
Clinical Standardization

PEDIATRIC ASTHMA, ED AND INPATIENT, PATHWAY

Updated: March 24, 2023

Clinical pathway summary

PATIENT POPULATION AND DIAGNOSIS: Includes all patients with a primary diagnosis of asthma between the ages of 2 and 18 years of age.

Exclusions:

- Patients admitted for an acute illness other than asthma, such as, a primary diagnosis of bronchiolitis, pneumonia, or croup
- Patients with Chronic Conditions in addition to asthma
 - Primary Lung Diseases (Cystic Fibrosis, restrictive lung disease, lung transplant)
 - Chronic Lung Disease (bronchopulmonary dysplasia)
 - Congenital and/or Acquired Heart Disease
 - Airway Issues (tracheostomy dependent, tracheomalacia)
 - Medically Complex Children (multiple, severe issues)
 - Immunocompromised (chemotherapy, sickle cell, primary immunodeficiency disorders)

APPLICABLE TO: Helen DeVos Children's Hospital, SH Regional Hospitals

BRIEF DESCRIPTION: Provide management guidelines for patients with primary diagnosis of asthma, utilizing assessment and monitoring to maximize the value of therapy.

[Asthma Severity Score](#)
[Emergency Department Management](#)
[Inpatient Management](#)
[Subspecialty Referral and Follow up](#)
[Regional ED Observation](#)
[Pediatric Critical Care Escalation](#)
[Pediatric Critical Care Weaning](#)

OPTIMIZED EPIC ELEMENTS:

- Pediatric Inpatient Asthma Orderset
- Pediatric ED Asthma Orderset
- Flowsheet documentation
- Inpatient referral
- ED referral

LAST REVISED: 3/24/23

Clinical algorithm:

Asthma Management ED Phase I A-C

Use Pediatric ED Asthma Orderset

Supplemental Oxygen should be administered to keep O₂ saturation at or above 90%

**ED
Initial Assessment
Phase IA**

AS 0-5
Albuterol 8 puffs MDI or 5mg NEB
Dexamethasone 0.6 mg/kg once oral
 (16 mg max)

AS 6-12
Albuterol 15 mg with Ipratropium Bromide 1 mg
 Continuous NEB (over 1 hour)
 (Continuous Oximetry Required)
Dexamethasone 0.6 mg/kg once oral (16 mg max)

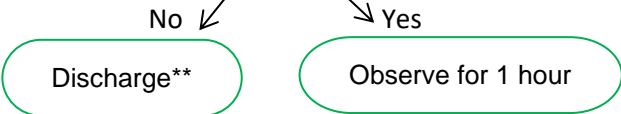
.....Reassess post therapy.....

**ED
Phase IB**

AS 0-4
 Was previous score greater than 5

AS 5-8
Albuterol 8 puffs MDI or 5mg NEB

AS 9-12
Albuterol 15mg Continuous NEB
 add Ipratropium Bromide 1mg if not already given
 (Continuous Oximetry Required)
 Consider magnesium sulfate IV 50mg/kg x1 (max 2 grams)
AS 9-10
 • Regional: Consider transfer to HDVCH ED
 • HDVCH Admit to Phase II
AS 11-12 or PCCU criteria present Admit to HDVCH PCCU



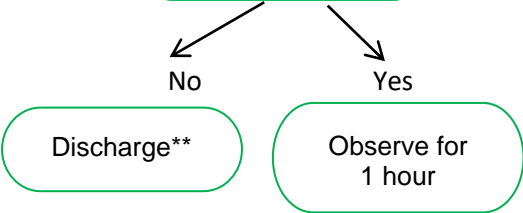
.....Reassess after phase IB therapy.....

**ED
Phase IC**

AS 0-4
 Was previous score greater than 5

AS 5-8
Albuterol 8 puffs MDI or 5mg NEB
 • Admit patient using Phase III guidelines
 • Regional hospitals may direct admit to a general HDVCH floor
 • Continue albuterol per asthma pathway until ED transfer

AS 9-12
Albuterol 15mg Continuous NEB
 add Ipratropium Bromide 1mg if not already given
 (Continuous Oximetry Required)
AS 9-10
 • Regional transfer to HDVCH ED
 • HDVCH Admit patient using Phase II guidelines
 • If score remains 9-10, consider admit to PCCU
AS 11-12 / PCCU criteria present
 • Admit to HDVCH PCCU



****Referral to Allergy Immunology Clinic for patients age 5+ with 2+ ED visits needing treatment for asthma symptoms in the past year**

PCCU Criteria:
AS 11-12
 Drowsiness Confusion
 Silent chest exam

Asthma Management Inpatient Phases II – V

Use Pediatric Inpatient Asthma Orderset

Supplemental Oxygen should be administered to keep O₂ saturation at or above 90%

All patients with an Asthma Score greater than 8 should be admitted to HDVCH

DIRECT ADMISSIONS to floor:

AS 10-12 Albuterol 15 mg with Ipratropium Bromide 1 mg Continuous NEB X1
Then follow phase progression

Inpatient Steroid Treatment

5-10 day course depending on severity of exacerbation

predniSONE / prednisoLONE
2mg/kg/dose daily

Or

Dexamethasone
0.6mg/kg/dose

Or

Methylprednisolone
2mg/kg loading dose via IV

Then

1 mg/kg/dose every 12 hours IV
Or
2mg/kg/dose daily IV
Maximum dose 60mg/day

ED/Observation Steroid Treatment

0.6mg/Kg (max 16 mg) one further home dose given in 4 mg dexamethasone tabs (round to nearest half tab)

Family must receive a copy of the Asthma Action Plan for all Inpatient Discharges

Hospitalist completes AAP.
Additional copies can be printed

Phase II: AS 9-10

Albuterol 10mg Continuous NEB
(Cardiac Monitoring Required)

Asthma Score hourly

Consider hospitalist/intensivist discussion if no progression after 3 hours at phase 2

Phase III: AS 5-8

Albuterol 8 puffs MDI or 5mg NEB every 2 hours

Asthma score every 2 hours.

Phase IV: AS 0-4

Albuterol 8 puffs MDI or 5 mg NEB every 4 hours

Asthma score every 4 hours

Advance to Phase V after one treatment if score remains less than 5

Phase V: AS 0-4

Albuterol 4 puffs MDI or 2.5mg NEB every 4 hours

Asthma score every 4 hours

May discharge after one treatment

PCCU Criteria:

AS 11-12

Drowsiness
Confusion
Silent chest exam
May give one **Albuterol 15mg NEB continuous on floor with Cardiac Monitoring**

Notify Hospitalist Consider calling an AWARE

Phase Progression/Regression

Plan of care is determined and therapy increased or decreased based on AS using scheduled frequency as outlined without the use of PRN therapy.

RT or RN to notify DR for:

- All phase transitions
- Failure to advance in phase II after 3 hours continuous albuterol
- Failure to progress after 12 hours all other phases
- Persistent oxygen requirement in Phase IV
- PCCU criteria present

DR to notify PCCU for

- Asthma score over 10
- Failure to advance after 3 hours continuous

Discharge

Subspecialty Consultation / Referral for Outpatient Follow-up

Consult to Inpatient Respiratory Care Management

- Consult for asthma education or review of Asthma Action Plan if needed.
- Patient will be seen after the Asthma Action Plan has been completed.
- Respiratory Care Managers are available Monday-Friday day shift.

Subspecialty Consultation and Referral

Both the HDVCH Pediatric Pulmonology and Pediatric Allergy/Immunology teams manage patients with asthma. For many patients hospitalized with asthma, subspecialist involvement may be helpful. Here are a few things to consider when deciding whether to seek Pulmonology versus Allergy/Immunology input:

- The Pulmonology Team generally has more inpatient consult availability. Consulting Pulmonology inpatient will allow the patient to be seen in Pulmonology clinic more quickly after discharge in a designated “hospital follow-up” appointment time. If *not* seen inpatient first, it may be several months before scheduled as a new patient in Pulmonology Clinic.
- The Pediatric Allergy/Immunology team generally has quicker outpatient clinic access and urgent visit slots but much less availability to do inpatient consults (Note: if a patient is admitted and already follows with A/I, please do let them know via PerfectServe as they may want to discuss with the team).
- Thus, if a patient hospitalized due to asthma has other suspected or known pulmonary issues such as Obstructive Sleep Apnea, Dysphagia, chronic cough, Bronchopulmonary Dysplasia or Chronic Lung Disease of Infancy, please consider Pulmonology inpatient consultation.
- If a patient has asthma as well as other atopic conditions such as allergic rhinitis, atopic dermatitis, food allergy, etc. please refer to Allergy/Immunology Clinic at discharge.
- Please also note that the Allergy/Immunology team manages all pediatric patients with severe asthma who require biologic therapy (such as Xolair/omalizumab, Dupixent/dupilumab, Fasenra/benralizumab, Nucala/mepolizumab, and Tezspire/Tezepelumab).
- Pulmonology and Allergy/Immunology work very closely together. If you seek subspecialist team involvement and it is determined later that the patient would benefit from seeing the other subspecialist service, Pulmonology or Allergy/Immunology will facilitate referral to the other clinic.

Pediatric Regional Observation Guidelines – Asthma

Inclusion Criteria

- Children \geq 2 years with asthma, reactive airway disease
- Stable vital signs
- Insufficient clinical improvement for discharge after Phase I of ED asthma management

Exclusion Criteria

- < 2 years of age
- Unstable vital signs or significant O₂ requirement (>2L nasal cannula or > 40% O₂ by face mask)
- Need for continuous albuterol or treatments greater than every 2 hours (Strongly consider inpatient admission if respiratory interventions in the ED fail to produce significant improvement after phase I)
- History of significant co-morbidities i.e. extreme prematurity, chronic lung disease, congenital heart disease, CF, significant neuromuscular disease

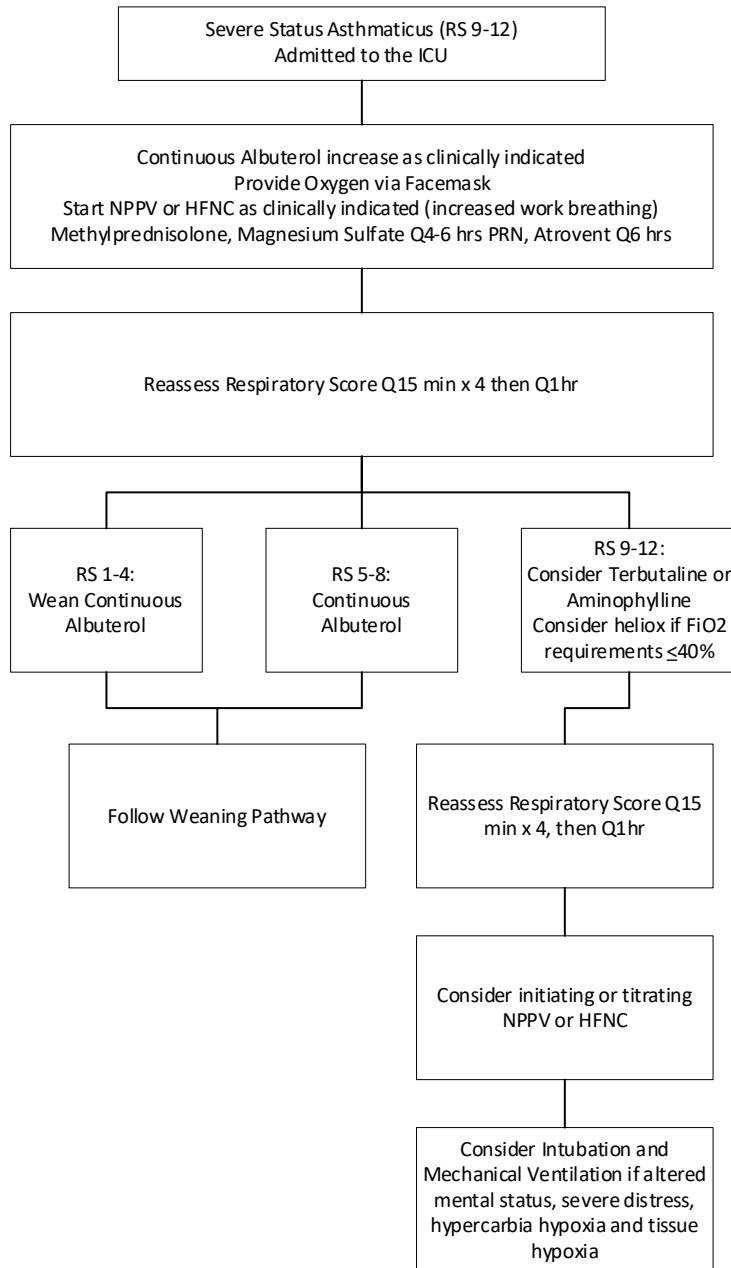
Observation Interventions

- Respiratory treatments every 2-4 hours
 - Please start with 5 mg Albuterol neb every 2 hours and wean down as condition improves (see phases II-V)
- Asthma education
 - RT to provide spacer/MDI education.
 - Consider time of day, ability of pharmacy to dispense medications, follow up availability prior to discharge
 - Consider HDVCH Allergy/Immunology Referral-especially for >5 yrs with \geq 2 ED visits in a year
- O₂ therapy
- Cardiac and SpO₂ monitoring
- Steroids – PO administration is typical; however, consider IV steroids in a sicker child
- IV fluids – Consider IV access in the child who is not taking oral fluids well, is worsening while in observation, or may benefit from fluids depending on amount of albuterol.

Observation Disposition

- Discharge home
 - Child is on room air and stable on current treatments
 - Therapies can be safely and competently delivered at home.
 - Follow up arranged and home needs addressed
- Medications
 - Albuterol MDI
 - Dexamethasone PO, dispensed as 4mg tabs (use $\frac{1}{2}$ tab aliquots)
 - Refill any home medications as needed
- Admission to the hospital
 - Clinical deterioration – increasing O₂ needs, worsening work of breathing
 - Need for more frequent nebs or continuous albuterol – strongly consider inpatient care if child is not showing significant improvement after 4 Q2 hour nebs.
 - Not ready for discharge after 23 hours of treatment.

PCCU Management – Escalation



Escalation Medications:

Continuous Albuterol (NEB):
INH:
5-20 mg/hr
Increase as indicated (max 40 mg/hr)

Methylprednisolone (IV):
IV Bolus: 2 mg/kg (max 60mg), IV:
1mg/kg q6-q12 hours (max 125mg/day)

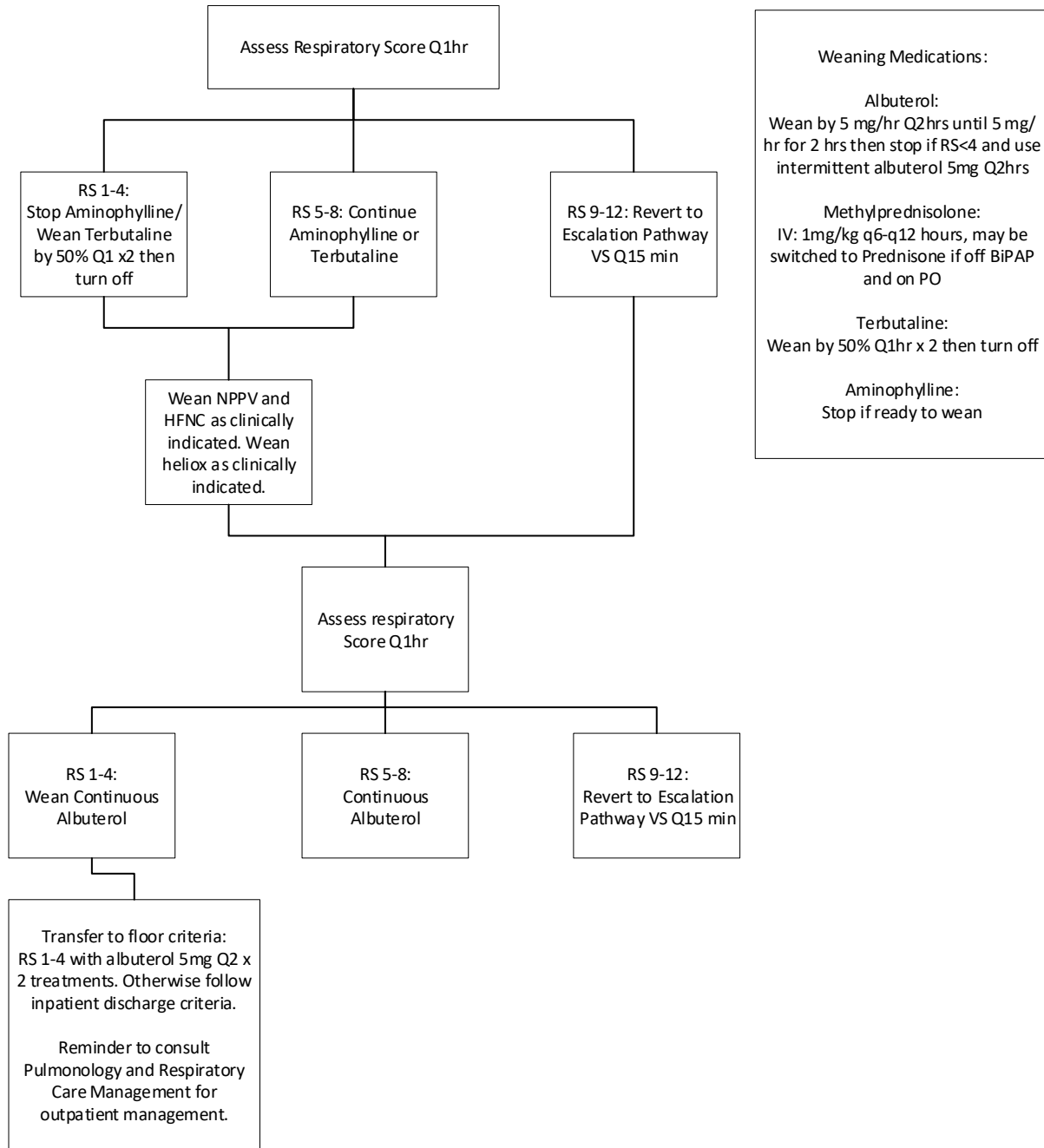
Magnesium Sulfate (IV):
IV: 50-75mg/kg (max 2g) over 20 min
Q4-6 hrs PRN
Consider a 20 ml/kg IV bolus of Normal Saline

Terbutaline (IV):
IV Bolus: 10mcg/kg over 5-10 min,
Cont IV 0.2-10mcg/kg/min, increase by 0.2mcg/kg Q30 min PRN

Aminophylline (IV):
IV Bolus: 5.7mg/kg over 30 min in D5Q, Cont IV: 0.5-1 mg/kg/hr, obtain level 30 min after bolus and 12-24 hours after initiating continuous infusion (goal plasma level: 5-15 mCg/mL)

Once intubated on maximum escalation therapies, consider the following: ketamine sedation, inhalational gases, consult for V-V ECMO

PCCU Management – Weaning



Weaning Medications:

Albuterol:
Wean by 5 mg/hr Q2hrs until 5 mg/hr for 2 hrs then stop if RS<4 and use intermittent albuterol 5mg Q2hrs

Methylprednisolone:
IV: 1mg/kg q6-q12 hours, may be switched to Prednisone if off BiPAP and on PO

Terbutaline:
Wean by 50% Q1hr x 2 then turn off

Aminophylline:
Stop if ready to wean

Clinical pathways clinical approach

TREATMENT AND MANAGEMENT:

Asthma Distress Score (Ages 2 -18 years)

Scoring	0	1	2	3
Respiratory Rate				
2-3 years	18-26	27-34	35-39	Greater than 39
4-5 years	16-24	25-30	31-35	Greater than 35
6-12 years	14-20	21-26	27-30	Greater than 30
12-18 years	12-18	19-23	24-27	Greater than 27
Auscultation	Normal breath sounds with good aeration	End Expiratory wheezes only	Expiratory wheezes throughout	Inspiratory & Expiratory wheezes to diminished throughout
Retractions	None	Mild – Subcostal or Intercostal	Moderate – 2 of the following Subcostal Intercostal Suprasternal or Nasal flaring	Severe- 3 of the following Subcostal Intercostal Suprasternal or Nasal flaring or head bobbing
Dyspnea	Normal vocalization and activity	Decreased vocalization, agitated or coughing	Minimal vocalization, short cry, decreased activity	Unable to speak, grunting, confused or drowsy
Total Score	0-4 Mild	5-8 Moderate	9-10 Severe	Greater than 10 Status

1. **Purpose**

Provide management guidelines for patients with primary diagnosis of asthma, utilizing assessment and monitoring to maximize the value of therapy.

2. **Responsibilities**

Physicians, Advanced Practice Providers (APP), Licensed Respiratory Therapists (LRT), Registered Nurses (RN)

3. **Guideline**

A. Includes all patients with a primary diagnosis of asthma between the ages of 2 and 18 years of age.

B. Patients who do not fall under this guideline include;

- Patients admitted for an acute illness other than asthma, such as, a primary diagnosis of bronchiolitis, pneumonia, or croup, do not fall under this guideline.
- Patients with Chronic Conditions in addition to asthma
 - Primary Lung Diseases (Cystic Fibrosis, restrictive lung disease, lung transplant)
 - Chronic Lung Disease (bronchopulmonary dysplasia)
 - Congenital and/or Acquired Heart Disease
 - Airway Issues (tracheostomy dependent, tracheomalacia)
 - Medically Complex Children (multiple, severe issues)
 - Immunocompromised (chemotherapy, sickle cell, primary immunodeficiency disorders)

C. Assessment

- i. All interventions contained in this guideline must have a provider order.
- ii. Patients meeting the inclusion criteria will be assessed using the [Asthma Score \(AS\)](#) to determine severity of symptoms.
- iii. Asthma score will determine treatment plan and orders placed
- iv. Supplemental oxygen should be administered to keep saturation greater than or equal to 90%
 - a. Continuous therapy monitoring requirements
 - b. Patients in ED phases require continuous pulse oximetry to monitor heart rate during continuous therapy and for one hour post treatment completion.
 - c. Patients in admission phases require a cardiac monitor during continuous therapy and for one hour post

NOTE: Albuterol doses of 8 puffs via Metered Dose Inhaler (MDI) and 5mg via nebulizer can be interchanged. The route of delivery is determined on a case by case basis considering patient presentation, ability, tolerance, and home therapy. MDI therapy is preferred for admitted patients with adequate technique. All MDI medications will be delivered with a spacer; a spacer mask can be utilized in conjunction if patient unable to maintain an adequate seal with a mouthpiece. Nebulizers should be given via mouthpiece. Masks will be used if the patient unable to maintain an adequate seal with a mouthpiece. All Continuous treatments will be delivered via mask.

D. Emergency Department Management Plan of care is determined and modified based on the [Asthma Score](#) see **Pediatric ED Asthma Order set**.

i. Phase IA Initial Assessment

- a. Asthma Score 0 to 5
 - 1) Administer Albuterol 8 puffs via MDI or 5mg nebulization
 - 2) Administer Dexamethasone 0.6mg/kg once oral (16mg max)
- b. Asthma Score 6-12

- 1) Administer Albuterol 15mg with Ipratropium Bromide 1mg via continuous nebulization over one hour
 - 2) Administer Dexamethasone 0.6mg/kg once oral (16mg max)
- ii. Phase IB Reassess 20 minutes after initial therapy
- a. Asthma Score 0 to 4
 - 1) Discharge if criteria met
 - 2) If initial score was greater than 5 observe for one hour prior to discharge
 - b. Asthma Score 5 to 8
 - 1) Administer Albuterol 8 puffs via MDI or 5mg via nebulizer
 - c. Asthma Score 9 to 12
 - 1) Administer Albuterol 15mg via continuous nebulization over one hour
 - 2) Add Ipratropium Bromide 1mg if not already given
 - 3) Consider Magnesium Sulfate 50mg/kg IV once (max 2 grams)
 - 4) Consider Patient Admission Status (See Appendix B)
 - 5) Regional Hospitals: patient must transfer to HDVCH if asthma score remains above 8 after next round of therapy. Continue Care; Consider Transfer.
 - 6) PCCU admission criteria regardless of Asthma Score: Drowsiness, Confusion, Silent Chest exam, PEFV less than 25% predicted
- iii. Phase IC Reassess 20 minutes after second round of therapy
- a. Asthma Score 0 to 4
 - 1) Discharge if criteria is met
 - 2) If initial score was greater than 5 observe for one hour prior to discharge
 - 3) Emergency Department Discharge: Prescribe additional dose of Dexamethasone to be taken 24 hours after discharge. Use 4 mg tablets rounded to the nearest ½ tab (max 16mg.) Tablets should be crushed for children unable to swallow pills.
 - b. Asthma Score 5 to 8
 - 1) Admit patient using Phase III guidelines while continuing care in ED
 - 2) Administer Albuterol 8 puffs via MDI or 5mg via nebulizer
 - 3) Patients can be directly admitted to a general HDVCH floor if a regional hospital does not accept pediatric admissions.
 - c. Asthma Score 9-12
 - 1) Administer Albuterol 15mg via continuous nebulization over one hour
 - 2) Add Ipratropium Bromide 1mg if not already given
 - d. Asthma Score 9 or 10
 - 1) HDVCH: Admit patient using Phase II guidelines while continuing care in ED
 - 2) Regional Hospitals: Admit to HDVCH ED while continuing care in ED
 - e. Asthma Score 11 to 12
 - 1) Admit to HDVCH PCCU while continuing care in ED
 - 2) PCCU admission criteria regardless of Asthma Score: Drowsiness, Confusion, Silent Chest exam, PEFV less than 25% predicted
4. Admission: Treatment Frequency and Dosage: All patients with an Asthma Score greater than 8 should be admitted to HDVCH. Plan of care is determined and therapy increased or decreased based on [Asthma Score](#) using scheduled frequency as outlined without the use of PRN therapy. See: **Pediatric Inpatient Asthma Order set.**
- A. Inpatient Steroid Treatment options for 5 to 10 day course depending on severity of exacerbation.
- i. PredniSONE / PredniSOLONE 2mg/kg/dose oral daily
 - ii. Methylprednisolone 2mg/kg loading dose via IV
 - iii. Methylprednisolone 1mg/kg/dose every 12 hours intravenous
 - iv. Methylprednisolone 0.5mg/kg/dose every 6 hours intravenous

- v. Methylprednisolone 1mg/kg/dose every 6 hours intravenous for very severe status asthmaticus (no maximum dose)
 - vi. Maximum dose:
 - Less than 12 years of age= 60 mg/day
 - Greater than or equal to 12 years of age: max = 80 mg/day
- B. Severe: Asthma Score greater than 10
- i. Administer Albuterol 15 mg continuous nebulization
 - ii. For direct admissions add 1mg Ipratropium Bromide
 - iii. PCCU transfer if the Asthma Score remains greater than 10 after one hour of therapy.
 - iv. PCCU criteria regardless of Asthma Score: Drowsiness, Confusion, Silent Chest exam, PEFr less than 25% of predicted
- C. Moderate/Severe: Asthma Score of 9 to 10
- i. Phase II: Administer Albuterol 10 mg continuous nebulization
 - a. Provider (HDVCH Hospitalist or Senior Resident) must notify PCCU attending if Asthma Score remains 9 to 10 after 3 hours on continuous albuterol treatment.
- D. Moderate: Asthma Score of 5 to 8
- i. Phase III: Administer Albuterol 5mg every two hours
 - a. Transition to Albuterol 8 puffs MDI every two hours for patients with adequate technique.
- E. Mild: Asthma Score 0 to 4
- i. Phase IV: Administer Albuterol 8 puffs MDI or 5mg Neb every 4 hours
 - a. Advance to phase V if score remains less than 5 after one treatment
 - ii. Phase V: Administer Albuterol 4 puffs MDI or 2.5mg every 4 hours
 - iii. Maintain home therapy (if admitted for reasons other than exacerbation)
- F. Discharge when Asthma Score 0 to 4
- i. May discharge after first treatment in phase V
 - ii. Family must receive a copy of the Asthma Action Plan at discharge.
- G. RT to Notify Provider for; (at HDVCH contact Hospitalist or Senior Resident)
- i. All phase transitions
 - ii. Failure to advance from phase II after 3 hours on continuous Albuterol
 - iii. Failure to progress after 12 hours in all other phases
 - iv. Persistent oxygen requirement in phase IV.
 - v. PCCU criteria present
 - vi. Physician orders written outside of Pediatric Asthma Management Guideline.
6. Provider Communication
- A. Regional Hospitals should notify HDVCH for patients with an Asthma Score greater than 8
 - B. HDVCH Hospitalists or Senior Resident to notify PCCU Intensivist when:
 - i. Asthma Score greater than 10
 - ii. Failure to advance from phase II after 3 hours on continuous Albuterol
 - iii. PCCU criteria present
7. Documentation
- A. Asthma Score ([How to document](#)) (How to find it for providers: [wrench in](#) "Asthma Distress Score")
 - B. Medications administered
 - C. Response to therapy
 - D. Asthma Action Plan (for admitted patients)

Pathway information

OWNER(S): Erica Michiels, Tom Czolgosz, James VanBeynen, Amanda Holsworth, Lee Morris

CONTRIBUTOR(S): Robert Schoumacher, Beth Prentice, Lauren Alessi, Britney Gunnel, Sara Hollingsworth, Ashleigh Nurski, Ankit Shukla

EXPERT IMPROVEMENT TEAM (EIT): N/A

CLINICAL PRACTICE COUNCIL (CPC): Children's

CPC APPROVAL DATE: February 28, 2023

OTHER TEAM(S) IMPACTED: Respiratory Therapy, Respiratory Therapy Care Management

References

1. Reddel HK, Bacharier LB, Bateman ED, Brightling CE, Brusselle GG, Buhl R, Cruz AA, Duijts L, Drazen JM, FitzGerald JM, Fleming LJ, Inoue H, Ko FW, Krishnan JA, Levy ML, Lin J, Mortimer K, Pitrez PM, Sheikh A, Yorgancioglu AA, Boulet LP. Global Initiative for Asthma Strategy 2021: executive summary and rationale for key changes. *Eur Respir J*. 2021 Dec 31;59(1):2102730.
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, Blake KV, Brooks EG, Bryant-Stephens T, DiMango E, Dixon AE, Elward KS, Hartert T, Krishnan JA, Lemanske RF Jr, Ouellette DR, Pace WD, Schatz M, Skolnik NS, Stout JW, Teach SJ, Umscheid CA, Walsh CG. 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. doi: 10.1016/j.jaci.2020.10.003. Erratum in: *J Allergy Clin Immunol*. 2021 Apr;147(4):1528-1530.
3. Patel SJ, Teach SJ. Asthma. *Pediatr Rev*. 2019 Nov;40(11):549-567. doi: 10.1542/pir.2018-0282.
4. Carroll CL, Sala KA. Pediatric status asthmaticus. *Crit Care Clin*. 2013 Apr;29(2):153-66.
5. Koninckx M, Buysse C, de Hoog M. Management of status asthmaticus in children. *Paediatr Respir Rev*. 2013 Jun;14(2):78-85.
6. Powell CV. Acute severe asthma. *J Paediatr Child Health*. 2016 Feb;52(2):187-91.
7. Pardue Jones B, Fleming GM, Otilio JK, Asokan I, Arnold DH. Pediatric acute asthma exacerbations: Evaluation and management from emergency department to intensive care unit. *J Asthma*. 2016 Aug;53(6):607-17.

8. Hasegawa K, Craig SS, Teach SJ, Camargo CA Jr. Management of Asthma Exacerbations in the Emergency Department. *J Allergy Clin Immunol Pract.* 2021 Jul;9(7):2599-2610.
9. Rehder KJ. Adjunct Therapies for Refractory Status Asthmaticus in Children. *Respir Care.* 2017 Jun;62(6):849-865.
10. Griffiths B, Ducharme FM. Combined inhaled anticholinergics and short-acting beta2-agonists for initial treatment of acute asthma in children. *Cochrane Database Syst Rev.* 2013 Aug 21;(8).
11. Doymaz S, Ahmed YE, Francois D, Pinto R, Gist R, Steinberg M, Giambruno C. Methylprednisolone, dexamethasone or hydrocortisone for acute severe pediatric asthma: does it matter? *J Asthma.* 2022 Mar;59(3):590-596.
12. Stulce C, Gouda S, Said SJ, Kane JM. Terbutaline and aminophylline as second-line therapies for status asthmaticus in the pediatric intensive care unit. *Pediatr Pulmonol.* 2020 Jul;55(7):1624-1630.
13. Self TH, Usery JB, Howard-Thompson AM, Sands C. Asthma treatment protocols in the emergency department: are they effective? *J Asthma.* 2007 May;44(4):243-8.
14. Kucher NM, S Dhaliwal D, Fischer GA, Davey CS, Gupta S. Implementation of a Critical Asthma Protocol in a Pediatric ICU. *Respir Care.* 2021 Apr;66(4):635-643.
15. Miksa, Michael MD, PhD; Kaushik, Shubhi MD; Antover, Gerald RRT; Brown, Sakar RRT; Ushay, H. Michael MD, PhD; Katyal, Chhavi MD. Implementation of a Critical Care Asthma Pathway in the PICU. *Critical Care Explorations* 3(2):p e0334, February 2021. | DOI: 10.1097/CCE.0000000000000334
16. J. Zorc, MD; R. Scarfone, MD; A. Reardon, CRNP; N. Stroebel, CRNP; W. Frankenberger, RN; L. Tyler, RT; D. Simpkins, RT; R. Abaya, MD; E. Delgado, MD; E. Brill, RN. Emergency Department Clinical Pathway for Evaluation/Treatment of Children with Asthma. Children's Hospital of Philadelphia. December 2020. <https://www.chop.edu/clinical-pathway/asthma-emergent-care-clinical-pathway>
17. C. Kenyon, MD; J. Zorc, MD; M. Dunn, MD; K. Pumphrey, MD; C. Shannon, MD; H. Pezzimenti, RT; D. Simpkins, RT; J. Coyne, RT. Inpatient Clinical Pathway for Children with Acute Asthma Exacerbation. Children's Hospital of Philadelphia. November 2022. <https://www.chop.edu/clinical-pathway/asthma-inpatient-care-clinical-pathway>
18. Seattle Children's Hospital, Atkins R, Ken L, Beardsley E, Drummond K, Foti J, Klee K, Mitgita R. 2015 July. Asthma Pathway. Available from: <http://www.seattlechildrens.org/pdf/asthma-pathway.pdf>