### PHASE I (Criteria & Respiratory Score)

**Inclusion Criteria**
- Age < 2 years
- Prematurity and/or age < 12 weeks may be included, but expect a more severe course of illness
- Viral upper respiratory symptoms & lower respiratory symptoms that may include: increased work of breathing, cough, feeding difficulty, tachypnea, wheeze, fever

**Exclusion Criteria**
- Cardiac disease requiring baseline medication
- Anatomic airway defects
- Neuromuscular disease
- Immunodeficiency
- Chronic lung disease

---

**Respiratory Score (RS)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>0 points</th>
<th>1 point</th>
<th>2 points</th>
<th>3 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 2 mo</td>
<td>≤ 60</td>
<td>61-69</td>
<td>≥ 70</td>
<td></td>
</tr>
<tr>
<td>2-12 mo</td>
<td>≤ 50</td>
<td>51-59</td>
<td>≥ 60</td>
<td></td>
</tr>
<tr>
<td>1-2 yr</td>
<td>≤ 40</td>
<td>41-44</td>
<td>≥ 45</td>
<td></td>
</tr>
<tr>
<td>Retractions</td>
<td>None</td>
<td>Subcostal or intercostal</td>
<td>2 of the following: subcostal, intercostal, substernal, OR nasal flaring (infant)</td>
<td>3 of the following: subcostal, intercostal, substernal, suprasternal, supraclavicular OR nasal flaring / head bobbing (infant)</td>
</tr>
</tbody>
</table>

**Dyspnea**

<table>
<thead>
<tr>
<th>0-2 years</th>
<th>Normal feeding, vocalizations and activity</th>
<th>1 of the following: difficulty feeding, decreased vocalization or agitated</th>
<th>2 of the following: difficulty feeding, decreased vocalization or agitated</th>
<th>Stops feeding, no vocalization or drowsy and confused</th>
</tr>
</thead>
</table>

**Auscultation**

| Normal breathing, no wheezing present | End-expiratory wheeze only | Expiratory wheeze only (greater than end-expiratory wheeze) | Inspiratory and expiratory wheeze OR diminished breath sounds OR both |
Bronchiolitis v11.0: ED Management

PHASE II (ED)

Inclusion Criteria
- Age <2 years
- Prematurity and/or age < 12 weeks may be included, but expect a more severe course of illness
- Viral upper respiratory symptoms & lower respiratory symptoms that may include: increased work of breathing, cough, feeding difficulty, tachypnea, wheeze, fever

Exclusion Criteria
- Cardiac disease requiring baseline medication
- Anatomic airway defects
- Neuromuscular disease
- Immunodeficiency
- Chronic lung disease

Initial assessment
- Place in viral isolation
- Respiratory score and suction (SCORE, SUCTION, SCORE). Start with nasal suction if score <9; follow with NP suction if needed.
- Provide supplemental O2 to keep saturation >90% (>88% asleep). Start at ½ L and titrate as needed.

Rehydration
- Give supplemental NG or IV fluids if moderately to severely dehydrated, secretions thick and difficult to mobilize, or severe respiratory distress
- If safe for PO feeds and mildly to moderately dehydrated, attempt oral feeding

Family teaching
- Viral illness, treated by hydration and suction
- Signs of respiratory distress
- How to suction
- When to suction
- Frequent feeds and watch hydration status
- Cough may last 2-4 weeks, do not use OTC cough and cold medications, avoid tobacco smoke

Suction and reevaluation
- Respiratory score (SCORE, SUCTION, SCORE)
  - Q 1 hour + prn if mild to moderate distress
  - Respiratory score and suction q30 minutes + prn if severe respiratory distress
  - For patients with prolonged ED stays, may space suctioning per MD discretion

Decide to Admit / Discharge

Medical Unit Admit Criteria (any of the following)
- Sustained hypoxemia (SpO2 < 90% awake, 88% asleep)
- Apnea
- Dehydration/impaired oral hydration requiring ongoing IV or NG fluids
- HFNC trial initiated, clinically improved or unchanged
- Moderate to severe respiratory distress AND one of the above criteria

Intensive Care Unit Admit Criteria (any of the following)
- Clinical worsening despite floor max HFNC support
- Desaturations below 90% despite 90% FiO2
- Other late findings of respiratory failure:
  - Inappropriately low respiratory rate with worsening obstruction
  - Lethargy despite noxious stimuli
  - Poor perfusion
  - Apnea > 20 seconds with associated bradycardia desaturation requiring intervention

Therapies NOT routinely recommended
- Albuterol
- Racemic Epinephrine
- Corticosteroids
- Chest Physiotherapy
- Montelukast
- Antibiotics
- Hypertonic Saline

Routine testing for viral pathogens NOT recommended unless for cohorting

Considerations for severely ill patients
May consider ONE-TIME albuterol MDI trial if:
- Severe respiratory distress OR
- Increased risk for asthma (>12 months old, wheeze, and one of the following: personal history of atopy or recurrent wheezing OR strong family history of atopy or asthma)

If patient responds to albuterol (score decreases by 2 or more) and is felt to clinically have asthma, change to asthma pathway. If patient responds to albuterol but is still felt clinically to have bronchiolitis as a primary pathology, albuterol should be continued on a prn basis only.

Consider HFNC for significant hypoxia OR severe respiratory distress not improving with rigorous supportive care (suction, hydration, antipyretics) (Go to HFNC Phase).
**Bronchiolitis v11.0: Inpatient Management**

**Approval & Citation**

**Summary of Version Changes**

**Explanation of Evidence Ratings**

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### PHASE III (Inpatient)

**Patient admitted**

- Begin family teaching
  - Signs of respiratory distress
  - How to suction
  - When to suction

**Assess patient and calculate respiratory score**

**Pre-suction score is LOW (1-4)**
- Score, Suction, Score prior to feeding or if more distressed, minimum q 4 hours
- Nasal suction
- No continuous pulse oximetry
- If on IV/NG fluids, discontinue fluids and restart oral feeds

**Pre-suction score is MODERATE (5-8)**
- Score, Suction, Score prior to feeds or if more distressed, minimum q 2 hours
- Nasal suction
- NP suction if clinically indicated after nasal suctioning
- No continuous pulse oximetry unless on supplemental O2

**Pre-suction score is HIGH (9-12)**
- Score, Suction, Score in 1 hour
- Nasal suction
- NP suction if clinically indicated after nasal suctioning
- Continuous pulse oximetry
- NG/IV fluids and evaluate safety of oral feeds
- May consider albuterol trial and HFNC trial as outlined in escalation box below

**Rescore at interval specified above (either 1, 2, or 4 hours) and recategorize based on pre-suction score**

**Ready for discharge?**

**Escalation for worsening patients**

May consider ONE-TIME albuterol trial (only if not previously trialed) if:
- Severe respiratory distress OR
- Increased risk for asthma (>12 months old, wheeze, and one of the following: personal history of atopy or recurrent wheezing OR strong family history of atopy or asthma)

Continue albuterol PRN ONLY if respiratory score improves by at least 2 points with trial; otherwise discontinue it.

Consider HFNC for significant hypoxia OR severe respiratory distress not improving with rigorous supportive care (suction, hydration, antipyretics)

Go to HFNC phase.

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**Inclusion Criteria**
- Age <2 years
- Prematurity and/or age < 12 weeks may be included, but expect a more severe course of illness
- Viral upper respiratory symptoms & lower respiratory symptoms that may include: increased work of breathing, cough, feeding difficulty, tachypnea, wheeze, fever

**Exclusion Criteria**
- Cardiac disease requiring baseline medication
- Anatomic airway defects
- Chronic lung disease

**Therapies NOT routinely recommended**
- Albuterol
- Racemic Epinephrine
- Corticosteroids
- Chest Physiotherapy
- Antibiotics
- Montelukast
- Hypertonic Saline

**Discharge Criteria**

Patients should be meet ALL of the following criteria:
- Respiratory score <5 for at least 8 hours
- No need for NP suctioning for 4 hours
- Off supplemental O2 for 12 hours
- If apnea occurred, no further apnea for 48 hours
- Feeding adequately
- Family teaching on respiratory distress and suction completed, teach-back done
- Follow up established

For questions concerning this pathway, contact: bronchiolitis@seattlechildrens.org

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Last Updated: December 2018
Next Expected Review: November 2020
Bronchiolitis v11.0: HFNC Management

PHASE IV (HFNC)

Pre-HFNC care
- Optimize NP suctioning. Recommend at least three rounds of suction.
- Fluid bolus completed
- Antipyretic administered, if febrile
- May consider albuterol trial ONCE

Floor initiations: Also call RRT; resident to notify attending MD.

Initiate HFNC at floor max flow, FiO2 21%
- Titrate FiO2 to maintain SpO2 > 90% awake, 88% asleep; max floor FiO2 is 50%
- Score, suction, score + VS q 30 min x 3
- Ensure NPO

Huddle 60 minutes past HFNC initiation
ED: include ED, RN, RT, resident, and fellow/attending, and accepting floor resident
Floor: include PICU (RISK RN, APP/fellow/attending), and resident

Clinically worsening

Clinically unchanged

Improving

Sign of clinical improvement:
- Improving respiratory score
- Lower respiratory rate with improved aeration
- Lower heart rate

Criteria for transfer to the ICU:
- Clinical worsening despite floor max HFNC support
- Desaturations below 90% despite 50% FiO2
- Other late findings of respiratory failure:
  - Inappropriately low respiratory rate with worsening obstruction
  - Lethargy despite noxious stimuli
  - Poor perfusion
  - Apnea > 20 seconds with associated bradycardia/desaturation requiring intervention

Criteria for transfer from the ICU to floor:
- Meets pathway criteria and stable on flow rate at or below the floor maximum for ≥12 hours
- If does not meet bronchiolitis HFNC pathway criteria, see HFNC policy

HFNC Inclusion Criteria
- Children on bronchiolitis pathway
  - Age ≥ 44 weeks PMA ≤ 2 years
- ONE of the following:
  1) Severe respiratory distress (deep retractions in multiple areas, grunting, head bobbing), or
  2) Significant hypoxia (FiO2 > 0.60, PaO2/FiO2 ≤ 200, pH ≤ 7.20, or PtcCO2 ≥ 70 mmHg)

Floor initiations: Also call RRT; resident to notify attending MD.

Initiate HFNC at floor max flow, FiO2 21%
- Titrate FiO2 to maintain SpO2 > 90% awake, 88% asleep; max floor FiO2 is 50%
- Score, suction, score + VS q 30 min x 3
- Ensure NPO

Huddle 60 minutes past HFNC initiation
ED: include ED, RN, RT, resident, and fellow/attending, and accepting floor resident
Floor: include PICU (RISK RN, APP/fellow/attending), and resident

Clinically worsening

Clinically unchanged

Improving

Sign of clinical improvement:
- Improving respiratory score
- Lower respiratory rate with improved aeration
- Lower heart rate

Criteria for transfer to the ICU:
- Clinical worsening despite floor max HFNC support
- Desaturations below 90% despite 50% FiO2
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Criteria for transfer from the ICU to floor:
- Meets pathway criteria and stable on flow rate at or below the floor maximum for ≥12 hours
- If does not meet bronchiolitis HFNC pathway criteria, see HFNC policy

Model: HFNC Floor Minimum (L/min)

<table>
<thead>
<tr>
<th>Age</th>
<th>HFNC floor maximum (L/min)</th>
<th>HFNC floor minimum (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>44wk PMA - 90 days*</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>91 days - 6 months*</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>&gt;6 months - 1 year</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>&gt;1 year - &lt;2 years</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

*Correct for gestational age

*Trial HFNC at floor max flow

Frequently Asked Question:
- What is the definition of failed wean?
  - Wean is defined as successful if
    - On floor, patient condition allows
    - Wean is attempted at least once a day
    - Weans should be trialed at least once a day
    - Patient should be assessed every 30 minutes
    - Weaning HFNC on the medical unit:
      - Rapidity: Flow and FiO2 should be weaned quickly in improving patients, including at night.
      - Frequency of weaning trials:
        - Weans should be trialed at least once a day, unless team holds wean due to anticipated trajectory or ongoing respiratory distress.
        - Improving patients should be assessed by RT or RN for readiness to wean q 4 hours.
        - Step-wise approach: Flow should be weaned from floor max flow, to floor min flow, to off (remove cannula).
        - Avoid gradual weans using other flows.
        - Weaning from max flow directly to off is also possible, as patient condition allows.
        - Team guidance: Physicians should order flow rate after assessing patient, observe patient for 10 minutes after flow turned down, and reassess within 2 hours to ensure sustained successful wean.
        - Definition of failed wean: Increased work of breathing that the team judges difficult to sustain for next 12-24 hours, which resolves when flow wean is reversed.
        - RRT considerations: May restart HFNC without RRT, if within 24 hours of failed trial off, and if severity does not warrant RRT.

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Last Updated: December 2018
Next Expected Review: November 2020
Scope of the Problem

Bronchiolitis: leading cause of infant hospitalization in the U.S.

- Approximately 3% of all children are hospitalized with bronchiolitis at some point in their lives
- Annual mid-winter epidemics of bronchiolitis lead to a 239% increase in hospitalizations in children <6 months

Costs associated with bronchiolitis admissions:

- Charges: $1.7 billion annually and increasing over time
- Relative cost: among top 10 costliest pediatric inpatient diagnoses

Hasegawa 2013, Keren 2012, AAP Clinical Practice Guideline 2014

Definition

Bronchiolitis is an acute infectious inflammation of the bronchioles resulting in obstructive airway disease.

- **Age <2 years** (peak 3-6 months)
- **Prodromal viral upper respiratory symptoms**
- **Lower respiratory symptoms follow**
  - Small airway edema and epithelial cell sloughing
    - mucus production
    - bronchospasm
    - hyperinflation
Etiology

- **Respiratory Syncytial Virus** (50-80%)
- Other viruses
  - Human Metapneumovirus
  - Rhinovirus
  - Coronavirus
  - Parainfluenza
  - Influenza
  - Adenovirus
- **Coinfection (multiple pathogens) in up to 30%**


Natural History

- **Epidemiology**
  - Peak incidence December–March
  - >90% infected with RSV by 2 years of age
  - 40% develop a lower respiratory tract infection with first infection, and most do not require hospitalization

- **Transmission**
  - Direct contact with secretions (including on fomites, where it can persist for >6 hours)
  - Young children typically shed virus for ≥ 2 weeks
  - 30-70% of household contacts become ill

- **Natural history**
  - Begins with a URI
  - Progresses to LRI in 2-6 days
  - Variable and dynamic course
  - Lasts ~2-4 weeks

- **Reinfection common**

Natural History: Complications

• **Respiratory complications uncommon**
  - Apnea (~3%), esp. if premature
  - Respiratory failure

• **Bacterial complications relatively uncommon**
  - Otitis media most common
  - In young infants, most common is UTI
  - Pneumonia uncommon

• **Mortality rare**
  - Fewer than 400 deaths annually
  - Most deaths in those 6 months of age and younger, with approximately half in patients with comorbidities

AAP 2014, Zorc 2010, Hasegawa 2013
Diagnosis

The diagnosis of bronchiolitis is clinical and based on the history and physical exam. Evidence does not support routine ordering of labs or radiologic studies (AAP 2014).

Diagnosis: Symptoms

Upper followed by lower respiratory tract infection

– URI: Rhinorrhea, congestion, cough
– LRI: Airway obstruction (tachypnea, wheezing, respiratory distress)

May also have:

– Fever
– Feeding difficulty
– Post-tussive emesis

Source: AAP 2014
Diagnosis: Differential Diagnosis

Consider alternate diagnoses for babies with severe respiratory distress, lack of viral symptoms, or frequent / recurrent episodes.

- Viral-triggered wheeze
- Infection
  - Pneumonia
  - Pertussis
- Irritant
  - Gastro-esophageal reflux
  - Aspiration
- Anatomic
  - Foreign body aspiration
  - Congenital airway anomaly
- Congestive heart failure

NOTE: The exam may change quickly / often due to varying clearance of obstruction.

Diagnosis: Physical Exam

- Vital signs
  - Tachypnea
  - Hypoxemia
- Inspection
  - Respiratory distress
    - Grunting, flaring, retractions
  - Vigor vs. fatigue
- Auscultation
  - Prolonged expiratory phase
  - Wheezes
  - Crackles

NOTE: The exam may change quickly / often due to varying clearance of obstruction.
**Diagnosis: Identification of Pathogen**

*Identification of a pathogen is not routinely recommended (AAP 2014).*

- **Diagnostic testing may be considered if:**
  - Need for cohorting
  - Uncertain clinical diagnosis
  - Age <2 months
  - To assess for influenza

- **Pathogen identification IS recommended:**
  - any patient with hospital-acquired infection
  - High-risk patients (immune-compromised, chronic lung / heart disease)
Identifying Patients Appropriate for the Bronchiolitis Pathway

Patients who meet criteria should be placed on the bronchiolitis pathway via bronchiolitis orderset (AAP 2014).

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt;2 years</td>
<td>Chronic lung disease or other significant lung disease (e.g., cystic fibrosis)</td>
</tr>
<tr>
<td>Viral upper respiratory symptoms &amp; lower respiratory symptoms that may include: increased work of breathing, cough, feeding difficulty, tachypnea, wheeze, fever</td>
<td>Cardiac disease requiring daily medications or with baseline symptoms</td>
</tr>
<tr>
<td></td>
<td>Anatomic airway defects</td>
</tr>
<tr>
<td></td>
<td>Neuromuscular disease</td>
</tr>
<tr>
<td></td>
<td>Immunodeficiency</td>
</tr>
</tbody>
</table>

NOTE: Ex-premature infants and those <12 weeks of age are not excluded from the pathway, but providers should be aware that these children may have a more severe course of illness.

Defining Admission Criteria

Admit to ward if patient meets **ANY** of the following criteria:
- Sustained hypoxemia (SpO2 < 90% awake, 88% asleep)
- Apnea
- Dehydration/impaired oral hydration requiring ongoing IV or NG fluids
- HFNC trial initiated, clinically improved or unchanged
- Moderate to severe respiratory distress AND one of the above criteria

Admit to ICU for:
- Clinically worsening despite maximum floor HFNC flow
- Desaturations despite maximum floor FiO2 50%
- Late findings of respiratory failure: lethargy despite noxious stimuli, inappropriately low respiratory rate despite worsening obstruction, poor perfusion
- Apnea with bradycardia and cyanosis
Respiratory Scoring Tool (Slide 1 of 3)

How do I use the respiratory scoring tool?

- The respiratory scoring tool consists of 4 elements that make up the respiratory assessment of the patient in distress.
- You assess each component distinctly and add them to make a total between 1-12.
  - A patient’s RR is 1-3 whereas all other categories are scored 0-3.

Respiratory Scoring Tool (Slide 2 of 3)

Respiratory Scoring Tool Table (Part 1 of 2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>0 points</th>
<th>1 point</th>
<th>2 points</th>
<th>3 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RESPIRATORY RATE: assessed over 60 seconds (1-3)</td>
<td>&lt;2 mo</td>
<td>≤60</td>
<td>61-69</td>
<td>≥70</td>
</tr>
<tr>
<td></td>
<td>2-12 mo</td>
<td>≤50</td>
<td>51-59</td>
<td>≥60</td>
</tr>
<tr>
<td></td>
<td>1-2 yr</td>
<td>≤40</td>
<td>41-44</td>
<td>≥45</td>
</tr>
<tr>
<td></td>
<td>2-3 yr</td>
<td>≤34</td>
<td>35-39</td>
<td>≥40</td>
</tr>
<tr>
<td></td>
<td>4-5 yr</td>
<td>≤30</td>
<td>31-35</td>
<td>≥36</td>
</tr>
<tr>
<td></td>
<td>6-12 yr</td>
<td>≤26</td>
<td>27-30</td>
<td>≥31</td>
</tr>
<tr>
<td></td>
<td>&gt;12 yr</td>
<td>≤23</td>
<td>24-27</td>
<td>≥28</td>
</tr>
</tbody>
</table>

NOTE: This is the same respiratory score as used for asthma.
Respiratory Scoring Tool (Slide 2 of 3)

Respiratory Scoring Tool Table (Part 2 of 2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>0 points</th>
<th>1 point</th>
<th>2 points</th>
<th>3 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. RETRACTIONS: work of breathing (0-3)</td>
<td>None</td>
<td>Subcostal or intercostal</td>
<td>2 of the following: subcostal, intercostal, substernal, OR nasal flaring (infant)</td>
<td>3 of the following: subcostal, intercostal, substernal, suprasternal, supraclavicular OR nasal flaring / head bobbing (infant)</td>
</tr>
<tr>
<td>3. DYSPNEA: shortness of breath (0-3)</td>
<td>Normal feeding, vocalizations and activity</td>
<td>1 of the following: difficulty feeding, decreased vocalization or agitated</td>
<td>2 of the following: difficulty feeding, decreased vocalization or agitated</td>
<td>Stops feeding, no vocalization, drowsy or confused</td>
</tr>
<tr>
<td>0-2 years</td>
<td>Normal feeding, vocalizations and activity</td>
<td>1 of the following: decreased appetite, increased coughing after play, hyperactivity</td>
<td>2 of the following: decreased appetite, increased coughing after play, hyperactivity</td>
<td>Stops eating or drinking, stops playing, OR drowsy and confused</td>
</tr>
<tr>
<td>2-4 years</td>
<td>Normal feeding, vocalizations and play</td>
<td>Counts to ≥10 in one breath</td>
<td>Counts to 7-9 in one breath</td>
<td>Counts to 4-6 in one breath</td>
</tr>
<tr>
<td>&gt;4 years</td>
<td>Counts to ≥10 in one breath</td>
<td>Counts to 7-9 in one breath</td>
<td>Counts to 4-6 in one breath</td>
<td>Counts to ≤3 in one breath</td>
</tr>
<tr>
<td>4. AUSCULTATION: wheezing on lung exam (0-3)</td>
<td>Normal breathing, no wheezing present</td>
<td>End-expiratory wheeze only</td>
<td>Expiratory wheeze only (greater than end-expiratory wheeze)</td>
<td>Inspiratory and expiratory wheeze OR diminished breath sounds OR both</td>
</tr>
</tbody>
</table>

NOTE: This is the same respiratory score as used for asthma.

Defining Discharge Criteria

Patients should be discharged when they meet ALL of the following criteria:

- Respiratory distress only mild / moderate (respiratory score <5 for at least 8 hours)
- No need for nasopharyngeal suctioning x 4 hours
- Off supplemental O₂ for 12 hours
- If apnea occurred, no further apnea x 48 hours
- Feeding adequately
- Caregiver teaching re: respiratory distress and suction completed with teach-backs
- Follow-up established
Caregiver and Family Teaching

- **Teaching should start on arrival:**
  - Signs of respiratory distress
    - When to call PCP, go to ED, call 911
  - How and when to nasally suction
    - Using bulb syringe or mouth operated nasal aspirator
  - Maintaining hydration
    - Small frequent feeds
    - Signs of dehydration
  - Anticipatory guidance:
    - Cough can last up to 4 weeks
    - Do not use over-the-counter cough/cold medications

Treatment: Therapies that Work

Best practice is **FEWER** interventions. Therapy is primarily supportive.

- Suction
- Intravenous or nasogastric fluids if dehydrated
- Supplemental oxygen if hypoxemic
- Escalation therapies only if high risk of respiratory failure
Suctioning is not widely evaluated in the literature, but is considered essential to bronchiolitis care.

- Used to clear secretions from the nares / airway that the child is unable to clear himself / herself.
- Induces coughing, which allows child to clear lower airway secretions.
- Reduces work of breathing and improves oral intake.
- Suction gaps may be associated with longer LOS.

Patients admitted with bronchiolitis should receive suction of the nares at frequent intervals.

Mussman 2013, AAP 2014

- Suction should be primarily nasal:
  - **Nasal suction** (with an olive tip catheter, bulb, or parental mouth-operated nasal aspirator) should be used routinely, at regular intervals.
  - **Nasopharyngeal suction** should be used in patients in severe respiratory distress and fail to improve with olive tip suction. Nasal edema may result from repeated nasopharyngeal suction events. Some articles suggest nasopharyngeal suction is associated with a longer LOS, and using it less often does not make outcomes worse (Mussman 2013, Mittal 2014).

- Suction response should be documented, with a respiratory score recorded before and after all types of suctioning.
- Family should be trained how/when to use nasal suction at home.
**Treatment: Supplemental Oxygen**

Supplemental oxygen should be provided if SpO$_2$ falls persistently below 90%. The goal is to provide oxygen to maintain SpO$_2$ at or above 90%. (AAP 2014)

- Oxygen is supplied via nasal cannula, using the lowest flow possible.
- SpO$_2$ drops to 88% are acceptable during sleep.
- <20 sec drops in SpO$_2$ to the 80s in the sleeping child do not require supplemental oxygen; these may occur in healthy infants. (Hunt 1999)
- Deeper self-resolving desaturations may not be clinically meaningful in mild-to-moderate bronchiolitis patients, who should therefore be taken off continuous pulse oximetry once off supplemental oxygen. (Principi 2016)

**Treatment: IV Fluids** (Slide 1 of 2)

Intravenous (IV) or nasogastric (NG) fluid administration should be considered if the patient cannot maintain hydration orally or is severely dehydrated (AAP 2014).

- NG hydration is as effective as IV hydration in patients with bronchiolitis, and requires fewer attempts at placement. It is advisable to involve caregivers in the decision of how to hydrate their child.
- Because respiratory distress may increase the risk of aspiration:
  - Patients with significant coughing, choking, gagging, or worsening tachypnea with feeds should be made NPO, and IV/NG feeds started.
  - Patients with a sustained respiratory rate > 60 should be evaluated for safety of a feeding trial. If severe distress, do not attempt feeding trial and make NPO.
  - Patients on HFNC at floor maximum flow rates should be NPO.
Treatment: IV Fluids (Slide 2 of 2)

- Hypotonic IV fluids should not be used in patients with bronchiolitis.
- Bronchiolitis patients should be started on D5NS with potassium per Maintenance IV Fluids Pathway
- Hyponatremia can be seen in severe bronchiolitis, as fever, pain, and inflammation are non-osmotic triggers for ADH release.
  - Consider checking a sodium level in patients with severe bronchiolitis on IV fluids.
  (AAP 2014)

Treatment: Therapies *NOT* Routinely Recommended

Numerous randomized controlled trials do not demonstrate benefit with:

- Bronchodilators
- Corticosteroids
- Chest physiotherapy
- Antibiotics
- Leukotriene receptor antagonists
**Treatment: Bronchodilators (Slide 1 of 2)**

There is NO consistent improvement in duration of illness or length of hospitalization due to bronchodilators. As with any medication, bronchodilators have side effects and costs. Albuterol should NOT be used routinely in children with bronchiolitis (AAP 2014, Gadomski Cochrane 2014).

**Treatment: Bronchodilators (Slide 2 of 2)**

- Because there is a paucity of data on critically-ill infants, albuterol may be trialed in patients with severe distress or risk factors for asthma (>12 months old with wheeze, history of recurrent wheeze, strong family history of atopy or asthma).
- Document response (pre /post respiratory score and exam).
- Continue PRN only if significant improvement in respiratory score (2+ point improvement) after albuterol administration.
- If no significant response, albuterol should not be trialed again.
- If albuterol not effective, higher doses are not better.
- MDI is the preferred delivery method.
Treatment: Corticosteroids

**Corticosteroids do not improve length of stay in the hospital, length of illness, or clinical score, and should not be used routinely** (AAP 2014).

- Even if there is concern for a significant reactive airway component, steroids may not benefit young viral wheezers (Panickar 2009).
- Consider steroids in patients with chronic lung disease who are EXCLUDED from pathway (+/- in consultation with pulmonary medicine).

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**Treatment: Racemic Epinephrine**

*Racemic epinephrine has no benefit over albuterol for treatment of inpatients with bronchiolitis and should not be used routinely* (AAP 2014).

- Though there is some evidence suggesting benefit in the outpatient setting, studies conflict. There is no evidence to support its use in inpatients with bronchiolitis.
- The bronchodilator of choice, if a child is to have a trial, should be albuterol (due to its longer duration of action, low risk for adverse effects, and common use in other settings).
**Treatment: Chest Physiotherapy**

_Chest physiotherapy does not improve respiratory score, length of stay, or O₂ requirement, and is not recommended for routine use in bronchiolitis (AAP 2014)._
Treatment: Montelukast

There is no evidence for improvement with montelukast and it is not recommended for use in bronchiolitis (AAP 2014).

Treatment: Hypertonic Saline

There is currently insufficient evidence regarding hypertonic saline efficacy. Hypertonic saline is not recommended for routine use in outpatients. Hypertonic saline may be used in inpatients anticipated to have longer LOS (> 3 d) (AAP 2014, Zhang 2015).

- Hypertonic saline is thought to increase mucociliary clearance of secretions.
- Although some evidence suggests hypertonic saline may reduce risk of hospitalization and LOS, studies are variably generalizable and effect magnitudes are small.
- Questions remain:
  - Which patients benefit most?
  - How best to administer it?
  - What is the cost benefit analysis for routine administration?
- It may be considered in patients with severe respiratory distress or anticipated to have LOS > 3 days.
### Monitoring: Continuous Pulse Oximetry

*Continuous pulse oximetry should be discontinued when patients are clinically improving and no longer require supplemental oxygen (AAP 2014).*

- Pulse oximetry can lead to alarm fatigue, caregiver distress, and overtreatment. In some studies, it is associated with higher admission rates or longer LOS without evidence of patient benefit.
- Pulse oximetry should be used judiciously and discontinued once patients improve.

(Shuh 2014, Hunt 1999, AAP 2014)

### Monitoring: Blood Gas Monitoring

*Clinicians may check a CBG if there are signs of clinical deterioration (apnea, lethargy, poor perfusion, signs of impending respiratory failure).*
Monitoring: Apnea

- Initiate ABC (apnea / bradycardia / cyanosis) monitoring if patient has an episode of apnea while inpatient or a significant history of apnea.
- Consider ICU consult / transfer for persistent episodes of apnea or for apnea with bradycardia and/or cyanosis.

**NOTE:** Pertussis PCR is recommended for infants with apnea.

Escalation Therapies

- Cochrane reviews on HFNC and CPAP state that there is insufficient evidence to recommend routine use in bronchiolitis.
- There is a paucity of high-quality research in critical illness.
- Retrospective ICU studies of HFNC in bronchiolitis show decreased intubation rates and decreased ICU length of stay.

- 2014 AAP guideline: “Although promising, the absence of any completed randomized trial of the efficacy of high-flow nasal cannula in bronchiolitis precludes specific recommendations on its use at this time.”
Escalation Therapies: High Flow Nasal Cannula

- **Terms:** Also called high-flow, or high-humidity nasal cannula
- **Function:** HFNC delivers a higher flow of air or oxygen than nasal cannula. Gas is delivered with a mixer so FiO\(_2\) can be adjusted (21-100%), although actual delivered FiO\(_2\) does not reach 100%. By contrast, nasal cannula oxygen is not humidified and dries airways at higher flow rates.

- **Proposed mechanisms of HFNC action in bronchiolitis:**
  1. Provides CO\(_2\) “washout” of respiratory physiologic dead space
  2. Provides very low-level positive pressure that aids lung recruitment
     - Exact amount of PEEP varies based on:
       - Flows
       - Nasal cannula fit to nares
       - Whether mouth is open or closed
  3. **Warmth and humidity**
     - Keep secretions moist, improving mucociliary clearance
     - Inhibit bronchoconstriction reflexes triggered by cold and dry air

Escalation Therapies: HFNC Setup Example

Air/O2 blender to set FiO2 and flow rate
Humidifier
Heater (shows temperature)
Cannula (similar to low flow NC)
Escalation Therapies: HFNC Recommendations

- HFNC has been shown to improve work of breathing and decrease the need for intubation in patients with severe bronchiolitis.
- However, HFNC has less benefit for patients who are less severely ill, and is associated with considerable cost.

Consider a trial of HFNC for patients at high risk of deterioration, despite rigorous secretion management:
- Severe respiratory distress
- Significant hypoxia (see below)

<table>
<thead>
<tr>
<th>Age</th>
<th>Significant hypoxia if NC O₂ flow rate* greater than:</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-90 days</td>
<td>1 L/min</td>
</tr>
<tr>
<td>91 days – &lt; 6 months</td>
<td>1.5 L/min</td>
</tr>
<tr>
<td>6 months – 2 years</td>
<td>2 L/min</td>
</tr>
</tbody>
</table>

*Rate need to keep SpO₂ > 90% awake, 88% asleep

Escalation Therapies: HFNC Pathway Criteria

Patients eligible for HFNC bronchiolitis pathway:
- Children on bronchiolitis pathway
- Age 44 weeks PMA to <2 years with clinical bronchiolitis
- ONE of the following, despite rigorous supportive care trial:
  - Severe respiratory distress
  - Significant hypoxia (> 1 L/min NCO₂ if 30-90 days, >1.5 L/min for 91 days – 6 months, >2 L/min for 6 months – 2 years)

<table>
<thead>
<tr>
<th>Exclusion Criteria</th>
<th>Concern for respiratory failure:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac disease requiring baseline medication</td>
<td>• Lethargy</td>
</tr>
<tr>
<td>Anatomic airway defects</td>
<td>• Poor perfusion</td>
</tr>
<tr>
<td>Neuromuscular disease</td>
<td>• Apnea</td>
</tr>
<tr>
<td>Immunodeficiency</td>
<td>Born prematurely &lt; 34 weeks if &lt; 6 mo</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>History of intubation for respiratory failure</td>
</tr>
<tr>
<td>Concurrent treatment of pneumonia, asthma, or croup</td>
<td></td>
</tr>
</tbody>
</table>
Escalation Therapies: HFNC Initiation

Escalation steps

1. Suction and hydrate well prior to HFNC
2. Consider albuterol trial ONCE if appropriate and not already done
3. **For inpatients:** Call RRT, notify attending MD  
   **For ED:** Call respiratory therapist
4. Make patient NPO
5. Set up HFNC initially at 21% FiO2 and maximum floor flow for age
6. Continue to suction frequently both pre- and post-HFNC initiation.

**NOTE:** If patient weaned off HFNC and it is re-initiated >24 hours later, an RRT must be called.

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**Escalation Therapies: HFNC 60-minute huddle**

Studies show that HFNC responders show improvement in respiratory rate, heart rate, and work of breathing within 60-90 minutes.

Recommendations:

- Conduct a huddle, in which key players in the patient’s care re-evaluate the patient’s clinical course 60 minutes after HFNC initiation
- Clinically worsening patients are transferred to the PICU
- Clinically improving or unchanged patients may stay on the floor

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Return to Criteria & RS  |  Return to ED  |  Return to Inpatient  |  Return to HFNC
**Escalation Therapies: HFNC Weaning**

*HFNC should be weaned quickly in improving patients.*

- FiO2 may be weaned by RN/RT
- Flow must be weaned by provider order
  - RN/RT should **assess readiness to wean** flow every 4 hours, and prompt team to wean if appropriate
  - Teams should **wean flow at least daily**, unless team holds due to anticipated trajectory or patient severity
  - Flow should be weaned **stepwise**, from floor max to min to off.
  - **Trials off**: Flow can be weaned from max flow to off if appropriate

**Escalation Therapies: HFNC PICU–to–Floor Transfers**

**PICU bronchiolitis patients** should meet criteria before transfer:
- Be stable on a flow rate at or below the floor maximum for **>12 hours**
- Have **no HFNC pathway EXCLUSION criteria** (i.e. no neuromuscular disease, no chronic lung disease, etc.)

**For patients who do not meet criteria for HFNC pathway:**
- Transfer subject to hospital-wide policy
- See CHILD: Care of the Patient on High-Flow Nasal Cannula (HFNC)
Signs of Deterioration in a Patient With Bronchiolitis

- Increasing respiratory distress
- Inappropriately low respiratory rate despite worsening obstruction
- Increasing heart rate
- Worsening hypoxia
- Apnea requiring intervention
- Lethargy
- Poor perfusion

Criteria for transfer to the ICU:
- Clinical worsening despite floor max HFNC support
- Desaturations below 90% despite 50% FiO2
- Other late findings of respiratory failure:
  - Inappropriately low respiratory rate with worsening obstruction
  - Lethargy despite noxious stimuli
  - Poor perfusion
- Apnea > 20 seconds with associated bradycardia/desaturation requiring intervention

Criteria for transfer from the ICU to floor:
- Meets pathway criteria and stable on flow rate at or below the floor maximum for >12 hours
- If does not meet bronchiolitis HFNC pathway criteria, see HFNC policy

Escalation Therapies: Feeding Patients on HFNC

No strong evidence exists to guide feeding practices on HFNC.

**Recommendations:**
- Patients who wean to minimum floor flow are eligible to resume oral feeds.
- Patients should only attempt oral feeding if clinically improving and if no known aspiration history
- First oral feeding should be supervised by an RN, SLP/OT, or provider
- Oral feeding should be stopped if associated with increased coughing, choking, or worsening respiratory distress.
- An NG tube should be placed and enteral feeds initiated for patients NPO for > 2 days.

Return to Criteria & RS  Return to ED  Return to Inpatient  Return to HFNC
Prevention

RSV can persist on fomites for hours and has been identified in the air up to 22 feet from the patient's bed.

- **Viral isolation is standard for inpatients at Seattle Children's:**
  - **Strict handwashing / alcohol-based rubs, gown, gloves, mask**
  - **Wash hands or gel before and after patient contact, after contact with inanimate objects directly near the patient, and after glove removal**
  - **Limit visits by young children**

- **Family education re: hand hygiene (AAP 2014)**

- **Consider RSV monoclonal antibody (i.e. monthly Synagis) for at-risk infants (AAP palivizumab policy statement 2014)**

Source: AAP 2014, AAP Committee on Infectious Diseases 2014
Bronchiolitis Approval & Citation

Approved by the CSW Bronchiolitis Team for the January 3, 2017 go live.

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Retrieval Website:  http://www.seattlechildrens.org/pdf/bronchiolitis-pathway.pdf

Please cite as:
Seattle Children’s Hospital, Zaman S, Beardsley E, Crotwell D, Di Blasi R, Foti J, Hoffer D, Ringer C,
This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children’s. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94.):

Quality ratings are *downgraded* if studies:
- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings are *upgraded* if it is felt that:
- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

Guideline – Recommendation is from a published guideline that used methodology deemed acceptable by the team.

Expert Opinion – Our expert opinion is based on available evidence that does not meet GRADE criteria (for example, case-control studies).

**Quality of Evidence:**
- ☑️ ☑️ ☑️ ☑️ High quality
- ☑️ ☑️ ☑️ Moderate quality
- ☑️ ☑️ Low quality
- ☑️ ☑️ ☑️ Very low quality

Guideline
Expert Opinion

To Bibliography, Pg 1

Return to Criteria & RS Return to ED Return to Inpatient Return to HFNC
Summary of Version Changes

- **Version 1.0 (10/10/2011):** Go live
- **Version 1.1 and 1.2 (07/20/2012):** Copystyle photos and diagrams removed
- **Version 2.0 (10/22/2012):** Updated to SpO2 monitoring recommendations
- **Version 3.0 (12/10/2013):** Go live of Bronchiolitis HFNC Pathway
- **Version 3.1 (12/13/2013):** Changes made to add contact hospitalist; correction to oral feeds to match training slide; wording change in trial of albuterol to match the orders
- **Version 3.2 (01/15/2014):** Changes to inclusion and exclusion criteria; changes to reflect medical hospitalist at ED 90 minute huddle; admit to medical hospitalist
- **Version 4.0 (02/5/2014):** Pathway document was divided into two documents and posted as Bronchiolitis Pathway and HFNC Pathway
- **Version 5.0 (10/01/2014):** Added citation page and link; removed “HFNC Test Your Knowledge” link; updated training slides L, M, and V. In the HFNC phase only: Removal of daily CBG while on HFNC; highlighting of ability to recheck PC02 after HFNC started for improved patients to meet floor admit criteria; PC02 removed from inclusion criteria; composition of members of ED huddle; ability to admit to general medicine service; ability to trial patient on RA or low flow NC O2 after stable on HFNC at 2 lpm for 4 hours
- **Version 6.0 (01/30/2015):** HFNC Phase ONLY: Update to the pathway inclusion criteria to include severe respiratory distress; added ICU to floor transfer criteria and link to education slide in transfer criteria box
- **Version 7.0 (11/04/2015):** Periodic Review; updated literature search, recommendations and pathway tools; combined bronchiolitis and HFNC pathway documents
- **Version 8.0 (3/7/2016):** HFNC inclusion/exclusion criteria amended, HFNC huddle participants amended, changes to HFNC ED management for unchanged patients, HFNC restarting after weaning clarified
- **Version 9.0 (1/3/2017):** Process Improvement Change; optimization of secretion management, focusing on high-flow cannula use, and improving high-flow efficacy
- **Version 9.1 (2/27/17):** Title of first green box on HFNC Phase changed and grammar adjustment made in Inclusion Criteria
- **Version 10.0 (11/13/2017):** Removal of hospitalist involvement for HFNC initiation/huddle
- **Version 11.0 (12/14/2018):** Removal of respiratory score from admit criteria and change to “moderate to severe distress”
Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children’s Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

Readers should confirm the information contained herein with other sources and are encouraged to consult with their health care provider before making any health care decision.
Studies were identified by searching electronic databases using search strategies developed and executed by a medical librarian, Susan Groshong. This periodic review search was completed in April, 2015, and updated searches originally performed in 2010, 2012 and 2013. The following databases were searched: Cochrane Database of Systematic Reviews via the Ovid platform, CINAHL, and Cincinnati Children’s Evidence-Based Care Recommendations. Retrieval was limited to ages 0-18, English, French or German languages, and the period October 1, 2013 to current, reflecting incorporation of a 2014 American Academy of Pediatrics guideline. For review of Medline and Embase, the team relied upon ongoing quarterly alert results. Appropriate CINAHL Headings were used, along with text words, and the search strategy was adapted for other databases using text words. Concepts searched were bronchiolitis, respiratory syncytial viruses and metapneumovirus. All retrieval was further limited to certain evidence categories, such as relevant publication types, index terms for study types and other similar limits.

Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535


Perotta et al. Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old. Cochrane Database Syst Rev. 2008


