Guideline

Pre-school Wheeze – Emergency Management in Children

**Purpose**

This guideline provides clinical practice guidelines to inform health professionals in the emergency setting in the management of pre-school aged children (1 to 5 years of age) with wheezing.

**Scope**

This guideline applies to all staff involved in the emergency care and management of pre-school aged children with wheezing.

- For children under 1 years of age with wheeze please refer to the CHQ Bronchiolitis guideline
- For children aged over 5 years of age please refer to the CHQ Asthma guideline

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**ALERT - Asthma and Preschool Wheeze**

The understanding of wheeze in children under 5 years of age is still evolving. Wheezing in this group is due to a heterogeneous group of diseases. These may include bronchoconstriction, lower airways inflammation and other underlying disorders.

This guideline attempts to address some of the particulars of diagnosis and management of wheeze in this age group. Specifically it recommends against use of steroids in a specific group of children with mild to moderate severity of first presentation or infrequent viral wheeze. The remainder of children should still receive steroids.

Families and healthcare professionals will still often label and treat this group with a label of asthma. This may result in confusion for families. Therefore to understand each individual's pattern of disease a thorough clinical history, assessment, and continuous review both during hospital stay and care in the community is required. Clear communication regarding diagnosis and treatment plan with parents, caregivers and general practitioners is essential.

This guideline recommends a more conservative approach for some patients however wheezing illnesses can still be life threatening. Paediatric and/or senior emergency department input should be sought for children with respiratory distress where there is failure of therapy, or an atypical or severe course.
Related documents

Procedures, Guidelines, Protocols
- Asthma/Reactive Airways Disease Clinical Pathway
- Asthma/Reactive Airways Disease Education Checklist
- Children’s Health Queensland Guideline – Asthma: Emergency Management in Children
- Children’s Health Queensland Guideline – Bronchiolitis: Emergency Management in Children

Forms and templates
- Children’s Health Queensland Fact Sheet – Asthma
- LCCH Emergency Department – Wheeze Fact Sheet (In development)
- CHQ LCCH Asthma/Reactive Airways Disease Plan generator (In development)

Guideline

Introduction
Wheeze is a very common reason for children to present to the emergency department and is most commonly caused by intercurrent viral infection or other environmental triggers. Children between the ages of 1 to 5 years represent a specific group of patients. Some display a phenotype consistent with asthma. However other may not go on to develop asthma, and for these patients recent evidence suggests that standard asthma treatment may not be efficacious.

For the purposes of this guideline we describe the patient age group for “Preschool Wheeze” as those under 5 years of age. More specifically patients are able to be further defined into those with Episodic Viral Wheeze (EVW) compared to those with Multi Trigger Wheeze (MTW). We note that preschool wheeze is also commonly referred to as “Reactive Airways Disease” and often described as “Asthma”.

Definition of wheeze
Wheeze is a continuous high-pitched sound with musical quality emitting from the chest during expiration \(^1\), with increased work of breathing \(^2\).

The term wheeze is often used imprecisely. Studies have shown that parental report of a wheeze can be unreliable, but that physicians accurately identify wheeze \(^2\). Therefore ideally a wheeze should be confirmed by a healthcare worker.

Epidemiology
It has been reported that up to 30% of children will have had at least one episode of wheezing prior to their third birthday \(^3\) \(^4\). Of those over half will have more than one episode \(^5\). In the group of pre-school wheezers 60% will stop wheezing by the age of 6. With such rates of recurrence and a large proportion (nearly two thirds) growing out of it this is an area of difficulty in correctly diagnosing, classifying and predicting later risk of asthma.
Classification

The classification of children with wheeze is a complex area with an ever growing body of research leading to more insight into the pathology and natural progression of this disease. Importantly we are now understanding that some children in the preschool aged group have differing pathological processes underlying their wheezing illness and that although many may have recurrent wheezing episodes this does not directly correlate with a diagnosis of asthma.

The epidemiological classification is used in research and has helped our understanding of disease, but because it can only be determined retrospectively its use should be limited to population-based cohort studies.

In the 2008 European Respiratory Task Force (ERS) [1] consensus they proposed the following clinical definitions for the temporal pattern of preschool wheeze:

**Episodic (viral) wheeze (EVW)** - Wheeze during discrete time periods, often in association with clinical evidence of a viral infection, with absence of wheeze between episodes

**Multi-trigger wheeze (MTW)** - Wheezing that shows discrete exacerbations but also symptoms between episodes

**Episodic (viral) wheeze (EVW)** appears to be most common in preschool children. It is usually associated with clinical evidence of a viral respiratory tract infection; the most common causative agents including rhinovirus, respiratory syncytial virus (RSV), coronavirus, human metapneumovirus, parainfluenza virus and adenovirus. Repeated episodes tend to occur seasonally [1]. EVW most commonly declines over time, disappearing by the age of 6 years; but can continue as episodic wheeze into school age, change into MTW or disappear at an older age [1].

**Multi-trigger wheeze (MTW)**. Viral infections are the most common trigger; other proposed triggers include tobacco smoke and allergen exposure; also mist, crying, laughter or exercise [1]. Though it is thought that MTW reflects chronic allergic airway inflammation there is little evidence to support this [1].

It is suggested that pre-school wheezer’s should be described in terms of the temporal patterns (EVW and MTW), but also frequency, severity and age of onset including relevant associated clinical parameters such as atopy and eczema [8]. The main purpose of classification is to guide treatment, also aiding to prognosticate. Note that children may change between categories over time and in that event pharmacological treatment should also change [9].

Asthma

The term asthma is not used to describe preschool wheezing illness as there is insufficient evidence that the pathophysiology of preschool wheezing illness is similar to that of asthma in older children and adults [1].

Several clinical predictive indices for future risk of asthma have been developed based on combinations of the presence of atopic manifestations, indirect evidence of airway inflammation such as peripheral blood eosinophil count, and severity of preschool wheeze [2]. In the Bristol ALSPAC birth cohort study they found a strong association with the development of asthma and atopy in children with wheezing onset after 18 months of age [3].

Limitations of such predictive indices are that they all have a poor positive predictive value (PPV) ranging 44 to 54, with high negative predictive values 81 to 88 [2].

Although the proposed clinical predictive indices are generally not applicable with only 50% of those who meet the criteria having asthma; it can be useful to use the known risk factors (eg. Onset over 18 months, maternal asthma, multiple early atopic sensitisation) when discussing with parents the long term risk of
asthma. For example; in the case of a patient with young onset (< 18 months) episodic viral wheeze, with no atopy or maternal asthma parents can be reassured that their child is unlikely to grow up to have asthma.

**Assessment**

**History**

The purpose of history taking and physical examination is to confirm a wheezing disorder, identify symptom pattern, the severity of the condition and possible trigger factors, look for features suggestive of an alternative diagnosis or associated condition [1].

As mentioned wheeze is not always accurately identified and can be used to describe a variety of symptoms. During history taking further questioning into the noises heard and other signs (example respiratory distress) is important to clarify the diagnosis.

Family history should be elicited, including maternal history of asthma and siblings with atopy or asthma. A smoking history is also important and all health professionals have a role in advocating for their patients by advising parents about the increased risk of wheezing associated with parental smoking.

**Differential Diagnosis**

Wheeze is due to narrowing of intrathoracic airways and expiratory flow, irrespective of the underlying mechanism. However there are alternative and less common reasons for a child to wheeze. A thorough history and examination should identify any features that make you consider the following differential diagnoses and should prompt consideration of further investigation.

**Respiratory**

- Anatomical abnormalities of the airway
  - Tracheomalacia
  - Bronchomalacia
- Cystic fibrosis
- Chronic suppurative lung disease/ bronchiectasis
- Primary Ciliary Dyskinesia
- Bronchiolitis obliterans

**Other**

- Inhaled foreign body
- Cardiac failure
- Gastro-oesophageal reflux

**Examination**

In the acute setting an initial assessment of a child should be performed within the time frame recommended by the patient’s triage (ATS) category. The most important parameters of severity being the child's general appearance or mental state and level of respiratory distress (accessory muscle use and chest wall recession)
It is important to remember that wheeze is an unreliable indicator of severity and may and may be absent in severe cases due to severe airway obstruction or extreme fatigue meaning that they are unable to generate enough airflow to wheeze. A “silent chest” in this case is a sign of impending respiratory failure.

Initial rapid severity assessment to be completed immediately:

<table>
<thead>
<tr>
<th>Mild-moderate</th>
<th>Severe</th>
<th>Life threatening</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Walk and/or can move around</td>
<td>o Respiratory distress (eg. accessory muscle use, tracheal tug, intercostal and subcostal recession)</td>
<td>o Altered conscious level</td>
</tr>
<tr>
<td>o Speak in phrases</td>
<td>o Unable to complete sentences in one breath due to dyspnoea</td>
<td>o Exhaustion</td>
</tr>
<tr>
<td>o Sats &gt; 90% in room air (RA)</td>
<td>o Sats &lt;90% (RA)</td>
<td>o Cyanosis</td>
</tr>
</tbody>
</table>

Secondary severity assessment, to be completed concurrently with initial bronchodilator dose:

<table>
<thead>
<tr>
<th>Mild-moderate: all of the following</th>
<th>Severe any of the following</th>
<th>Life threatening any of the following</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consciousness</td>
<td>Alert</td>
<td>Agitated, restless, distressed</td>
</tr>
<tr>
<td>Speech</td>
<td>Can talk or vocalise</td>
<td>May be limited</td>
</tr>
<tr>
<td>Posture</td>
<td>Can walk or crawl</td>
<td>Lethargic</td>
</tr>
<tr>
<td>Breathing</td>
<td>Respiratory distress is not severe</td>
<td>Paradoxical chest movement: inward movement on inspiration and outward movement on expiration or use of accessory muscles of neck or intercostal muscles (‘tracheal tug’) or subcostal recession (abdominal breathing)</td>
</tr>
<tr>
<td>Skin colour</td>
<td>Normal</td>
<td>Not applicable [NB2]</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>Normal [NB3]</td>
<td>Tachypnoea</td>
</tr>
<tr>
<td>Heart rate</td>
<td>Normal [NB4]</td>
<td>Tachycardia [NB4]</td>
</tr>
<tr>
<td>Chest auscultation</td>
<td>Wheeze or normal lung sounds</td>
<td>Not applicable [NB2]</td>
</tr>
<tr>
<td>Pulse oximetry</td>
<td>Sp02 &gt;90%</td>
<td>Sp02 &lt;90%</td>
</tr>
</tbody>
</table>

SpO₂ = oxygen saturation measured by pulse oximetry

NB2: May be the same as mild–moderate and does not determine severity level.

NB3: Normal respiratory rate (breaths/min): younger than 1 year, 30 to 40; 1 to 2 years, 25 to 35; 2 to 5 years, 25 to 30.

NB4: Normal heart rate (beats/min): younger than 1 year, 110 to 160; 1 to 2 years, 100 to 150; 2 to 5 years, 95 to 140.

Source: Adapted from Therapeutic Guidelines and Asthma Handbook
Oxygen Monitoring

Oxygenation is measured effectively and non-invasively through a pulse oximeter which provides measurement of oxygen saturations (SaO2). Poor gas exchange and decreased saturations may be due to severe airway obstruction due to bronchoconstriction, airway oedema, and mucous plugging [8]. The application of oxygen to a patient corrects hypoxia due to ventilation-perfusion mismatch but does not improve alveolar ventilation [8]. Oxygen is not an effective treatment for respiratory distress; therefore should only be prescribed when oxygen saturations are low [9].

There is no evidence to clearly define an optimal oxygen saturation (SaO2) target and therefore threshold for supplemental oxygen administration. It has been suggested that the risk of hypercapnoea is increased when oxygen saturations fall below 90% [10]. Consensus opinion supports a target of SaO2 of 93% and above. Oxygen should be prescribed accordingly to keep the saturations in the target range [9].

Nurse-initiated commencement of supplemental oxygen is suitable [8] however a medical officer must be notified, review the patient within 30 minutes and oxygen should be prescribed on an “oxygen order form”.

Continuous oximetry should be performed in children requiring oxygen or on salbutamol less than 2nd hourly only.

Investigations

For the majority of children with preschool wheeze no routine investigations are necessary.

The diagnosis of a preschool wheezing disorder can be made by history taking alone [1] and most preschool wheezers do not require additional tests [2].

It is generally accepted that investigations are justified in the following circumstances [1]:

- Severe symptoms
- Atypical clinical presentation prompting diagnostic uncertainty
  - Symptoms present from birth
  - Atypical clinical course eg. recovery is very slow or incomplete
  - Episodes continue in the absence of a viral infection
- Significant parental concern

Microbiological investigations

Viral culture and PCR technology enables a wide range of respiratory viruses to be identified, which additionally may reassure the family, though there is no evidence this alters management (short or long term). The cost of performing this test should also be a consideration. It is therefore recommended that patients with viral induced wheeze who are being discharged should not routinely have a Respiratory Viral PCR performed.

Local infection control and bed management protocols may require a diagnostic sample to be collected for all admitted patients.

Radiological examination

There is no evidence that chest radiographs (Chest X-ray) help in the diagnosis or treatment of preschool children with acute or recurrent wheezing [1]. A single CXR is justifiable in a child who presents with an
atypical history or who does not respond to therapy to assess for alternative or additional causes of the presentation e.g. pneumonia or inhaled foreign body.

**Blood tests**

Blood tests may be considered in patients with a severe/life-threatening episode not responding to therapy, those being considered for escalation including intravenous medications or receiving treatment for contributing causes such as pneumonia. A venous gas may be useful for venous carbon dioxide (CO₂) and electrolyte monitoring.

**Management**

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**ALERT - Management of Preschool Wheeze**

This guideline recommends a more conservative approach to management, and in particular regarding the use of steroids, in patients of preschool age with wheeze.

Therefore we suggest steroids should not be given for children with first presentation or infrequent, mild-moderate, and uncomplicated wheeze. Note that children with bronchoconstriction, particularly those who display a phenotype more consistent with asthma, or those requiring frequent bronchodilators, are likely to still benefit from steroids.

All preschool aged patients with wheeze, either caused by bronchoconstriction and/or other respiratory pathology, can still have a life threatening illness.

If the patient with preschool wheeze has severe respiratory distress, an atypical course, or is not responding to conventional therapy, senior medical consultation or paediatric advice should be sought promptly.

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The management of toddlers with wheeze in the Emergency Department comprises medications targeted at relieving acute bronchospasm, alleviating lower airways inflammation, and providing respiratory support in the form of oxygen and non-invasive ventilation. The presence of wheeze may not reflect the severity of the illness and therefore an assessment targeted at degree of associated respiratory distress is important. Medications to treat wheeze when associated with mild respiratory distress may not be necessary. Additionally, there is a spectrum of clinical presentations of wheeze in young children, and patients may transition from one phenotype to another. Therefore repeated clinical assessment is recommended following the initiation of any treatment. Medications should be discontinued if there is no objective change in clinical symptoms (deterioration or improvement) following these interventions. These should be well documented in the patient clinical notes.

**Acute management**

**Bronchodilators**

A trial of short acting inhaled beta₂ agonists is justified in all wheezing children between the ages of 12 months and 5 years. Short acting beta₂ agonist medication (salbutamol, Ventolin) should be administered.

Repeated clinical assessment is recommended following the trial of bronchodilators toobjectively determine the change in clinical symptoms (improvement or no change) following these interventions. These should be
well documented in the patient clinical notes. Bronchodilator therapy should not be continued if there is no evidence of improvement in clinical symptoms.

Salbutamol may be effectively administered by metered dose inhaler (MDI) with a mask and spacer device (6 puffs, 100 microgram/puff, total 600 micrograms <20kg, 12 puffs >20kg, or nebuliser (2.5mg <20kg, 5mg >20kg).

To optimise drug delivery, new spacers should be primed (to negate electrostatic charge) with 10 puffs of salbutamol before use. The MDI should be shaken before each puff. It should then be administered 1 puff at a time into the spacer with a face mask attached. The medication is cleared from the spacer by the child taking 5 breaths following each puff of medication.

While the effectiveness of nebulisation is widely recognised, the method has several disadvantages. Studies have indicated that delivery of salbutamol by nebuliser results in greater facial and oropharyngeal deposition of medication delivering at best 10% of the prescribed drug to the lungs, with consequent systemic absorption and side effects such as tachycardia and tremor. Nebulisation of salbutamol requires a child to sit still for at least 10 minutes. Studies in paediatric populations have confirmed that metered dose inhalers with spacers are as effective as nebulisers in the treatment of acute asthma and may be a more cost effective and quicker means of delivery. Metered dose inhalers should therefore be encouraged as first line management in all instances except children requiring continuous delivery of salbutamol or oxygen therapy.

Note that in children with underlying suspected or confirmed structural abnormalities such as bronchomalacia or tracheomalacia, bronchodilator medications may produce a paradoxical effect [12].

There is no evidence to support the use of long acting beta₂ agonists in preschool wheeze [13].

**Inhaled anticholinergic agents**

There is insufficient evidence to support the routine use of anti-cholinergic therapy (ipratropium bromide, Atrovent) for the wheezing pre-schooler [13].

Children with severe symptoms should be considered for nebulised ipratropium bromide at a dose of 250 mcg. This can be given up to 3 times and should be combined with salbutamol nebulisers [14].

**Steroids**

In preschool children with mild to moderate wheeze, steroids do not appear to reduce the severity of symptoms, nor the need for treatment in an Emergency Department or hospitalisation [8]. A large randomised, double-blind, placebo-controlled trial found no significant difference in the duration of hospitalisation in children with mild to moderate wheezing associated with viral infection in those given oral steroids compared to placebo [15].

Therefore for preschool aged children with mild to moderate disease and a first presentation of viral wheeze or infrequent episodes, steroids should not be given.

Steroids should still be used for patients with preschool wheeze who have:

- More frequent episodes
- Ongoing frequent bronchodilator use (<2 hourly)
- History suggestive of an asthma phenotype eg. atopy and maternal family history of asthma
- Severe or life threatening symptoms
A requirement for intensive care unit admission

The systemic steroid of choice is oral prednisone/prednisolone. Consensus recommends a dose of 2mg/kg on the first day. This should be continued for 3 days at a dose of 1mg/kg. \[^{18}\] A more prolonged course of up to 5 days may be indicated in severe cases.

**Intravenous medications**

Some patients who have severe/life threatening respiratory distress and not responding to inhaled bronchodilators may benefit from the use of intravenous medications to assist in managing their bronchospasm.

*Magnesium sulphate*

There is no clear evidence for the role of magnesium sulphate in the treatment of preschool wheeze. However, it can be considered in patients with acute severe wheezing illnesses which are not responding to inhaled therapies \[^{13}\].

The action of magnesium sulphate remains unclear. It is thought that magnesium ions decrease the uptake of calcium by bronchial smooth muscle cells, which leads to bronchodilation. Magnesium may also have a role in inhibiting mast cell degranulation, which reduces inflammatory mediators.\[^{17, 18}\]

The standard bolus dose of magnesium sulphate is 0.2 mmol/kg (equivalent to 50 mg/kg) with a maximum dose of 8 mmol (2000mg), infused over 20 minutes.\[^{16}\] Magnesium sulphate infusions are used rarely at a rate of 0.01-0.05mmol/kg/hr.

Magnesium therapy is usually well tolerated with only minor side effects reported, such as epigastric or facial warmth, flushing, pain or numbness at the infusion site, dry mouth and malaise.\[^{19}\] Allergic reaction, respiratory depression, hypotension and circulatory collapse can rarely occur. When giving repeated doses, knee reflexes should be monitored between each dose as loss of reflexes can occur in magnesium toxicity. If reflexes are absent discontinue magnesium as use of the drug beyond this point risks respiratory failure.

*Intravenous salbutamol*

An intravenous infusion of beta\(_2\) agonists are an advantage only in very severe acute wheeze in young children.\[^{20}\]

There has been some recent conjecture regarding an appropriate dose of intravenous salbutamol for use in children with severe, acute asthma. Additionally, there are significant concerns that current intravenous salbutamol dosing recommendations for children may be excessive and may unnecessarily raise the potential for adverse reactions such as lactic acidosis and tachycardia, and through increasing respiratory workload, exacerbate respiratory fatigue.

Intravenous salbutamol should be considered for use in the children with life threatening acute episodes. The dosing recommendation is an initial bolus dose 100mcg/kg (max 5g) given over 20 mins of which is equivalent to 5mcg/kg/min for 20 mins. The child should be closely observed and monitored for signs of salbutamol toxicity (extreme tachycardia, lactic acidosis, and hypertension). If there are significant concerns regarding toxicity, the infusion should be slowed down or ceased. The clinical response to this initial dose should be evaluated and the requirement for progression to an intravenous salbutamol infusion considered at a rate of 1-10mcg/kg/min. All children requiring treatment with IV salbutamol should be discussed with Paediatric Intensive Care Unit (PICU) or Retrieval Services Queensland (RSQ).

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**ALERT - Intravenous Bronchodilators - Magnesium Sulphate and Salbutamol**

Patients being administered IV magnesium sulphate or IV salbutamol require full cardiac monitoring. Heart rate, blood pressure and respiratory rate should be recorded at least every 5 minutes during the infusion. If hypotension persists - cease infusion. Magnesium should be prescribed in mmols and administered using safety software syringe drivers to avoid medication errors.
**Intravenous steroids**

Whilst oral and parenteral corticosteroids appear to have similar efficacy, intravenous steroids may be considered in patients who have a severe episode of wheeze. Other indications may include patients who are unable to tolerate oral medication or who have a decreased conscious level.

Options include IV Hydrocortisone 4mg/kg every 6 hours (maximum 200mg) or methylprednisolone at an initial dose of 2 mg/kg (maximum 60 mg) and subsequent doses 1mg/kg every 6 hours on day 1, then every 12 hours on day 2, and then daily. [18]

**Oxygen**

*Low Flow Oxygen*

For children with saturations persistently <93%, supplemental low flow oxygen may be administered via nasal prongs (<2L/min) and should ideally be humidified. For children who have a requirement of >2L/min, oxygen should be delivered via Hudson mask starting at 4L/min (there is no role for 2-4L/min via mask). Low flow oxygen should not be administered for respiratory distress alone.

Transient (less than 5 minute) desaturations below 93% during sleep with rapid self-correction may not necessitate increasing or commencing supplemental oxygen.

*High Flow Nasal Cannula Oxygen (HFNC)*

For children with acute respiratory insufficiency due to wheeze who have not responded to standard medical therapies, HFNC oxygen and Non Invasive Ventilation (NIV) are usually well tolerated and early use may prevent the requirement for intubation and mechanical ventilation. There are no randomised control trials to confirm the efficacy of high flow oxygen support in patients with severe preschool wheeze.

The benefits of HFO2 are [21][22][23][24].
1. Flushes out the dead space of the nasopharyngeal cavity allowing for better ventilation as well as oxygenation
2. Provision of flow adequate to support inspiration, thereby reducing the inspiratory work of breathing
3. Improvement in lung and airway compliance due to heating and humidification of oxygen
4. Ability to accurately deliver gas mixtures at body temperature with 100% humidity, thus facilitating mucociliary transport and minimising the viscosity of secretions
5. Delivery of end distending pressure (CPAP)

If there is inability to maintain SaO2 >94% despite oxygen via a Hudson mask with reservoir, or the child has deteriorating work of breathing with increasing fatigue, tachycardia, and tachypnoea modalities such as HFNC oxygen, CPAP or BiPAP should be considered. Children who are candidates for NIV should have a normal level of consciousness. In children with a deteriorating level of consciousness, who may require intubation and ventilation, HFNC oxygen may be valuable to provide pre-oxygenation whilst preparation for the intubation is underway.

Commencement of NIV and HFNC is guided by CHQ NIV and HFNC oxygen protocols, and should involve liaison with a Level 6 PICU. The child should be nursed as an appropriate (1:1 or 1:2) nurse to patient ratio, in an acute area such as a resuscitation room with continuous oximetry and ECG monitoring. Vascular access must be secured and the child must remain nil by mouth with consideration given to the placement of a nasogastric tube to prevent gastric insufflation.

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**ALERT - High Flow Oxygen and Ongoing Bronchodilator Therapy**

The rate of oxygen flow through the high flow circuit reduces the delivery of inhaled medications. Therefore for patients requiring ongoing bronchodilator therapy, via either the nebuliser or metered dose inhaler, the high flow needs to be stopped during this administration. For patients who are too unwell to come off high flow therapy but require further bronchodilator an IV infusion of salbutamol should be considered.
Hypertonic saline
Whilst there is evidence supporting use of hypertonic saline in infants with bronchiolitis, there is insufficient evidence to support the routine use of hypertonic saline in children with preschool wheeze.

Oral bronchodilator medication
There is no role for oral preparations of beta_2_ agonists (e.g. Ventolin syrup) due to systemic side effects [25].

Inhaled corticosteroids
There is no role of inhaled corticosteroids for acute management of wheeze of any type in toddlers [1].

Intermittent Leukotriene antagonists
There is no evidence for the role of intermittent montelukast [26].

Chronic management
In the emergency setting, parents and caregivers may request information on preventative medications for the management of recurrent wheeze episodes. The following information can be provided but the commencement of medications from the emergency department is not recommended. If indicated, medication can be considered and undertaken via the child’s general practitioner or paediatrician.

Inhaled corticosteroids
There is insufficient evident to support the use of inhaled corticosteroids in episodic viral wheeze (EVW).

For children with multi trigger wheeze, a randomised controlled trial of long term inhaled corticosteroid demonstrated improvement benefits in symptoms, exacerbation rates, lung function, and airway hyper responsiveness. Although the effect is smaller than that seen in school age children and adults, a 3 month trial can be undertaken [27][28].

Leukotriene antagonists
For toddlers with multi trigger wheeze and who are identified to be at high risk for asthma, an alternative to inhaled corticosteroids is daily montelukast. There is some benefit demonstrable in preschool children, however the cost effectiveness is a consideration [29]. Parents should be counselled on side effects of montelukast including headaches and mood disturbance/depression.

Disposition
Admission to the Emergency Short Stay Unit (ESSU)
Those patients who require bronchodilator therapy of a frequency less than hourly should remain in the acute assessment area of the emergency department for vigilant monitoring and regular review by medical staff [30]. If symptoms occur within 1-2 hours of initial treatment with bronchodilator, but the child does not require further investigation or supplemental oxygen, the child should be admitted to the Emergency Short Stay Unit (ESSU) [31]. If the child requires bronchodilator therapy less than hourly, transfer to ESSU may be considered after liaison with ESSU medical and nursing staff [31]. On admission to ESSU salbutamol must be prescribed on the “Variable frequency medication sheet” by medical officer. The order must be for a specific time and not a range.
Ongoing Bronchodilator Therapy

After admission to ESSU, vital signs and respiratory assessment should be recorded in line with bronchodilator frequency; or hourly if requiring oxygen supplementation\(^{[30]}\).

- Patients who require 1 to \(4^{th}\) hourly bronchodilator could be weaned by nursing staff who are trained to make this judgement.

Assessment for stretching the need for bronchodilator should include:

- Respiratory distress (“Work of breathing”): subcostal & intercostal recession/ tracheal tug / nasal flaring
- Activity level - lethargy / alertness
- Respiratory rate: decreasing to within normal limits for age
- Heart rate: decreasing to within normal limits for age. Note bronchodilator therapy increases heart rate.
- Speech: able to talk in sentences
- Auscultation: air entry improved
- Auscultation: wheeze reduced or appearance of wheeze in previously quiet chest (note wheeze alone is not an indication for giving salbutamol)
- Cough: reduction or change in cough ie. becomes looser
- Oxygen saturations: increasing oxygen saturations and decreasing oxygen requirement

All assessment should be done in collaboration with the child and caregiver\(^{[30]}\).

Referral to Inpatient Teams

There is little evidence to support specific requirements around admission to an inpatient facility, however criteria for consideration would be:

- Severity of illness i.e. respiratory distress; continued need for frequent bronchodilators (every 1 to 2 hours)\(^{[8]}\) at 24 hours post presentation.
- Failure to progress: after 12hrs of care patient has not improved – consider poor bronchodilator responder, suboptimal frequency of administration, or alternate diagnoses
- NOTE: Oxygen requirement: transient hypoxia (saturations below 94\%) is relatively common in these patients, especially when asleep. Supplemental oxygen required to maintain oxygen saturation levels equal to or above 94\%\(^{[8]}\) in isolation is no longer an indicator for admission, and can be delivered in the short stay unit.

A lower threshold for admission may be used for specific patients despite meeting discharge criteria detailed below.

These include:

- High risk
  - Past PICU admission
  - Previous sudden deterioration
- Social issues
  - Geographical distance to local hospital
  - Other family issues affecting ability to care for patient at home
Discharge home

Criteria

Children with pre-school wheeze may be safely discharged home if they meet the following criteria:

- Well, active child requiring 2 to 3 hourly salbutamol
- Saturations greater than or equal to 93%
- Normal hydration and toleration of diet and fluids

Patients who are at high risk for deterioration with more severe disease (including those with previous Intensive Care admission) should be considered for a period of longer short stay or inpatient observation despite meeting the above criteria.

It is also important to assess the family’s ability and confidence to safely manage the child and their symptoms at home, and ensure they are able to promptly return for review with deterioration. This includes families who reside in areas with remote or limited access to health facilities. Some patients may have to be admitted if social factors could impede optimal care.

Education

Prior to discharge, families should receive education regarding the expected clinical course, including potential for and signs of deterioration, reasons to return to the emergency department and other management strategies for home. They should be able to access further doses of medication, and have access to transport or emergency services and feel comfortable with the diagnosis and what to do if symptoms recur.

Children’s Health Queensland recommends use of an Asthma/Reactive Airways Disease education checklist (see Appendix 2) which supplements didactic education of patients, parents and carers with an active assessment of understanding. This specifically includes management in relation to life threatening episodes.

Upon discharge, specific wheeze education should be provided including the following;

- Discharge letter
- Parent handout
  - Asthma
  - Preschool wheeze (In development)
  - Use and care of spacer
- Printed action plan
  - Three copies (one each for family, general practitioner, and filed in patient notes)
  - This can be generated using
    - Online Royal Children’s Hospital generator at http://www.rch.org.au/clinicalguide/forms/Asthma_Action_Plan/
  - CHQ Action Plan Generator (In development)
- Recommended arrangements for follow-up with general practitioner (recommended for all children) and/or paediatrician
- Information about other sources of information about wheeze
  - Asthma Australia Discharge Pack
Consultation

Key stakeholders who reviewed this version:

- Emily Casey, Clinical Nurse, Emergency Department, Lady Cilento Children’s Hospital
- Nora Phelan, Associate Nurse Unit Manager, Emergency Department, Lady Cilento Children’s Hospital
- Dr Katie Reeves, Staff Specialist, Emergency Department, Lady Cilento Children’s Hospital
- Dr Laura Sumners, Fellow, Emergency Department, Lady Cilento Children’s Hospital

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We would like to acknowledge the following LCCH Physicians who provided consultation on this topic.

- Dr Nitin Kapur, Paediatric Respiratory Physician
- Dr David Levitt, Director of Paediatrics

References and suggested reading

8. Royal Children's Hospital, Melbourne., Acute Asthma. 2015.

### Guideline revision and approval history

<table>
<thead>
<tr>
<th>Version No.</th>
<th>Modified by</th>
<th>Amendments authorised by</th>
<th>Approved by</th>
</tr>
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<tr>
<td>1.0</td>
<td>Dr Jason Acworth, Director Paediatric Medicine</td>
<td>Medicines Advisory Committee</td>
<td>Executive Director Medical Services</td>
</tr>
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</table>

### Keywords
- Wheeze, preschool, asthma, airway, emergency, 00730

### Accreditation references
- NSQHS Standards (1-10): 4, 12

### Appendices

- Appendix 1 - Preschool Wheeze – Key Learning Points
- Appendix 2 – Flowchart: Preschool Wheeze Management
- Appendix 3 – Preschool Wheeze: Severity Assessment
- Appendix 4 – Preschool Wheeze: Medication Dosing
- Appendix 5 – Clinical Pathway Asthma/Reactive Airway Education Checklist
Appendix 1 – Preschool Wheeze – Key Learning Points

Clinical Classification
- Episodic Viral Wheeze
- Multi Trigger Wheeze

Risk factors and association with asthma
- Onset over 18 months of age
- Maternal asthma
- Atopy eg. Eczema

Management:
- Inhaled salbutamol via spacer preferred method
- Avoid use of steroids in mild-moderate episodes for those patients with first or infrequent episodes of wheeze

Discharge
- If well and requiring salbutamol no more frequently than 3 hourly
- Completion of CHQ asthma Education Checklist
- Provision of three copies of Asthma/Reactive Airways Action Plan
Appendix 2 - Flowchart: Preschool Wheeze Management

- Initial rapid severity assessment
  - Mild - moderate
    - Salbutamol MDI with mask
      - Good response with no ongoing respiratory distress
  - Severe
    - Ongoing respiratory distress
      - Complete salbutamol burst (total 3 doses)
      - Continuous reassessment
  - Life threatening
    - Continuous salbutamol via nebuliser
      - Call for senior help
      - Consider ipratropium bromide (maximum 3 doses)
      - Consider early commencement of High Flow Nasal Cannula Oxygen (HFNC)

- Continuous reassessment
  - Salbutamol required < 1 hourly
    - No
      - Consider steroids
      - Consider alternative diagnoses
    - Yes
      - Salbutamol required < 1 hourly
        - No
          - Suitable for step down to continue observation and management in emergency short stay unit or paediatric ward
        - Yes
          - Salbutamol required >3 hourly
            - Yes
              - Discharge with advice
            - No
              - Ongoing observation
                - Reconsider steroids
                - Consider referral to inpatient team
      - Yes
        - Responding to therapy
          - Decreasing salbutamol requirement
            - Yes
              - Seek Intensive Care or Paediatric Retrieval Services Input
            - No
              - No
                - No
                  - No
                    - Yes
Appendix 3 – Preschool Wheeze: Severity Assessment

<table>
<thead>
<tr>
<th>Mild-Moderate</th>
<th>Severe</th>
<th>Life threatening</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Minimal respiratory distress</td>
<td>• Accessory muscle use, intercostal and subcostal recession, tracheal tug</td>
<td>• Poor respiratory effort</td>
</tr>
<tr>
<td>• Walk, active</td>
<td>• Speech limited due to dyspnoea</td>
<td>• Soft or absent breath sounds</td>
</tr>
<tr>
<td>• Speak in phrases</td>
<td>• Oxygen saturations 90-93%</td>
<td>• Altered conscious level</td>
</tr>
<tr>
<td>• Minimal respiratory distress</td>
<td></td>
<td>• Exhaustion</td>
</tr>
<tr>
<td>• O2 saturations&gt;93% RA</td>
<td></td>
<td>• Oxygen saturations &lt;90% (RA)</td>
</tr>
</tbody>
</table>

Discharge Criteria

• Well active child requiring salbutamol no more frequently than 3rd hourly
• Normal hydration and nutrition
• Parents/carer education complete
• Medication prescribed/provided
• Asthma/reactive airways plan completed and 3 copies provided
## Appendix 4 – Preschool Wheeze: Medication Dosing

### INHALED SALBUTAMOL

| Salbutamol | <20kg 6 puffs (600mcg) via MDI or 2.5mg via nebuliser  
| Salbutamol burst | 3 doses at 20 minute intervals  
| Salbutamol continuous | Doses continuously, replenish reservoir when empty  

### INHALED IPRATROPIUM BROMIDE

Use in severe cases only, and MDI ipratropium bromide not routinely available. Combine in reservoir with salbutamol.

| Ipratropium | <20kg 250mcg via nebuliser, up to 3 doses  
| >20kg 500mcg via nebuliser, up to 3 doses  

### INTRAVENOUS SALBUTAMOL

| Salbutamol bolus | 100mcg/kg (maximum dose, max 5g) over 20 minutes  
| Salbutamol infusion | 1-10mcg/kg/min  

### INTRAVENOUS MAGNESIUM SULPHATE

| Magnesium sulphate | 0.2 mmol/kg (max 8 mmol) over 20 minutes  
| (Dose equivalent to 50 mg/kg)  
| (Use safety software syringe driver with standard concentration of 25mmol magnesium sulphate in 50mL 0.9% sodium chloride)  

### STEROIDS

| Prednisolone PO | 2mg/kg (max 50mg) daily for first day  
| 1mg/kg daily for subsequent 2 days  
| Hydrocortisone IV or Methylprednisolone IV | 4mg/kg (max 200mg) Q6 hourly  
| 2mg/kg (max 60mg) initial dose  
| 1mg/kg Q6 hourly for first day  
| Q12 hourly for second day Daily thereafter  

### Appendix 5 – Clinical Pathway Asthma/Reactive Airway Education Checklist

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>1. Can you give an explanation / definition of asthma? (allow opportunity for each parent, carer and child to respond)</td>
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<tr>
<td>• Long-term (chronic) condition</td>
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<tr>
<td>• Abnormally sensitive or inflamed airways in the lungs:</td>
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<tr>
<td>• Wheezing and breathlessness (narrowing of airways due to contraction of smooth muscle in airway wall, swelling of lining of airways, increased mucus secretion into airway)</td>
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<tr>
<td>2. Do you know what triggers are?</td>
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<tr>
<td>• Colds and flu</td>
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<tr>
<td>• Smoke – cigarette or fire</td>
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<tr>
<td>• Changes in temperature and weather</td>
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<tr>
<td>• Activity and exercise</td>
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<tr>
<td>• Dust and pollution</td>
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<tr>
<td>• Inhaled allergens including pollen, moulds, pet allergen etc</td>
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<tr>
<td>• Emotions, including laughter or stress</td>
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<td>• Workplace environment</td>
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<tr>
<td>3. Do you know that even children categorised as mild-moderate asthma, can still experience severe life threatening asthma attack / flare up?</td>
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<tr>
<td>• Explain that the severity of a particular asthma flare-up (e.g. acute asthma causing a trip to the emergency department) is not the same as the severity of the child’s asthma overall</td>
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<tr>
<td>4. Do you know the name of your blue / grey puffers - the reliever medication?</td>
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<tr>
<td>• Ventolin/Asmol/Epiaq (Salbutamol)</td>
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<td>• Acomir – albuterol (Salbutamol)</td>
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<tr>
<td>• Bricanyl – turbuhaler (Terbutaline Sulphate)</td>
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<tr>
<td>• Atrovent (Ipratropium Bromide)</td>
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<tr>
<td>5. Do you know how the reliever medication works and when to take it?</td>
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<tr>
<td>• Relievers make the abnormally narrowed breathing tubes (airways) wider so it is easier to breathe</td>
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<tr>
<td>• It works very quickly, in about 4 minutes, and lasts up to 4 hours</td>
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<tr>
<td>• Relievers should only be used in an emergency, or before exercise if prescribed for exercise-induced bronchoconstriction</td>
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<tr>
<td>• Relievers should not be used at other times ‘just in case’, and that using reliever too often is a sign that the child’s asthma is poorly controlled – child may need regular preventer medicine</td>
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<tr>
<td>6. Do you know the name of the preventer medication?</td>
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<tr>
<td>• Floctide (Fluticasone)</td>
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<tr>
<td>• Qvar (Beclomethasone)</td>
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<tr>
<td>• Alvesco (Ciclesonide)</td>
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<tr>
<td>• Pulmicort – turbuhaler (Budesonide)</td>
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<tr>
<td>• Intal forte (Sodium Cromoglycate)</td>
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<tr>
<td>• Seretide – combination (Fluticasone/Salmeterol)</td>
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<tr>
<td>• Symbicort – combination (Budesonide/Efomterol)</td>
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<tr>
<td>• Flutiform – combination (Fluticasone/Efomterol)</td>
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<tr>
<td>• Singular (Montelukast)</td>
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<tr>
<td>7. Do you know how your preventer medication works and when to take it?</td>
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<tr>
<td>• Preventers (inhaled corticosteroids, montelukast, and combinations of inhaled corticosteroid and long-acting beta2 agonist) work mainly by settling down the inflammation in the airways and dries up the mucus. Combination preventers (inhaled corticosteroids plus long-acting beta2 agonist) also contain a second medicine that helps keep narrow airways open for a longer time.</td>
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<tr>
<td>• Preventers must be taken every day even if you feel well. Preventer medication doesn’t work straight away, but you will start to feel better in a few weeks.</td>
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<tr>
<td>8. Do you know about possible side effects of preventer medication and how to reduce these?</td>
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<tr>
<td>• Oral thrush, voice change, sore throat</td>
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<tr>
<td>• Intal forte – cough after use</td>
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</tr>
<tr>
<td>• Singular – headaches and stomach upset</td>
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<tr>
<td>• Reduce these side effects by following directions closely, using a spacer with puffers, rinsing, gargle and spitting after use. Small children and babies can drink or brush teeth afterwards.</td>
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</tr>
<tr>
<td>Name:</td>
<td>DOB:</td>
<td>UR No:</td>
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</tr>
</tbody>
</table>

- Nurse to initial in YES / NO column
- YES > No further education or explanation is required
- NO > Further education or escalation is required
  - In hours: Contact CNC Respiratory
  - Out of hours: Contact medical staff and document details in Progress Notes

<table>
<thead>
<tr>
<th>Escalation required</th>
<th>Date</th>
</tr>
</thead>
</table>

9. Do you know how to tell if the puffer is full or empty and how to check the expiry date?
   - The total number of doses and expiry is written on the canister (take out of plastic canister)
   - Work out how long the puffer will last with the parent/carer
   - On average they last 1-2 months if used regularly every week (most contain 120 doses)

10. Do you have an oral steroid?
    - Check that the parent/carer knows the dose and when to take the medicine (in the morning) and for how many days post discharge to continue the oral steroid.
    - Check that the parent/carer is able to identify location of expiry date on the oral steroid bottle

11. Do you know how to use the puffer and spacer or dry powder inhaler device?
    - Physically demonstrate how to use the device, provide training, then watch the child or parents perform each step
    - Highlight the importance to parent/carer of removing the dust cap from the puffer and the spacer prior to use
    - Check if parent/carer is aware of requirement to shake the puffer before each puff

12. Do you know how to clean and care for the spacer?
    - Wash in warm soapy water every 2-3 weeks, do not rinse, shake off excess water and leave to air dry. Do not dry spacer with a cloth or paper towel as this can result in electrostatic charge on the inside of the spacer, which can reduce the availability of the medication

**Asthma Action Plan**

13. Have you received a new written Asthma Action Plan for this admission?
    - Royal Children’s Hospital Melbourne Online Asthma Action Plan

14. Have you received a minimum of 2 copies of the Asthma Action Plan – 1 copy for self, 1 copy for GP?
    - Instruct parent/carer to give one copy of the Asthma Action Plan to their child’s GP

15. Do you know how to use the written Asthma Action Plan?
    - Review the action plan with parent/carer
    - Always bring the Asthma Action Plan, puffer, spacer to all medical appointments, GP & Hospital
    - Instruct parent/carer to give a copy of the Asthma Action Plan to their child’s school or childcare centre

16. Do you know the signs when your child needs to take their reliever medication?
    - Refer to the Asthma Action Plan

17. Do you know how to use the reliever?

18. Do you know how to use the preventer (if applicable)?

19. Do you know what to do in the event of an asthma attack/flare up?
    - Refer to the Asthma Action Plan

20. Do you know when to seek help from a doctor?
    - Refer to the Asthma Action Plan
    - Explain warning signs that mean the child needs to see a doctor or needs emergency care

21. Do you know when to call an ambulance?
    - Refer to the Asthma Action Plan

22. Do you know your clinical follow up? [ ] Outpatient appointment [ ] GP

**Parent/carer to sign on completion of the Asthma Education Checklist**
I have discussed the above with the nursing/medical staff and consider that I understand this information:

Parent/carer signature: ____________________________________________ Date: __/__/____