Purpose

This procedure provides clinical practice guidelines to guide clinicians involved in the emergency management of infants with acute bronchiolitis.

Scope

This guideline relates to all staff involved in the care and management of infants with acute bronchiolitis.

Related documents

Procedures, Guidelines, Protocols

- Flowchart: Emergency Management of Infants with Acute Bronchiolitis
- Parent Information: Acute Bronchiolitis
- Admission/Discharge Criteria for Infants with Acute Bronchiolitis
- Clinical Care Pathway- Bronchiolitis (Draft)
- CHQ Procedure 10020: Oxygen Therapy

Policy and standard(s)

- CHQ Nursing Standard 01409: Suctioning – Oro-pharyngeal and Nasopharyngeal
- CHQ Nursing Standard 10030: Pulse Oximetry
- CHQ Procedure 10033: Non-Invasive Ventilation
Introduction

Bronchiolitis is a respiratory illness affecting children under 12 months of age, caused by a viral pathogen, and resulting in widespread inflammation of the small airways of the lungs.¹

Epidemiology

The illness has a seasonal variation coinciding with the peak incidence of viral agents, with a peak in presentations in winter. These presentations account for 2% of all emergency department presentations in Australia and New Zealand and are the most common reason for admission to hospital for infants under 6 months of age.²

Aetiology

Any virus causing respiratory illnesses may lead to bronchiolitis. Respiratory Syncytial Virus (RSV) is the most common viral pathogen³, and can result in a more severe clinical picture.⁴ Other factors affecting severity may include dual viral infection and viral load.⁵

Clinical Presentation and Course

Bronchiolitis is usually a self-limiting illness characterised by respiratory distress which resolves in the course of 1 week in most infants. The typical picture is deterioration over the first three days with coryzal symptoms, upper respiratory tract congestion, cough and sneeze.¹,⁶,⁷ The peak severity occurs at days three to six with the development of increased work of breathing, feeding difficulties and auscultatory findings of crepitations (commonly) or wheeze. Affected infants then typically improve over three days.

Feeding difficulties are multifactorial in origin and infants may feed for shorter periods and/or ingest a decreased volume which can result in dehydration. Nasal congestion impacts on infants who are obligate nasal breathers, creating difficulty ingesting breast or bottle feeds. An increase in baseline respiratory effort coupled with increased work of breathing results in fatigue throughout feeds. Pulmonary hyperinflation also impacts upon gastric expansion.

Apnoea may be the only presenting symptom in infants, particularly the very young.⁷ Some infants may also experience low grade fever (<50% of patients).⁷ High grade fever (temperature >39°C) is not typical for viral bronchiolitis and its presence should prompt consideration of alternate diagnoses.

Older infants, usually those close to 12 months of age, may experience a clinical picture similar to asthma or viral induced wheeze. These infants are typically atopic and may have a history of eczema or a family history of asthma or atopy.

Severe illness

Some infants are at risk for more severe illness¹ and should have a lower threshold for admission, investigation, and close observation. These include:

Age:
- History of preterm delivery <32 weeks gestation
- Chronological age <6 weeks
Known underlying conditions:
- Congenital cardiac disease
- Neurological or neuromuscular disorder
- Immunodeficiency
- Trisomy 21
- Chronic respiratory illness including chronic neonatal lung disease (CNLD) or cystic fibrosis (CF)

Assessment

Bronchiolitis is a clinical diagnosis and evaluation should define both clinical features and severity of the illness. This includes the following:

- Duration of illness
- Respiratory symptoms
- Feeding
- Hydration status
- Presence of high risk features

Severity of the illness should assess clinical features of behaviour, feeding, hydration and respiratory distress (see Table 1), however clinically bronchiolitis should be considered to be a continuous spectrum of signs and symptoms.

Note: Central capillary refill time is a part of hydration assessment in infants however may be a marker of poor perfusion related to other causes such as fever or being generally unwell.

Table 1: Assessment of severity of acute bronchiolitis

<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Life Threatening</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behaviour</strong></td>
<td>Normal</td>
<td>Lethargy, intermittent irritability</td>
<td>Progressive lethargy, increasing irritability</td>
<td>Obtunded</td>
</tr>
<tr>
<td><strong>Feeding</strong></td>
<td>Normal</td>
<td>Difficulty, reduced intake</td>
<td>Reluctance or inability, poor intake</td>
<td>Absent feeding</td>
</tr>
<tr>
<td><strong>Hydration</strong></td>
<td>Normal</td>
<td>Mildly decreased</td>
<td>Mild to moderately decreased</td>
<td>Moderate to severely decreased</td>
</tr>
<tr>
<td><strong>Circulation</strong></td>
<td>Central capillary refill time (CCRT) &lt; 2 seconds</td>
<td>CCRT 2-3 seconds</td>
<td>CCRT &gt; 3 seconds</td>
<td>Mottled skin, prolonged CCRT</td>
</tr>
<tr>
<td><strong>Respiratory</strong></td>
<td>Saturations (in room air) Normal ≥ 94%</td>
<td>Mild hypoxia &lt; 94%</td>
<td>Moderate hypoxia &lt; 90%</td>
<td>Severe hypoxia &lt; 85%, cyanosis</td>
</tr>
<tr>
<td><strong>Respiratory rate (RR)</strong> Normal</td>
<td>Mildly increased</td>
<td>Markedly increased or decreased</td>
<td>Markedly increased or decreased</td>
<td>Markedly increased or decreased</td>
</tr>
<tr>
<td><strong>Accessory muscle use</strong> Normal or minimal</td>
<td>Moderate retractions</td>
<td>Marked retractions</td>
<td>Severe retractions</td>
<td></td>
</tr>
<tr>
<td><strong>Apnoea</strong></td>
<td>No apnoeic episodes</td>
<td>Brief</td>
<td>Increasingly frequent</td>
<td>Prolonged</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Nasal flare</td>
<td>Grunt, head bob</td>
<td>Grunt</td>
<td>Bradycardia</td>
</tr>
</tbody>
</table>

Adapted from Fitzgerald (6) and Clinical Practice Guidelines RCH Melbourne
Differential diagnosis

Whilst bronchiolitis is the most common cause of respiratory distress in infants, less common diagnoses, or dual diagnoses must be considered in all children presenting with this clinical symptom.

Other causes of respiratory distress in infants include:1,8
- Bacterial pneumonia, including whooping cough (caused by *Bordetella pertussis*)
- Aspiration of milk/formula or foreign body
- Tracheo/broncho malacia
- Allergic reaction
- Intrathoracic mass
- Cystic fibrosis
- Viral induced wheeze
- Congestive cardiac failure (CCF)

Congenital cardiac diseases has an incidence of approximately 1% of infants, and up to one third of patients remain undiagnosed at 12 weeks of age and have had normal antenatal screening and newborn examinations. They may therefore present at any time with respiratory distress and decreased feeding due to the development of CCF. Note that decompensation may be triggered by an intercurrent illness.

Cardiac disease should be considered in those infants with:
- Absence of precipitating viral illness and symptoms
- Hypoxia out of proportion to severity of respiratory disease
- Presence of abnormal or unequal peripheral pulses
- Presence of cardiac murmur
- Presence of hepatomegaly

Investigations

For the majority of infants with bronchiolitis, no routine investigations are necessary.

Respiratory Viral PCR

Identification of aetiological viral agent does not alter management of acute bronchiolitis and the cost of performing this test should also be a consideration. It is recommended that patients with mild bronchiolitis who are being discharged should not routinely have a Respiratory Viral PCR performed.8

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

Samples may be collected by nasopharyngeal aspirate (NPA), usually performed during therapeutic nasal clearance. A nasal flocked swab (Floq™) is also a suitable sample.

Chest Xray (CXR)

In acute bronchiolitis presentations, a CXR rarely provides additional information that affects treatment, therefore should not be routinely performed. It should be considered in the following cases:1
- Severe cases of bronchiolitis
- Atypical clinical course
- Unexpected clinical deterioration
- Unusual presentation prompting diagnostic uncertainty e.g. high fever, abnormal cardiovascular examination
**Blood tests**

The following blood tests may be considered in patients in the following situations:

- **Blood sugar**
  - Via heelprick in decreased feeding, or with increasing lethargy
  - Venous sample if requiring IV insertion
- **Serum electrolytes, urea and creatinine**
  - Suspected dehydration
  - Prior to the commencement of supplement IV fluids to check baseline
- **Full blood count (FBC)**
- **Blood culture**
  - Suspected sepsis or pneumonia
  - Severe bronchiolitis
  - Those requiring further investigation of fever
- **Blood gas analysis**
  - Most commonly via venous blood gas (VBG)
  - Rarely is an arterial sample required
  - Both samples adequately assess carbon dioxide (CO₂) retention, which may indicate fatigue

*Note*: Patients with Chronic Neonatal Lung Disease may have higher than normal baseline CO₂ levels so any previous results for these patients should be considered when interpreting venous blood gas results.

**Management**

The management of bronchiolitis is supportive care, mainly involving supplementation of feeding and hydration and respiratory assistance. It is important to ensure adequate rest for the infant, with minimal handling and grouping of cares such as observations, feeding and nappy changing.

**Nasal clearance**

Nasal clearance is proposed to assist infants with bronchiolitis by improving breathing through the nose, especially during feeds. Normal saline drops may be administered to both nostrils, which may then be followed by suction.

“Deep suctioning” involves placement of a catheter into the nasopharynx and suction from a negative pressure vacuum. “Non-invasive suctioning” involves a shallow suction catheter device being placed into the over the nares (or for home management with a nasal bulb) and suction via vacuum.⁹ Deep suctioning has been shown to result in increased length of hospital stay for infants with bronchiolitis via a proposed mechanism of causing oedema and irritation of the upper airway.⁹

The duration of relief of nasal obstruction by suctioning is time limited. Lapses greater than four hours between nasal suction were associated with longer length of stay in one study.⁹

Overall, nasal clearance is therefore recommended via non-invasive suction and at a regular frequency less than every four hours. The caregivers can continue this at home.

**Hydration**

Fluid replacement therapy is required in approximately 30% of infants admitted with bronchiolitis and modes can include nasogastric or intravenous fluids. The CRIB study (Comparative Rehydration in Bronchiolitis)¹⁰ demonstrated that both intravenous and nasogastric modes are appropriate means to hydrate in bronchiolitis, but that neither is significantly better. Therefore, the approach to feeding should be based on clinical assessment and escalated or downgraded as appropriate. Consideration should be given to negative aspects of repeated failed attempts at IV access which may contribute to patient discomfort and worsening of respiratory distress. Nasogastric insertion may require fewer attempts and is associated with a higher success rate of insertion than intravenous cannula placement.¹⁰
Oral feeds
In mild to moderate cases of bronchiolitis, oral feeds should be offered. Smaller volume feeds or shorter
breast feeds may be offered more frequently. Oral feeding should be stopped if feeding results in a significant
increase in work of breathing, fatigue, coughing, or desaturations. Historically, comfort feeds (very small
volume oral feeds) were offered in patients, however current practice for infants with mild to moderate
bronchiolitis is for close supervision and assessment of unrestricted oral feeding.

Nasogastric feeds
Nasogastric feeds are indicated if the infant is unable to maintain adequate hydration with oral intake or if
feeding results in significant respiratory compromise. Formula or expressed breast milk can be given at
maintenance rates (see Tables 2 and 3 for calculation of volume requirements). Intermittent bolus feeds can
be given every 2nd to 3rd hour. In patients with more severe bronchiolitis, gastric distension from bolus feeds
can result in worsening of respiratory symptoms, therefore continuous nasogastric feeds should be used.

Intravenous fluids
Intravenous fluids should be commenced in the following:
• All infants with severe bronchiolitis
• Infants who are unable to tolerate nasogastric feeds due to worsening of respiratory distress
In addition, intravenous fluids may be commenced where intravenous access has been established for other
reasons e.g. for blood collection as part of diagnostic assessment.

The replacement fluid for infants with bronchiolitis should be normal saline (0.9% NaCl) + 5% dextrose.
There is NO role for the use of 0.45% Saline + 5% Dextrose due to the risk of hyponatremia which can then
result in cerebral oedema.

For infants requiring acute fluid resuscitation boluses of 10-20mL/kg of Normal Saline (0.9% NaCl) should be
used. Note that signs of shock requiring fluid resuscitation are not typical of bronchiolitis and should prompt
consideration of alternative diagnoses including serious bacterial illness.

For infants with hypoglycemia (BSL <2.7) boluses of 10% dextrose (2mL/kg) should be given. Testing for
causes of hypoglycemia must be undertaken and subsequent maintenance fluids adjusted according to blood
glucose level (BGL) monitoring. (see Hypoglycemia Protocol).

Fluid restriction
Severe bronchiolitis may be associated with syndrome of inappropriate antidiuretic hormone (SIADH) which
can lead to hyponatremia. Up to 30% of patients with RSV bronchiolitis in one study had mild
hyponatremia. Consideration should be given to mild volume restriction (75% of maintenance) in children
on IV fluids to avoid hyponatraemia.

Monitoring
In all patients receiving supplemental intravenous fluid therapy, monitoring of blood electrolytes (at least
daily) should be performed to monitor for the development of hyponatremia and other electrolyte imbalances.

Table 2: Calculation of enteral (PO/NG) fluid requirements for infants up to 10kg

<table>
<thead>
<tr>
<th>Age in months</th>
<th>Recommended requirement</th>
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<tbody>
<tr>
<td>Day 5 to 3 months</td>
<td>150 mL/kg/day</td>
</tr>
<tr>
<td>3 to 6 months</td>
<td>120 mL/kg/day</td>
</tr>
<tr>
<td>&gt; 6 months (up to 10 kg)</td>
<td>100 mL/kg/day</td>
</tr>
</tbody>
</table>

Note: For any infant weighing >10 kg and all infants requiring intravenous fluids, calculate using the general method
for calculation of IV fluid requirements (maintenance) for children (Table 3).
Table 3: Calculation of fluid requirements (maintenance) for enteral fluids in infants over 10kg and intravenous fluids for infants of all weights

<table>
<thead>
<tr>
<th>Weight</th>
<th>Rate (mL/kg/hr)</th>
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<tbody>
<tr>
<td>First 10 kg</td>
<td>4 mL/kg/hr</td>
</tr>
<tr>
<td>Second 10 kg</td>
<td>2 mL/kg/hr</td>
</tr>
<tr>
<td>Subsequent 10 kg</td>
<td>1 mL/kg/hr</td>
</tr>
</tbody>
</table>

Examples:
For a 6 kg infant Fluid = 4mL x 6kg = 24 mL/hour
For a 12kg infant Fluid = (4mL x 10kg) + (2mL x 2kg) = 44 mL/hr

Oxygen

Supplemental oxygen
Note there is no evidence to clearly define an optimal oxygen saturation (SaO$_2$) target and therefore threshold for supplemental oxygen administration. Consensus opinion supports a target of SaO$_2$ of 94% and above.

Low Flow Oxygen
Supplemental low flow oxygen may be administered to infants via nasal prongs (<2L/min) and should ideally be humidified. For infants 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 for infants for work of breathing (in the absence of oxygen saturations <94%) is not recommended.

High Flow Oxygen
Heated humidified high flow oxygen (HFO$_2$) therapy is a form of non-invasive ventilation for patients with bronchiolitis. It can be used for the management of hypoxia and/or any patient with significant work of breathing.

The benefits of HFO$_2$ are:\textsuperscript{12-15}
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)

Patients being commenced on HFO$_2$ should have a nasogastric tube inserted to assist with aspiration of air that may distend the stomach, in addition to assistance with enteral feeds.

Patients then should be managed in an acute setting according to local hospital protocols.

Other non-invasive ventilation
CPAP or BiPAP may also be considered in patients who have failed to improve with HFO$_2$.

Intubation and ventilation
Non-invasive ventilation has assisted in avoidance of intubation for most patients with severe bronchiolitis. Some infants who are severely unwell may require intubation however HFO$_2$ should be commenced to assist in optimising infants whilst preparing for intubation and ventilation.
**Medications**

**Hypertonic saline**
Nebulised 3% (hypertonic) saline is proposed to reduce the clinical symptoms and hospital length of stay in infants with acute viral bronchiolitis.\(^{16-18}\) Evidence has demonstrated that the use of hypertonic saline is safe without the concurrent use of bronchodilators to protect against the theoretical risk of bronchospasm.\(^{18}\) There is insufficient evidence overall to support the routine use of hypertonic saline in the management of infants with bronchiolitis.\(^{19-22}\)

**Bronchodilators**
There is insufficient evidence to support the routine use of bronchodilators for all infants with bronchiolitis.\(^{1,8,23}\) Some older infants may have bronchoconstriction and a trial of bronchodilator may be considered, with careful re-assessment after administration. Therefore, trial salbutamol (6 puffs via spacer if normal saturations, 2.5mg via nebuliser if saturations <94% on room air) in infants who meet the following criteria:

>6 months of age AND predominant wheeze on auscultation

**Corticosteroids**
There is no evidence to support the use of corticosteroids in infants less than 12 months of age with bronchiolitis. Even in those patients who show a bronchodilator response for wheeze as part of bronchiolitis there is also no evidence to support the use of corticosteroids.\(^{1,8,24,25}\)

**Nebulised adrenaline**
There is no evidence to support the use of nebulised adrenaline in the treatment of acute bronchiolitis in infants.\(^{26}\)

**Ongoing assessment**
Repeated clinical assessment is recommended following the initiation or administration of any hydration or treatment for infants with bronchiolitis to objectively determine the change in clinical symptoms (deterioration or improvement) following these interventions. These should be well documented in the patient clinical notes.

**Disposition**

**Discharge home from Emergency**
Infants with mild bronchiolitis may be safely discharged home if they meet the following criteria:
- saturations greater than or equal to 94%
- normal hydration with current level of feeding
- no history of apnoea

In addition, patients who are at high risk for deterioration with more severe disease should be considered for a period of 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.

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 such as feeding and nasal clearance techniques. A parent information sheet on bronchiolitis should also be provided. (See Parent Information - Bronchiolitis).
Admission
All patients with hypoxia (saturations <94% and therefore requiring supplemental oxygen) will require admission to hospital. In addition, patients who require supplemental hydration due to feeding difficulties will need inpatient admission.

Other patient groups for consideration of admission include those with risk factors for severe disease who are early in their illness (days 1-3) and have the potential to deteriorate. These infants may benefit from admission for observation.

Criteria for admission to Level 6 Paediatric Facility or PICU
Consultation with a Level 6 Paediatric Facility or PICU may be required for patients with severe illness including symptoms of apnoea, progressive fatigue, requirement for respiratory support including HFO2, other non-invasive ventilation (NIV) as well as intubation and ventilation.

A Level 6 service is a stand-alone service dedicated to paediatric services. This level of service is capable of providing initial treatment and advanced care for all emergency presentations and the full spectrum of care for all seriously ill and injured infants, children and adolescents.

For patient transfer, PICU consultation and patient retrieval, Retrieval Services Queensland (RSQ) should be contacted directly via 1300 799 127.

Consultation
Key stakeholders who reviewed this version:
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References and suggested reading

Guideline revision and approval history

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<tr>
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<th>Modified by</th>
<th>Amendments authorised by</th>
<th>Approved by</th>
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<tr>
<td>1.1</td>
<td>Greater Brisbane metropolitan area clinical procedures working group</td>
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Keywords
Children; acute bronchiolitis; emergency management

Accreditation references
EQuIP and other criteria: 1.3.1, 1.4.1, 1.5.1
NSQHS Standard:
## Appendix 1  Admission/Discharge Criteria for Infants with Bronchiolitis

### Risk factors for severe bronchiolitis

- **Age**
  - History of preterm delivery <32 weeks gestation
  - Chronological age <6 weeks
- **Known underlying conditions**
  - Congenital cardiac disease
  - Neurological or neuromuscular disorder
  - Immunodeficiency
  - Trisomy 21
  - Chronic respiratory illness including chronic neonatal lung disease (CNLD) or cystic fibrosis (CF)

### Criteria for inpatient admission

- Saturations <94% in room air
- Patients requiring supplemental hydration
- Patients at high risk for deterioration or severe disease as listed above
- Social circumstances such as long distance to hospital and family/carers unable to manage symptoms

### Criteria for discharge from Emergency

- Maintaining SaO2 greater than or equal to 94% in room air
- Normal hydration with current level of feeding
- Minimal or no increased work of breathing
- Day 1-3 of illness with no risk factors for severe bronchiolitis
- Favourable social circumstances including:
  - Family able to manage at home
  - Close distance to local hospital
  - Ability to and comprehension regarding return in the event of deterioration
  - Parent education provided including provision of bronchiolitis fact sheet

### Criteria for admission to level 6 Paediatric Service or PICU

- Apnoeic events
- Severe or life threatening bronchiolitis
- Signs of progressive fatigue
- Requirement for non-invasive ventilation:
  - HFO2 (some centres)
  - Other NIV
  - Intubation and ventilation

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Guideline 00701: Bronchiolitis – Emergency Management in Children

Children’s Health Queensland Hospital and Health Service