



Dr Michael Barrett

Department of Emergency Medicine

## Acute Asthma – Care in the Emergency Department

[Link to Algorithm](#)

### Aim

Evidence-based management of children with acute asthma exacerbations

### Definition of terms

Metered Dose Inhaler (MDI)  
Paediatric Intensive Care Unit (PICU)  
Paediatric Respiratory Assessment Measure (PRAM)  
Oxygen Saturations (SpO<sub>2</sub>)  
Carbon dioxide (pCO<sub>2</sub>)  
Blood Pressure (BP)  
Electrocardiogram (ECG)  
Continuous Positive Airway Pressure (CPAP)  
Bi-level Positive Airway Pressure (BIPAP)  
Intermittent Positive Pressure Ventilation (IPPV)

### Target Patient Population

This evidence summary applies to patients (1 years +) presenting with mild, moderate, severe or life threatening exacerbation of asthma. It does not deal with the management of bronchiolitis or laryngotracheobronchitis. Children < 12 months of age presenting with wheeze are most likely to have bronchiolitis. Up to two-thirds of children with asthma who seek emergency care can be classified as having mild respiratory distress, between 2 and 5% have severe respiratory distress, and the remainder have moderate respiratory distress. The following children may need to be managed differently and should be discussed with a senior physician:

- Children who are under the care of the Respiratory Team
- Children who have other serious disorders that affect the management of asthma (e.g. heart disease, neuromuscular disorders)
- Infants under 1 year of age.

### Target Users

This guide is directed at health-care professionals in the Emergency Department or Urgent Care Centre engaged in the care of patients with acute exacerbations of asthma.

### Assessment

Medical History: Family history of asthma, atopy, or allergic disease is common.

Enquire specifically about the following:

- duration and nature of symptoms;
- treatments used (relievers, preventers);
- trigger factors (including upper respiratory tract infection, allergy, passive smoking);
- pattern and course of previous acute episodes e.g. admission or ICU admissions
- parental understanding of the treatment of acute episodes; and
- the presence of interval symptoms.

Consider other causes of wheeze e.g. bronchiolitis, aspiration, foreign body, anaphylaxis.

### Initial Assessment

A validated paediatric asthma clinical scoring system (the Paediatric Respiratory Assessment Measure (PRAM)) helps classify the initial severity and clinical response of respiratory distress in children. Using this scoring system will facilitate the appropriate use of evidence based medicines and see reductions in rates of hospitalisations.<sup>1, 2</sup> PRAM is a 12-point clinical scoring rubric that captures a patient's asthma severity using a combination of scalene muscle contraction, suprasternal retractions, wheezing, air entry and oxygen saturation.<sup>1</sup>

PRAM Scoring Table and Notes				
Criteria	Description	Score	Notes	
<b>O<sub>2</sub> saturation</b>	≥95%	0	O <sub>2</sub> saturation must be measured with the patient breathing ambient air until stabilisation of the oximetry value for at least 1 minute. 1. TURN OFF supplementary oxygen 2. If SpO <sub>2</sub> falls to <92% you can turn oxygen back on immediately as they have automatically scored maximum (2) points.	
	92-94%	1		
	<92%	2		
<b>Suprasternal Retraction</b>	Absent	0	The suprasternal retraction is visible Retraction indrawing of the skin above the sternum and between the sternocleidomastoid muscle with every intake of breath. <i>This is a visual assessment</i>	
	Present	2		
<b>Scalene muscle Contraction</b>	Absent	0	The scalenes are deep cervical muscles located in the floor of the lateral aspect of the neck. Scalene contraction cannot be seen. This is a palpable assessment. Land mark for locating scalene muscles in the triangle bordered by the clavicle (in the front), the trapezius (in the back) and neck (medially) in line with the ear lobe. Occurs in about 10% of all patients – only those with severe asthma exacerbations.	
	Present	2		
<b>Air Entry</b>	Normal	0	**In cases of asymmetry, the most severely affected lung field determines the rating. Use lung fields to grade air entry. Lung field = two contiguous VERTICAL auscultation zones of the Major Lobes: Right anterior lung field: Upper and Middle Zones Right posterior lung field: Upper and Lower Zones Left anterior lung field: Upper and Lower Zones Left posterior lung field: Upper and Lower Zones	
	Decreased at base	1		
	Decreased at apex and the base	2		
	Minimal or absent	3		
<b>Wheezing</b>	Absent	0	Use auscultation zones to grade wheeze. At least two auscultation zones must be affected to influence the rating  The most severely affected zones will determine the rating criterion	
	Expiratory only	1		
	Inspiratory (±expiratory)	2		
	Audible without Stethoscope or <b>Silent Chest (min or no air entry)</b>	3		
<b>Severity</b>	<b>Mild</b>	<b>Moderate</b>	<b>Severe</b>	<b>Life Threatening</b>
	<b>0-3</b>	<b>4-7</b>	<b>8-12</b>	<b>Respiratory - silent chest, exhaustion, cyanosis, increasing hypoxia</b> <b>Neurological - agitation, confusion, drowsiness</b> <b>Cardiovascular - marked tachycardia, bradycardia</b> <b>PRAM Score is irrelevant &amp; consider causes</b>

### Investigations

- Chest x-ray is not generally required. Consider for Fever without focus, Focal findings on exam, concern for Foreign body, Failure to improve or Failing to oxygenate (life threatening episode)<sup>3</sup> & Discuss with Registrar or consultant
- In the case of patients with diffuse bilateral wheeze, bacterial infection is rarely implicated. Antibiotics are rarely needed in acute asthma as pneumonia is extremely uncommon. Without a fever, serious bacterial infection is extremely unlikely.<sup>3</sup>

- In the severe or critical episode, a venous blood gas measurement may be useful. However, a normal venous pCO<sub>2</sub> value does not rule out a critical problem and should be interpreted with caution.
- Arterial blood gas and spirometry are **NOT** required in the assessment of acute asthma in children.
- Electrolytes for potassium levels may be indicated, although most children will not need long periods of electrolyte monitoring due to rapid improvement and reduced Salbutamol requirements.

## Management

See CHI Hospital formulary for dosing information for each medication.

### Initial Treatments

Severity	Initial Management
<b>Mild</b>  <b>(PRAM 0-3)</b>	Salbutamol MDI/Spacers <sup>5</sup> : One dose, can repeat every 20mins if necessary for up to 1 hour. Ensure Device/technique appropriate Consider Oral steroids ( <i>Dexamethasone as a single dose or Prednisolone x 3/7</i> ) <sup>6, 7, 8, 9</sup> Target SpO <sub>2</sub> ≥92 % Reassessment of response within 20 minutes of last bronchodilator See Admission/Discharge Criteria Below
<b>Moderate</b>  <b>(PRAM 4-7)</b>	Salbutamol MDI/Spacer every 20 mins x 3 doses & review 20 mins after 3rd dose given Consider Ipratropium MDI & Spacer every 20 mins x 3 doses Ensure Device/technique appropriate Oral Steroids ( <i>Dexamethasone as a single dose once or Prednisolone x 3/7</i> ) <sup>6,7,8,9</sup> Target SpO <sub>2</sub> ≥92% See Admission/Discharge Criteria Below
<b>Severe</b>  <b>(PRAM 8-12)</b>  <b>Link to Asthma Severe &amp; life threatening PICU</b>	High Flow Oxygen via mask (e.g. 15L/min) to maintain SpO <sub>2</sub> 94-98% Salbutamol Nebulised, (every 20-30 mins for 1-3 hours) <sup>10,11</sup> and review 20 mins after 3rd dose. Continue as appropriate until improvement or escalate treatment. Ipratropium nebulised every 20 minutes x 3 doses Thereafter, wean Salbutamol to 1-2hrly and Ipratropium to 4-6hrly <sup>11</sup> IV access Systemic intravenous steroids ( <i>Hydrocortisone 6hrly initially</i> ) <sup>11</sup> + Involve Senior Emergency Medicine Staff +/- Intensive Care Consult (See Consult Criteria Below)
<b>Life Threatening</b> <sup>27</sup> <b>Clinical Signs</b> silent chest, exhaustion, cyanosis, increasing hypoxia agitation, confusion, drowsiness, marked tachycardia, bradycardia  <b>Link to Asthma Severe &amp; life threatening PICU</b>	If Anaphylaxis <sup>23</sup> give IM Adrenaline into lateral thigh which should be repeated after 5 minutes if the child is not improving. Involve Senior Emergency Medicine Staff + Intensive Care Review (See Criteria Below) High flow oxygen via mask (e.g. 15 L/min) Primary Assessment Airway, Breathing, Circulation, Disability, Exposure Consider supporting respirations if the patient is exhausted Salbutamol Nebulised: At least three doses given continuously every 20-30mins, without interruption between doses <sup>10,11</sup> . Review 10mins after 3 <sup>rd</sup> dose. May continue for up to 180 mins (3 hours). Ipratropium Nebulised every 20 minutes X 3 doses only. Venous Gas (CO <sub>2</sub> ) * + Portable Chest X-Ray Fluid bolus 10mL/kg (0.9%w/v Sodium Chloride or Compound Sodium Lactate Solution) aliquots to achieve euvolaemia IV Magnesium Sulphate <sup>11,12,13,14</sup> o Monitor BP closely.

### After Initial Treatments and Clinical Reassessment

Severity	Second line acute management
<b>Moderate</b>  <b>(PRAM Score 4-7)</b>	Salbutamol MDI every 30-60 mins  Consider IV Magnesium Sulphate <sup>11,12,13,14</sup> if poorly responsive to Salbutamol; <i>Monitor BP closely.</i>
<b>Poorly responsive</b> <b>Severe or Life threatening</b>  <b>(PRAM 8-12)</b>	+ Senior Emergency Medicine Staff +/- Intensive Care Consult/Review (See Consult Criteria Below) Venous Gas (CO <sub>2</sub> ) * + Chest X-ray (collapse, consolidation, pneumothorax(Consider POCUS)) Fluid bolus 10mL/kg (0.9%w/v Sodium Chloride or Compound Sodium Lactate Solution) aliquots to achieve euvolaemia 1. IV Magnesium Sulphate <sup>11,12,13,14</sup> <i>Monitor BP closely.</i> 2. IV Aminophylline <sup>11</sup> , (If currently taking oral theophylline, do not give IV aminophylline) o <i>ECG monitoring required. Loading dose followed by Continuous infusion: See Formulary. Monitor serum levels if duration of treatment prolonged</i> 3. IV Salbutamol <sup>15,16</sup> <i>Continuous ECG monitoring and at least 12 hourly electrolytes</i> Magnesium Sulphate, Aminophylline or salbutamol are given through separate lines Consider supporting respirations if the patient is exhausted <ul style="list-style-type: none"> <li>• High Flow Nasal Cannula at a flow rate 2L/kg/min<sup>17,18,19</sup></li> <li>• Non-invasive Positive Pressure with PICU support (CPAP, BIPAP)<sup>20, 21,22</sup></li> </ul> + <b>Further Rescue therapies:</b> See CHI Clinical Guideline <b>Asthma: Management of Severe and Life-threatening Disease</b>  If the child is improving therapy can be de- escalated at any stage

\* Venous blood gas measurement may be useful. However, a normal venous pCO<sub>2</sub> value does not rule out a critical problem and should be interpreted with caution.

^Beware severe Hypokalaemia can occur with frequent Salbutamol use, as this draws Potassium into cells. Consider monitoring Potassium levels. If the child is on IV fluids, consider adding potassium (KCL) to prevent hypokalaemia in children likely to require frequent Salbutamol.

#### Consult with Intensive Care Team

Peri-respiratory arrest, Respiratory arrest
Severe acute or life threatening asthma who are failing to respond to initial appropriate therapy
Severe or life threatening asthma requiring > 1 intravenous therapy or ventilation support

#### Consult with Paediatric Team

Severe or Critical episodes
Oxygen Requirement
The patient cannot stretch to longer than one hour between doses of salbutamol (either via spacer/MDI or nebuliser) after the initial treatment period has elapsed
Complicated episode (e.g. pneumothorax)
Previous episode that required ICU Admission
Social reasons e.g. likely poor compliance with education measures aimed at reducing re-attendance/readmission

### Discharge Home Criteria

Clinical Findings	<ul style="list-style-type: none"> <li>• &gt;1 hour after their last MDI via spacer</li> <li>• No significant intercostal and/or suprasternal indrawing at least 1 to 2 hours after the last bronchodilator treatment;</li> <li>• Good air movement on auscultation with at most mild expiratory wheezes; and stable oxygen saturations on room air</li> <li>• Oxygen saturations on room air <math>\geq 92\%</math></li> <li>• Acceptable oral intake</li> <li>• <b>The above must equate to PRAM score <math>\leq 3</math></b></li> </ul>
Discharge Management	<ul style="list-style-type: none"> <li>• Provide oral and written advice on what to do if symptoms worsen<sup>11,24,25</sup></li> <li>• Bronchodilator (MDI) therapy weaning frequency to as needed frequency</li> <li>• Steroid treatment: A single dosage of dexamethasone or 3 days of prednisolone is usually sufficient (for bronchodilator responsive wheeze &lt; 5 years old)</li> <li>• Communicate with primary care doctor or hospital physician</li> </ul>
Further consideration	<ul style="list-style-type: none"> <li>• Arrange follow-up as appropriate considering severity of initial presentation, overall control and family's knowledge</li> </ul>

### Special Considerations

- Delivery of Non-Invasive Positive Pressure will require the early involvement of intensive care medicine and clinical engineering. Intubation is required based on a clinical judgement of progressive fatigue, worsening hypoxia or following a respiratory arrest. Notify the emergency consultant in Charge. Intubation of such patients is high risk and should ideally be performed by a **Consultant** Intensivist or Anaesthetist.

### Companion Documents

- [Acute Asthma – Inpatient Care](#)
- [Asthma Discharge – 1-5 Years Old](#)
- [Asthma Discharge – >6 Years Old](#)
- [Parental Information leaflet – Asthma Information](#)

### Links to useful websites

- CHI Paediatric Formulary: <http://www.mobanode.mobi/formulary/desktop/drugDosages.php>
- Asthma Society of Ireland- Written Asthma Action Plan: <https://www.asthma.ie/document-bank/asthma-action-plan-0>
- PRAM on line: <https://www.mdcalc.com/pediatric-respiratory-assessment-measure-pram-asthma-exacerbation-severity>
- Starship Clinical Guidelines, New Zealand <https://www.starship.org.nz>
- Royal Children's Hospital Clinical Guidelines, Australia <https://www.rch.org.au>
- TREKK <https://trekk.ca/><sup>28</sup>

### [Link to References](#)