Asthma v.6.2: Criteria and Respiratory Score

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

Appropriate Use

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

Medications

RESPIRATORY SCORE (RS)

Variable	0 points	1 points	2 points	3 points
RR				
<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
Retractions	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)
Dyspnea				
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
Auscultation	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

Last Updated: December 2015
Next Expected Revision: July 2020

Asthma v.6.2: ED Management

Assess and Score at Triage

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

1st HOUR (ED) PHASE Ia

RS 1-5

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

RS 6-12

- Albuterol continuous neb 20 mg x 1hr
- Ipratropium neb 1.5 mg (0.75 mg for <2 yo)
- Dexamethasone 0.6 mg/kg x1 (16 max)

Assess and Score at end of 1st hour

2nd HOUR (ED) PHASE Ib

RS 1-4
If first hour RS 1-5, discharge

RS 1-4

- If first hour RS 6-9, observe for 1 hour
- If first hour RS 10-12, observe for 2 hours

RS 5-8

Albuterol MDI 8 puffs

RS 9-12

- Albuterol continuous neb 20 mg/hr
- Ipratropium neb 1.5 mg (0.75 mg for <2 yo) if not given
- Magnesium Sulfate IV 50 mg/kg x1 (max 2 grams) for age ≥ 2 y.o
- Place bed request

Assess and Score at end of 2nd hour

3rd HOUR (ED) PHASE Ic

RS 1-4

Discharge

RS 5-8

- Albuterol MDI 8 puffs
- Give Ipratropium neb 1.5 mg (0.75 mg for <2 yo) if not given
- Admit to Phase III

RS 9-12

- ICU Consult for RS 10-12
- Albuterol continuous neb 20 mg/hr
- Magnesium Sulfate IV 50 mg/kg x1 (max 2 grams) for age ≥ 2 y.o. if not given
- Admit to Inpatient / ICU
- If undecided on Inpatient or ICU, move on to 4th hour

Assess and Score at end of 3rd hour

4th HOUR (ED) PHASE Id

RS 1-8
Admit to Inpatient

RS 9-10
Albuterol continuous neb 20 mg/hr x 1 hr

RS 11-12
Admit to ICU

Assess and Score at end of 4th hour

- Huddle with: Floor Charge Nurse, Floor Team and consider ICU consult (if not already done)
- Admit to Inpatient or ICU

Urgent Care Transfer Criteria

- Score >8 following first hour of nebulized albuterol- send by ALS
- Score 5-8 following 8 puffs of albuterol in second hour- send by ALS
- Signs of clinical deterioration or poor clinical response to therapy

ED Discharge Criteria

- RS 1-4 for minimum of 1 hour (Patients with an initial RS of 10-12 should be observed for 2 hours prior to discharge)
- Tolerating oral intake
- Adequate family teaching
- Follow-up established

Discharge Instructions

- Continue to use albuterol MDI every 4 hours until seen by provider
- Follow up with provider within 24-48 hours (when possible)

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For questions concerning this pathway, contact: Asthma@seattlechildrens.org

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Next Expected Revision: July 2020

Asthma v.6.2: Inpatient Management

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

!
Signs of Clinical Deterioration:

Drowsiness, confusion, silent chest exam, hypercapnea

PHASE II: INPATIENT

- **Albuterol** continuous neb 20 mg/hr (maximum on floors)
- 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
- Begin discharge teaching and planning

PHASE IV: INPATIENT

- **Albuterol** MDI 8 puffs q 4 hours
- Assessment q 4 hours

PHASE V: INPATIENT

- **Albuterol** MDI 4 puffs q 4 hours
- Assessment q 4 hours

Call RRT for:

- Signs of clinical deterioration
- RS 9-10 on Continuous albuterol for 12 hours in phase II
- RS 11-12

RISK Watch on Inpatient
- Dashboard until RS <9

ICU Transfer
- RS 11-12 with 3 hours continuous
- Signs of clinical deterioration

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 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 Change by Respiratory Score is the standard of care for patients on the asthma pathway
- Scoring is performed by RN & RT

Patients with unique clinical conditions that complicate their asthma treatment: Phase Change by Physician Assessment & Order Only
- Scoring by RN, RT & MD
- Provider to assess pt every 2-3 hrs

Conditions in which this is appropriate:
- Patient transferred from ICU
- Complex asthma history (e.g. hx intubation for asthma)
- Medical comorbidity (e.g. morbid obesity)

If Physician Assessment needed for phase changes, go to Inpt Asthma phase to discontinue "Phase Change by Respiratory Score" subplan and order "Phase Change by Physician Assessment & Order Only" subplan. If appropriate, "Phase Change by Respiratory Score" may also be re-ordered as patient improves.

Discharge Criteria
- **In Phase V with RS 1-4**
- **Observe for minimum of 2 hours after initial treatment in Phase V**
- **Tolerating oral intake**
- **No supplemental oxygen**
- **Completion of asthma education and asthma management plan**
- **Follow-up established**

Discharge Instructions
Discharge With Asthma Management Plan
- **"Living with Asthma" book**
- **Follow-up with PCP in 24-48 hours (when possible)**

For questions concerning this pathway, contact: Asthma@seattlechildrens.org

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Next Expected Revision: July 2020

Asthma v.6.2: Appropriate Use of the Pathway

Asthma Orderset
For use with any patients with an asthma exacerbation.

Does patient meet inclusion/exclusion criteria?

YES

NO

Asthma Pathway
For use with all patients with an asthma exacerbation who are expected to benefit from standardized care.

Please select "Exclude from Pathway" and indicate the reason.

Note: Patients not on the asthma pathway are not considered safe to receive continuous albuterol on the floors. Contact the charge nurse or the CNS to discuss alternatives.

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

Do you anticipate that your patient will score reliably?

YES

NO

Phase Change by Respiratory Score

- This is the standard.
- Your patient will be scored by the RN and RT and advanced by protocol.

Phase Change by Physician Assessment and Order Only

- The MD is expected to assess the patient every 2-3 hours while in phase 2 & 3.
- Please discuss the use of this order with RN and RT prior to use as it represents a deviation from the standard of care.

Phase Change by Respiratory Score is the standard of care for patients on the asthma pathway.

- Scoring is performed by RN & RT

Patients with unique clinical conditions that complicate their asthma treatment: Phase Change by Physician Assessment & Order Only

- Scoring by RN, RT & MD
- Provider to assess pt every 2-3 hrs

Conditions in which this is appropriate:

- Patient transferred from ICU
- Complex asthma history (e.g. hx intubation for asthma)
- Medical comorbidity (e.g. morbid obesity)

If Physician Assessment needed for phase changes, go to Inpt Asthma phase to discontinue "Phase Change by Respiratory Score" subplan and order "Phase Change by Physician Assessment & Order Only" subplan. If appropriate, "Phase Change by Respiratory Score" may also be re-ordered as patient improves.

To Pg 2

Return to Criteria & Respiratory Score

For questions concerning this pathway, contact: Asthma@seattlechildrens.org

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Next Expected Revision: July 2020

Asthma v.6.2: Examples for Appropriate Use of the Pathway

Scenario	Issue	Pathway Inclusion	Phase Advancement	Education
Patient also has a viral illness	Viral illnesses that result in pneumonia, bronchiolitis or croup may not score predictably.	**Yes**	**Standard (RN & RT)**	Virus alone does not preclude use of pathway or scoring tool.
Patient also has pneumonia	Patients with pneumonia may have hypoxia that does not respond to asthma treatment.	**Yes**	**Standard (RN & RT)**	Assess the patient for evidence that pneumonia might be the predominant problem: • infiltrate on CXR • minimal or no response to albuterol treatment • fever
Patient also has bronchiolitis	Some patients with bronchiolitis respond to albuterol treatment.	**Yes**	**Standard (RN & RT)**	Assess the patient for evidence that bronchiolitis might be the predominant problem: • responsive to nasal suctioning • minimal or no response to albuterol treatment • less than 2 year old (children < 1 yr should not be on the asthma pathway)
Patient also has croup	Some patients with croup wheeze as well.	**Yes**	**Standard (RN & RT)**	Assess the patient for evidence that croup might be the predominant problem: • moderate stridor • wheeze not improved with albuterol
Patient transferred from ICU	Patient's exacerbation may be more severe than a typical floor patient.	**Yes**	Most patients: **Standard (RN & RT)** *Consider using MD assessment orderable*	The decision to order advancement by MD should be discussed with RN and RT prior to use.
Complex asthma history	Intubation for asthma, previous ICU stay for asthma, 2+ admits for asthma in past year, or chronic steroid use for asthma.	**Yes**	Most patients: **Standard (RN & RT)** *Consider using MD assessment orderable*	The decision to order advancement by MD should be discussed with RN and RT prior to use.
Medical comorbidity	Obstructive sleep apnea, morbid obesity, or another condition that might impair assessment.	**Yes**	Most patients: **Standard (RN & RT)** *Consider using MD assessment orderable*	The decision to order advancement by MD should be discussed with RN and RT prior to use.
Patient requires continuous albuterol but does not meet inclusion criteria.	Patients < 1 year or with significant comorbidities are not considered safe to receive continuous albuterol on the floors.	**No**	**N/A**	**Contact ICU and discuss case with medical CNS or charge.** This patient population likely requires a higher level of nursing care while on continuous albuterol.
The medical team disagrees with the content of the Asthma CSW.	Some providers bring experience or knowledge to patient care that differ from these standards.	**Yes**	**Standard (RN & RT)**	Please discuss any concerns that you have with the CNS or charge nurse. To contact the Asthma CSW Team, **Email:** asthma@seattlechildrens.org

To Pg 2

Return to Criteria & Respiratory Score

Respiratory Scoring Tool

How are patients scored using the tool?

The respiratory scoring tool consists of four 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
- The SCH respiratory scoring tool has been validated for interobserver reliability. *(15)*

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

- *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. (1,2,20,23,26)*

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

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Respiratory Scoring Tool

Variable	0 POINTS	1 POINT	2 POINTS	3 POINTS
RR				
<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
RETRACTIONS				
	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)
DYSPNEA				
0-2 yrs	Normal feeding, vocalizations & 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 yrs	Normal feeding, vocalizations & 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 & confused
>4 yrs	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
AUSCULTATION				
	Normal breathing, no wheezing present	End-expiratory wheeze only	Expiratory wheeze only (greater than end-expiratory wheeze)	Inspiratory & expiratory wheeze OR diminished breath sounds OR both

Return to Criteria & Respiratory Score

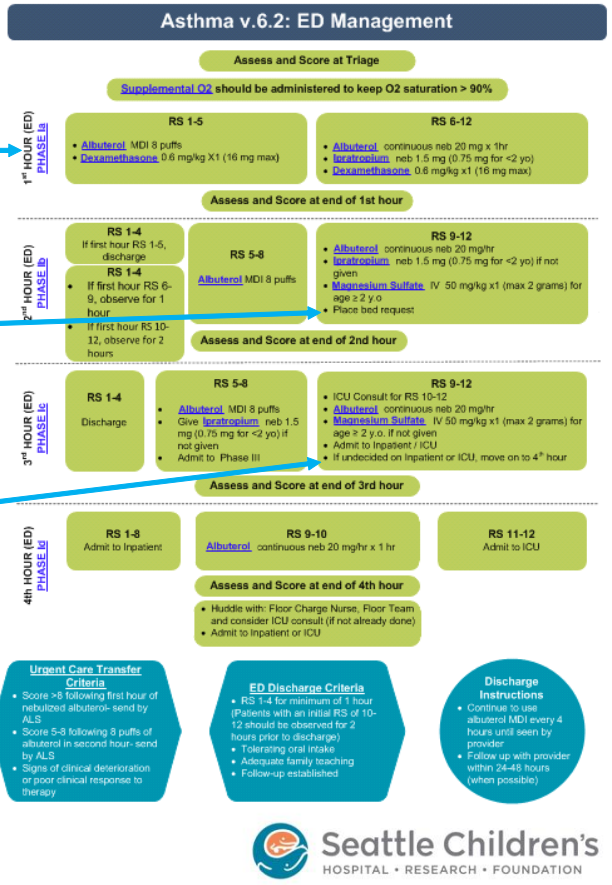
ED Pathway Overview

Patients >2 yrs old will now get 1.5 mg Ipratropium bromide

Patients >2 yrs old scoring 9-12 in the first hour should receive one dose of Magnesium sulfate

Patients can be admitted to the floors or the ICU after 2 hours of therapy

Patients in urgent care who score >8 following the first hour should transfer to the SCH ED



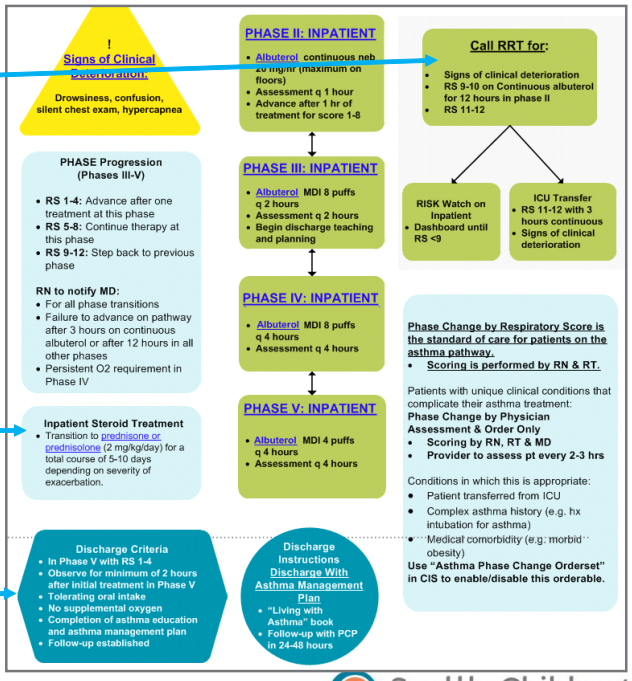
Return to Management

Inpatient Overview

RISK nurse and RRT available to assure that patients who do not respond appropriately to therapy can be more closely monitored or transferred to the ICU.

After their ED dose of dexamethasone, transition to prednisone or prednisolone to complete a total of 5-10 days of steroids based on clinical severity.

Patients no longer need to receive 2 treatments in phase V for discharge. They should be observed for at least 2 hours prior to leaving though.



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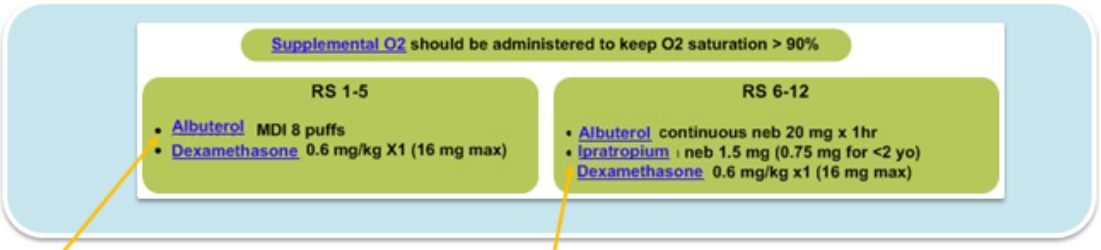
Return to Inpatient

Phase Ia: Treatment in the First Hour in the ED



Lower acuity patients receive albuterol MDI.

- It is just as effective as nebulized delivery.

The dose of ipratropium has been doubled to 1.5 mg in patients greater than 2 years old.

- Evidence suggests that this might reduce admission rates.

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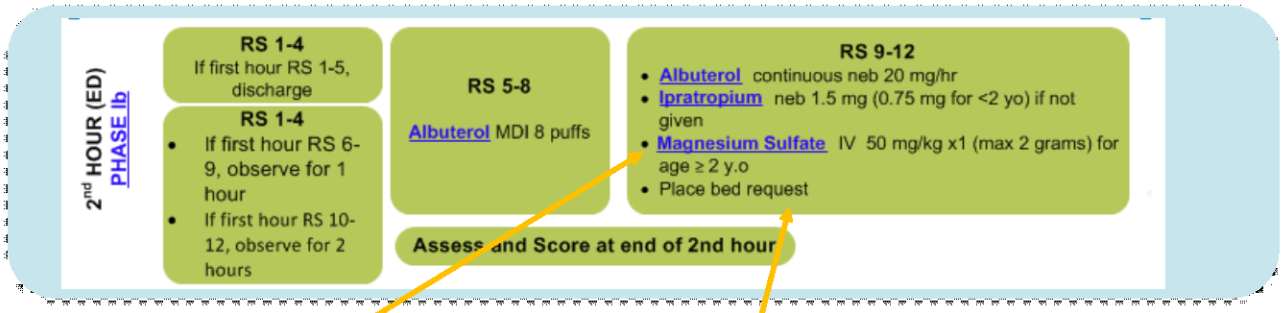
Phase Ib: Second Hour in the ED



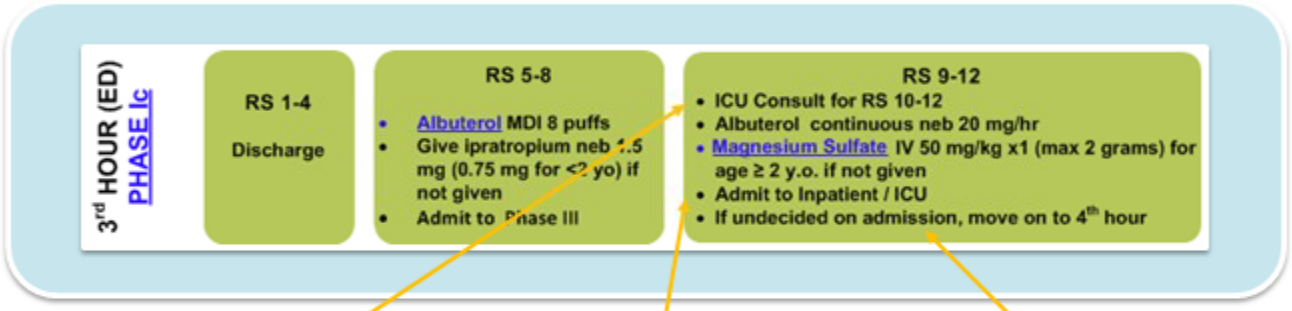
All patients who continue to have a RS of 9-12 after one hour of therapy should be given Magnesium Sulfate IV one time.

- Patients scoring 9-12 should not be admitted prior to receiving Magnesium as this is not available on the floors.

Place a bed request at this point to facilitate patient flow.

Return to Management

Phase Ic: Third Hour in the ED



All patients scoring 10-12 should get a PICU consult at this point.

If uncertain about disposition, have a follow-up huddle after another hour of treatment with the ICU and floor team.

Admission should be facilitated at this point to the inpatient unit or the ICU.

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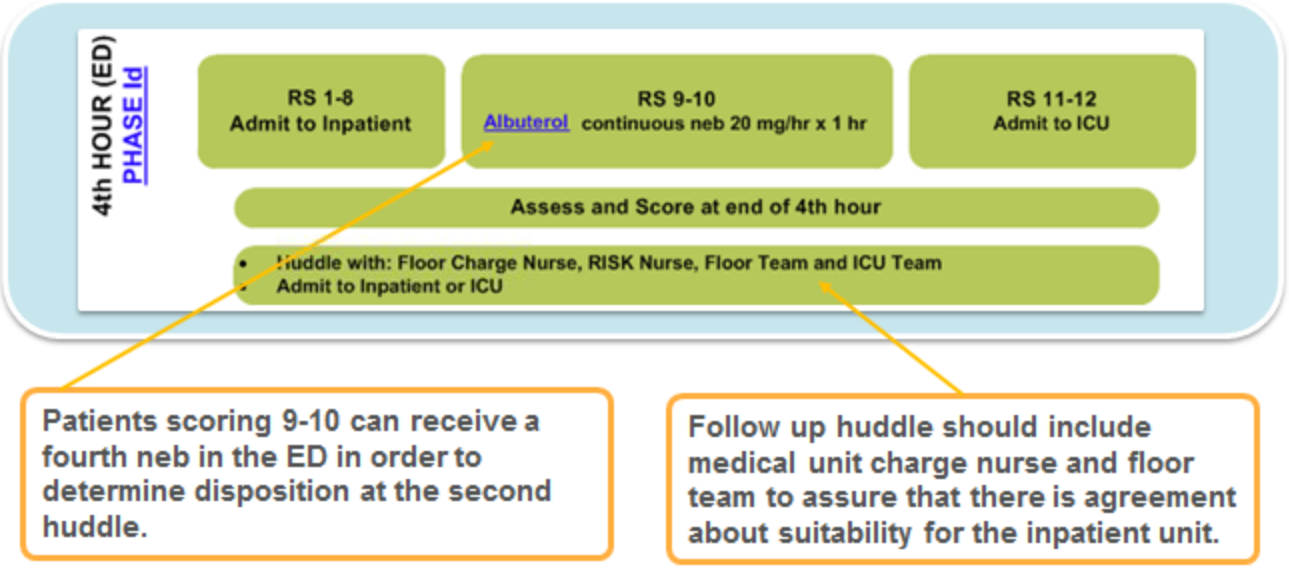
Phase Id: Fourth Hour in the ED



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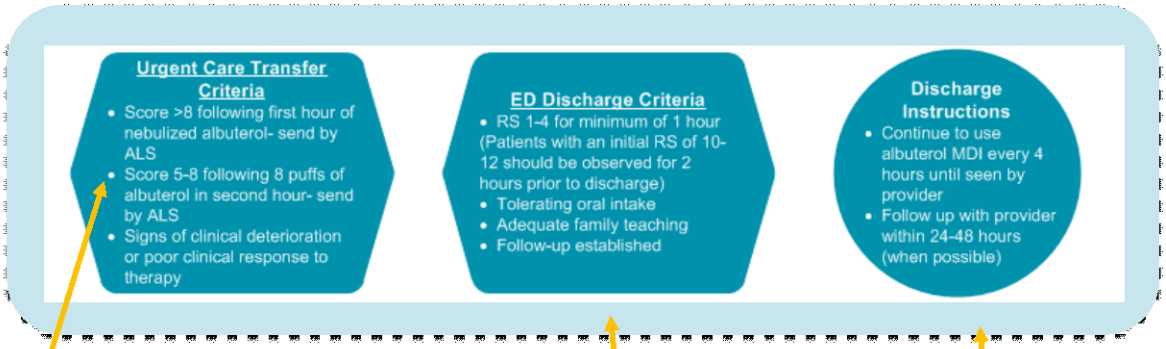
Return to Management

Transfer / Discharge in Urgent Care and the ED



Patients who are likely to be admitted have criteria to be transferred to the ED.

Patients receiving continuous albuterol should be observed for 2 hours off therapy prior to discharge.

All asthma discharges should have follow up arranged within 24-48 hours.

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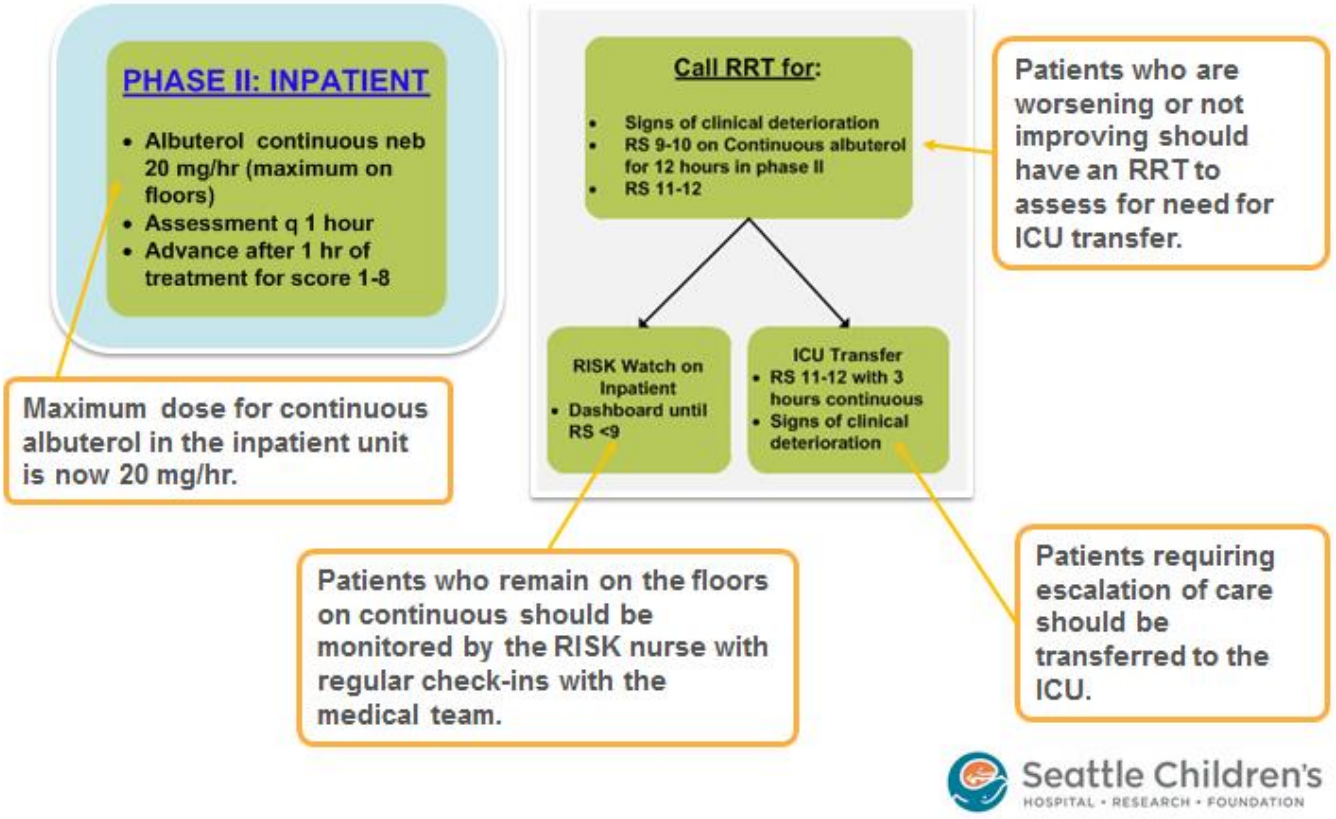
Phase II: Continuous Nebulized Albuterol 20 mg/hr



Return to Management

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 12 hours in any phase.
Drowsiness:	Drowsiness is highly associated with acute respiratory acidosis. (100)
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 pCO2 of >40-45. (1,4,5,100-104)
Confusion:	Altered mental status

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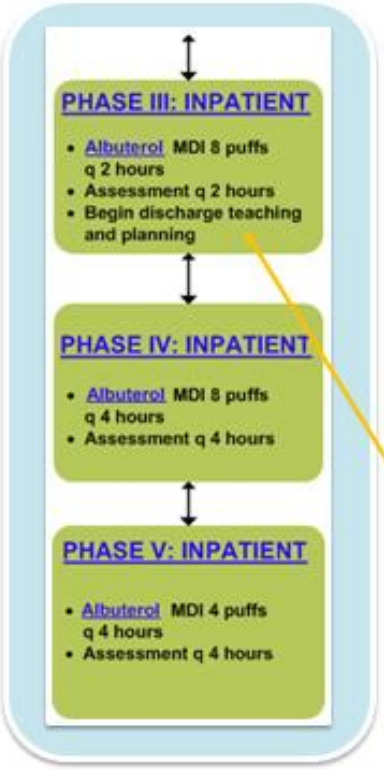
Phase III-V: Weaning Albuterol MDI treatment



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

Nurses and RTs score the patient in order to wean them off albuterol until the patient reaches an appropriate regimen for home.

Once a patient is on MDI, the respiratory therapist begins asthma teaching using the Living with Asthma book.

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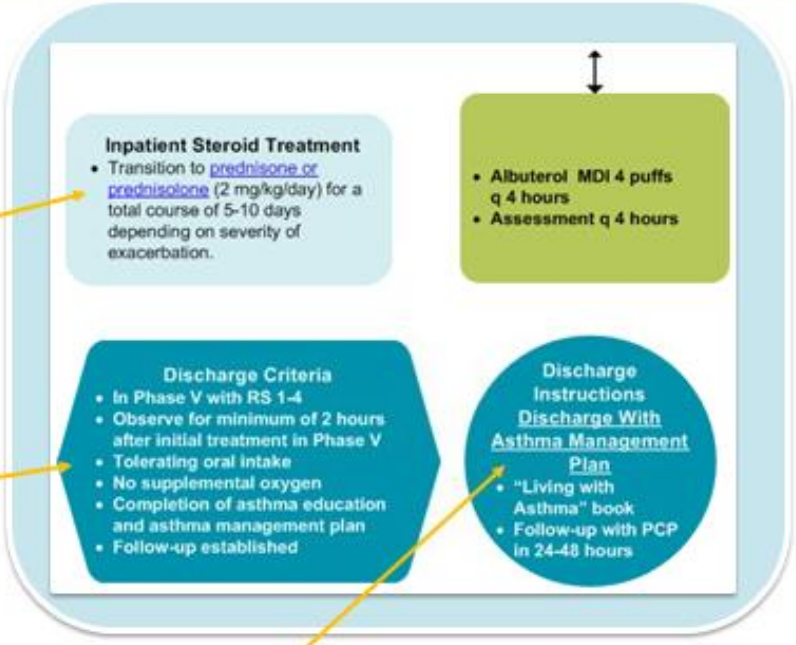
Inpatient Asthma Discharge

Inadequate treatment with oral steroids is a risk factor for readmission.

- As a guideline, patients should receive 3-5 days of steroid past discharge day.



Patients should be observed for a minimum of 2 hours after their first treatment with 4 puffs.

The asthma management plan ("asthma action plan") is required discharge education for families. It can be found in "ad hoc charting " in CIS.

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Asthma Education and Discharge

Discharge Instructions
Discharge With Asthma Management Plan
- "Living with Asthma" book
- Follow-up with PCP in 24-48 hours

Discharge Checklist:	
❑ "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.
❑ 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.

❑ *Patients should be offered refills on all medications.*

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Asthma Exacerbation Management Options

- Oxygen
- Albuterol
- Ipratropium
- Magnesium Sulfate
- Systemic Corticosteroid
- Terbutaline
- Heliox

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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: Guideline] (1,2,3)*
  - Supplemental oxygen is administered with all continuous nebulization therapy.
- *Monitoring oxygen saturation is recommended for patients with acute asthma exacerbations. [LOE: Guideline,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. (8,9)
- However, it is not useful as the sole indicator for need for admission. (11,13)
- An oxygen saturation of < 92% after 1 hour of treatment is a better predictor of need for hospitalization than initial oxygen saturation. (7,14).
- Persistent hypoxia in the presence of an adequate response to therapy can be indicative of another contributing condition such as pneumonia.

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Albuterol Treatment for Asthma Exacerbations

Albuterol

- An inhaled short-acting beta2-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)*

Albuterol Treatment for Asthma Exacerbations (Cont'd)

- Methods of administration (Cont'd):
  - Metered dose inhaler (MDI) versus nebulized medication

Recommendations (2015):

- ***Give albuterol in the form of MDI as the standard method of delivery. (●●○○Ditcham 2014, Sabato 2011, Titus 2012)***
- ***Give nebulized albuterol as the standard for method of delivery for continuous. (●●○○Ditcham 2014, Sabato 2011, Titus 2012)***
- ***Breath actuated nebulizers should be explored as an alternative delivery method.***

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Albuterol Treatment for Asthma Exacerbations (Cont'd)

- 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. (23)
    - MDI use in acute asthma is associated with shorter length of stay in the ED and lower pulse rates. (1,4,5,23,27,39,43)
    - MDIs should always be administered with a valved-holding chamber (VHC). (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

Albuterol Treatment for Asthma Exacerbations (Cont'd)

- Levalbuterol
  - An alternative short-acting beta2-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. (1,4,28,29,31,32,33,37)
  - It is therefore not recommended for use.

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. (1,4,5,49)

Recommendations (2015):

Use ipratropium dosing of 750 mcg for patients less than 2 years of age and 1500 mcg in patients older than 2 years of age the ED for treatment of status asthmaticus. All admitted patients should receive ipratropium in the ED.
(✪✪✪○ Zorc 1999, Dotson 2009, Griffiths 2012, Iramain 2011, Qureshi 1997, Vezina 2014, Craven 2001, Goggin 2001, Qreshi 1998, Schuh 1995)

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Ipratropium Treatment for Asthma Exacerbations (Cont'd)

Ipratropium bromide (Atrovent) (Cont'd)

- In the ED setting when given as multiple doses, ipratropium has been shown to improve lung function and reduce admission rate. (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. (52,53)

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

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Return to Management

Magnesium Sulfate IV as an Adjunctive Therapy for Asthma Exacerbations

Magnesium sulfate IV ($MgSO_4$)

- Mechanism: This drug produces bronchodilation, smooth muscle relaxation and may also have an anti-inflammatory effect.

Recommendations (2015):

Give IV Magnesium sulfate to all patients 2 years of age and older who are being admitted on continuous albuterol prior to leaving the ED *(✪✪○○ Low quality- Shan 2013, Powel 2014, Egelund 2013)*

- We recommend use in the first 6 hours of presentation in moderate to severe exacerbations whose respiratory score remains 9-12 after the first hour of continuous nebulized albuterol.
- Magnesium sulfate can be administered IV at 50 mg/kg/dose 1 time over 30 minutes in the emergency department prior to admission. (Max dose: 2 grams)

Magnesium Sulfate IV as an Adjunctive Therapy for Asthma Exacerbations (Cont'd)

Magnesium sulfate IV ($MgSO_4$) (Cont'd)

- We recommend administration of 20 mL/kg NS bolus prior to infusion to avoid hypotension. 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 has been demonstrated to be efficacious in children but is currently not the recommended therapy at SCH.

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Return to Management

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. (58)
  - Use of corticosteroids within 1 hour of presentation to an ED significantly reduces the need for hospital admission in patients with acute asthma. (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. (56,61,66)
  - Additional regimens such as single dose dexamethasone PO and IM have been studied but are not recommended at this time. (60,62,65,66)

Corticosteroids in the ED for Asthma Exacerbations (Cont'd)

ED Treatment: Dexamethasone (Cont'd)

- 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. (1,4,5,70)
    - Extra doses of inhaled corticosteroids have not been shown to be of any benefit in an asthma exacerbation. (69)

Recommendations (2015):

Use dexamethasone for the treatment of status asthmaticus in the ED. *(✪✪✪✪ Meyer 2014, Keeney 2014)*

- *There is less emesis associated with the administration of dexamethasone versus alternative oral steroids.*

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Inpatient Corticosteroids

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. (1,4,5)
- Prednisone and prednisolone are dosed QD at 2 mg/kg/day (60 mg max)
  - QD dosing is recommended to improve adherence.
  - 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. (57)
- Only 3 patients need to be treated to prevent a relapse in this systematic review.

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Return to Management

Asthma Pathway Medications

Medication	Dosage	Notes
Inhaled Short Acting Beta$_2$-Agonists (SABA)		
Albuterol Nebulizer Solution 0.5% 5 mg/mL	20 mg/hr continuous nebulization	Doses up to 20 mg/hr allowed in the inpatient unit. Doses beyond this require ICU.
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	0.75-1.5 mg (750-1500 mcg)	1500 mcg is the recommended dose for 2 years and older. 750 mcg should be used for less than 2 years old. Not recommended for use in inpatients.
Systemic corticosteroids		
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 (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 (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 (60 mg max per dose)	Only indicated in patients who cannot tolerate orals or have concerns about GI absorption.
Adjunctive medications		
Magnesium Sulfate IV	50 mg/kg IV over 30 minutes x1 dose (max dose 2g)	Limits: age 2-18 yo only and only one dose in the ED.

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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 beta1 stimulation.
- This drug is currently reserved for use with ED and/or ICU consultation.
- Given concerns about cardiac effects evidenced by diastolic hypotension and elevated cardiac enzymes in other studies (see albuterol data), its use should be carefully considered.

Restrict terbutaline usage to ICU consult only. (✪✪✪○ *Travers 2012, Carroll 2006)*

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. (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. (96-99)

Return to Criteria & Respiratory Score

Return to Management

Executive Summary

Objective

Update the CSW Asthma Pathway to ensure consistency with current literature and CSW standards.

Recommendations

1. Magnesium sulfate IV will now be used in patients age 2 and older who continue to have a respiratory score of 9-12 after the first hour of therapy in the Emergency Department.
2. Terbutaline remains restricted to use with ICU consult only, secondary to concerns about cardiotoxicity.
3. Subcutaneous epinephrine should be restricted to use in anaphylaxis only.
4. Breath actuated nebulizers should be explored as an alternative delivery method for inhaled medications in asthma.
5. Levalbuterol is not routinely recommended for use in an asthma exacerbation.
6. Dexamethasone remains the treatment of choice (due to ease of use and decreased emesis) in the Emergency Department setting.
7. Prednisone / Prednisolone for a total of 5-10 days remains the treatment of choice for patients admitted with asthma.
8. Continuous albuterol at doses greater than 20 mg/hr is restricted to use with ICU consult only, secondary to concerns about cardiotoxicity.
9. Increased dosing of Ipratropium 1500 mcg in patients age 2 and older in the Emergency Department for treatment of status asthmaticus. Dosing of 750 mcg should be used for patients less than 2 years of age. All admitted patients should receive ipratropium in the Emergency Department.

Rationale

- The recommendations have been made based on nursing, respiratory therapist and provider feedback, quality and safety data collected at Seattle Children's Hospital, and evidence based medicine.

Evidence

A complete literature search was performed consisting of the following databases: Medline, Cochrane Database of Systematic Reviews, Embase, Clinical Evidence, National Guideline Clearinghouse, TRIP and Cincinnati Children's Evidence-Based Care Guidelines. Clinical questions regarding albuterol and ipratropium were searched from 1990 to date; clinical questions regarding magnesium sulphate, levalbuterol, and corticosteroids were searched from 2011 to date; clinical questions regarding terbutaline and subcutaneous epinephrine were searched from 2004 to date.

Implementation Items

- Revised algorithm, including Urgent Care setting and improved admission and discharge criteria
- Revised web-based training module for clinicians
- Revised powerplan

Return to Criteria & Respiratory Score

To Pg 2

Executive Summary

Metrics Plan

- CSW Core Metrics
  - Count of inpatient and observation discharges
  - Median Length of Stay
  - Percent of patients with any of the specified powerplans
  - Average charges per case
  - Readmission
- Asthma Process Metrics
  - Magnesium sulfate usage in the ED
  - Asthma management plan activation rate
  - Time to corticosteroids in the ED
  - Corticosteroid prescription rate for hospitalized patients
  - Future metrics as determined by asthma improvement team

PDCA Plan

The clinical pathway team will meet quarterly to review metrics, medical literature, and any issues with the use of pathway related tools.

Revision History

Date Approved: **July 2015**
Next Review Date: **July 2020**

Approved by the CSW Asthma Pathway team on July 15, 2015

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Owner:	Chad Atkins, MD
Owner:	Lynda Ken, MD
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Emergency Department:	Russ Migita, MD
Emergency Department CNS:	Elaine Beardsley, RN, MN
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Return to Criteria & Respiratory Score

Asthma Approval & Citation

Approved by the CSW Asthma Team for the July 2015 go live.

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Retrieval Website: http://www.seattlechildrens.org/pdf/asthma-pathway.pdf

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Return to Criteria & Respiratory Score

Self-Assessment

- **Completion qualifies you for 1 hour of Category II CME credit. If you are taking this self-assessment as a part of required departmental training at Seattle Children's Hospital, you MUST logon to Learning Center.**

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 3 yo patient in the ED who receives a respiratory score of 10 on arrival. They receive a continuous albuterol neb at 20 mg with 1.5 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) As a one-time nebulized treatment during the ED visit
   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

Return to Criteria & Respiratory Score

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 with the new recommendations, to give Magnesium Sulfate for all patients ≥ 2 who continue to have a high RS (9-12). (a) is wrong because they are scoring in the 9-12 range. (c) Is wrong because a second dose of ipratropium is not recommended. If the patient has come from an outside hospital and has only received 0.75mg and they are ≥ 2, then you should give them the rest of the dose to equal a total dose of 1.5mg (d) 30 mg continuous albuterol is not a recommended dose outside of the ICU given concerns for cardiotoxicity.

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 the ED; the new recommended doses are 1.5mg nebulized for ≥2yo and 0.75mg for <2yo.

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.

Return to Criteria & Respiratory Score

Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children's. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94.):

Quality ratings are *downgraded* if studies:

- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings are *upgraded* if it is felt that:

- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

Guideline – Recommendation is from a published guideline that used methodology deemed acceptable by the team.

Expert Opinion – Our expert opinion is based on available evidence that does not meet GRADE criteria (for example, case-control studies).

Quality of Evidence:

✪✪✪✪ High quality
✪✪✪○ Moderate quality
✪✪○○ Low quality
✪○○○ Very low quality
Guideline
Expert Opinion

To Bibliography

Return to Home

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
- **Version 2.1 (10/19/2011):** Added reminder to algorithm that IV Magnesium Sulfate is restricted to patients ≥ 6 years of age.
- **Version 3 (12/4/12):** Added information regarding appropriate use of pathway; Magnesium Sulfate should be given to all qualified patients in the Emergency Department
- **Version 4.0 (10/13/2014):** "Poor Clinical Response" added. Clinical deterioration altered to promote RRT or code blue as response. Peak flow suggestion removed.
- **Version 5.0 (1/29/2015):** Poor clinical response page changed: specific medication recommendations removed and re-huddle time changed to 4 hours.
- **Version 6.0 (7/15/2015)**: Scheduled review update (see executive summary for significant changes)
- **Version 6.1 (7/22/2015)**: Methylprednisolone IV and Magnesium Sulfate IV updated on medication slide/tab.
- **Version 6.2 (12/11/15):** Generic language clarification for ED phase.

Return to Criteria & Respiratory Score

Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children's Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

Readers should confirm the information contained herein with other sources and are encouraged to consult with their health care provider before making any health care decision.

Return to Home

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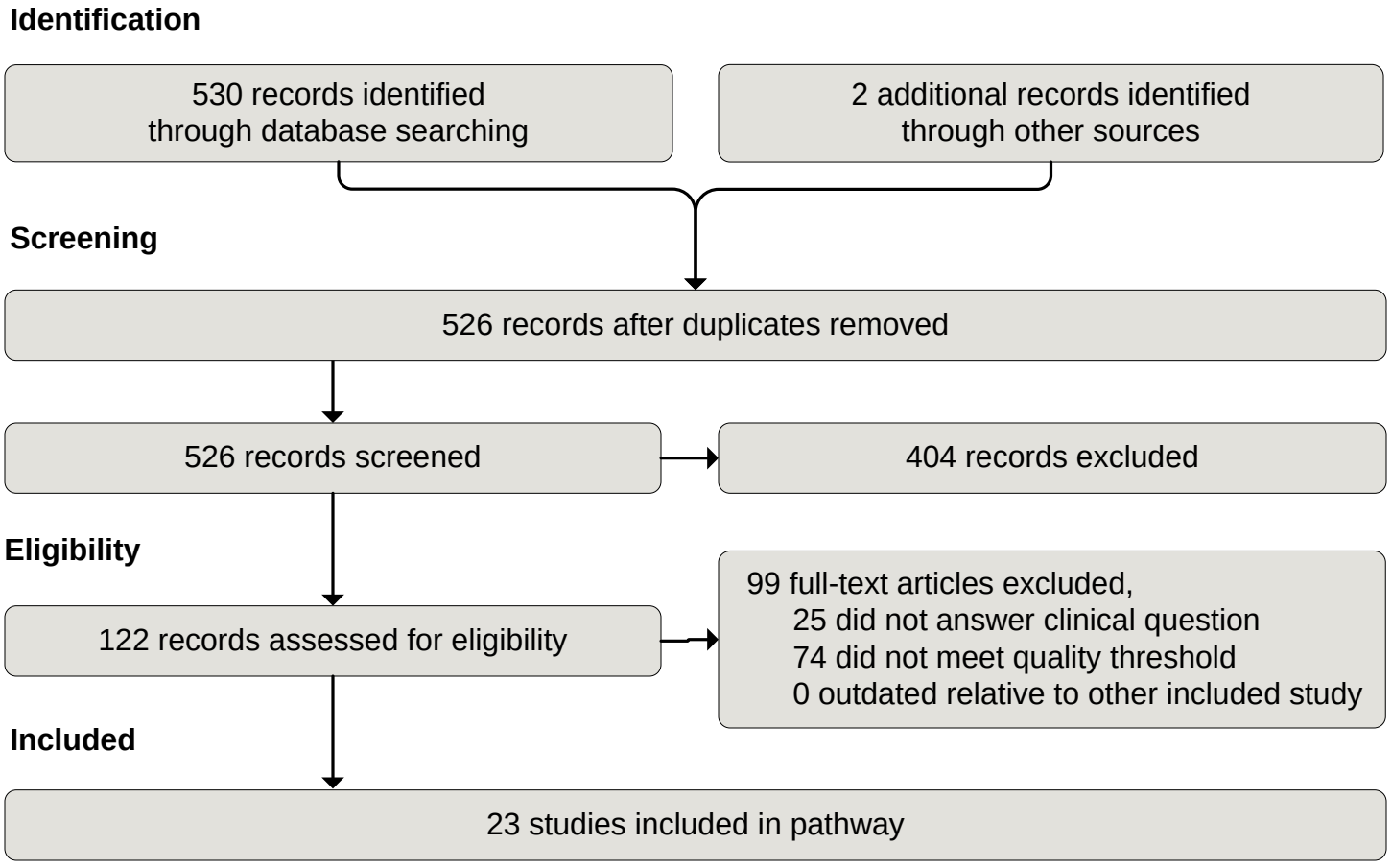
Search Methods, *Asthma Pathway,* Clinical Standard Work

Studies were identified by searching electronic databases using search strategies developed and executed by a medical librarian, Jackie Morton. Searches were performed in December, 2014. The following databases were searched – on the Ovid platform: Medline, Cochrane Database of Systematic Reviews; elsewhere – Embase, Clinical Evidence, National Guideline Clearinghouse, TRIP and Cincinnati Children's Evidence-Based Care Guidelines. Clinical questions regarding albuterol and ipratropium were searched from 1990 to date or the closest date range available in the respective databases. Clinical questions regarding magnesium sulphate, levalbuterol, and corticosteroids were searched from 2011 to date and clinical questions regarding terbutaline and subcutaneous epinephrine were searched from 2004 to date.

Retrieval was limited to humans ages 0 – 18 and English language. In Medline and Embase, appropriate Medical Subject Headings (MeSH) and Emtree headings were used respectively, along with text words, and the search strategy was adapted for other databases using their controlled vocabularies, where available, along with text words. Concepts searched were asthma or status asthmaticus, therapeutics, dosing and drug delivery systems. All retrieval was further limited to certain evidence categories, such as relevant publication types, Clinical Queries filters for diagnosis and therapy, index terms for study types and other similar limits.

Jackie Morton, MLS
June 18, 2015



Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535

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To Bibliography Pg 2

Return to Home

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