Clinical Guideline

This guideline serves as a guide and does not replace clinical judgment.

PICU Asthma Treatment Guideline

Pediatric Critical Care Medicine

The use of this progressive treatment guideline is suggested for patients admitted to the Pediatric Intensive Care Unit (PICU) who are not responding to steroids and β2-agonists and need further therapy based on their clinical status and asthma score.

During patient assessment, a respiratory therapist (RT) will document the Pediatric Asthma Score (PAS) every hour (1 hr) while the patient is receiving continuous albuterol treatment. Advancement in therapy to the next level will be performed when there is a worsening of the PAS.

Pediatric Asthma Escalation / De-escalation Criteria			
	De-escalation	**Maintenance**	**Escalation**
Criteria	MS reassuring **AND** PAS < 4 x2	MS reassuring **AND** PAS = 4-5	Combative / Obtunded **OR** PAS ≥ 6 or rising CO_2
Therapies	Remove escalation medication first	Continue current therapy	Escalate to 2nd-tier therapies
Next Step	Consider Pulmonary consult	Reassess in 1 hour	Consider intubation / ECMO
Pediatric Asthma Score, Mental Status, Vital Signs: every 1 hr Intake/Output: every 1-4 hr BMP/Mag/Phos: every 12-24 hr POCT ABG/VBG PRN			

Moderate / Severe	**Critical**	**Impending Respiratory Arrest**
Mental status reassuring with: PAS < 4 **AND** FiO_2 ≤ 50% If stable x4 hours, consider downgrading level of care and/or transfer to ACP	Mental status reassuring with: PAS > 4 **OR** FiO_2 > 50% **OR** Mental status agitated / drowsy **<u>Consider NIPPV</u>** Rapid titration of NIPPV steps to reduce work of breathing Step 1: IPAP 10 / EPAP 5 Step 2: IPAP 14 / EPAP 6 Step 3: IPAP 16 / EPAP 8 Step 4: IPAP 20 / EPAP 10 (MAX) • Obtain ABG / VBG • Anxiolysis only if needed • NPO	Mental status combative **OR** obtunded **WITH:** PAS ≥ 6 **AND** rising CO_2 **<u>Consider Mechanical Ventilation</u>** • High-risk of cardiac arrest • Consider NIPPV as temporizing measure • Consider ECMO consult

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Step	Therapy	Comments
Conventional or First-Line Therapies		
1	**Continuous Albuterol Nebulization (CAT)**	• 10-20 mg/hr • Reassess pt every hour if PAS score ≥ 8 or if PAS score is rising • If PAS is not improving or if PAS increasing, consider escalating to Supplemental and/or 2nd line therapies • Wean escalation steps in reverse order once PAS score ≤ 6 and extubated (if applicable) • Transition to 4-8 puffs MDI* every 2 hours when CAT at 10 mg/hr, PAS 3, and patient no longer has a prolonged expiratory phase • Reassess PAS prior to and after each treatment. • Transfer to general care when patient tolerates albuterol q 2 hours x 2 treatments (with PAS same or less than previous), *Consider CAT 5 mg/hr if overnight and pt needs to sleep
2	**Steroids: Methylprednisolone (IV)**	• 2 mg/kg/day divided every 6 hours, begin upon PICU admission even if dosed in ED (with Decadron or Methylprednisolone) • < 12 yr old, MAX Dose: 60 mg/day • ≥ 12 yr old, MAX Dose: 80 mg/day* *Consider MAX daily 120 mg/daily for intubated / ECMO asthmatics
3	**Supplemental Oxygen**	To maintain saturations > 92%
4	**Heliox**	60-79% Helium / 21-40% Oxygen
Escalation Medications		
5	Intravenous Magnesium	50mg/kg (max 2000 mg) over 20 min
6	Ipratropium Nebulization	0.5 mg every 20 min for 3 doses (usually done in ED) Infants/Children: 250 mcg every 6 hours Adolescents: 500 mcg every 6 hours
Second-Line Therapies		
7	High Flow Nasal Cannula	• Liter flow dependent on age, size, severity • Range 7-12 LPM usually used in conjunction with CAT and Heliox • Wean by 1-2 LPM as tolerated assessing WOB to 7 LPM* • When able to discontinue CAT, continue HFNC wean. *Need minimum of 7L flow for albuterol to nebulize

<table>
<tr><td>8</td><td>Intravenous Aminophylline</td><td>Theophylline should be used for children with severe acute asthma exacerbation with impending respiratory failure, or those on mechanical ventilation who are already getting other bronchodilator or anti-inflammatory therapies.

Loading Dose: 5.7mg/kg over 30 minutes
Continuous infusion: MAX 1.4mg/kg/hr
Less than 6 months: 0.5 mg/kg/hr
6 months to 1 year: 0.6-0.7 mg/kg/hr
1 to 9 years: 1 mg/kg/hr
10 years and older: 0.75 mg/kg/hr

- 1 mg/kg of aminophylline increases serum concentration by approximately 2 mcg/mL.
- Obtain levels 3 hours after the loading dose infusion is finished and then every 12 hours.

Goal Serum Levels 5-10 mcg/mL:
• IF level < 5 mcg/mL, give bolus based on 1 mg/kg increases serum concentration by 2 mcg/mL and increase infusion by 10%.
• IF level 5-10 mcg/mL, maintain if tolerated and symptoms controlled.
• IF level 5-10 mcg/mL, patient tolerating but symptoms are NOT controlled, then consider bolus based on 1 mg/kg increases serum concentration by 2 mcg/mL and increase infusion by 10 %.
• IF level 11 - 15 mcg/mL, then consider reducing infusion by 10%
• IF level 16-20 mcg/mL, then consider decreasing infusion by 20%.
• IF level > 20 mcg/mL, then STOP infusion until level falls below 15 mcg/mL and reduce infusion by 25%
Side Effects: nausea, persistent vomiting, headache, insomnia, cardiac dysrhythmias, seizures.</td></tr>
<tr><td colspan="3" align="center">OR</td></tr>
<tr><td>8</td><td>Intravenous Terbutaline</td><td>Loading Dose: 4 mcg/kg infused for 10 minutes
Continuous infusion: Start 0.4 mcg/kg/min
• Increase by 0.1-0.2 mcg/kg/min every 30 minutes to achieve desired effect, depending on the patient's clinical response, monitoring for adverse drug reactions.
• Range: 0.1-3 mcg/kg/min – MAX 3 mcg/kg/min

- Be mindful of weight/dose titration with larger patients
- Monitor Troponin 1 every 12 hours
- IF symptomatic: get EKG, CK-MB, Troponin 1 STAT (Wheeler/Wong, 2014, pg. 56)
Side Effects: tachycardia, arrhythmias, diastolic hypotension, hypokalemia, or (rarely) myocardial ischemia</td></tr>
<tr><td>9</td><td>Non-Invasive Positive Pressure</td><td>BiPAP: IPAP 10, EPAP 5 – ideally no mechanical rate, titrated to comfort and work of breathing.
*First number is total PIP (not pressure control)
BiPAP Step 1: 10/5
BiPAP Step 2: 14/6
BiPAP Step 3: 16/8
BiPAP Step 4: 20/10</td></tr>
<tr><td>10</td><td>Intravenous Ketamine</td><td>Loading Dose: 1-2 mg/kg
Continuous Infusion: 0.3-1.2 mg/kg/hr (= 5-20 mcg/kg/min)</td></tr>
</table>

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Rescue Therapies		
11	Intubation	**Give FLUID BOLUS** prior to intubation due to risk of decreased preload, decreased CO with positive pressure ventilation. • Use Ketamine for induction for intubation: 1-2 mg/kg dose • PC, TV 6-8 mL/kg, RR 5-8, PEEP LOW, Long e-time • Allow for patients loops to close • Avoid neuromuscular blockade if possible • Permissive hypercapnia, pH ≥ 7.2
12	ECMO	Extracorporeal Life Support or Extracorporeal Carbon Dioxide Clearance **Criteria:** 1. Air leak (pneumothorax, pneumomediastinum) 2. Plateau Pressure > 30 3. Refractory hypoxia and/or significant acidosis
Other Orders		
RESP		• CXR if 1st time wheezer, fever, or persistent hypoxia or poor response to above therapies • Pulmonary consult • Home meds/controllers once off CAT
FEN/GI		• NPO if concern for intubation or on CAT • Advance diet when spaced to q2 hours • D5 NS + 20 mEq KCL/L at maintenance • Famotidine 0.5 mg/kg dose (MAX 20 mg) q12 hours, discontinue when taking PO • BMP daily IF on IVF and CAT • Mg IF > 1 escalation dose given
Neuro		• Neuro checks every 4 hours while on CAT • Neuro checks every hours if AMS
ID		IF concern for bacterial infection/pneumonia: • CBC w/ diff • Azithromycin if pt ≥ 6 years (can also have some anti-inflammatory properties) • Ceftriaxone if pt < 6 years • NO antibiotics if bacterial infection NOT suspected

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Instructions for Assessment of PAS:

1. If applicable, turn oxygen therapy off on entry into patient's room.
2. Stepwise assessment (respiration rate (RR), dyspnea, retractions, auscultation).
3. Children admitted to the PICU will score at least PAS 2 while on continuous albuterol. Do not remove respiratory support to determine PAS. Children will be granted a PAS of at least 2 while on continuous albuterol.
4. Calculate total score: 2-10.

Table 1: (Modified) Pediatric Asthma Score (PAS)

Variable	Score		
	0 points	**1 point**	**2 points**
Resp Rate (b/min) 2-3 years 4-5 years 6-12 years >12 years	< 35 < 31 < 27 < 24	35-39 31-35 27-30 24-27	> 39 > 35 > 30 > 27
Dyspnea	Full sentences **and** good PO intake	Partial sentences **or** poor PO intake	Single words **or** unable to PO
Retractions*	1 or less accessory groups	2 accessory groups	3 or more accessory groups
Auscultation	Normal breath sounds	Expiratory wheezing only	Inspiratory and expiratory wheezing **or** diminished breath sounds
Oxygen Sats (%) *On Room Air*	> 95%	90-95%	< 90% or on any oxygen therapy

*Accessory muscle groups considered in evaluation of retractions:

1. Nasal (flaring)
2. Supra-sternal (retractions)
3. Intercostals (retractions)
4. Substernal (retractions)

Chest radiography is not routinely indicated in a child with previous history of asthma. Potential indications for chest radiography may include clinical suspicion for pneumonia, pneumothorax, atelectasis, foreign body aspiration, or after endotracheal intubation.

Executive Summary

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Retrieval website: **https://www.chrichmond.org/health-care-professionals/chor-clinical-guidelines**

Example:
Children's Hospital of Richmond at VCU, Robinson C, Moore J, Purrington D, Marinello M. PICU Asthma Treatment Guideline. Available from: https://www.chrichmond.org/health-care-professionals/chor-clinical-guidelines