

# Asthma v.2: Criteria and Respiratory Score

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## Inclusion Criteria

- 1-18 y.o with asthma exacerbation admitted to general medicine service

## Exclusion Criteria

- Acute Illnesses
  - Patients with pneumonia, bronchiolitis, or croup as their primary diagnosis
- Chronic Conditions:
  - Chronic lung disease: (e.g. cystic fibrosis, restrictive lung disease, bronchopulmonary dysplasia)
  - Congenital and acquired heart disease:
  - Airway Issues: (e.g. vocal cord paralysis, tracheomalacia, tracheostomy dependent)
  - Medically complex children
  - Immune disorders
  - Sickle cell anemia

!

## Risk Factors

Associated with Asthma Related Death

## RESPIRATORY SCORE (RS)

Variable	0 points	1 points	2 points	3 points
<b><u>RR</u></b>				
<2 mo		≤60	61-69	≥70
2-12 mo		≤50	51-59	≥60
1-2 yr		≤40	41-44	≥45
2-3 yr		≤34	35-39	≥40
4-5 yr		≤30	31-35	≥36
6-12 yr		≤26	27-30	≥31
>12 yr		≤23	24-27	≥28
<b><u>Retractions</u></b>	None	Subcostal or intercostal	2 of the following: subcostal, intercostal, substernal, OR nasal flaring (infant)	3 of the following: subcostal, intercostal, substernal, suprasternal, supraclavicular OR nasal flaring / head bobbing (infant)
<b><u>Dyspnea</u></b>				
0-2 years	Normal feeding, vocalizations and activity	1 of the following: difficulty feeding, decreased vocalization or agitated	2 of the following: difficulty feeding, decreased vocalization or agitated	Stops feeding, no vocalization, drowsy or confused
2-4 years	Normal feeding, vocalizations and play	1 of the following: decreased appetite, increased coughing after play, hyperactivity	2 of the following: decreased appetite, increased coughing after play, hyperactivity	Stops eating or drinking, stops playing, OR drowsy and confused
>4 years	Counts to ≥10 in one breath	Counts to 7-9 in one breath	Counts to 4-6 in one breath	Counts to ≤3 in one breath
<b><u>Auscultation</u></b>	Normal breathing, no wheezing present	End-expiratory wheeze only	Expiratory wheeze only (greater than end-expiratory wheeze)	Inspiratory and expiratory wheeze OR diminished breath sounds OR both

# Asthma v.2: Management

**Supplemental O2** should be administered to keep O2 saturation > 90%

1<sup>st</sup> HOUR (ED)  
**PHASE Ia**

**RS 1-5**

- **Albuterol** MDI 8 puffs
- **Dexamethasone** 0.6 mg/kg X1 (16 mg max)

**RS 6-12**

- **Albuterol** neb 20 mg (over 1 hr)
- **Ipratropium** neb 0.75 mg
- **Dexamethasone** 0.6 mg/kg x1 (16 mg max)

2<sup>nd</sup> HOUR (ED)  
**PHASE Ib**

RS 1-4  
Discharge

**RS 5-8**

**Albuterol** MDI 8 puffs  
+  
1 hour observation

**RS 9-12**

- **Albuterol** neb 20 mg (over 1 hr)
- **Ipratropium** 0.75 mg if not yet given
- Admit to Phase II
- Consider **Magnesium Sulfate IV** 50 mg/kg x1 (max 2 grams)

**RS 1-4**  
Observe for 1 hour

3<sup>rd</sup> HOUR (ED)  
**PHASE Ic**

RS 1-4  
Discharge

**RS 5-8**  
Admit to Phase III

**RS 9-12**

- **Albuterol** neb 20 mg (over 1 hr)
- **Ipratropium** 0.75 mg if not yet given
- Admit to Phase II
- Consider **Magnesium Sulfate IV** 50 mg/kg x1 (max 2 grams)

**PHASE II: INPATIENT**

- **Albuterol** continuous neb 20 mg/hr
- Assessment q 1 hour
- Advance after 1 hr of treatment for score 1-8

**PHASE III: INPATIENT**

- **Albuterol** MDI 8 puffs q 2 hours
- Assessment q 2 hours

**PHASE IV: INPATIENT**

- **Albuterol** MDI 8 puffs q 4 hours
- Assessment q 4 hours
- Begin discharge teaching and planning

**PHASE V: INPATIENT**

- **Albuterol** MDI 4 puffs q 4 hours
- Minimum of 2 treatments before discharge
- Assessment q 4 hours

Discharge With  
Asthma  
Management  
Plan

**! Signs of Clinical Deterioration:**

Drowsiness, confusion, silent chest exam, hypercapnea, PEF<25%, or MPEWS increasing

Notify MD  
Consider calling Rapid Response Team

**Inpatient Steroid Treatment**

- Transition to **prednisone** or **prednisolone** (2 mg/kg/day) for a total course of 5-10 days depending on severity of exacerbation.

**PHASE Progression (Phases III-V)**

- **RS 1-4:** Advance after one treatment at this phase
- **RS 5-8:** Continue therapy at this phase
- **RS 9-12:** Step back to previous phase

**RN to notify MD:**

- For all phase transitions
- Failure to advance on pathway after 3 hours on continuous albuterol or after 12 hours in all other phases
- Persistent O2 requirement in Phase IV

**Inpatient Peak flow**

- Consider performing peak flows before and after each treatment for children > 5 years old.

**A Completed Asthma Discharge Summary and Management Plan is Required for All Discharges**

**RN is responsible for the Asthma Discharge Plan (page 1)**

- Follow-up care instructions must be complete.
- Family must receive original color document.
- RN and family must sign the discharge plan.
- Signed copy must be included in the chart.

**MD is responsible for the Asthma Management Plan (page 2)**

- Fill out and review the plan with the family.
- Indicate if the patient is taking controller meds.
- Provider must sign the plan.

## Highlights of the new Asthma Pathway

### What's new?

- **New format:** integration of emergency department care and inpatient care into a single pathway.
- **More MDI use:** Albuterol MDI will be used for a triage respiratory score of 1-5 and patient will be transitioned to MDI prior to discharge.
- **Less ipratropium use:** Ipratropium will be given only for the first hour of therapy with continuous nebulized albuterol.
- **Expedited admission:** Patients should be assessed for admission after the first hour of treatment.
- **New adjunctive therapy in the ED:** Magnesium sulfate IV will be offered for patients who remain severe after an hour of continuous albuterol.
- **New inpatient steroid courses:** Patients who are admitted will be transitioned to prednisone or prednisolone to facilitate a 5-10 day course of steroids. Dexamethasone remains the drug of choice for asthma exacerbations in the ED.
- **Timely discharge:** Discharge will occur after patients demonstrate clinical stability at phase 5: albuterol MDI 4 puffs q4.
- **New Asthma Management Plan:** Redesigned for improved communication with families.



## Asthma Care at Seattle Children's Hospital

### Why a new format?

#### ED Pathway Change

*Assessing a patient after the first hour of therapy appears to be more accurate at predicting the need for admission than the initial assessment. [LOE: C, NC] (1,7,8,17)*

Previously, our ED asthma pathway utilized low score and a high score pathways that diverged after the respiratory score at triage. By combining these two pathways, an emphasis will be placed on determining disposition based on response to therapy in the first hour.

#### Inpatient Pathway Change

*It is recommended that inpatient management be viewed as a continuation of any therapies initiated in the emergency department. [LOE: NC] (1,4)*

National guidelines have emphasized the need for a continuum of care which begins in the ED and extends through discharge from the inpatient unit. Where our previous inpatient pathway was 3 pages, we have consolidated the ED and inpatient portions into one page.



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# Asthma Ordersets

## New Ordersets

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### **ED Asthma Initial (phase 1a) Orderset** (for use in phase 1a)

- This allows either albuterol MDI or continuous albuterol with ipratropium to be ordered based on their triage respiratory score.
- All patients should receive dose of dexamethasone PO as well.

*Use of corticosteroids within 1 hour of presentation to an ED significantly reduces the need for hospital admission in patients with acute asthma. [LOE: M, NC] (1,4,5,58)*

### **ED Asthma Second and Subsequent Hours (phase 1b,1c) Orderset** (for use in phase 1b, 1c)

- Use this orderset for subsequent albuterol orders given in the 2<sup>nd</sup> and 3<sup>rd</sup> hours.
- Magnesium sulfate IV is available here for patients who remain severe after their first or second hour of treatment.

### **Asthma Admit Orderset** (for use in phases 2-5)

- The asthma admit orderset contains an option for patients to be initiated on the *asthma pathway*.
- All patients who meet criteria should be placed on the pathway to facilitate shared management with respiratory therapy and nursing based on respiratory scoring.



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# Inclusion and Exclusion Criteria

Patients who meet the following criteria should be placed on the *asthma pathway* through the use of the asthma admit orderset.

## Inclusion Criteria:

- 1 year of age to 18 years of age with an asthma exacerbation admitted to the general medical service.

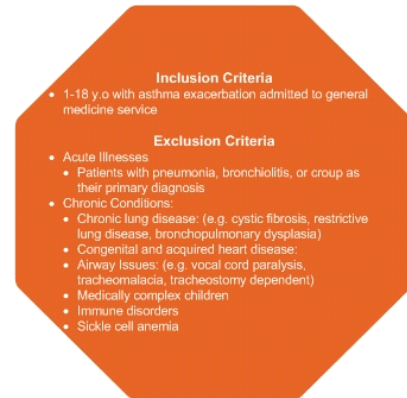
## Exclusion Criteria:

### Acute Illnesses:

- Patients with pneumonia, bronchiolitis, or croup as their primary diagnosis.

### Chronic Conditions:

- Chronic lung disease: (e.g. cystic fibrosis, restrictive lung disease, bronchopulmonary dysplasia)
- Congenital and acquired heart disease
- Airway issues: (e.g. vocal cord paralysis, tracheomalacia, tracheostomy dependent)
- Medically complex children
- Immune disorder
- Sickle cell anemia



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# Risk Factors Associated for Asthma Related Death

## Which patients do not belong on the pathway?

Please take the following risk factors for asthma related death into consideration when placing a patient on the *asthma pathway*.

These risk factors warrant consideration in the management of a patient with acute asthma but do not absolutely preclude use of the pathway or serve as criteria for admission to the inpatient unit or ICU.

### **Risk factors** (LOE: NCJ) (1,2,3)

Previous intubation or ICU admission for acute asthma  
2+ hospitalizations for asthma in the past year  
3+ ED visits for asthma in the past year  
Hospitalization or ED visit in the past month  
Using >2 albuterol MDI canisters per month  
Difficulty perceiving symptoms or severity of exacerbation  
Obesity  
Comorbid conditions (see exclusion criteria for examples)  
Lack of a written asthma action plan

Note: patients with significant comorbid conditions should always be carefully evaluated for their appropriateness for the pathway. Of note, only patients on the general medical service can be on the pathway.



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# Respiratory Scoring Tool

## How do I use the respiratory scoring tool?

The respiratory scoring tool consists of 4 elements that make up the respiratory assessment of the patient in distress.

You assess each component distinctly and add them to make a total between 1-12.

• A patient's RR is 1-3 whereas all other categories are scored 0-3.

(1-3) **Respiratory rate:** assessed over 60 seconds  
 (0-3) **Retractions:** work of breathing  
 (0-3) **Dyspnea:** shortness of breath  
 (0-3) **Auscultation:** wheezing on lung exam  
 Total: (1-12)

*The SCH respiratory scoring tool has been validated by comparing the assessment amongst various types of providers. [LOE: C] (15)*

*There are other scoring tools that have been validated such as the pulmonary score (PS), pediatric asthma severity score (PASS) and pediatric respiratory assessment measure (PRAM) but no single tool that has been adopted universally. [LOE: NC] (1,2,20,23,26)*

The respiratory scoring tool is displayed on the next page and is always included with the pathway for convenience.



# Respiratory Scoring Tool

Variable	0 points	1 points	2 points	3 points
<b>RR</b>				
<2 mo		≤60	61-69	≥70
2-12 mo		≤50	51-59	≥60
1-2 yr		≤40	41-44	≥45
2-3 yr		≤34	35-39	≥40
4-5 yr		≤30	31-35	≥36
6-12 yr		≤26	27-30	≥31
>12 yr		≤23	24-27	≥28
<b>Retractions</b>	None	Subcostal or intercostal	2 of the following: subcostal, intercostal, substernal, OR nasal flaring (infant)	3 of the following: subcostal, intercostal, substernal, suprasternal, supraclavicular OR nasal flaring / head bobbing (infant)
<b>Dyspnea</b>				
0-2 years	Normal feeding, vocalizations and activity	1 of the following: difficulty feeding, decreased vocalization or agitated	2 of the following: difficulty feeding, decreased vocalization or agitated	Stops feeding, no vocalization, drowsy or confused
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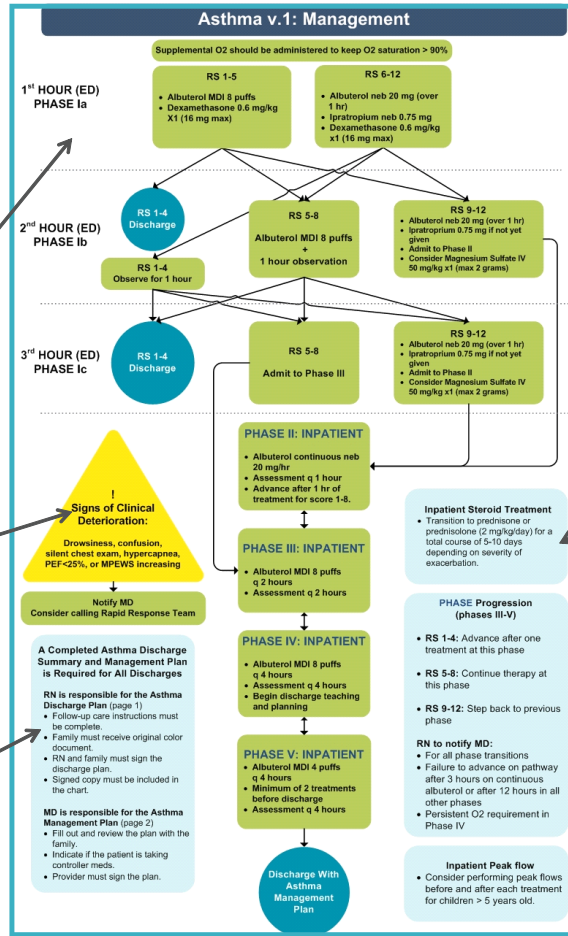
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# Pathway Walkthrough

Patients should be evaluated for admission based on their response to the first hour of therapy.

Indications that a patient is not responding appropriately to therapy.

Don't forget to complete the newly revised **Asthma Discharge Summary and Management Plan** when patient gets to Phase IV.



ED pathway

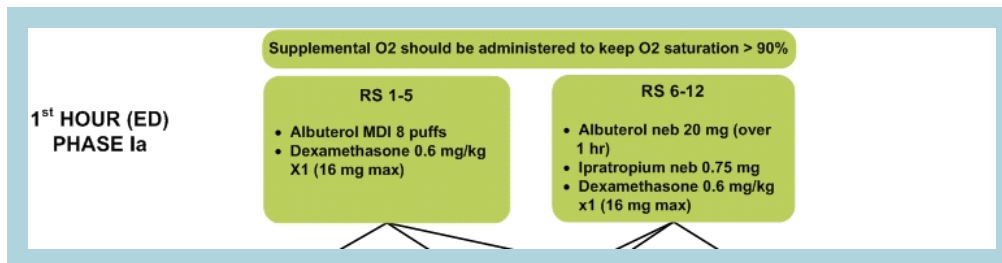
New steroid recommendations

Inpatient pathway

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## Phase Ia: Initial Treatment in the First Hour in the ED



### Patients with respiratory score (RS) 1-5:

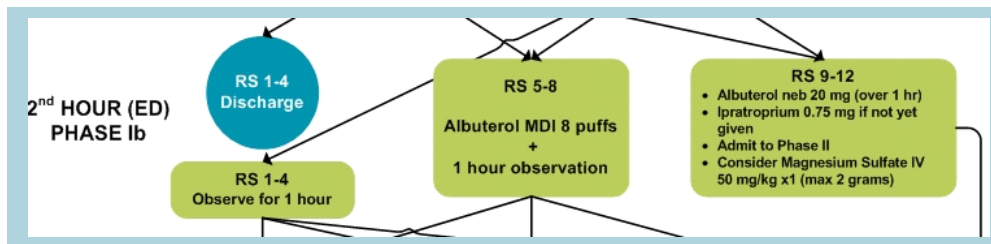
- 8 puffs of albuterol MDI
- Ipratropium has not been shown to be effective in mild to moderate acute asthma.
- Dexamethasone 0.6 mg/kg (16 mg max)

### Patients with respiratory score (RS) 6-12:

- Continuous albuterol 20 mg neb with O<sub>2</sub> administered over 1 hour
- Include ipratropium 0.75 mg
- Dexamethasone 0.6 mg/kg (16 mg max)

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## Phase Ib: Second Hour in the ED



### Patients with RS 1-4:

- Evaluate for discharge.
- If a patient has just received continuous albuterol they should be observed for a minimum of 1 hour and rescored.

### Patients with RS 5-8:

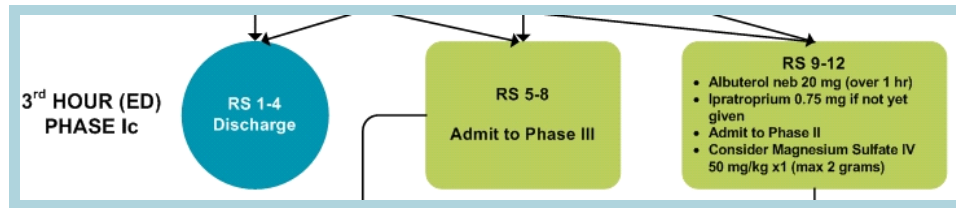
- 8 puffs of albuterol MDI
- 1 hour observation then rescoring.

### Patients with RS 9-12:

- Admit to phase II
- Continuous albuterol 20 mg neb with O<sub>2</sub> over 1 hour + ipratropium if not yet given.
- Consider magnesium sulfate IV 50 mg/kg (max 2 grams) x1 for patients not responsive to the 1<sup>st</sup> hour of treatment.

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## Phase Ic: Third Hour in the ED



### Patients with RS 1-4:

- Evaluate for discharge.

### Patients with RS 5-8:

- Admit to phase III
- Patient will receive albuterol 8 puffs q2 in phase III.

### Patients with RS 9-12:

- Admit to phase II
- Continuous albuterol 20 mg neb with O<sub>2</sub> over 1 hour + ipratropium if not yet given.
- Consider magnesium sulfate IV 50 mg/kg (max 2 grams) x1 for patients not responsive to the 1<sup>st</sup> hour of treatment.

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# Phase II: Continuous Nebulized Albuterol 20 mg/hr



## PHASE II: INPATIENT

- Albuterol continuous neb 20 mg/hr
- Assessment q 1 hour
- Advance after 1 hr of treatment for score 1-8.

## Respiratory score (RS): q1 hour (minimum)

RS 1-8: after a minimum of 1 hour of treatment in this phase may advance to **phase III**.

RS 9-12: remain in this phase on continuous nebulized albuterol and be rescored in 1 hour.



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# Signs of Clinical Deterioration

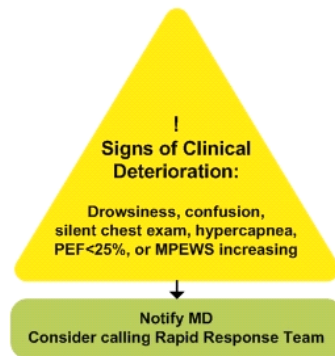
The following are **red flags** that a patient may have impending respiratory failure.

- **Inadequate response to therapy**

Characterized by a patient who receives optimal therapy and does not improve clinically.

- **Failure to progress along the pathway**

This is defined as 3 hours on continuous or 12 hours at any other phase.



- **Drowsiness**

*Drowsiness is highly associated with acute respiratory acidosis. [LOE:C ] (100)*

- **Confusion**

- **Silent chest exam**

• The absence of breath sounds in a patient with respiratory distress.

- **Hypercapnea**

*Values cited for hypercapnea in an asthmatic range from a pCO<sub>2</sub> of >40-45. [LOE: NC] (1,4,5,100-104)*

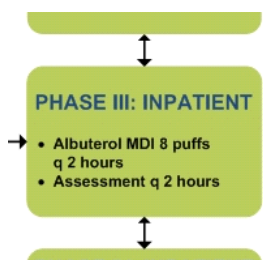
• We recommend a CBG for most circumstances.

- **Peak expiratory flow <25%**

- **MPEWS increasing (per protocol)**

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# Phase III: Albuterol MDI 8 puffs q2



**Respiratory score (RS): q2 hour (minimum)**

**RS 1-4:** after 1 treatment in this phase, may advance to **phase IV**.

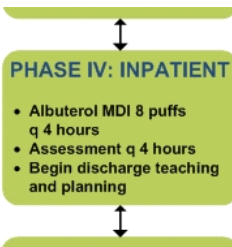
**RS 5-8:** remain in this phase on albuterol MDI 8 puffs q2 and be rescored in 1 hour.

**RS 9-12:** remain return to **phase II**, be placed on continuous nebulized albuterol 20 mg/hr and be rescored in 1 hour.

- PHASE Progression (phases III-V)**
- **RS 1-4:** Advance after one treatment at this phase
  - **RS 5-8:** Continue therapy at this phase
  - **RS 9-12:** Step back to previous phase
- RN to notify MD:**
- For all phase transitions
  - Failure to advance on pathway after 3 hours on continuous albuterol or after 12 hours in all other phases
  - Persistent O2 requirement in Phase IV

**Return to Management**

## Phase IV: Albuterol MDI 8 puffs q4



### Respiratory score (RS): q4 hour (minimum)

**RS 1-4:** after 1 treatment in this phase, may advance to **phase V**.

**RS 5-8:** remain in this phase on albuterol MDI 8 puffs q4 and be rescored in 4 hours.

**RS 9-12:** remain return to **phase III**, be placed on albuterol MDI 8 puffs q2 and be rescored in 1 hour.

### **PHASE Progression (phases III-V)**

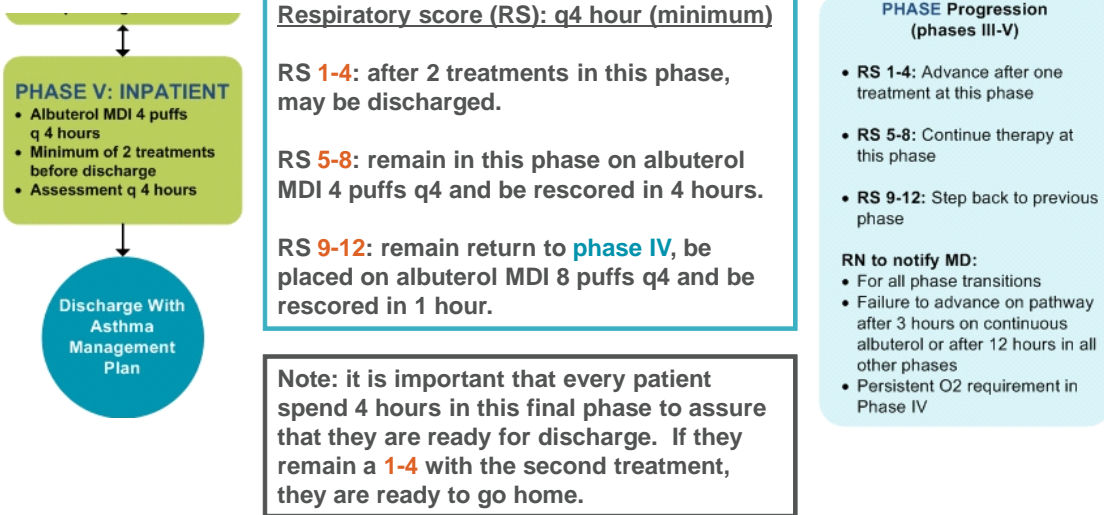
- **RS 1-4:** Advance after one treatment at this phase
- **RS 5-8:** Continue therapy at this phase
- **RS 9-12:** Step back to previous phase

#### **RN to notify MD:**

- For all phase transitions
- Failure to advance on pathway after 3 hours on continuous albuterol or after 12 hours in all other phases
- Persistent O2 requirement in Phase IV

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# Phase V: Albuterol MDI 4 puffs q4



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# Asthma Education and Discharge

Discharge With  
Asthma  
Management  
Plan

## Discharge check list:

### "Living with Asthma" Asthma Education Booklet

- Patients should have received the asthma education booklet in an appropriate language and reviewed this with a respiratory therapist (RT).



### Asthma Discharge Summary and Management Plan.

- RN is responsible for completing the Discharge Summary (page 1) and reviewing with the family.
- MD is responsible for completing the Asthma Management Plan (page 2) and reviewing with the family.



Page 1

### Inhaled corticosteroids (ICS)

- Patients with clinically significant asthma exacerbations should be started on an ICS at discharge unless there is a question about whether or not the patient will benefit from it.
- The decision to start the patient on inhaled corticosteroids should be made with the primary care doctor when possible.



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- Patients should be offered refills on all medications.

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# Supplemental Oxygen Use in Asthma Exacerbations

## When does a patient require oxygen?

*Patients with acute asthma should receive supplemental oxygen to maintain oxygen saturation greater than 90%. [LOE: NC] (1,2,3)*

- Supplemental oxygen is administered with all continuous nebulization therapy.

*Monitoring oxygen saturation is recommended for patients with acute asthma exacerbations. [LOE: NC,C] (1,2,12)*

- Once a patient has reached phase IV, oxygen saturation monitoring is no longer necessary unless the patient has persistent hypoxia.

### Oxygen saturation as a diagnostic tool

*Oxygen saturation is correlated with severity of illness in asthma. [LOE: C] (8,9)*

*However, it is not useful as the sole indicator for need for admission. [LOE: C] (11,13)*

*An oxygen saturation of < 92% after 1 hour of treatment is a better predictor of need for hospitalization than initial oxygen saturation. [LOE: C] (7,14)*

- Persistent hypoxia in the presence of an adequate response to therapy can be indicative of another contributing condition such as pneumonia.

# Albuterol Treatment for Asthma Exacerbations

## Albuterol

An inhaled short-acting beta<sub>2</sub>-agonist (SABA) that is the drug of choice in the US for rapid reversal of airflow obstruction.

- The onset of action for albuterol is less than 5 minutes.
- Repetitive administration produces incremental bronchodilation.

### Methods of administration:

- Continuous versus intermittent delivery

**Continuous delivery is the preferred method for severe acute asthma.** [LOE: M] (24,25,34,35,36,38)

**Intermittent delivery is appropriate for relief of mild and moderate exacerbations.** [LOE: M] (24,25,34,35,36,38)

- Metered dose inhaler (MDI) versus nebulized medication

**In mild to moderate exacerbations, equivalent bronchodilation can be achieved by high doses of albuterol MDI with a valved holding chamber (VHC) or by nebulizer therapy.** [LOE: M, NC] (23,26,27,30,39,40,41,42,47,48)

**MDI is the preferred method of delivery for intermittent delivery in mild and moderate acute asthma.** [LOE: LC] (see benefits of MDI use)

**As it is not practical to use MDI therapy for continuous delivery, continuous nebulized albuterol remains the delivery method of choice for severe acute asthma.** [LOE: LC]



# Albuterol Treatment for Asthma Exacerbations

## Albuterol (continued)

### Facts about MDI use

- MDI is the preferred method of delivering albuterol at our institution.

**MDIs deliver a discreet dose, are portable, and do not require a power source.** [LOE: M, LC] (23)

**MDI use in acute asthma is associated with shorter length of stay in the ED and lower pulse rates.** [LOE: NC,M] (1,4,5,23,27,39,43)

**MDIs should always be administered with a valved-holding chamber (VHC).** [LOE: NS] (1,4,5,42,43,44)

- It is at times necessary to substitute nebulized albuterol for MDI in an uncooperative patient.
  - The dose equivalency is as follows: 2.5 mg = 4 puffs MDI and 5 mg = 8 puffs MDI.

### Levalbuterol

- An alternative short-acting beta<sub>2</sub>-agonists (SABA) formulated with the intention of creating a drug with fewer adverse side effects than albuterol.

**Levalbuterol is an adequate substitute but it provides no additional benefit in efficacy or side effects over albuterol and is more costly.** [LOE: A, NS] (1,4,28,29,31,32,33,37)

- It is therefore not recommended for use.



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# Ipratropium Treatment for Asthma Exacerbations

## Ipratropium bromide (Atrovent)

An acetylcholine receptor antagonist that is used as an adjunctive therapy for asthma exacerbations by administering in combination with albuterol.

*Ipratropium produces additional bronchodilation particularly in patients noted to have severe airflow obstruction. [LOE: M, NC] (1,4,5,49)*

Patients with moderate to severe asthma exacerbations should receive 0.75 mg (750 mcg) of ipratropium over an hour mixed with a continuous albuterol nebulization.

- This is our equivalent of the regimen used in most studies of: ipratropium neb 0.25 mg every 20 minutes for 3 doses.

*In the ED setting when given as multiple doses, ipratropium has been shown to improve lung function and reduce admission rate. [LOE: M] (49)*

- The number of children needed to treat in this systematic review was 12 to prevent one admission.

*There is no evidence that treatment with ipratropium is of benefit to children beyond their initial dosing in the ED. [LOE: B] (52,53)*

We do not recommend routine use of ipratropium in the inpatient unit.

# Corticosteroids in the ED for Asthma Exacerbations

## ED Treatment: Dexamethasone

All patients with asthma exacerbations should receive a single dose of dexamethasone at 0.6 mg/kg within the first hour of presentation. (max: 16 mg)

*Initial effects of systemic steroids are noted at 2 hours with maximal effects seen at 6 hours. [LOE: M] (58)*

*Use of corticosteroids within 1 hour of presentation to an ED significantly reduces the need for hospital admission in patients with acute asthma. [LOE: M, NC] (1,4,5,58)*

If the patient can be discharged from the ED, they should complete a second dose of 0.6 mg/kg on the following day for a total of 2 days of therapy.

*For outpatients, this is as effective as 5 days of prednisone or prednisolone. [LOE: B] (56,61,66)*

*Additional regimens such as single dose dexamethasone PO and IM have been studied but are not recommended at this time. [LOE: B] (60,62,65,66)*

IV methylprednisolone is not recommended for routine use but is dosed as follows:

•Loading dose 2 mg/kg/dose x1 then 1 mg/kg q6-12 hrs until patient can be transitioned to orals.

*IV steroid is only needed when orals are not tolerated or GI absorption is in question. [LOE: NC,C] (1,4,5,70)*

*Extra doses of inhaled corticosteroids have not been shown to be of any benefit in an asthma exacerbation. [LOE: M] (69)*

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# Inpatient Corticosteroids for Asthma Exacerbations

## Inpatient Treatment: Prednisone or Prednisolone

We recommend transitioning inpatients to prednisone or prednisolone to complete a 5-10 day total course.

***The standard therapy for an acute asthma exacerbation is a 5-10 day course of systemic steroid. [LOE: NC] (1,4,5)***

Prednisone and prednisolone are dosed at QD or BID at 2 mg/kg/day (60 mg max)

- BID is ideal for absorption but QD is considered adequate therapy.
- Prednisone should only be used for the oral tablet form.
- Prednisolone should be used for the liquid preparation.

Why not just continue the dexamethasone?

- There are no studies on using extended courses of dexamethasone for asthma.

***Steroids reduce length of stay in the hospital and reduce relapse rate. [LOE: M] (57)***

- Only 3 patients need to be treated to prevent a relapse in this systematic review.

*For example,*

- A 20 kg 4 yo boy who received one dose of dexamethasone in the ED is hospitalized for 4 days with an asthma exacerbation. How would you dose his steroid course?
- Answer: The patient is treated for 4 days with prednisone 20 mg bid and then discharged with 3 additional days to cover him until he is seen by his provider.

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# Magnesium Sulfate IV as an Adjunctive Therapy for Severe Asthma Exacerbations

## Magnesium sulfate IV (MgSO<sub>4</sub>)

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This drug produces bronchodilation, smooth muscle relaxation and may also have an antiinflammatory effect.

*Several randomized controlled trials have demonstrated that this is a safe and beneficial treatment for severe acute asthma exacerbations. [LOE: M, A] (70-76, 77-81)*

Magnesium sulfate IV is currently recommended for use in patients 6-18 years old with a moderate to severe exacerbation who do not respond adequately to the first hour of therapy with continuous nebulized albuterol.

### How do I give magnesium sulfate IV? (ED only)

- Magnesium sulfate can be administered IV at 50 mg/kg/dose 1 time over 20 minutes in the emergency department prior to admission. (Max dose: 2 grams)
- We recommend regular vitals during therapy to document any hypotension that might arise. This is an expected side effect that is self-limited and not harmful in the trials noted.
- Checking Mg or Ca levels routinely for patients receiving this therapy is not recommended.
- IV Magnesium sulfate is currently not approved for use in asthma in the inpatient unit.

*Nebulized magnesium sulfate has not been demonstrated to be efficacious in children. [LOE: M] (77)*



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# Asthma Pathway Formulary

Medication	Dosage	Notes
<b>Inhaled Short Acting Beta<sub>2</sub>-Agonists (SABA)</b>		
Albuterol Nebulizer Solution 0.5% 5 mg/mL	20 mg/hr continuous nebulization	Doses up to 30 mg/hr allowed in the inpatient unit.
Albuterol MDI 90 mcg/puff	4-8 puffs q 2-4 hours	Always use with a valved holding chamber (VHC), aka spacer.
Levalbuterol (R-albuterol) 45 mcg/puff	4-8 puffs q 2-4 hours	Not recommended over albuterol but is safe and effective.
Ipratropium bromide Nebulizer Solution 500 mcg/2.5 mL	0.75 mg (750 mcg)	Recommended for mixture with continuous albuterol in initial treatment in moderate to severe exacerbations. Not recommended for use in inpatients.
<b>Systemic corticosteroids</b>		
Dexamethasone PO (tablet or liquid)	0.6 mg/kg/day PO QD (16 mg max dose)	Should be given within 1 hour of entering the ED.
Prednisone PO (tablet)	2 mg/kg/day PO QD or divided BID (60 mg daily max dose)	For inpatient use. Recommended duration of therapy 5-10 days total of steroids.
Prednisolone PO (liquid)	2 mg/kg/day PO QD or divided BID (60 mg daily max dose)	For inpatient use. Recommended duration of therapy 5-10 days total of steroids.
Methylprednisolone IV	1 mg/kg IV q6	Only indicated in patients who cannot tolerate orals or have concerns about GI absorption.
<b>Adjunctive medications</b>		
Magnesium Sulfate IV	50 mg/kg IV over 20 minutes x1 dose	Limits: age 6-18 yo only and only one dose in the ED.

## Additional Adjunctive Therapy for Severe Asthma Exacerbations

### Terbutaline IV

This drug is a nonselective beta-agonist that produces bronchodilation with risk for additional side effects associated with beta<sub>1</sub> stimulation.

- This drug is currently reserved for use with ED and/or ICU consultation.

*Terbutaline's efficacy is not demonstrated by medical literature at this point but it remains widely used for patients who do not respond to conventional therapy. [LOE: M] (82,83)*

### Heliox

Heliox-driven albuterol nebulization has been studied as a method for more effectively delivering medication in asthma exacerbations.

- This treatment is currently reserved for use with ED and/or ICU consultation.

*There is insufficient evidence regarding the effectiveness of heliox in asthma exacerbations to recommend its routine use. [LOE: M] (96-99)*

# Executive Summary



## Project Summary

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### Objective

To update the asthma pathway with the asthma committee's most recent recommendations.

### Recommendations

1. The ED and Inpatient asthma pathways will be combined to optimize treatment as a seamless continuum between the two areas of the hospital.
2. Patients should be evaluated for admission after one hour of therapy.
3. Albuterol MDIs will be used more frequently in the treatment of mild and moderate exacerbations.
4. Ipratropium bromide treatment will be used only in the initial treatment of moderate to severe asthmatics (RS 6-12) and discontinued after 24 hours of use.
5. Magnesium sulphate IV 50 mg /kg x1 can be used in the ED for the adjunctive treatment of patients who remain severe (RS 9-12) after 1 hour of continuous nebulized albuterol.
6. Dexamethasone will be used for initial therapy in the ED and patients will be transitioned to prednisone / prednisolone in the inpatient setting.
7. Patients need only reach albuterol every four hour dosing to be discharged from the hospital.
8. The new asthma management plan (AMP) will be used to promote better communication with families.

### Rationale (Safety, Quality, Cost, Delivery, Engagement, and Patient/Family Satisfaction):

- Costs will be reduced by eliminating the use of ipratropium MDI in the inpatient setting. This will decrease utilization of respiratory therapy resources for administration as well.
- Delivery of care will be improved by expediting patient flow through the emergency department and inpatient setting.
  - Increased albuterol MDI use in the emergency department has been shown to reduce ED length of stay.
  - Evaluation for admission based on response to therapy after 1 hour is anticipated to reduce length of stay in the ED.
  - Inpatient length of stay may be reduced by facilitating discharge at albuterol q4 hours in place of q6.
- Quality of care will improve by:
  - Making magnesium sulphate IV available as an option for treating recalcitrant severe exacerbations. This may reduce ICU admission as well.
  - The change to using prednisone and prednisolone for inpatients should reduce the number of patients who are discharged with an inadequate steroid course which would have resulted in returns to the ED or inpatient setting.
- Engagement is grounded in the fact that the pathway has been developed by RNs, RTs, and MDs.
  - The implementation will include a training module to educate the clinical staff who will be using the pathway.
- Patient/Family Satisfaction will be addressed by implementing clinical standard work that will assure the highest quality of care.
  - The improved asthma management plan should enhance patient education.
  - It is hoped that fewer patients will need to return to the ED or be readmitted with longer steroid courses.

### Evidence

# Executive Summary



## Project Summary

- National Asthma Education and Prevention Program (NAEPP): Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma—Full Report 2007
- Acute Asthma Guideline, Cincinnati Children's Hospital Medical Center: Evidence-based care guideline for management of acute asthma exacerbation in children
- Cates CC, Crilly JA, Rowe BH. Holding chambers (spacers) versus nebulizers for beta-agonist treatment of acute asthma. *Cochrane Database Syst Rev* 2006 Apr 19;(2):CD000052. Review
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- See asthma pathway on CHILd for expanded bibliography.

### Implementation Highlights

- New ordersets
- Asthma pathway training module
- Respiratory therapy teaching sessions / video
- GME sponsored resident noon conference
- Integration with Clindoc

### Metrics Plan

- Monitor ED length of stay, number of cases, ED admit rate (to inpatient & ICU), ED return visit rate, corticosteroid type, ipratropium use, magnesium sulfate use, and adjusted charges/case.
- Monitor inpatient length of stay, order set usage, order set usage for complicated asthma, return rate to inpatient, corticosteroid type, ipratropium use, number of discharges and adjusted charges/case.
- CAC-3 statistics for asthma management plan (AMP)

### PDCA Plan

The asthma CSW owner and committee will follow metrics, continue to review medical literature, and make alterations to pathway in response to these.

### Revision History

Date Approved: August 2011

Review Due: June 2014

# Self-Assessment

- If you are taking this self-assessment as a part of required departmental training, you will need to logon to the [Learning Center](#) to receive credit. Completion also qualifies you for 1 hour of Category II CME credit.

- 1) Which of the following conditions is not an exclusion criterion for being on the SCH asthma pathway?
  - a) Cystic fibrosis
  - b) Sickle cell anemia
  - c) Allergic rhinitis
  - d) Hypoplastic left heart
- 2) A reliable method for determining the need for admission is the response to therapy after one hour of continuous nebulized albuterol.
  - a) True
  - b) False
- 3) You are seeing a 9 yo patient in the ED who receives a respiratory score of 10 on arrival. They receive a continuous albuterol neb at 20 mg with 0.75 mg ipratropium over the first hour as well as their dexamethasone dose. They rescore at an 11. What is the recommended next step for treatment?
  - a) 8 puffs albuterol MDI + admit
  - b) 20 mg continuous albuterol + magnesium sulfate IV + admit
  - c) 20 mg continuous albuterol + ipratropium + admit
  - d) 30 mg continuous albuterol + admit
- 4) Nebulized albuterol is superior to MDI therapy in the treatment of an acute asthma exacerbation.
  - a) True
  - b) False
- 5) Ipratropium is a bronchodilator has been demonstrated to be effective when given:
  - a) Every 6 hours for 5-10 days as an inpatient
  - b) 0.25 mg inhaled every 20 minutes in the ED
  - c) As a continuous drip in the ICU
  - d) In conjunction with theophylline in the ED
- 6) Which of the following is not a sign of impending respiratory failure in a patient with an asthma exacerbation?
  - a) Tinnitus
  - b) Drowsiness
  - c) Silent chest
  - d) Confusion
- 7) Your patient is a 7 year old girl admitted for a moderate asthma exacerbation. After receiving a dose of dexamethasone in the ED, she is ready to go home the following afternoon. What steroid course should you send her on?
  - a) She is sufficiently treated, no more steroids needed
  - b) Prednisolone for 1 more day
  - c) Dexamethasone for 4 more days
  - d) Prednisone for 4 more days
- 8) Which of the following case histories is appropriate for the pathway?
  - a) Patient recently recovered from a "bout of the croup"
  - b) Patient is undergoing chemotherapy for leukemia
  - c) Patient with spastic quadriplegia, a VP shunt and GERD
  - d) Patient admitted for pneumonia who develops wheezing on day 2
- 9) Which care team member is responsible for completing the Asthma Management Plan (AMP)?
  - a) Child life
  - b) MD
  - c) RT
  - d) RN
  - e) MSW
- 10) Which of the following is not a feature of MDIs + spacers?
  - a) Portability
  - b) Do not require a power source
  - c) Delivery of a discrete dose
  - d) No teaching required

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[View Answers](#)

## Answer Key

- 1) The correct answer is (c), all of the other conditions are absolute contraindications for being on the pathway listed earlier.
- 2) The correct answer is (a) based on Kelly et al. which suggests that while it is difficult to predict which patients can be discharged early from the ED that it is fairly reliable to admit patients that do not respond well to their first hour of treatment.
- 3) The correct answer is (b). The recommended therapy is continuous albuterol and to arrange for admission with an option to consider magnesium sulfate in children ages 6-18. (a) is wrong because they are scoring in the 9-12 range. (c) is wrong because a second dose of ipratropium is not recommended. (d) 30 mg continuous albuterol is not a recommended dose although it would be a safe dose.
- 4) The correct answer is (b) False. The Cochrane report on this topic from 2006 shows that these two modalities of administration are equivalent although MDI is our preferred delivery method for all patients except those requiring continuous albuterol.
- 5) The correct answer is (b); Ipratropium has been shown to reduce improve lung function and reduce hospital admission in severe asthma exacerbations if given in 3 consecutive doses of 0.25-0.5 mg inhaled every 20-60 minutes.
- 6) The correct answer is (a); Tinnitus is ringing in your ears. Drowsiness, silent chest and confusion all represent signs of impending respiratory failure in a patient with respiratory distress associated with an asthma exacerbation.
- 7) The correct answer is (d); The recommended corticosteroid for inpatient admission is prednisone or prednisolone to a total of 5-10 days. Duration of therapy is determined based on clinical course and history.
- 8) The correct answer is (a); all other conditions meet exclusion criteria. Having pneumonia, bronchiolitis or croup as your primary diagnosis is an exclusion criteria.
- 9) The correct answer is (b); the MD is responsible for completing the AMP and reviewing with the family. It is important that all of it is filled out including any daily medication such as inhaled corticosteroids. MDs must sign the form as well so that parent's can use it at school if necessary.
- 10) The correct answer is (d); Teaching is vital for patients to properly administer medication to themselves or for parents to give them to their child. Aside from that, all other aspects are features of MDIs.

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# Evidence Ratings

## KEY TO LEVELS OF EVIDENCE

M =Meta-analysis or Systematic Review

A =Randomized controlled trial: large sample

B =Randomized controlled trial: small sample

C=Prospective trial or large case series

D= Retrospective analysis

O= Other evidence

S=Review article

LC =Expert opinion or consensus

NC = National consensus

F =Basic Laboratory Research

X= No evidence

This will appear in the text as [LOE: M]

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## Summary of Version Changes

- **Version 1 (9/14/2011):** Go live
- **Version 2 (9/15/2011):** Patients progressing from Phase II to Phase III are now advanced for a respiratory score of 1-8

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