone/prednisolone 2mg/kg PO qday, (Max: 60mg) for 5 days. There is no known advantage for higher doses of corticosteroids in severe asthma exacerbations, nor is there any advantage for intravenous administration over oral therapy provided gastrointestinal transit time or absorption is not impaired. The total course of systemic corticosteroids for an asthma exacerbation requiring an ED visit or hospitalization may last from 3-10 days. For corticosteroid courses of less than 1 week, there is no need to taper the dose. For slightly longer courses (e.g., up to 10 days), there probably is no need to taper, especially if patients are concurrently taking ICSs.

Dexamethasone 0.6mg/kg PO, (Max: 16mg) x 2 doses have equivalent efficacy to prednisone/prednisolone in children hospitalized with asthma.

- **Magnesium sulfate iv**

Give magnesium sulfate 2g in adults and 25-75 mg/kg x 1 (max: 2g) 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, reduces symptoms and hospital admission rates. The efficacy of iv magnesium sulfate in asthma has not been studied in children < 2 years of age and the number of children < 2 year 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.

*EPR-3 Guideline.*

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# Treatments Not Recommended

- **Ipratropium bromide**  
**In the hospital:** not recommended. Two controlled clinical trials failed to detect a significant benefit from the addition of ipratropium to treatment after hospitalization for severe acute asthma.
- **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.
- **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.
- **Chest physical therapy** 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.
- **Mucolytics** are not recommended because they may worsen cough or airflow obstruction.

*EPR-3 Guideline*

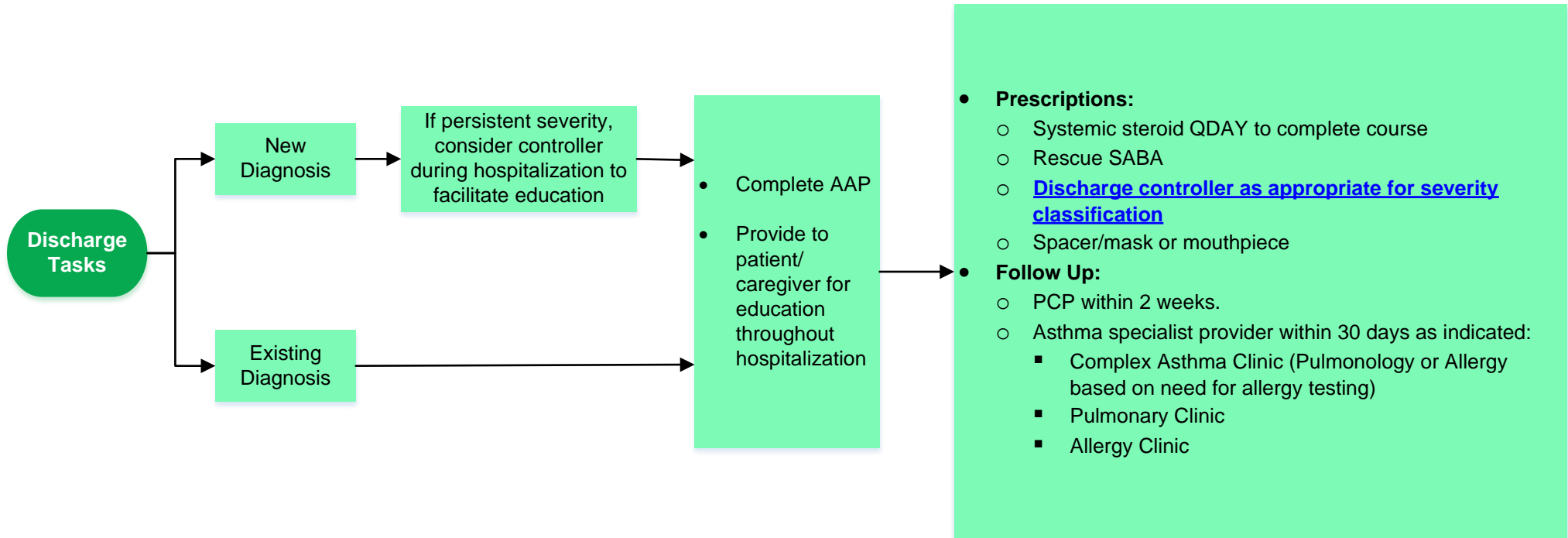
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# Discharge Planning



Patient's  
Home

**Discharge**

Yes

SABA 2-4 puffs Q4H for 24-48hrs based on exacerbation severity, then home management per Asthma Action Plan

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# Discharge Medication Options

Click here to view the full [Partners For Kids Outpatient Asthma Pathway](#), including medication Mediglyphs and education resources

For Step 2-6 only daily controller medications are shown. As needed albuterol should also be prescribed for these patients if not using ICS-Formoterol as [SMART](#).

Age	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
	<u>Intermittent</u>	<u>Mild Persistent</u>	<u>Moderate Persistent</u>	<u>Severe Persistent</u>		
Age: 0-4	<a href="#">SABA PRN and short course daily ICS at start of RTI</a>	<a href="#">Low dose ICS</a>	<a href="#">Medium dose ICS</a>	<a href="#">Medium dose ICS-LABA</a>	<a href="#">High dose ICS-LABA</a>	<a href="#">High dose ICS-LABA + OCS</a>
Age: 5-11	<a href="#">SABA PRN</a>	<a href="#">Low dose ICS</a>	<a href="#">Low dose ICS-formoterol</a> #	<a href="#">Medium dose ICS-formoterol</a> #	<a href="#">High dose ICS-LABA</a>	<a href="#">High dose ICS-LABA + OCS</a>
Age: 12+	<a href="#">SABA PRN</a>	<a href="#">Low-dose ICS daily or PRN</a>	<a href="#">Low dose ICS-formoterol</a>	<a href="#">Medium dose ICS-formoterol</a>	<a href="#">Medium or High dose ICS-LABA + LAMA</a>	<a href="#">High dose ICS-LABA + OCS</a>

## Choosing the correct discharge controller:

- New Asthma Dx:** Select controller based on **Asthma Severity** → select box above to see dosing
- Previous Asthma Dx:** Review pre-hospitalization controller dosing → **step-up** → select box above to see dosing

# 4 year old's can also be treated with this approach

For alternative treatment options click here to view 2020 NHLBI guidelines.

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## Short-Acting Beta-2 Agonists (SABA)

**BOLD** = Preferred, no PA required for Medicaid patients

Mechanism of delivery	Drug	Strength	Dose and Frequency	Cost
<b>Metered-dose Inhalers (MDI)</b> <ul style="list-style-type: none"> <li>Shake before use</li> <li>Needs primed</li> <li>Use with spacer</li> </ul>	<b>Ventolin<sup>®</sup>, Proventil<sup>®</sup>, Proair<sup>®</sup></b> Albuterol HFA	90 mcg	2-4 puffs as needed Every 4 hours	\$76
<b>Nebulizer Solution</b> <ul style="list-style-type: none"> <li>Passive inhalation via nebulizer</li> <li>Requires nebulizer device</li> </ul>	<b>AccuNeb<sup>®</sup></b> <b>Albuterol solution</b>	2.5 mg/3 mL (0.083%)	1 vial as needed Every 4 hours	\$17

## Intermittent Inhaled Corticosteroids (ICS)

Mechanism of delivery	Drug	Strength	Dose and Frequency	Cost
<b>Nebulizer Solution</b> <ul style="list-style-type: none"> <li>Passive inhalation via nebulizer</li> <li>Requires nebulizer device</li> </ul>	<b>Pulmicort<sup>®</sup> Respules</b> Budesonide	1 mg/2mL solution	1 mg (1 ampule) BID for 7 to 10 days at first sign of respiratory illness	\$106
<b>Metered-dose Inhalers (MDI)</b> <ul style="list-style-type: none"> <li>Shake before use</li> <li>Needs primed</li> <li>Use with spacer</li> </ul>	<b>Flovent<sup>®</sup> HFA*</b> Fluticasone propionate	110 mcg	2 puffs BID for 7 to 10 days at first sign of respiratory illness	\$351

\*Flovent HFA dosing is the expert opinion of Nationwide Children's Hospital and is not described in the NHLBI guidelines

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# Inhaled Corticosteroids (ICS) – Low and Medium Dose

**BOLD** = Preferred, no PA required for Medicaid patients

Inhaler Mechanism	Drug	Age (years)	Low Dose Inhaler Strength	Dose and Frequency	Medium Dose Inhaler Strength	Dose and Frequency	Cost per Inhaler
<b>Metered-dose Inhalers (MDI)</b> <ul style="list-style-type: none"> <li>Aerosolized inhalation that is pushed to activate</li> <li>Shake before use</li> <li>Needs primed</li> <li>Spacer compatible</li> </ul>	<b>Flovent® HFA</b> Fluticasone propionate	0-4	44 mcg	2 puffs BID	110 mcg	1 puff BID	\$351
		5-11				2 puffs BID	
		≥ 12	44 mcg	2 puffs BID	110 mcg	2 puffs BID	
	<b>Asmanex® HFA</b> Mometasone furoate	0-4	NA	NA	NA	NA	\$250
		5-11	NA	NA	50 mcg	1 puff BID	
		≥ 12	100 mcg	1 puff BID	100 mcg	2 puffs BID	
<b>Dry Powder Inhalers (DPI)</b> <ul style="list-style-type: none"> <li>Breath-actuated</li> <li>Spacer Incompatible</li> </ul>	<b>Asmanex® Twisthaler®</b> Mometasone furoate	≥ 12*	110 mcg	2 inhalations Daily	220 mcg	2 inhalations Daily	\$238
	<b>Pulmicort® Flexhaler®</b> Budesonide	≥ 12*	90 mcg	2 inhalations BID	180 mcg	2 inhalations BID	\$269
	<b>Qvar® Redihaler®</b> Beclomethasone	≥ 12*	40 mcg	2 inhalations BID	80 mcg	2 inhalations BID	\$260
	<b>Arnuity® Elipta®</b> Fluticasone furoate	≥ 12*	100 mcg	1 inhalation Daily	100 mcg	1 inhalation Daily	\$220
<b>Nebulizer Solution</b> <ul style="list-style-type: none"> <li>Passive inhalation via nebulizer</li> <li>Requires nebulizer device</li> </ul>	<b>Pulmicort® Respules</b> Budesonide	≤ 6	0.25 mg/2mL solution	2 ampules Daily	0.5 mg/2mL solution	2 ampules Daily	\$106

For patients ages 5 and older, the medium and low doses are suggestions based on the 2020 GINA guidelines. For patients ages 0-4, the NHLBI EPR3 2007 guidelines were referenced. These doses are based on available studies and product information, and are not steroid equivalencies. NA: There is not sufficient evidence to recommend a dose for this age and medication

\*DPIs may also be used in patients < 12 with shared decision-making. A younger patient may have the inspiratory capacity and coordination to use a DPI, but an MDI with mask and spacer is the optimal delivery method for patients < 12.

Global Initiative for Asthma. Global Strategy for Asthma Management and. Prevention, 2020. Available from: [www.ginasthma.org](http://www.ginasthma.org)

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Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma. [Bethesda, Md.]: U.S. Dept. of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute, 2007. National Heart, Lung, and Blood Institute.

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# ICS + Long-Acting Beta Agonist (LABA) – Low and Medium Dose

**BOLD** = Preferred, no PA required for Medicaid patients

Inhaler Mechanism	Drug	Age (years)	Low Dose Inhaler Strength	Medium Dose Inhaler Strength	Dose and Frequency	Cost per Inhaler
<b>Metered-dose Inhalers (MDI)</b> <ul style="list-style-type: none"> <li>Aerosolized inhalation that is pushed to activate</li> <li>Shake before use</li> <li>Needs primed</li> <li>Spacer compatible</li> </ul>	<b>Symbicort® HFA</b> Budesonide / formoterol	0-4*	80-4.5 mcg	160-4.5 mcg	1-2 puffs BID	\$359
		5-11	80-4.5 mcg	160-4.5 mcg	2 puffs BID	
		≥ 12	80-4.5 mcg	160-4.5 mcg	2 puffs BID	
	<b>Dulera® HFA</b> Mometasone / formoterol	0-4*	50-5 mcg	50-5 mcg	1-2 puffs BID	\$374
		5-11				
		≥ 12	100-5 mcg	100-5 mcg		
	<b>Advair® HFA</b> Fluticasone/ salmeterol	0-4*	45-21 mcg	115-21 mcg	1-2 puffs BID	\$327
		5-11			1-2 puffs BID	
		≥ 12	45-21 mcg	115-21 mcg	2 puffs BID	
<b>Dry Powder Inhalers (DPI)</b> <ul style="list-style-type: none"> <li>Breath-actuated</li> <li>Spacer Incompatible</li> </ul>	<b>Advair® Diskus®</b> Fluticasone / salmeterol	≥ 12`	100-50 mcg	250-50 mcg	1 inhalation BID	\$182
	<b>Airduo® Respiclick®</b> Fluticasone / salmeterol	≥ 12	55-14 mcg	113-14 mcg	1 inhalation BID	\$120

\*Dosages for products used in these age groups are not referenced in clinical guidelines and there are limited studies available. The suggested reference doses provided are the expert opinion of clinicians at Nationwide Children's Hospital.

For patients ages 5 and older, the medium and low doses are suggestions based on the 2020 GINA guidelines or Lexicomp® reference doses. These doses are based on available studies and product information, and are not steroid equivalencies.

Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention, 2020. Available from: [www.ginasthma.org](http://www.ginasthma.org)

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# ICS + Long-Acting Beta Agonist (LABA) – High Dose

**BOLD** = Preferred, no PA required for Medicaid patients

Inhaler Mechanism	Drug	High Dose Inhaler Strength	Dose and Frequency	Cost per Inhaler
<b>Metered-dose Inhalers (MDI)</b> <ul style="list-style-type: none"> <li>Aerosolized inhalation that is pushed to activate</li> <li>Shake before use</li> <li>Needs primed</li> <li><b>Use with spacer</b></li> </ul>	<b>Dulera® HFA</b> Mometasone / formoterol	200-5 mcg	2 puffs BID	\$374
	<b>Advair® HFA</b> Fluticasone/ salmeterol	230-21 mcg	2 puffs BID	\$327
<b>Dry Powder Inhalers (DPI)</b> <ul style="list-style-type: none"> <li>Breath-actuated</li> <li>Spacer Incompatible</li> </ul>	<b>Advair® Diskus®</b> Fluticasone / salmeterol	500-50 mcg	1 inhalation BID	\$182
	<b>Airduo® Respiclick®</b> Fluticasone / salmeterol	232-14 mcg	1 inhalation BID	\$120

Ages are not specified on this chart. If a patient has progressed to step 5 or 6 and requires a high dose ICS-LABA, consult with or refer patient to an asthma specialist to assess patient specific dosing.

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# Single Maintenance and Reliever Therapy (SMART)

**New initiation** of SMART therapy should be considered outside of an acute exacerbation at PCP or subspecialty follow up through shared decision making with the family.

## ICS + Long-Acting Beta Agonist (LABA)

**BOLD** = Preferred, no PA required for Medicaid patients

Inhaler Mechanism	Drug	Age (years)	Low Dose Inhaler Strength	Medium Dose Inhaler Strength	Dose and Frequency	Max Dose
<b>Metered-dose Inhalers (MDI)</b> <ul style="list-style-type: none"> <li>Aerosolized inhalation that is pushed to activate</li> <li>Shake before use</li> <li>Needs primed</li> <li>Use with spacer</li> </ul>	<b>Symbicort® HFA</b> Budesonide / formoterol	4-11	80-4.5 mcg	160-4.5 mcg	2 puffs BID and 1 puff PRN	8 puffs
		≥ 12	80-4.5 mcg	160-4.5 mcg	2 puffs BID and 2 puffs PRN	12 puffs
	<b>Dulera® HFA</b> Mometasone / formoterol	4-11	50-5 mcg	100-5 mcg	2 puffs BID and 1 puff PRN	8 puffs
		≥ 12	50-5 mcg	100-5 mcg	2 puffs BID and 2 puffs PRN	12 puffs

## Example Prescription – Low Dose ICS + LABA

Age (years)	Drug	Strength	Directions
4-11	<b>Symbicort® HFA</b> Budesonide / formoterol	80-4.5 mcg	Inhale 2 puffs twice a day. May also inhale 1 puff every 4 hours, as needed for symptoms (Max: 8 puffs per day). Dispense 2 inhalers for 30-day supply.
≥ 12	<b>Symbicort® HFA</b> Budesonide / formoterol	80-4.5 mcg	Inhale 2 puffs twice a day. May also inhale 2 puffs every 4 hours, as needed for symptoms (Max: 12 puffs per day). Dispense 2 inhalers for 30 day supply.

Expert Panel Working Group of the National Heart, Lung, and Blood Institute (NHLBI) administered and coordinated National Asthma Education and Prevention Program Coordinating Committee (NAEPCC), Cloutier MM, et al. 2020 Focused Updates to the Asthma Management Guidelines: A Report from the National Asthma Education and Prevention Program Coordinating Committee Expert Panel Working Group. J Allergy Clin Immunol. 2020 Dec;146(6):1217-1270.

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# Asthma Action Plan

## Asthma Action Plan

Caroline Zzadtdonotuse

DOB: 7/9/2017





MRN: 2277609

Asthma Type:

My Asthma Triggers:



Last Updated:

Green	Zone: Doing Well	Do These Things Every Day!
 <p>All of these are true:</p> <ul style="list-style-type: none"> <li>Breathing is great!</li> <li>No coughing or wheezing</li> <li>Asthma doesn't bother sleep or exercise</li> </ul>	Take these medications every day:	
Yellow	Zone: Symptoms Start	Start Relief Medicine!
 <p>Any of these are happening:</p> <ul style="list-style-type: none"> <li>Getting a cold</li> <li>Coughing a lot</li> <li>Wheezing</li> <li>Having trouble breathing</li> </ul>	Take these medicines:	Keep taking Green Zone Medicine!
Orange	Zone: IN TROUBLE	CALL YOUR DOCTOR FOR HELP!
 <p>Relief medicine isn't working:</p> <ul style="list-style-type: none"> <li>Medicine not lasting 4 hours - symptoms coming back too soon</li> <li>Constant coughing</li> <li>Awake all night from asthma</li> <li>Needing more than 4 doses of relief medicine in 1 day</li> </ul>	<p>Call:</p> <p>Take these medicines:</p> <p>If you can't reach your doctor and symptoms continue: <b>Go to urgent care or ER!</b></p>	
Red	Zone: IN DANGER!	GET HELP NOW!
 <p>Breathing is bad:</p> <ul style="list-style-type: none"> <li>Gasping (breathing hard and fast)</li> <li>Ribs show when breathing</li> <li>Neck or stomach caving in</li> <li>Hard to talk or walk</li> </ul>	<p>Go to the Closest ER or DIAL 9-1-1!</p> <p>On the way take:</p>	

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# Quality Measures

- Acute asthma patients with minimum ACS score of 2 who receive oral steroid therapy within 60 minutes of ED arrival
- Rate of asthma order set use (ED Asthma, IP Admission, IP Transfer from PICU and IP Escalation of Care)
- Rate of transfers from floor to PICU
- ALOS
- Asthma discharges that have a follow-up appointment with an asthma outpatient provider, scheduled and documented in the AVS prior to discharge
- Discharge Efficiency: Median time from 1st Q4H albuterol administration to discharge
- 7 and 30 day return to the ED after inpatient discharge

Metrics Population: Age 2-18 years

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# References

1. National Asthma Education and Prevention Program. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007 [published correction appears in *J Allergy Clin Immunol*. 2008 Jun;121(6):1330]. *J Allergy Clin Immunol*. 2007;120(5 Suppl):S94-S138. doi:10.1016/j.jaci.2007.09.043
2. Expert Panel Working Group of the National Heart, Lung, and Blood Institute (NHLBI) administered and coordinated National Asthma Education and Prevention Program Coordinating Committee (NAEPPCC), Cloutier MM, Baptist AP, et al. 2020 Focused Updates to the Asthma Management Guidelines: A Report from the National Asthma Education and Prevention Program Coordinating Committee Expert Panel Working Group [published correction appears in *J Allergy Clin Immunol*. 2021 Apr;147(4):1528-1530. doi: 10.1016/j.jaci.2021.02.010]. *J Allergy Clin Immunol*. 2020;146(6):1217-1270. doi:10.1016/j.jaci.2020.10.003

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# Team & Process

## Pathway Development Team

### Leader(s):

Hospital Pediatrics:

Shauna Schord, MD  
Monica Hoff, MD  
Gerd McGwire, MD, PhD

### Members:

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Pharmacy:

Alexander Swick, PharmD

Partners For Kids:

Kelin Wheaton, PharmD

PICU:

Samantha Gee, MD

## Clinical Pathways Program:

Medical Director – Hospital Pediatrics:

Gerd McGwire, MD, PhD

Medical Director – Clinical Informatics & Emergency Medicine:

Laura Rust, MD, MPH

Business & Development Manager:

Rekha Voruganti, MBOE, LSSBB

Program Coordinators:

Tahje Brown, MBA

Tara Dinh, BS

## Clinical Pathway Approved

Associate Chief Medical Officer, Center for Clinical Excellence:

Ryan Bode, MD, MBOE

Advisory Committee Date: *October, 2023*

Origination Date: *July, 2017*

Last Revision Date: *May, 2024*

Next Revision Date: *May, 2027*

## 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 associated 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.

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# Overview & Workflow - Floor Continuous Albuterol (Level 3 care)

- **MCED patient** with asthma exacerbation who is stable or improving after > 45 minutes of continuous albuterol.
- **PICU patient** with asthma exacerbation who is improving after > 4 hours of continuous albuterol.
- Meets [Criteria for Floor Continuous Albuterol Protocol](#).

- **Floor patient with asthma exacerbation, requiring continuous albuterol** (ACS  $\geq 5$  after albuterol burst for 2 hours **and** one Mg bolus).
- ACT completed and patient meets [Criteria for Floor Continuous Albuterol Protocol](#).

- Contact **SOD or Pulmonologist on call** to accept patient. Keep same service if transfer to H8A/H9A from other floor unit.
- After receiving bed request from ED, **PCTC** assigns bed in conjunction with H8A or H9A Charge RN. Max 6 patients on continuous albuterol; Max 4 on H8A and max 2 on H9A.
- **H8A or H9A Charge RN** contacts **accepting service Senior Resident/APN** for bedside handover in ED.

- See [ED bedside handover](#) for admission on continuous albuterol from MCED
- **PICU bedside handover** with PICU resident/NP, HP or Pulmonary senior resident/APN & H8A or H9A charge RN and RT (Resident *SHOULD* step away from rounds unless prohibited by urgent patient care needs.)

- Patient **admitted** from MCED or **transferred** to H8A or H9A (from PICU or other floor unit) and made **Watcher**.
- Floor continuous albuterol is ordered, using **IP Asthma Clinical Pathway (Admission, Transfer, Escalation)** by primary resident/APN and set up by H8A or H9A RT

- Patient assessment with **ACS Q1H x 2** by RT, bedside RN and primary team physician/APN (senior resident/APN and/or HP fellow/attending) and **documented in continuous albuterol note template**.

- Patient assessment with **ACS Q2H, and Q1H PRN**, by RT and bedside RN

ACS  $\leq 3$  x 2?

Yes

No

If >8hrs on floor continuous albuterol, notify resident to assess

- **Change to albuterol MDI Q2H**
- Patient assessment and **ACS Q1H x 2** after stopping continuous albuterol.

ACS  $\geq 5$ ?

Yes

No

- Wean successful.
- **Albuterol MDI Q2H for 2 more hours.**

ACS  $\geq 5$ ?

Yes

No

Continue wean per Asthma Clinical Pathway

- Wean has failed.
- RT notifies resident/APN of failed wean
- Resident/APN re-orders continuous albuterol

4/14/2025

# Continuous Albuterol - MCED Bedside Handover

## [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 Pulmonologists 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

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

**In person** evaluation by charge RN and/or charge RT & senior resident/APN (attending optional) **within 30 minutes** of receiving the admission notification.

Floor senior resident/APN (attending optional) documents handover.  
**Note template:**  
IP Asthma Evaluation for floor continuous albuterol

*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/APN and RN have completed bedside evaluation and communicated acceptance to ED physician team.

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# 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.

#### Indication/Usage

- **PICU transfer** of established, stable, and ideally weaning, asthma pathway patient on continuous albuterol for > 4 hours
- **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
- **Floor patient with asthma exacerbation** and continued respiratory distress, increased work of breathing and/or ACS  $\geq 5$  after albuterol burst for 2 hours **and** one Mg bolus **and** approved by ACT.

#### Exclusion Criteria

- Age < 2 or > 18 yrs
- Patients in severe respiratory failure (PPV requirement, altered mental status, bradycardia, poor perfusion)
- FiO<sub>2</sub> requirement  $\geq 50\%$
- MCED patient that received epinephrine, ketamine or continuous magnesium
- History of recent intubation for current illness
- Known concurrent bacterial pneumonia
- Patients with significant comorbidities (cardiac, pulmonary, or neuromuscular disease, craniofacial abnormalities, immunodeficiency)

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# Continuous Albuterol Floor Protocol

## Initiation

- **PICU transfers**

- The following criteria should be followed as closely as possible when accepting potential PICU transfer:
  - Hospital Pediatrics or Pulmonology service and transfer to H8A or H9A
  - > 4 hours stability on continuous albuterol
  - Meeting all other inclusion/exclusion criteria
  - > 4 hours removed from non-invasive ventilation requirement (i.e. BiPap)
  - No history of recent intubation for current illness
  - No (off) magnesium drip
  - No active sedation wean
  - Patient made “Watcher” status for “escalating respiratory support”
  - Communication/agreement by Safety Officer/Hospital Pediatrics attending or Pulmonologist on call, senior resident/APN, accepting unit charge nurse and RT

- **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, senior resident/APN, accepting unit charge nurse and RT.

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# Continuous Albuterol Floor Protocol

## Initiation (continued)

- **Floor Escalation of Care**

- The following criteria should be followed as closely as possible when escalating care on floor patients:
  - Hospital Pediatrics or Pulmonary Service and patient on H8A or H9A
  - Patient made “Watcher” status for “escalating respiratory support”
  - **Bedside ACT** with RN, charge nurse, RT, resident(s)/APNs, PICU fellow/attending and SOD **is required for initiation**. Involvement/communication with primary Hospital Pediatrics attending/fellow or Pulmonary attending/fellow as appropriate based on time of day.
  - ACT team must agree on treatment strategy of continuous albuterol on H8A or H9A. No need for NIPPV per ACT team assessment
  - Communication by charge RN to H8B ICU charge RN to ensure awareness of number of continuous albuterol patients on the floor
  - Safety Officer to report number of patients on continuous albuterol on H8A/H9A on the daily safety call Mon-Fri to increase awareness of the acuity on the floor
  - Patient made NPO and IV access established. Continuous cardiac and pulse oximetry monitoring in place.
  - Obtain CXR
  - Patient will be set up on continuous albuterol by Respiratory Therapy and bedside RN
  - Supplemental O2 and continuous SpO2 if saturation is < 90%
  - Nebulized albuterol: 10 mg/hr
  - Place IV. NPO and IV fluids.
  - If not already given: IV magnesium sulfate: 50mg/kg over 20min (Max. 2g & 1 dose)
  - Methylprednisolone 1mg/kg/Q6H (max dose: 30mg Q6H) iv if > 6hrs since last dose

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# Continuous Albuterol Floor Protocol

## Reassessment/Monitoring

- Respiratory therapist, bedside RN, and physician (senior resident/APN and/or fellow/attending) will assess the patient every hour for two occurrences with documentation of vital signs and Assessment/Plan (**Note template: IP Asthma continuous albuterol Initiation and Reassessment Note**). RT and bedside RN will continue to assess every 1-2 hours thereafter.
- RT will document albuterol dose and ACS with every patient assessment. RT to notify resident/APN if increasing ACS or any other concern.
- Indications for **ACT** and potential ICU transfer: ACS  $\geq 7$ , PEWS score  $> 7$ , requiring  $\geq 50\%$  FiO<sub>2</sub> for more than 10 minutes to maintain SpO<sub>2</sub>  $\geq 90\%$ , non-response to continuous albuterol therapy where response is defined as improvement in ACS to  $\leq 5$ , systolic hypotension or diastolic hypotension not resolved by single IVF bolus. In addition, team may initiate ACT/ICU transfer on the basis of other clinical concerns.

## Weaning

- RT will page Resident/APN if patient does not meet weaning criteria for  $> 8$  hours.
- Wean albuterol to Q2H when ACS has been  $\leq 3$  for 2 assessments. Continue Q1H reassessment with documentation of ACS x 2 after stopping continuous albuterol.
- If ACS increases to  $\geq 5$  the wean has failed. RT to notify resident/APN of failed wean and need for re-starting continuous albuterol for  $\geq 4-6$  hours before re-attempting wean.
- If wean successful, continue albuterol Q2H for at least 4 hrs, then wean and monitor per asthma pathway.

## Fluid, Electrolytes and Feeding Considerations

- Patient should remain NPO with isotonic maintenance IV fluids (D5LR preferred, alternatively D5NS with 20mEq/L K) until weaned to Q2H albuterol.
- Check chem7 after 4 hours on continuous albuterol then QAM, to monitor for hypokalemia.
- A 0.9NS IVF bolus of 20mL/kg may be warranted if diastolic hypotension  $< 30$  mm Hg. If given, resident should reassessment in 1 hr. Continue treatment per protocol if hypotension has resolved and UOP is adequate. ACT is patient has sustained or recurrent hypotension.

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# Continuous Albuterol Floor Protocol

## **Protocol Disclaimer:**

Clinical practice guidelines and algorithms at Nationwide Children's Hospital (NCH) are standards which provide general guidance to clinicians. Patient choice and clinician judgment remain central to the selection of diagnostic tests and therapy. The ordering provider is ultimately responsible for care decisions. NCH's guidelines and algorithms are reviewed periodically for consistency with new evidence; however, new developments may not be represented.

During periods of extremely high census and exceeding capacity within PICU, Medical-Surgical Units and Emergency Department – patient safety clearly takes priority and adjustments to the above protocol recommendations may be necessary including number of patients on HFNC on the floor, units able to administer HFNC and inclusion/exclusion criteria.

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