

# Provincial Clinical Knowledge Topic

## *Bronchiolitis, Infant – Emergency and Inpatient*

### V 1.0

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**Revision History**

<b>Version</b>	<b>Date of Revision</b>	<b>Description of Revision</b>	<b>Revised By</b>
1.0	July 2018	Document Complete	Christopher Andrews

## Important Information Before You Begin

The recommendations contained in this knowledge topic have been provincially adjudicated and are based on best practice and available evidence. Clinicians applying these recommendations should, in consultation with the patient, use independent medical judgment in the context of individual clinical circumstances to direct care. This knowledge topic will be reviewed periodically and updated as best practice evidence and practice change.

The information in this topic strives to adhere to Institute for Safe Medication Practices (ISMP) safety standards and align with Quality and Safety initiatives and accreditation requirements such as the Required Organizational Practices. Some examples of these initiatives or groups are: Health Quality Council Alberta (HQCA), Choosing Wisely campaign, Safer Healthcare Now campaign etc.

## Guidelines

This knowledge topic is based on the following guidelines:

### Guidelines Available on the AHS Internal Website

1. ACH Hospital Pediatrics Bronchiolitis Clinical Care Guideline 2012.
2. “Weaning” Oxygen in Patients in Bronchiolitis – Alberta Health Services, Alberta Children’s Hospital Section of Hospital Pediatrics 2014
3. Alberta Children’s Hospital Pediatric Intensive Care Unit Clinical Practice Guidelines and Protocols: Bronchiolitis.

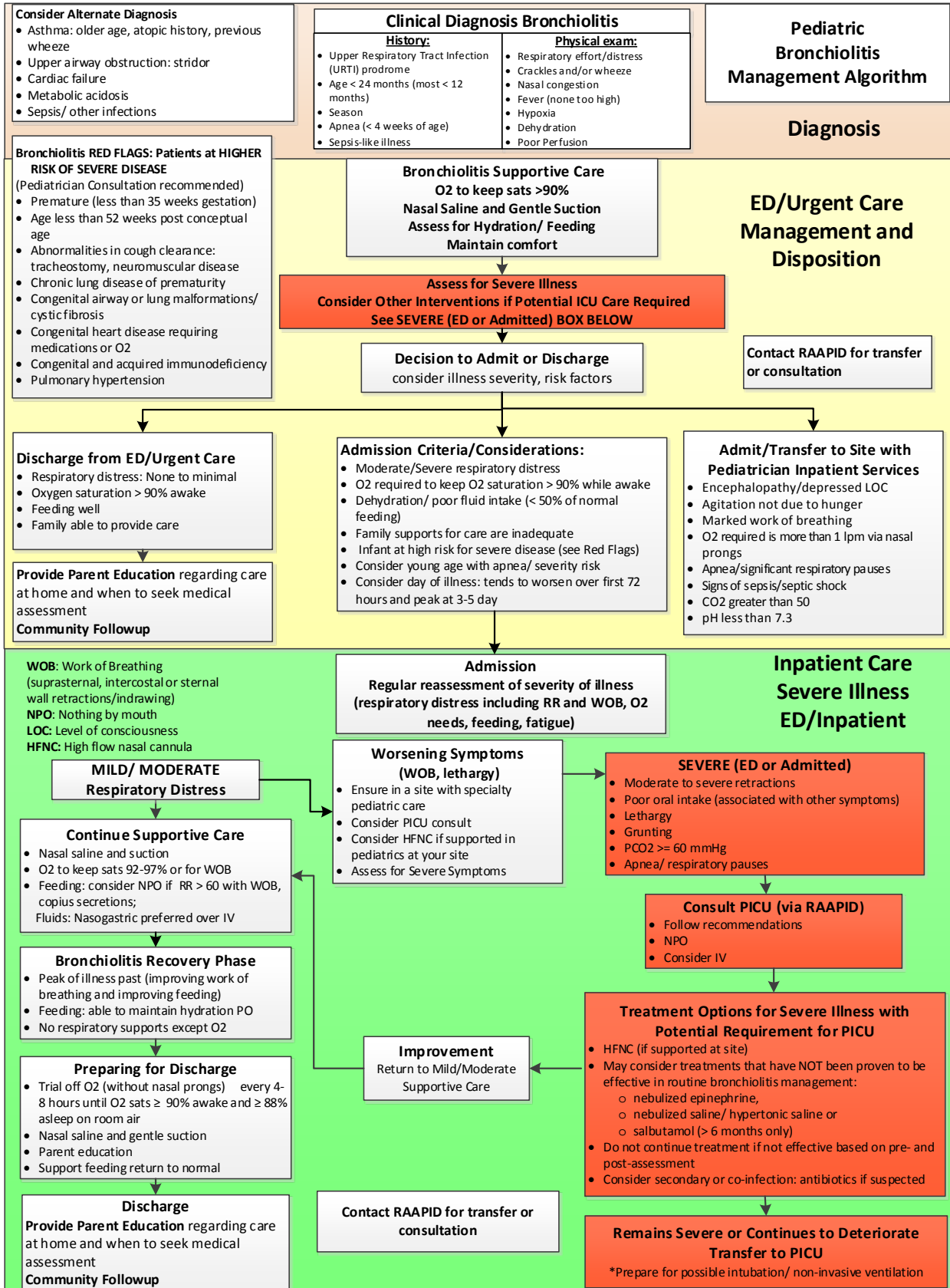
### Guidelines Available Outside of AHS Network

4. [Canadian Pediatric Society Position Statement - Bronchiolitis: Recommendations for Diagnosis, Monitoring and Management of Children one to 24 Months of Age](#)
5. [American Academy of Pediatrics Clinical Practice Guideline: The Diagnosis, Management and Prevention of Bronchiolitis](#)
6. [Cochrane summary: epinephrine for acute viral bronchiolitis in children less than two years of age, 2011](#)

7. [Cochrane summary: high-flow nasal cannula \(tube\) therapy for infants with bronchiolitis, 2014](#)
8. [Cochrane summary: Nebulized hypertonic saline solution for acute bronchiolitis in infants, 2013](#)
9. [Seattle Children's Hospital Bronchiolitis Pathway](#)
10. [Translating Emergency Knowledge for Kids \(TREKK\): Bottom Line Recommendations – Bronchiolitis](#)

### Keywords

- first time wheeze
- bronchiolitis
- respiratory syncytial virus
- RSV



## Rationale

Bronchiolitis is a common lower respiratory tract infection in infants and young children. Approximately 30% of all infants less than 24 months of age experience bronchiolitis.<sup>1</sup> Of those who develop bronchiolitis, 10% are hospitalized for further monitoring or care. Bronchiolitis is usually self-limiting and requires supportive care and minimum investigations and interventions.

The most common cause of bronchiolitis is respiratory syncytial virus (RSV) ~ 50% are caused by RSV alone and a further 20% or so by RSV in combination with other viruses. Human metapneumovirus (3-19%), rhinovirus, and less commonly, influenza, parainfluenza or adenovirus may also produce bronchiolitis.<sup>2</sup> RSV infection does not grant permanent or long term immunity thus re-infections are very common.<sup>3</sup> The majority of severe disease is seen in infants under 6 months however the clinical picture of bronchiolitis occurs up to 2 years of age: a time of rapid changes in respiratory anatomy, physiology and growth. In Canada, RSV season generally begins between November and January and lasts 4 to 5 months, however sporadic cases of bronchiolitis occur throughout the year.<sup>1</sup>

## Decision Making

### Goals of Management

1. Ongoing management is supportive:
  - a. Hydration and nutrition
  - b. Clearing of nasal congestion/obstruction
    - Nasal suctioning to improve work of breathing, discomfort and ability to feed orally
  - c. Support of oxygenation
    - Supplemental oxygen to lessen the work of breathing and tachypnea and reduce the impact of a ventilation-perfusion mismatch on oxygenation status.
2. Limit investigations to minimize handling of distressed infants
3. Reassess patients frequently
4. Infection control – all infants with symptoms of respiratory viral illness should be placed on droplet and contact isolation to prevent spread of infection to other hospitalized infants.
  - Isolation can be discontinued when the patient is asymptomatic. The main exception are immunocompromised children who may require isolation for a prolonged period of time.

### Indications for use of this clinical guidance:

- Age less than 24 months
- Presenting with Viral Upper/Lower Respiratory Tract Symptoms

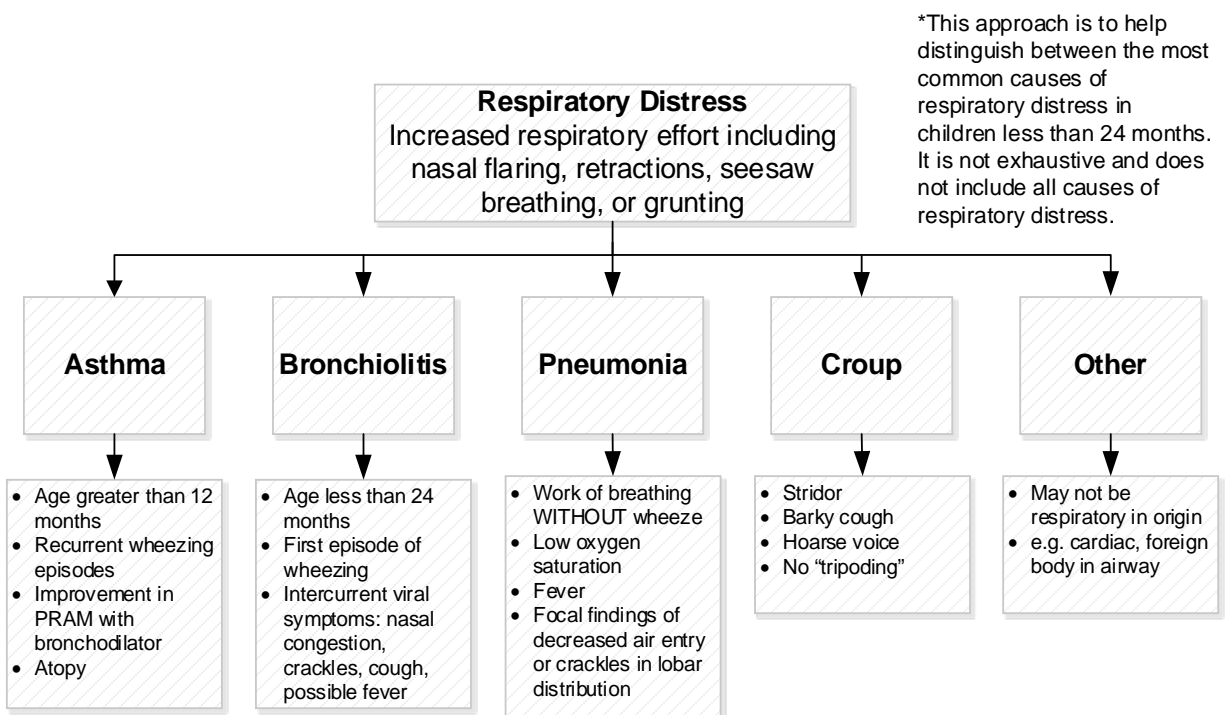
### Complex medical patients:

The following groups of children are at risk for severe disease, consultation with an experienced Pediatric provider is recommended:

- Infants born prematurely at less than 35 weeks gestation
- Up to 52 weeks post conceptual age: e.g. up to 12 weeks for infants born at term, and 12 weeks corrected age for infants born prematurely.
- Cardiac disease requiring altered oxygen saturation goals or baseline medications for management.
- Neuromuscular disease
- Chronic lung disease
- Pulmonary hypertension
- Cystic fibrosis
- Anatomic airway anomalies
- Congenital and acquired immunodeficiency

## Making the Diagnosis

**Table 1. Differential Diagnosis for Respiratory Distress**



### Common Presentations

Bronchiolitis has three common presentations with the presence of fever being variable:

- Cough, wheeze, crackles and respiratory distress including tachypnea, accessory muscle use, nasal flaring and hypoxemia – most common
- Apnea may be the first sign/symptom especially for children less than 4 weeks of age
- Sepsis-like illness

### Physical Findings

The following physical findings may be present:

- General
  - Fever
  - Signs of dehydration (if respiratory distress has interfered with feeding)
  - Tachycardia
  - Poor perfusion
- Respiratory
  - [Tachypnea](#)
  - Wheeze, crackles, crepitation on auscultation



- Respiratory distress - may include indrawing, intercostal or subcostal retractions, abdominal breathing, nasal flaring, accessory muscle use, grunting or nasal flaring
- Apnea

### **Differential Diagnoses:**

Consider:

- Pneumonia/Pneumonitis
- Asthma (uncommon in children less than 12 months)
- Upper airway obstruction
- Cardiac failure
- Metabolic acidosis-driven respiratory distress
- Tracheobronchomalacia
- Other causes of airway compression e.g. Scimitar syndrome
- Unusual infections e.g. PJP, Chlamydia, Mycoplasma, pertussis

### **Supportive Clinical Management**

***The treatment of bronchiolitis is supportive care. There is little evidence to support the use of investigations and medications in the diagnosis and treatment of bronchiolitis.***

### **Precautions and Safety:**

- Droplet and Contact Isolation:
  - Parents and visitors should be educated about the use of Personal Protective Equipment (PPE) and encouraged to use it; however, if they have been exposed at home the benefit of PPE is questionable.
  - Stethoscopes should be available in the patient's room.
  - Isolation can be discontinued when the patient is asymptomatic.
    - *Exception: Immunocompromised children may require isolation for a prolonged period of time. For these situations duration of isolation is determined on a case by case basis in discussion with infection prevention and control.*
  - Confirmation of negative viral shedding is not required.

### **Monitoring:**

- Pulse Oximetry:
  - Intermittent Monitoring:
    - *Strongly recommend for MOST children who are stable or improving in clinical condition; whether they are on supplemental oxygen or not.*
  - Continuous Monitoring:
    - *Continuous oxygen sat monitoring is NOT recommended for patients on oxygen or for weaning of oxygen.*
    - Should only be reserved for patients with concern for deterioration.
    - Not a substitute for assessing respiratory status.
    - Discontinue monitoring as soon as the infant is stable or improving.
    - Desaturation to 88% during sleep is acceptable. Intermittent desaturations to mid 80's can be normal in healthy infants.

**Nursing Support:**

Intermittent Oxygen Saturation monitoring use suggestions:

- Evaluate oxygen saturation and respiratory status 5-15 minutes and 30 minutes post discontinuation of supplemental oxygen therapy.
- Remove O2 saturation monitor between assessments.
- Subsequent respiratory assessments and spot SpO2 checks every 4 hours with vital signs.

- Cardiac Monitoring
  - **Continuous cardiopulmonary monitoring is not required in the vast majority of bronchiolitic patients.**
  - Indicated for use in infants with risk for severe illness:
    - Young age (less than 1 month of age or less than 52 weeks post conceptual age in premature infants)
    - Infants meeting the criteria of [Complex Medical Patients](#)

**Nasal Suctioning:**

- Intermittent superficial (non-invasive) nasal suctioning WITH instillation of sodium chloride prior should be used routinely and at regular intervals including prior to feeding orally.
- Deep, nasopharyngeal suctioning should be avoided in most patients as it has been shown to worsen symptoms by causing trauma to nose resulting in edema that worsens the obstructive symptoms.
  - Consider limited use in patients who are unable to manage secretions with superficial suctioning and are decompensating.
- Response to suctioning and frequency of required suctioning should be recorded.

**Diet / Nutrition / Hydration:**

- Oral Feeding:
  - Encourage frequent breast feeding or bottle feeding in children without severe respiratory distress, facilitated by providing supplemental oxygen and non-invasive nasal suctioning
- Nasogastric Feeding:
  - *NG hydration is AS effective as IV hydration and should be considered first. Insertion may require fewer attempts and have higher success rate than IV placement with fewer adverse effects.*
  - Depending on the respiratory status, continuous NG feeds, bolus feeds, or oral feeds with NG top ups could be offered to optimize nutrition.
  - Formula, milk, or electrolyte solution can be considered.
- IV Fluids:
  - *IV hydration and NPO status should be considered in children at risk for impending respiratory failure or who are being considered for invasive or non-invasive ventilation.*

- Generally hypotonic fluids are NOT recommended, as severe bronchiolitis can be associated with syndrome of inappropriate antidiuretic hormone secretion (SIADH).
  - If on prolonged IV fluids monitoring electrolytes is suggested.
  - Suggested fluids:
    - IV fluids at 75% of maintenance rate is suggested
    - Less than 1 month of age:
      - dextrose 10% - sodium chloride 0.45% with potassium chloride 20 mmol/L (if potassium not contraindicated)
- OR if dextrose 10% - sodium chloride 0.45% not available:
- dextrose 5% - sodium chloride 0.45% with potassium chloride 20 mmol/L (if potassium not contraindicated); monitor blood sugar
  - Greater than 1 month of age:
    - dextrose 5% - sodium chloride 0.9% with potassium chloride 20 mmol/L (if potassium not contraindicated)

**Nursing Support:**

Patients should be made NPO and offered alternative means of hydration IF choking, coughing with attempted feeds; respiratory rate sustained over 60 breaths per minute, associated with severe work of breathing, copious nasal secretions; OR if receiving oxygen by high flow nasal cannula

**Oxygen:**

- Suggested for use if oxygen saturation falls below 90%. Goal saturations while on supplemental oxygen of 92-97% during the acute phase of illness.
- Also, may be used to relieve work of breathing in the absence of hypoxia.
- If supplemental oxygen support is increasing consider alternative diagnosis or impending respiratory failure.

**Nursing Support:**

- Initiate 0.5L to 1 L per minute via nasal prongs with goal of using lowest flow rate possible to maintain saturations of 92-97%.
- Discontinue oxygen once clinical improvement is demonstrated (i.e. respiratory rate less than 60 breaths per minute, feeding well).
- Goal oxygen saturations greater than 90% on room air (awake) and 88% (asleep) and shows minimal signs of respiratory distress.<sup>4</sup>
- When clinically improving, room air trials should be attempted every 4-8 hours until successful.

- **Heated Humidified High Flow Nasal Cannula (HFNC)**

- *Evidence regarding the use of High Flow Nasal Cannula Oxygen is still evolving. At this time there is little evidence to support a clinical benefit but preliminary studies support the safety of HFNC in this population when appropriate equipment available.*
- If considering use, the following guidance is suggested:
  - Should be considered in moderate to severe bronchiolitic patients.
  - Should not be initiated on the [complex medical](#) patient (excluding age criteria) with bronchiolitis without consultation with a Pediatric ICU
  - Initiate 2L/kg of flow, 40-50% FiO<sub>2</sub>.
  - Suggest children using HFNC should be made NPO with IV fluids until confirmation of clinical improvement.
  - Monitor for clinical improvement in work of breathing over 2-3 hours.
    - If no improvement consultation with ICU is recommended.
    - Lack of response to HFNC is predictive of impending respiratory failure and the need for non-invasive or invasive ventilation.

#### **Family Education:**

- Should be started on admission to empower parents to help with care and understand disease course.
  - Signs of respiratory distress and when to call for help.
  - Suctioning methods (encouraging bulb or nasal aspirator when closer to discharge).
  - Importance of maintaining feeds and risks with increased respiratory effort.
  - Anticipatory guidance for discharge including potential duration of symptoms (cough and congestion), lack of medications to improve this.

#### **Subspecialty Consultation:**

- General Pediatrics:
  - General pediatric consultation is strongly recommended for patients:
    - Presenting with respiratory distress not responsive to supportive care.
    - At risk for severe illness secondary to [complex medical diagnoses](#).
- Respiriology:
  - In an otherwise well infant recovering from bronchiolitis with a persistently low oxygen saturation prolonging admission greater than 5 days, consider consult to Respiriology to help determine if alternative factor may be affecting dependence on supplemental Oxygen, to initiate pulse oximetry trending and consideration of home oxygen therapy (inpatient only).
- PICU:
  - PICU consultation for potential ICU transfer is suggested for infant with:
    - Apneic episode greater than 20 seconds in duration, requiring intervention or associated with bradycardia and cyanosis.
    - Severe respiratory distress with minimal response to suctioning.
    - A capillary blood gas with worsening respiratory acidosis and no evidence of compensation
    - Lethargy or altered mental status.

- Infants trialed on HFNC with no improvement in clinical symptoms after 2 to 3 hours of therapy.

## Evidence Summary: Other Interventions

The following interventions may be considered in special circumstances as outlined below:

Caution: repeated trials of medications should not delay ventilatory support in children with severe bronchiolitis.

### Medications:

- **Nebulized Hypertonic (3%) Sodium Chloride: Nebulized sodium chloride 3% is postulated to increase mucociliary clearance of secretions.**
  - *There is currently no evidence to indicate that hypertonic sodium chloride use will change length of stay, morbidity, or mortality.*
  - *Current studies support the safety of nebulized (3%) sodium chloride in bronchiolitic patients with no evidence of adverse events.<sup>5</sup>*
  - *Use can be considered in children whose length of stay is predicted to be more than 72 hours.*
  - If used consider the following guidance:
    - Sodium chloride 3% 4 mL every 4 to 8 hours by inhalation
- **Nebulized Saline (0.9%) Saline:**
  - There is currently no evidence to indicate that saline use will change length of stay, morbidity, or mortality.
  - Current studies compare other nebulized interventions to 0.9% Saline as a control have shown no benefit of other interventions compared to Saline.
  - There have been no studies to compare Saline to no intervention.
  - If used consider the following guidance:
    - Nebulized 0.9% Saline 4 mL every 4 to 8 hours
- **Bronchodilators:**
  - *There is insufficient evidence to suggest that the routine use of bronchodilators changes the outcome of bronchiolitis. Both the CPS and AAP recommend against routine use in bronchiolitis.*
  - *They may be considered in infants with severe bronchiolitis who are decompensating and being considered for ventilatory support.*
  - *IF used a pre and post assessment for response MUST be documented.*
  - **Salbutamol:**
    - *In the older child where the differential diagnosis includes asthma (greater than 12 months of age with wheeze, recurrent wheeze, strong personal or family history of atopy) a trial of salbutamol could be considered. An objective pre and post assessment for response must be performed and documented.*
    - *If age, history and response to therapy suggests asthma, consider changing to full asthma management.*
    - If used consider the following guidance:
      - 6 months and older: Salbutamol 2.5 to 5 mg nebulizer x 1 dose with documented pre and post assessment.

- *If given, ongoing PRN treatment should only occur if there are dramatic signs of clinical improvement.*
- o **Nebulized epinephrine:**
  - Although generally safe, has been associated with cardiac arrhythmia.
  - If used consider the following guidance:
    - Nebulized epinephrine 1 mg/mL, 0.5 mg/Kg inhaled to maximum of 5 mg with documented PRE and POST assessment
    - *If given, ongoing PRN treatment should only occur if there are dramatic signs of clinical improvement.*
    - *We strongly discourage ordering routinely available nebulized epinephrine. Continued use should be considered on a case by case basis. PICU consultation is suggested in patients requiring multiple doses of nebulized epinephrine.*
- **Antibiotics:**
  - o Antibiotics should only be considered in patients with evidence of specific secondary infection as the risk of serious bacterial infection with infants with bronchiolitis is low.

#### Lab Investigations:

*There are no routine investigations recommended for bronchiolitis.*

- Chemistry
  - o **The use of blood tests should be discouraged** in order to reduce handling and additional burden to the infant.
  - o Exception to this is children being managed on exclusive IV fluids with risk of SIADH, consider electrolytes after 24 hours.
- Microbiology
  - o Respiratory Virus Testing:<sup>6</sup>
    - **Routine nasopharyngeal swabs are not indicated as they do not alter management.**
    - High rates of co-infection with multiple viruses means testing is of limited usefulness for infection control, e.g. cohorting admitted patients.
    - Viral testing suggested for children with uncertain diagnosis, with possibility of influenza infection (treatment available), less than 2 months of age if septic workup otherwise indicated, [complex medical patients](#), or children requiring PICU care.
    - Pertussis testing is recommended in children with apneic episodes.
  - o Bacterial Cultures:
    - *Febrile infants with bronchiolitis in the first 2 months of life have the highest risk for serious bacterial infection (SBI). Urinary tract infection (UTI) rates 0-6%, bacteremia is less than 1% and meningitis is extremely rare (CPS 2014).*
    - *AAP suggests routine screening is not justified due to low rates of SBI.*
    - Suggested investigations:

- Infants less than 28 days old with temperature greater than 38.0°C consider a full septic work up and admission to hospital on IV antibiotics.
- Infants 29-89 days old with a temperature greater than 38.0° C should be considered for a catheter urine culture (incidence 0-6%).
- Blood Gases
  - Patients with severe respiratory distress may benefit from a blood gas as a component of assessing the adequacy of ventilation.
- Diagnostic Imaging
  - Chest x-rays are **not** routinely recommended in bronchiolitis but may be considered in severe illness (i.e. PICU patient) or when considering an alternative diagnosis.
  - If performed, patch consolidation/atelectasis is common and are not an absolute indication to start antibiotics for pneumonia.

### **Evidence Summary: Non-Evidence Based Interventions**

- Corticosteroids:
  - No evidence to show improvement with use in bronchiolitis and it is not recommended for use in patients with bronchiolitis.
- Montelukast
  - No evidence to show improvement with use in bronchiolitis and it is not recommended for use in patients with bronchiolitis.
- Antivirals:
  - Risk of toxicity outweigh benefits thus use in bronchiolitis is not recommended for use in patients with bronchiolitis



## Emergency Department / Urgent Care Disposition Planning

### 1. Considerations for admission to inpatient unit:

- Based on clinical judgement, age, infants respiratory status and degree of illness, ability to maintain adequate hydration, risk to deteriorate, and the family's ability to cope.
  - Disease tends to worsen over the first 72 hours and peak at 3-5 days
- Signs of severe respiratory distress – indrawing, grunting, respiratory rate greater than 70 respirations per minute.
- Supplemental O<sub>2</sub> required to keep oxygen saturation above 90%.
- Dehydration or history of poor fluid intake (less than 50% of normal feeding).
- Age (consider admission in infants less than 12 weeks of age).
- Infant at high risk for severe disease ([complex medical patients](#)).
- Family unable to cope.
- Inability to return to hospital for reassessment if condition worsened.

### 2. Considerations for admission to or transfer to unit or site with Pediatrician Inpatient Services with close observation:

- Encephalopathy/depressed level of consciousness.
- Agitation not due to hunger.
- Marked work of breathing.
- Oxygen required is more than 1 LPM via nasal prongs
- FiO<sub>2</sub> required greater than 45%
- True apnea or significant respiratory pauses.
- Sign sepsis/septic shock.
- CO<sub>2</sub> greater than 50 (if gas available)
- pH less than 7.3 (if gas available)

### 3. Considerations for discharge from emergency department:

- Respiratory distress has settled – minimal work of breathing and improved respiratory rate.
- Oxygen saturation greater than 90% awake.  
Note: Consistent practice for all patients at a site is highly recommended; Literature on best practice for discharge oxygen values is not conclusive at this time.
- Child is feeding well (more than 50% total fluid intake).
- Absence of outstanding social issues.

### 4. Patient education / discharge instructions :

- Alberta Health Service [HEAL Bronchiolitis handout](#)



## Inpatient Disposition Planning

### 1. Considerations for discharge

- Respiratory distress has settled – minimal work of breathing and improved respiratory rate.
- If apnea during admission, no episodes for at least 48 hours prior to discharge.
- No requirement of invasive suctioning for 12 hours prior to discharge.
- Oxygen saturation greater than 90% awake and greater than 88% asleep without supplemental oxygen.
- Child is feeding well.
- Family education for nasal aspirator use and identifying respiratory distress completed.

### 2. Family Discharge Education

- Should be started on admission to empower parents to help with care and understand disease course.
  - Signs of respiratory distress and when to call for help.
  - Suctioning methods (encouraging nasal aspirator or bulb when closer to discharge).
  - Importance of maintaining feeds and risks with increased respiratory effort.
  - Anticipatory guidance for discharge including potential duration of symptoms (cough and congestion), lack of medications to improve this.
  - Suggest follow up with Family Physician 1-2 weeks after discharge, as needed.

### 3. Family Support:

Alberta Health Service [HEAL Bronchiolitis handout](#)

## Clinical Decision Support

### Tachypnea

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**Table 2. Age-specific criteria for tachypnea (breaths per minute)**

<b>Age</b>	<b>Approximate normal respiratory rates</b>	<b>Upper limit that should be used to define tachypnea</b>
<2 months	34–50	60
2–12 months	25–40	50
1–5 years	20–30	40
>5 years	15–25	30

## Analytics

### Clinical Analytic Outcome Measure #1

<b>Name of Measure</b>	Frequency of ordering “Respiratory Virus DFA/Molecular Testing” within Bronchiolitis Order Sets
<b>Definition</b>	What % of the time is “Respiratory Virus DFA/Molecular Testing” ordered for patients in the Bronchiolitis Pediatric Emergency Department Order Set and/or the Bronchiolitis Pediatric Inpatient Order Set for patients with bronchiolitis?
<b>Rationale</b>	Intended to show compliance with guidance in topic as routine nasopharyngeal swabs are not indicated in bronchiolitis.
<b>Notes for Interpretation</b>	Must be able to collate if test was ordered on either order set for each individual patient, health record must have coding for disease/condition.

### Clinical Analytic Outcome Measure #2

<b>Name of Measure</b>	Length of stay in patients who receive hypertonic sodium chloride nebulizers
<b>Definition</b>	What is the length of stay for patients who receive “hypertonic sodium chloride nebulizers” for bronchiolitis vs those who do not?
<b>Rationale</b>	There is currently no evidence to indicate that hypertonic sodium chloride use will change length of stay, morbidity, or mortality. Current studies support the safety of nebulized (3%) sodium chloride in bronchiolitic patients with no evidence of adverse events. Potential benefit in children hospitalized greater than 72 hours.
<b>Notes for Interpretation</b>	Must be able to identify length of stay for patients who receive hypertonic sodium chloride nebulizers, health record must have coding for disease/condition.

## References

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## Additional Readings and General References

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## Appendix A: Order Sets

### Bronchiolitis Pediatric Emergency Department Orders

#### Order Set Components

**Order Set Restrictions:** Age less than 24 months

**Order Set Keywords:** Bronchiolitis, RSV, first time wheeze

**Order Set Requirements:** Weight

#### Patient Care

- Isolation: Contact and droplet

#### Monitoring

*Continuous cardiorespiratory monitoring should only be used for infants with severe illness, deteriorating respiratory status or acute risk of such, or at risk for apnea or bradycardia (up to 52 weeks post conceptual age):*

- Monitor CardioRespiratory - Peds

*Recommended:*

- Oxygen Saturation Monitoring: Intermittent. Remove O<sub>2</sub> saturation monitor between assessments.

*Only in children with severe disease:*

- Oxygen Saturation Monitoring: Continuous.

#### Respiratory Care

- Respiratory Suctioning: Nasal suctioning PRN
- sodium chloride 0.9% nasal drops instilled into both nostrils prior to suctioning
- O<sub>2</sub> Therapy: Titrate to maintain oxygen saturation 92-97% (in infants and children with moderate to severe respiratory distress) starting at 0.5 to 1 LPM via nasal prongs. *If greater flow rates required, re-evaluate response to oxygen therapy to determine if issue is airway related, oxygen is being effectively administered, and for the presence of a co-morbidity or increasing severity of bronchiolitis.*
- Notify physician if O<sub>2</sub> needs are increasing
- O<sub>2</sub> Therapy- Heated Humidified High Flow Nasal Cannula 2L/kg of flow, 40-50% FiO<sub>2</sub>. Follow local policy and procedure for Heated Humidified High Flow Nasal Cannula. *If no improvement in WOB, oxygenation in 2 hours consider a non-responders to Heated Humidified High Flow Nasal Cannula; Consider PICU consultation for bipap, CPAP or invasive ventilation.*

#### Diet / Nutrition / Hydration

Fluid Considerations:

*To calculate the hourly maintenance fluid requirement:*

- 4mL/kg/hour for the 1st 10kg (0-10kg)
- 2mL/kg/hour for the next 10 kg (11-20kg)
- 1mL/kg/hour for any additional kg above 20

*Please note neonates have different fluid needs. In children less than 1 week of life, consultation with a pediatric specialist is recommended for suggestions of calculation of maintenance fluids.*

*Suggest using 75% maintenance fluid calculation.*

## **Diet**

### **Oral Fluids:**

- NPO

*Encourage in children without severe respiratory distress:*

- Breast Milk / Formula Fed ad lib  
 Clear Fluids Diet

### **Tube Feeds:**

*Nasogastric hydration is as effective as IV hydration and insertion may require fewer attempts and have higher success rate than IV placement.*

*Consider if respiratory rate over 60 breaths per minute and associated with severe work of breathing, or copious nasal secretions, OR if receiving oxygen by high flow nasal cannula:*

- Nasogastric Feeding Tube - Insert for tube feeds  
 Enteral Nutrition – Infant via Nasogastric Tube, feeding instructions:
- Breast Milk or Formula \_\_\_\_\_(specify type)
  - Continuous: \_\_\_\_\_ mL/hour
- OR
- Bolus feeds: \_\_\_\_\_ mL every \_\_\_\_\_ hours

## **IV Fluids**

*Hypotonic Fluids are NOT Recommended*

### **IV Fluids with Potassium**

*For patients LESS THAN 1 month of age:*

- potassium chloride 20 mmol/L in dextrose 5% - sodium chloride 0.45% IV at \_\_\_\_\_ mL/hour

*For patients GREATER THAN 1 month of age:*

- potassium chloride 20 mmol/L in dextrose 5% - sodium chloride 0.9% IV at \_\_\_\_\_ mL/hour

### **IV Fluids if Potassium is Contraindicated**

*For patients LESS THAN 1 month of age:*

- dextrose 5% - sodium chloride 0.45% IV at \_\_\_\_\_ mL/hour

For patients **GREATER THAN 1 month of age:**

- dextrose 5% - sodium chloride 0.9% IV at \_\_\_\_\_ mL/hour

### Lab Investigations

**There are no recommended routine investigations in bronchiolitis.**

**Routine nasopharyngeal swabs are not indicated in the ED as they do not alter management. Due to high rates of co-infection with multiple viruses means of limited usefulness for infection control, e.g. cohorting admitted patients. ONLY perform Nasal Pharyngeal Aspirate/swab for children with SEVERE disease who may require intensive care**

- Respiratory Virus DFA/Molecular Testing

Consider in febrile infants less than 3 months of age (concurrent UTI up to 6% of febrile infants with bronchiolitis):

- Urinalysis (specimen source: catheter)
- Urine Bacterial Culture (specimen source: catheter)

Consider in febrile infants less than 1 month of age or other infants/children where you are considering sepsis:

- Complete Blood Count
- Blood Culture- Pediatric Set

Consider in febrile infants less than 1 month of age or other infants/children where you are considering meningitis:

- Cerebrospinal Fluid Culture and Gram Stain
- CSF Glucose
- CSF Cell Count
- CSF Glucose

### Blood Gases

Infants with bronchiolitis and respiratory rates over 70 breaths per minute or in those whom severe respiratory distress prevents oral feeds should undergo blood gas analysis to evaluate the adequacy of ventilation:

- Capillary Blood Gas
- Venous Mixed Blood Gas

### Diagnostic Imaging

**Chest x-rays are not routinely recommended in bronchiolitis**

Consider in severe illness (i.e. PICU patient) to assess for complications  
If performed, patch consolidation/atelectasis is common.

- Chest X-Ray 2 projections (GR Chest, 2 projections)

### Medications

**There is insufficient evidence to suggest that the routine use of bronchodilators changes the outcome of bronchiolitis.**

*They may be considered in infants with severe bronchiolitis who are being considered for ventilatory support- if given a pre and post assessment for response must be done and documented.*

hypertonic sodium chloride

- *There is currently no evidence to indicate that hypertonic sodium chloride use will change length of stay, morbidity, or mortality.*
- *Current studies support the safety of nebulized (3%) sodium chloride in bronchiolitic patients with no evidence of adverse events.*
- *Potential benefit in children hospitalized greater than 72 hours.*
- sodium chloride 3% 4 mL by inhalation every 4 to 8 hours.

**Bronchodilators** (*consider in deteriorating child only*)

epinephrine

- epiNEPHrine 1 mg/mL \_\_\_\_\_ mg by inhalation once (*0.5 mg/kg to a max of 5 mg, If given, ongoing treatment should only occur if there are clear signs of clinical improvement*).

salbutamol

- *Less than 6 months: do not trial salbutamol*
- *6-24 months: 2.5 to 5 mg x 1 dose, repeat only if clinical response is dramatic;*
- salbutamol 2.5 mg by inhalation ONCE
- salbutamol 5 mg by inhalation ONCE



## Bronchiolitis Pediatric Inpatient Orders

### Order Set Components

**Order Set Restrictions:** *Age less than 24 months, Presenting with Viral Upper/Lower Respiratory Tract Symptoms consistent with Bronchiolitis*

**Order Set Keywords:** Bronchiolitis, RSV, first time wheeze

**Order Set Requirements:** *Weight*

### Patient Care

- Goals of Care Designation: utilize appropriate Goal of Care
- Isolation: Contact and droplet

### Monitoring

*Continuous cardiorespiratory monitoring should only be used for infants with severe illness, deteriorating respiratory status or acute risk of such, or at risk for apnea or bradycardia (up to 52 weeks post conceptual age):*

- Monitor CardioRespiratory - Peds

*Continuous oxygen sat monitoring is NOT required for all patients on oxygen or for weaning of oxygen. Should only be reserved for patients with concern for deterioration and is not a substitute for assessing respiratory status.*

*Desaturation to 88% during sleep is acceptable. Intermittent desaturations to mid 80's can be normal in healthy infants.*

*Intermittent oxygen saturation monitoring is strongly recommend for children who are improving in clinical condition whether they are on supplemental oxygen or not:*

- Oxygen Saturation Monitoring: Every 4 hours with vital signs and respiratory assessments.
- Oxygen Saturation Monitoring: Continuous. Reassess in 24 hours.
- Oxygen Saturation Trending (Room Air Challenge) every 4 to 8 hours until successful.

### Respiratory Care

- Respiratory Suctioning: Nasal suctioning with every feed and PRN
  - Intermittent superficial (e.g. mushroom tip nasal aspirator) nasal suctioning prior to feeding and as needed
  - Deep nasal suctioning should be avoided as it has been shown to worsen symptoms by causing trauma to nose resulting in edema that worsens the obstructive symptoms. It should be limited to patients who are unable to manage secretions and are decompensating or not improving.
- sodium chloride 0.9% nasal drops instilled into both nostrils prior to suctioning
- O2 Therapy: Titrate to maintain oxygen saturation 92-97% (in infants and children with moderate to severe respiratory distress) starting at 0.5 to 1 LPM via nasal prongs. If greater flow rates required, re-evaluate response to oxygen therapy to determine if issue is airway related, oxygen is being effectively administered, and for the presence of a co-morbidity or increasing severity of bronchiolitis.
- Notify physician if O2 needs are increasing

- Discontinue oxygen therapy once respiratory rate is less than 60 breaths per minute, oxygen saturations greater than 90% on room air, child is able to feed and is and not showing signs of respiratory distress.

*IF child has severe disease and having difficulty maintaining oxygenation and ventilation and High Flow Nasal Cannula (HFNC) is supported at your site:*

- O<sub>2</sub> Therapy- Heated Humidified High Flow Nasal Cannula 2L/kg of flow, 40-50% FiO<sub>2</sub>.  
Follow local policy and procedure for Heated Humidified High Flow Nasal Cannula. *If no improvement in WOB, oxygenation in 2 hours consider a non-responders to Heated Humidified High Flow Nasal Cannula; Consider PICU consultation for bipap, CPAP or invasive ventilation.*

### **Diet / Nutrition / Hydration**

*IV hydration and NPO status should be considered in children at risk for impending respiratory failure or who are being considered for invasive ventilation.*

*Fluid Considerations:*

*To calculate the **hourly** maintenance fluid requirement:*

- 4 mL/kg/hour for the 1st 10 kg (0-10 kg)
- 2 mL/kg/hour for the next 10 kg (11-20 kg)
- 1 mL/kg/hour for any additional kg above 20

*Please note neonates have different fluid needs. In children less than 1 week of life, consultation with a pediatric specialist is recommended for suggestions of calculation of maintenance fluids.*

*Suggest using 75% maintenance fluid calculation.*

### **Diet**

#### **Oral Fluids:**

- NPO
- Breast Milk / Formula Fed (\_\_\_\_\_specify) ad lib
- Clear Fluids Diet
- Pureed Infant Diet (6-9 months)
- Full Diet (1-2 years)
- Clinical Communication – Encourage oral feeding in children without severe respiratory distress, facilitated by providing supplemental oxygen and non-invasive nasal suctioning

#### **Tube Feeds:**

*Nasogastric hydration is as effective as IV hydration and insertion may require fewer attempts and have higher success rate than IV placement.*

*Consider if respiratory rate over 60 breaths per minute and associated with severe work of breathing, or copious nasal secretions, OR if receiving oxygen by high flow nasal cannula:*

- Nasogastric Feeding Tube - Insert for tube feeds
  - Enteral Nutrition – Infant via Nasogastric Tube, feeding instructions:
    - Breastmilk/Formula: \_\_\_\_\_(specify)
    - Continuous: \_\_\_\_\_ mL/hour
- OR

Bolus feeds: \_\_\_\_\_ mL every \_\_\_\_\_ hours

- Notify Physician and hold oral/enteral feeds if patient choking, coughing with attempted feeds; respiratory rate sustained over 60 breaths per minute associated with severe work of breathing or copious nasal secretions;

#### **IV Fluids**

*Generally Hypotonic Fluids are NOT Recommended, severe bronchiolitis can be associated with syndrome of inappropriate antidiuretic hormone secretion (SIADH).*

*If on prolonged IV fluids monitoring Electrolytes is suggested.*

#### **IV Fluids with Potassium**

*For patients LESS THAN 1 month of age:*

- potassium chloride 20 mmol/L in dextrose 5% - sodium chloride 0.45% NaCl IV at \_\_\_\_\_ mL/hour

*For patients GREATER THAN 1 month of age:*

- potassium chloride 20 mmol/L in dextrose 5% - sodium chloride 0.9% NaCl IV at \_\_\_\_\_ mL/hour

#### **IV Fluids if Potassium is Contraindicated**

*For patients LESS THAN 1 month of age:*

- dextrose 5% - sodium chloride 0.45% IV at \_\_\_\_\_ mL/hour

*For patients GREATER THAN 1 month of age:*

- dextrose 5% - sodium chloride 0.9% IV at \_\_\_\_\_ mL/hour

#### **Lab Investigations**

***There are no recommended routine investigations in bronchiolitis.***

##### **Chemistry**

*Consider in a child being managed on exclusive IV fluids with risk of SIADH*

- Electrolytes (Na, K, CL, CO<sub>2</sub>) every 24 hours.

##### **Microbiology**

***Routine nasopharyngeal swabs are not indicated as they do not alter management. Consider for patients requiring admission to hospital who are unwell enough to suspect influenza due to available treatment, unclear diagnoses, severe disease requiring PICU care***

- Respiratory Virus DFA/Molecular Testing

*Consider in febrile infants less than 3 months of age (concurrent UTI up to 6% of febrile infants with bronchiolitis:*

- Urinalysis (specimen source: catheter)  
 Urine Bacterial Culture (specimen source: catheter)

Consider in febrile infants less than 1 month of age or other infants/children where you are considering sepsis:

- Complete Blood Count
- Blood Culture- Pediatric Set

Consider in febrile infants less than 1 month of age or other infants/children where you are considering meningitis

- Cerebrospinal Fluid Culture and Gram Stain
- CSF Glucose
- CSF Cell Count
- CSF Glucose

Recommended in children with apneic episodes:

- Bordetella pertussis Nucleic Acid Test (appropriate Pertussis test kit must be used and not Universal Transport Medium)

Blood Gases

Infants with bronchiolitis and respiratory rates over 70 breaths per minute or in those whom severe respiratory distress prevents oral feeds should undergo blood gas analysis to evaluate the adequacy of ventilation

- Capillary Blood Gas
- Venous Mixed Blood Gas

### Diagnostic Imaging

Chest x-rays are not routinely recommended in bronchiolitis

Consider in severe illness (i.e. PICU patient). If performed, patch consolidation/atelectasis is common and are not an absolute indication to start antibiotics for pneumonia.

- Chest X-Ray, 2 projections (GR Chest, 2 projections)

### Medications

**There is insufficient evidence to suggest that the routine use of bronchodilators changes the outcome of bronchiolitis.**

May be considered in infants with severe bronchiolitis who are being considered for ventilatory support. If given a pre and post assessment for response must be done and documented.

hypertonic sodium chloride

- There is currently no evidence to indicate that hypertonic sodium chloride use will change length of stay, morbidity, or mortality.
- Current studies support the safety of nebulized (3%) sodium chloride in bronchiolitic patients with no evidence of adverse events.
- Potential benefit in children hospitalized greater than 72 hours.
- sodium chloride 3% 4 mL by inhalation every 4 to 8 hours.

**Bronchodilators** (*consider in deteriorating child only*)

epiNEPHrine

**Not recommended by CPS or AAP for routine use but can be considered in deterioration.**

- *If concerned about croup component or severe deterioration.*
  - *Although generally safe, has been associated with cardiac arrhythmia*
- epiNEPHrine 1 mg/mL \_\_\_\_\_ mg by inhalation once (*0.5 mg/kg to a max of 5 mg, If given, ongoing treatment should only occur if there are clear signs of clinical improvement*)

Salbutamol

**Not recommended by CPS or AAP for routine use but can be considered in deterioration**

*Infants lack B2 receptors in their lungs to respond to salbutamol.*

*In the older child where the differential diagnosis includes asthma and a trial of ventolin is considered, an objective pre and post assessment for response must be performed and documented.*

- *Less than 6 months: do not trial salbutamol*
- *6-24 months: 2.5 to 5mg x 1 dose, repeat only if clinical response is dramatic*

- salbutamol 2.5 mg by inhalation ONCE
- salbutamol 5 mg by inhalation ONCE

**Consults**

*In an otherwise well infant recovering from bronchiolitis with a persistently low oxygen saturation, consider consult to Pulmonology for consideration of home oxygen therapy if available at your site.*

- MD Consult Pulmonary. Reason for consult \_\_\_\_\_.
- MD Consult PICU. Reason for consult \_\_\_\_\_.

## Appendix B: Use of Hypertonic Saline

An evaluation of literature on the use of hypertonic saline (HS) in children with acute bronchiolitis identified low-quality evidence for the following clinical outcomes: avoidance of invasive or non-invasive ventilation, improved oxygenation, reduced length of stay (LOS).

Of note: a ‘living meta-analysis’ continually evaluating the effect of hypertonic saline on bronchiolitis, last updated February 2018 <http://openmetaanalysis.github.io/Hypertonic-Saline-for-Bronchiolitis/>.

Two Cochrane Systematic Reviews (2013 and 2017) were published. Although the 2017 publication reported significance in the reduction of hospital admission in the HS group compared to normal saline (NS) (a risk difference of 7% between the groups), the admission criteria in the studies assessed were variable or not identified at all. This lack of consistency or well-defined admission criteria makes it difficult to evaluate the ‘true’ effect of HS on hospital admission.

The LOS was also reportedly significantly different between the two groups. Again, the discharge criteria varied, were not well-defined or were not reported. The lack of consistent and validated discharge criteria pose challenges to identifying the true treatment effect on LOS.

In both Cochrane Reviews, the more objective outcomes of: hemoglobin, saturation, respiratory rate, heart rate, oxygen supplementation, need for additional treatment and radiological score were *not significantly different* between children receiving HS compared to NS.

The Cochrane Review authors point to a number of important issues regarding research in this area:

- development of valid diagnosis criteria for acute bronchiolitis is urgently needed;
- well-defined, valid admission and discharge criteria should be used;
- there is a lack of robust and well-accepted efficacy outcome measures;
- LOS and rate of hospitalization are the most clinically important endpoints *but* are more susceptible to bias.

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