**Definition:** Bronchiolitis is an acute inflammatory disease of the lower respiratory tract, resulting from obstruction of small airways. It is the most common lower respiratory infection in children 0-2 years in addition to being one of the most common diseases leading to hospitalization in infants less than one year of age, costing more than $700 million annually in the United States. \(^{(1,2)}\)

**Pathophysiology:** Bronchiolitis causes acute inflammation, edema, and necrosis of epithelial cells lining the small airways, resulting in increased mucus production and bronchospasm. Infants and children aged 2-24 months are most likely to become infected. It occurs most frequently between December and March and is usually caused by a viral infection, with Respiratory Syncytial Virus (RSV) being the most common etiology. Other common viruses include parainfluenza, influenza, adenovirus, and human metapneumovirus. \(^{(1,2)}\)

**Inclusion Criteria** \(^{(1)}\)
- Age 0-2 years with respiratory symptoms

**Exclusion Criteria** \(^{(1-3)}\)
- Asthma, cystic fibrosis, bronchopulmonary dysplasia, or other chronic respiratory disease
- Recurrent wheezing
- Immunodeficiency
- Serious bacterial infection, shock, or toxic appearance
- Neuromuscular disease
- Artificial airway
- Cyanotic heart disease

**Differential Diagnosis**
- Community-acquired pneumonia
- Foreign body aspiration
- Trauma/Tumors
- Gastroesophageal reflux
- Congenital malformations
- Congenital heart disease

**Diagnostic Evaluation:** A clinical history and physical examination is sufficient to diagnose bronchiolitis. Infants present with symptoms of a common cold (i.e., runny nose and mild cough). Over the next few days, the cough worsens. A fever, difficulty breathing, and wheezing may develop. Symptoms, especially coughing and wheezing, can persist for 3-4 weeks, although they gradually improve during that time period. \(^{(2)}\)

**History: Assess for** \(^{(1,2)}\)
- Upper Respiratory Illness (URI) with rhinorrhea
- Exposure to viral URI
- Poor fluid intake (e.g., inability to suck)
- Fever
- Family history for allergy, asthma, or atopy
- Previous wheezing
- Passive exposure to smoking

**Physical Examination**
- Observe for rhinitis, tachypnea, cough, nasal flaring, shortness of breath, grunting, skin color changes, wheezing, and fever
- Obtain Clinical Respiratory Score (CRS) after nasopharyngeal suction. The CRS includes assessment of: respiratory rates, auscultation, use of accessory muscles, mental status, SpO\textsubscript{2}, and color (see below).

<table>
<thead>
<tr>
<th>Clinical Respiratory Score (CRS)</th>
<th>Score 0</th>
<th>Score 1</th>
<th>Score 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Respiratory Rate</strong></td>
<td>&lt;2 mos: &lt;50</td>
<td>&lt;2 mos: 50-60</td>
<td>&lt;2 mos: &gt;60</td>
</tr>
<tr>
<td></td>
<td>2-12 mos: &lt;40</td>
<td>2-12 mos: 40-50</td>
<td>2-12 mos: &gt;50</td>
</tr>
<tr>
<td></td>
<td>1-5 yrs: &lt;30</td>
<td>1-5 yrs: 30-40</td>
<td>1-5 yrs: &gt;40</td>
</tr>
<tr>
<td></td>
<td>&gt;5 yrs: &lt;20</td>
<td>&gt;5 yrs: 20-30</td>
<td>&gt;5 yrs: &gt;30</td>
</tr>
<tr>
<td><strong>Auscultation</strong></td>
<td>Good air movement, scattered expiratory wheezing, loose rales/crackles</td>
<td>Depressed air movement, inspiratory and expiratory wheezes or rales/crackles</td>
<td>Diminished or absent breath sounds, severe wheezing, or rales/crackles, or marked prolonged expiration</td>
</tr>
<tr>
<td><strong>Use of Accessory Muscles</strong></td>
<td>Mild to no use of accessory muscles, mild to no retractions, no nasal flaring on inspiration</td>
<td>Moderate intercostal retractions, mild to moderate use of accessory muscles, nasal flaring</td>
<td>Severe intercostal and substernal retractions, nasal flaring</td>
</tr>
<tr>
<td><strong>Mental Status</strong></td>
<td>Normal to mildly irritable</td>
<td>Irritable, agitated, restless</td>
<td>Lethargic</td>
</tr>
<tr>
<td><strong>Room Air SpO\textsubscript{2}</strong></td>
<td>&gt;95%</td>
<td>90-95%</td>
<td>&lt;90%</td>
</tr>
<tr>
<td><strong>Color</strong></td>
<td>Normal</td>
<td>Pale to normal</td>
<td>Cyanotic, dusky</td>
</tr>
</tbody>
</table>

(Add score from all rows to calculate total CRS score)
Critical Points of Evidence*

Evidence Supports
- History and physical should be the basis for diagnosis. (1-3) – Strong recommendation, low quality evidence
- Consider a trial dose of 0.5 mL of nebulized epinephrine to rapidly deteriorating patients only. If no effect noted from the trial dose, discontinue nebulized epinephrine. (1-14) – Weak recommendation, moderate quality evidence
- Obtain a Clinical Respiratory Score (CRS) to identify the severity of diagnosis. Pulse oximetry should be used as part of the CRS. (15-19) – Strong recommendation, low quality evidence
- Consider high flow nasal cannula therapy for patients with a CRS ≥7. If the patient is rapidly deteriorating and/or cannot maintain oxygen saturation levels ≥90% on 2 LPM of low-flow oxygen, consider high flow nasal cannula therapy. (20-23) – Weak recommendation, low quality evidence
- Administer albuterol only if there is a suspicion of asthma (based on historical and prior beta-agonist utilization risk factors). (1,2,7-14) – Strong recommendation, moderate quality evidence
- If patient requires supplemental oxygen, monitoring should be followed based on the oxygen weaning protocol. (1-3,24,25) – Weak recommendation, low quality evidence
- Consider withholding feedings if severe intercostal and substernal retractions, nasal flaring, and respiratory rate >60-70. (1, 27-29) – Weak recommendation, very low quality evidence
- Consider NG feeding for the following patients: unable to maintain hydration orally, age 2-12 months, CRS <5, not receiving high flow oxygen, not on BiPAP or CPAP, no craniofacial abnormalities precluding NG placement. (1,4-6,30-37) – Strong recommendation, very low quality evidence
- Admit the patient if: oxygen saturation consistently <90%, CRS ≥5, patient requires continuous clinical assessment of airway clearance and maintenance using suctioning, patient is unable to maintain oral feedings at a level to prevent dehydration, or it is unsafe to send the patient home/poor follow-up. (58) – Strong recommendation, low quality evidence
- Discharge the patient when the following criteria are met: room air, oral feedings tolerated at a level to maintain hydration, parents can demonstrate she/he can clear the patient’s airway using a nasal suction device, PCP follow-up appointment scheduled within 5 days, and parent discharge teaching completed. (59-61) – Strong recommendation, low quality evidence

Evidence Against
- Do not routinely administer antibiotics unless evidence of a bacterial infection. (2,3,42-43) – Strong recommendation, moderate quality evidence
- Do not routinely administer bronchodilators. (1,2,7-14) – Strong recommendation, moderate quality evidence
- Do not use chest physiotherapy. (1,3,46,47) – Strong recommendation, high quality evidence
- Do not routinely administer systemic or inhaled corticosteroids. (1,3,12,45-54) – Strong recommendation, moderate quality evidence
- Do not use anticholinergic drugs. (55) – Strong recommendation, moderate quality evidence
- Do not routinely administer hypertonic saline. (1,3,46,56-62) – Weak recommendation, moderate quality evidence
- Do not use high flow nasal cannula therapy for patients with a CRS <7 unless the patient is rapidly deteriorating and/or hypoxemic requiring ≥2 LPM of low-flow oxygen to maintain oxygen saturation levels ≥90%. (20-23) – Weak recommendation, low quality evidence
- Do not perform laboratory tests for diagnosis. (1,3,63-66) – Strong recommendation, low quality evidence
- Do not use ribavirin. (67) – Weak recommendation, moderate quality evidence
- Do not obtain a chest x-ray for diagnosis. (1,3,63,68) – Strong recommendation, low quality evidence

Evidence Lacking/Inconclusive
- Administer oxygen to maintain SpO2 ≥90%; however, transiently lower levels may be acceptable in patients who are otherwise ready for discharge. (1) – Consensus Recommendation
- Work-up and treatment for infants <28 days with fever should be based on clinical judgment. (69-71) – Consensus recommendation
- There is insufficient evidence to address the following topic: safety of discharging patients home with oxygen. (72-76)

*NOTE: The references cited represent the entire body of evidence reviewed to make each recommendation.

Condition-Specific Elements of Clinical Management

Treatment Recommendations
- Nasopharyngeal suctioning (1,3)
  - As needed for upper airway obstruction
  - Prior to feeding
  - During assessment
  - Pre- and post-suctioning respiratory assessment

Admission Criteria (2,39)
- Oxygen saturation consistently <90%
- CRS ≥5
- Patient requires continuous clinical assessment of airway clearance and maintenance using suctioning
- Patient is unable to maintain oral feedings at a level to prevent dehydration
- Unsafe to send home/poor follow-up

Discharge Criteria (2,3,39-41)
- Room air
- Oral feedings tolerated at a level to maintain hydration
- Parents can demonstrate he/she can clear the patient’s airway using a nasal suction device
- Parent discharge teaching completed on:
  - Signs and symptoms of concern (e.g., wheezing, difficulty breathing, difficulty feeding, cough, fever)
  - Proper use of nasal suction device (bulb syringe or other commercial products) to aspirate the infant’s nose
  - Proper handwashing techniques
  - Discharge care
  - Risks of passive smoking exposure

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Follow-Up Care
Primary care physician follow-up appointment scheduled within 5 days

Prevent Transmission\(^{(1-3)}\)
Transmission occurs by direct inoculation of contagious secretions from hands or from large-particle aerosols in the eyes and nose.
- Place patient on contact isolation
- Adhere to strict handwashing guidelines

Parent Teaching\(^{(1-3)}\)
- Stress importance of strict handwashing
- Teach parents to use nasal suction device (bulb syringe or other commercial product) to aspirate the infant’s nose
- Emphasize that infants should NOT be exposed to passive smoking; explore options for parents to quit smoking
- Encourage breastfeeding

Balanced Scorecard Measures
Process
- Order set utilization
- Routine testing (i.e., viral testing, chest x-rays)
- Use of non-evidence-based medications (i.e., use of oral and inhaled steroids, repeated doses of a beta-agonist, antibiotics)

Outcome
- Mean time on oxygen
- Percentage of patients who have an RRT within X hours of admission
- Percentage of patients with a change in level of care within X hours of arrival to unit
- Length of stay
- Readmission rate
**Clinical Algorithm for Bronchiolitis**

**Begin**
- History and physical exam
- Nasopharyngeal suctioning

**Respiratory assessment w/ CRS score**
- CRS 0-6
  - Clinical observation
  - Start oxygen if room air pulse oximetry is consistently <90%
  - Hydration
  - Frequent nasopharyngeal suctioning
  - Consider a trial dose of 0.5 mL of nebulized epinephrine if the patient is rapidly deteriorating; if no effect, discontinue

- Stable and/or improving
  - Yes
    - Discharge home
  - No
    - Meets discharge criteria
      - Yes
      - Discharge home
      - No

- CRS ≥7
  - Clinical observation
  - Start/Continue oxygen if room air pulse oximetry is consistently <90%
  - Hydration
  - Frequent nasopharyngeal suctioning
  - Consider high flow nasal cannula therapy (refer to HFNC Therapy: Initiation and Escalation for Respiratory Distress Pathway)
  - Consider a trial dose of 0.5 mL of nebulized epinephrine; if no effect, discontinue

- Stable and/or improving
  - Yes
    - Admit to hospital
  - No
    - Discharge home when patient meets discharge criteria

**Inclusion Criteria**
0-24 months, wheezing with no history of asthma

**Exclusion Criteria**
- Asthma, bronchopulmonary dysplasia, cystic fibrosis, chronic respiratory diseases, recurrent wheezing, immunodeficiency, SBI/shock, toxic appearance, neuromuscular disease, artificial airway, cyanotic heart disease

**Discharge Criteria**
- Room air
- Oral feedings tolerated at a level to maintain hydration
- Parents can clear the patient’s airway using a nasal suction device
- Parent understands:
  - Signs and symptoms, including: wheezing, difficulty breathing, difficulty feeding, fever
  - Proper use of nasal suction device to aspirate the patient’s nose
  - Discharge care
  - Risk of passive smoking exposure
  - Proper handwashing techniques
  - PCP follow-up appointment

**Discharge**
- CRS 0-6
- CRS ≥7

**Admission Criteria**
- Oxygen saturation consistently <90%
- CRS ≥5
- Patient requires continuous clinical assessment of airway clearance and maintenance using suctioning
- Patient is unable to maintain oral feedings at a level to prevent dehydration
- Unsafe to send home/poor follow-up

- Continue clinical observation
- Continue oxygen if room air pulse oximetry is consistently <90%
- Contact isolation
- Hydration
- Nasopharyngeal suctioning
- Parent teaching

- Discharge home when patient meets discharge criteria


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Clinical Standards Preparation
This clinical standard was prepared by the Evidence-Based Outcomes Center (EBOC) team in collaboration with content experts at Texas Children’s Hospital. Development of this clinical standard supports the TCH Quality and Patient Safety Program initiative to promote clinical standards and outcomes that build a culture of quality and safety within the organization.

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Development Process
This clinical standard was developed using the process outlined in the EBOC Manual. The literature appraisal documents the following steps:

1. Review Preparation
   - PICO questions established
   - Evidence search confirmed with content experts
2. Review of Existing External Guidelines
3. Literature Review of Relevant Evidence
   - Searched: PubMed, CINAHL, SUM search, Google Scholar
4. Critically Analyze the Evidence
   - 22 systematic reviews/meta-analyses, 17 randomized controlled trials, and 30 nonrandomized studies
5. Summarize the Evidence
   - Materials used in the development of the clinical standard, literature appraisal, and any order sets are maintained in a bronchiolitis evidence-based review manual within EBOC.

Evaluating the Quality of the Evidence
Published clinical guidelines were evaluated for this review using the AGREE II criteria. The summary of these guidelines are included in the literature appraisal. AGREE II criteria evaluate Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial independence using a 4-point Likert scale. The higher the score, the more comprehensive the guideline.

This clinical standard specifically summarizes the evidence in support of or against specific interventions and identifies where evidence is lacking/inconclusive. The following categories describe how research findings provide support for treatment interventions.

“Evidence Supports” provides evidence to support an intervention. “Evidence Against” provides evidence against an intervention. “Evidence Lacking/Inconclusive” indicates there is insufficient evidence to support or refute an intervention and no conclusion can be drawn from the evidence.

The GRADE criteria were utilized to evaluate the body of evidence used to make practice recommendations. The table below defines how the quality of the evidence is rated and how a strong versus weak recommendation is established. The literature appraisal reflects the critical points of evidence.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Type of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRONG</td>
<td>Desirable effects clearly outweigh undesirable effects or vice versa</td>
</tr>
<tr>
<td>WEAK</td>
<td>Desirable effects closely balanced with undesirable effects</td>
</tr>
<tr>
<td>High</td>
<td>Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies</td>
</tr>
<tr>
<td>Moderate</td>
<td>Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from observational studies</td>
</tr>
<tr>
<td>Low</td>
<td>Evidence for at least 1 critical outcome from observational studies, RCTs with serious flaws or indirect evidence</td>
</tr>
<tr>
<td>Very Low</td>
<td>Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence</td>
</tr>
</tbody>
</table>

Recommendations
Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible. The Content Expert Team and EBOC team remain aware of the controversies in the management of bronchiolitis in children. When evidence is lacking, options in care are provided in the clinical standard and the accompanying order sets (if applicable).

Approval Process
Clinical standards are reviewed and approved by hospital committees as deemed appropriate for its intended use. Clinical standards are reviewed as necessary within EBOC at Texas Children’s Hospital. Content Expert Teams are involved with every review and update.

Disclaimer
Practice recommendations are based upon the evidence available at the time the clinical standard was developed. Clinical standards (guidelines, summaries, or pathways) do not set out the standard of care and are not intended to be used to dictate a course of care. Each physician/practitioner must use his or her independent judgment in the management of any specific patient and is responsible, in consultation with the patient and/or the patient’s family, to make the ultimate judgment regarding care.
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<th>Date</th>
<th>Comments</th>
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<td>Originally completed</td>
</tr>
<tr>
<td>Jan 2010</td>
<td>Updated</td>
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<td>Jul 2016</td>
<td>Minor revisions</td>
</tr>
<tr>
<td>Feb 2017</td>
<td>Algorithm edits</td>
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<tr>
<td>Feb 2018</td>
<td>Changed hypertonic saline recommendation and CRS cutoff for HFNC therapy; added option for feedings via NG tube</td>
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