A Quality Collaborative for Improving Hospitalist Compliance with the AAP Bronchiolitis Guideline (B-QIP)

CHANGE PACKAGE—STRATEGIES AND TOOLS FOR CHANGE

The overall goal of B-QIP is to improve compliance with the American Academy of Pediatric Bronchiolitis Clinical Practice Guideline, “Diagnosis and Treatment of Bronchiolitis: Subcommittee on Diagnosis and Management of Bronchiolitis,” (Pediatrics 2006; 118;1774).

The elements from the guideline that the B-QIP project will address and the specific aims of the project related to each guideline element are incorporated in the Change Package grid.

A Change Package is meant to be a source of ideas that may help your quality improvement team progress toward your goals. Local adaptation of ideas will always be necessary to ensure the success of changes selected from the Change Package.

Aside from recommendations and options from the AAP Bronchiolitis Clinical Practice Guideline and related B-QIP project specific aims; tools, strategies and ideas for quality improvement change will be noted in the Change Package grid that follows. The tools and resources will be found in the tab or bookmark number.

A collection of a few key references of the best available evidence on the treatment of bronchiolitis will be included at the end of this Change Package.
OVERVIEW

This Quality Improvement Change Package is designed to provide your quality improvement team with ready-made material that your team can use to initiate improvement efforts as part of the Quality Collaborative for Improving Hospitalist Compliance with the AAP Bronchiolitis Guideline (B-QIP). Over the course of the project, your team and the other teams in the collaborative will be encouraged to refine and repurpose the tools and resources in this Toolkit based on further review of the evidence and your own experiences testing and implementing the changes. The tools included in this change package are intended to be examples that can be implemented, edited and applied to your specific setting, or provided as templates that may be introduced or discussed by your team. These tools are intended to be generic examples for use by any hospital; they do not have to replace tools that your team is using and that work for your site.

This Change Package is based on the American Academy of Pediatrics clinical practice guideline, published quality improvement projects on bronchiolitis, and the local experience of B-QIP Expert Group members. The Expert Group has chosen a subset of recommendations from the guideline, “Diagnosis and Treatment of Bronchiolitis: Subcommittee on Diagnosis and Management of Bronchiolitis,” (Pediatrics 2006; 118;1774), for which we have set specific goals in order to offer a framework for your local project. Depending on the particular circumstances in your hospital, you may also need to implement other practices or modify your goals in order to successfully improve outcomes.

The aims and measures in this collection are not necessarily the only ones required to achieve the improved outcomes that you are targeting. This project is not exhaustive, exclusive, or all-inclusive. Changes in practice will require testing and adaptation to your particular circumstances and context in order to achieve measured improvements in outcomes. As you test and implement new processes, you will monitor the results closely to ensure that you are obtaining the desired outcome, that no harm is being done, and that no unanticipated results or consequences emerge. In addition to the guideline-based measures, we have also provided some balancing measures to assess in order to help with the process of avoiding unanticipated consequences.

Model for Improvement
One theoretical basis for promoting change in healthcare is the Model for Improvement. We recommend the Model for Improvement1 as a framework for your efforts. The three key questions of the Model for Improvement are:

![Model for Improvement Diagram]

1. What changes can we make that will result in an improvement? (IDEAS)
2. How will we know that a change is an improvement? (MEASURES)
3. What are we trying to accomplish? (AIM)

Test Ideas & Changes in Cycles for Learning & Improvement

Act | Plan
--- | ---
Study | Do

---

For the B-QIP project, the following four items will be quality improvement elements which we will support:

1) Clearly identified aims
2) Targeted measures
3) Planned changes
4) Cycles of action - Plan-Do-Study-Act (PDSA)

Further quality improvement resources and tools will be included in Section 4 of this toolkit.

Thank you for your participation in this important systemic change to improve the treatment of acute bronchiolitis in the pediatric hospital setting.

Shawn L. Ralston, MD, MS, FAAP
Co-Chair, B-QIP Expert Group
Member, VIP Network Steering Committee

Matthew D. Garber, MD, FHM, FAAP
Co-Chair, B-QIP Expert Group
Medical Director, VIP Network

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### A. Addressing Overuse of Unnecessary Therapies (Guideline Elements 1a, 2a, 2b, 3 & 6b)

<table>
<thead>
<tr>
<th>Guideline Elements &amp; Related B-QIP Aim</th>
<th>Strategies and Tools for Change</th>
</tr>
</thead>
</table>
| 1a – Clinicians should diagnose bronchiolitis and assess disease severity on the basis of history and physical examination. Clinicians should not routinely order laboratory and radiologic studies for diagnosis. | Clinical Pathway  
- A clinical pathway is used to remind providers of the current state of the evidence.  
- Clinical pathways are intended to reduce variability in clinical practice.  
- **Examples**  
  a. [Bronchiolitis order set](#)  
  b. [ED Pathway](#) |
| **Related Project Measures** | |  
Decrease overall usage of chest radiography for inpatients with bronchiolitis by 50%.  
2a – Bronchodilators should not be used routinely in the management of bronchiolitis.  
**Related Project Measures** | |  
Decrease the overall usage of bronchodilators for patients admitted with bronchiolitis by 50%  
2b – A carefully monitored trial of beta-andrenergic or alpha-adrenergic medication is an option. Inhaled bronchodilators should be continued only if there is a documented positive clinical response to the trial using an objective means of evaluation.  
**Related Project Measures** | |  
Achieve 90% compliance with the usage of an “objective method of assessment” of response to bronchodilators in patients admitted with bronchiolitis. For this project, an objective method of assessment is interpreted to mean a respiratory score.  
3 – Corticosteroid medication should not be used routinely in the management of bronchiolitis.  
**Related Project Measures** | |  
Decrease the overall usage of systematic corticosteroids for patients admitted with bronchiolitis by 50%  
6b – Chest physiotherapy should not be used routinely in the management of bronchiolitis.  
**Related Project Measures** | |  
Decrease the overall usage of chest physiotherapy for patients admitted with bronchiolitis by 50%  

**Respiratory Distress Score**  
- The respiratory distress score serve as an objective way to quantitatively/objectively measure a response to therapy.  
- In practice, a respiratory distress score is shown to reduce the overuse of bronchodilators.  
- **Examples**  
  a. [WARM Respiratory Scoring Tool](#)  
  b. [Cleveland Clinic Tool](#)  
  c. [Sample Respiratory Score Protocol](#)
### B. Addressing Overuse of Monitoring and Testing (Guideline Elements 7a & 7b)

<table>
<thead>
<tr>
<th>7a – Supplemental oxygen is indicated if SpO2 falls persistently below 90% in previously healthy infants. If the SpO2 does persistently fall below 90% adequate supplemental oxygen should be used to maintain an SpO2 at or above 90%. Oxygen may be discontinued if SpO2 is at or above 90% and the infant is feeding well and has minimal respiratory distress.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related Project Measures</td>
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<tr>
<td>Achieve 90% compliance with the implementation of an institutional policy on conversion from continuous pulse oximetry to intermittent pulse oximetry when children admitted for bronchiolitis no longer require supplemental oxygen.</td>
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</table>

<table>
<thead>
<tr>
<th>7b – As the child’s clinical course improves, continuous measurement of SpO2 is not routinely needed.</th>
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<tbody>
<tr>
<td>Related Project Measures</td>
</tr>
<tr>
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### Oxygen Weaning protocol
- An oxygen weaning protocol can be used to limit continuous pulse oximetry and limit the duration of long-term oxygen use
- The protocol determines how to take patients off supplemental oxygen
- Examples
  - [Sample oxygen weaning and pulse oximetry management protocol](#)

### C. Addressing Tobacco Exposure (Guideline Element 10a)

<table>
<thead>
<tr>
<th>10a – Infants should not be exposed to passive smoking</th>
</tr>
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<tbody>
<tr>
<td>Related Project Measures</td>
</tr>
<tr>
<td>Achieve 90% compliance with screening and intervention for secondhand smoke exposure in children admitted with bronchiolitis.</td>
</tr>
</tbody>
</table>

### Identification of Tobacco Smoke Exposure (TSE)
- [Link to specific resources for identification](#)

### Interventions for family and caretakers with child identified as having TSE
- [Link to intervention resources](#)

### D. Other Tools & References

#### Other Tools
1. [Bronchiolitis patient brochure](#)
2. [Letter to referring provider](#)
3. [In-room communication log for Respiratory Score and dosing](#)

#### References
1. [Strategies from your peers (B-QIP Coaches)](#)
2. [Quality Improvement Basics Educational Webinar](#) (Slide deck)
3. [Bronchiolitis: The journey towards evidence-based care Educational Webinar](#) (Slide deck)
4. “Diagnosis and Treatment of Bronchiolitis: Subcommittee on Diagnosis and Management of Bronchiolitis,” *(Pediatrics 2006; 118;1774).*
5. [Evidence-Based Care Guideline for Infants with Bronchiolitis](#) (Cincinnati)
6. Institute for Healthcare Improvement (IHI) free online learning course via IHI Open School, L101: So You Want to Be a Leader in Health Care - [Link to course](#)
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Bronchiolitis Order Set Example

Diagnosis:  
1) Bronchiolitis with respiratory distress  
2)_______________________________

Suctioning:  
**Deep (nasopharyngeal) suctioning is NOT routinely indicated**  
___Nasal saline and suction as needed (external suctioning using noninvasive tip)  
___Educate parents on nasal saline bulb suctioning for home

Oxygen administration:  
___Administer Nasal Canula O₂ for saturations consistently less than 90%  
___Wean O₂ for saturations consistently greater than 90%

Monitoring/Assessments:  
___Pulse oximetry: intermittent Q4 with vitals and PRN respiratory distress  
___Bronchiolitis clinical scoring by RT or RN every four hours (or per protocol)

Diagnostic Testing: (routine diagnostic testing is not indicated)  
___Capillary blood gas for severe distress with signs of hypercarbia

Medications:  
**Corticosteroids and Inhaled Medications are NOT routinely indicated**  
___Racemic Epinephrine 0.5 ml neb x 1 (if trial is indicated per protocol for scores >3)

Diet:  
___Regular for age, call RN for increasing distress with feeds

Fluids/Hydration:  
___Place NG, _____ at _____cc/hr NG  
___Bolus 20cc/kg NS IV over 1 hour

Patient Education:  
___Provide Bronchiolitis Educational Materials  
___Provide Tobacco Cessation Education Materials or Referral
ED PROTOCOL FOR WHEEZING < 2 years of age

<2 year old with URI/LRI

Primary nurse will score patient initially

Score patient

BBG or Deep nasal suction if congestion

If pt score is 1 or 2 only suction is needed

Score patient

If Pt Score 7-9 notify MD

YES

Score 1-3

If patient’s Score is still 4-9 may try raci epi per MD

NO

Improvement

YES

Score 4-6

Trial of albuterol HFA 90mcg per puff with spacer and mask: 4 puffs

Assess no sooner than 15 minutes after treatment

NO

Improvement

YES

Score Patient

May continue with beta-agonist on an as needed basis. If meets criteria for admission, would admit on bronchiolitis pathway with a secondary diagnosis of RAD

NO

Do not continue patient on beta-agonist. If meets criteria for admission, admit per bronchiolitis pathway

Approved: QIC Dept. of Medicine
Date: Nov. 2009
### WARM Respiratory Scoring Tool

**Wheeze**  
- None: 0  
- End Expiratory: 1  
- Entire Expiratory / Any Inspiratory: 2  

**Air Exchange**  
*Assess the following 4 chest areas: left front, right front, left back, right back*  
- Normal: 0  
- One area Decreased: 1  
- More Than One Area Decreased: 2  

**Respiratory Rate**  
*Tachypnea threshold: 0-6 months, > 60; 6 – 18 months, >50*  
- Normal/Below Threshold: 0  
- Above Tachypnea Threshold: 1  

**Muscle Use (Retractions)**  
- None: 0  
- Subcostal / Intercostal: 1  
- Any Neck or Abdominal: 2  

**TOTAL**  
---  

Trial of treatment is recommended for a score of 4 or higher. Discontinuation of treatment is recommended when no improvement is assessed.
## Bronchiolitis Assessment and Treatment Record

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Date</th>
<th>Time</th>
<th>Score</th>
<th>Score</th>
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<th>Score</th>
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<td><strong>Respiratory Rate</strong></td>
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<tr>
<td>1 - Exceeds tachypnea range for age</td>
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<td>1 - Decreased or crackles in localized areas</td>
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<td>2 - Decreased or crackles in multilobar areas</td>
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<td><strong>Wheezes</strong></td>
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<td>1 - Expiratory phase only</td>
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<td>2 - Inspiratory and Expiratory phases</td>
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<td><strong>Accessory Muscles</strong></td>
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<td>1 - Retractions/Sternal/Intercostal</td>
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<tr>
<td>2 - Use of neck or Abdominal Muscles</td>
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<tr>
<td><strong>Pre/Post Intervention Score: Total</strong></td>
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</table>

- Suctioning Indicated
- Treatment Indicated

Racemic Epinephrine 0.5 ml
Albuterol 2.5 mg
Levalbuterol 0.63 mg
No Intervention Required/Time

<table>
<thead>
<tr>
<th>Initials</th>
</tr>
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## Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Normal RR for age</th>
<th>Tachypnea Threshold</th>
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</thead>
<tbody>
<tr>
<td>0-6 mo</td>
<td>30-50</td>
<td>&gt; 60</td>
</tr>
<tr>
<td>6 - 18 mo</td>
<td>25-40</td>
<td>&gt; 50</td>
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<tr>
<td>18-24 mo</td>
<td>20-35</td>
<td>&gt; 45</td>
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</tbody>
</table>

TREATMENT IS RECOMMENDED FOR A SCORE OF 4 OR HIGHER
**BRONCHIOLITIS SCORING PROTOCOL**

1. Scores generally recommended every 4 hours and should be repeated a few minutes after an intervention if indicated in order to document response.
2. If the patient scores in the moderate to severe range but has not been suctioned, perform nasal suction, let the child calm down, and score again, base intervention on the post-suction score.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Time:</th>
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<tbody>
<tr>
<td><strong>WHEEZE</strong></td>
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<td>0 - None or end expiratory</td>
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<td>1 - Expiratory phase only</td>
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<td>2 - Inspiratory and expiratory phases</td>
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<td><strong>AIR EXCHANGE</strong></td>
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<td>0 - Normal</td>
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<td><strong>RESP RATE</strong></td>
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<td>0 - Normal for age</td>
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<td><strong>MUSCLE USE</strong></td>
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<td>0 - Normal</td>
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<td>1 – Retractions (sternal/intercostal)</td>
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<td><strong>TOTAL</strong></td>
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**MILD (score range 0 – 3): use supportive measures including oxygen and suctioning as needed**

**MODERATE (score range 4-7): trial of racemic epinephrine at 0.5ml**

**SEVERE (score range >7): notify MD to assess patient**
<table>
<thead>
<tr>
<th>Tachypnea Threshold</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>AGE</td>
<td>RR</td>
</tr>
<tr>
<td>0 - 6 months</td>
<td>&gt;60</td>
</tr>
<tr>
<td>6 – 18 months</td>
<td>&gt;50</td>
</tr>
<tr>
<td>18 – 24 months</td>
<td>&gt;45</td>
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</table>
Sample Oxygen Weaning and Pulse Oximetry Management Protocol

I. Inclusion/Exclusion Criteria:

Children who are considered good candidates for the oxygen weaning protocol are those that have normal cardio-pulmonary circulation, are on room air when well, and are not on high flow $\text{O}_2$ (humidified $\text{O}_2$ with flow rates $\geq 4\text{LPM}$).

III. Management of oxygen:

A. Oxygen saturation will be documented with each RT assessment or every four hours by nursing. If the SaO\textsubscript{2} is greater than 90%, the flow rate will be decreased:

1. Patients weighing less than 15kg: wean flow by increment of ¼ LPM.
2. Patients weighing greater than or equal to 15kg: wean flow by increment of ½ LPM.

If the SaO\textsubscript{2} is less than 90%, the flow rate will be increased until the SaO\textsubscript{2} is $\geq 90\%$.

If the SaO\textsubscript{2} is 90%, the flow rate will remain the same.

B. The respiratory therapist (RT) and/or nurse will document any changes to oxygen flow rates in the medical record.

C. Anytime the oxygen flow rate has been changed, the RT or nurse will document the SaO\textsubscript{2} five (5) to ten (10) minutes following the adjustment. Further adjustments should be made as needed to reach target SaO\textsubscript{2} as noted above.

IV. Use of oximetry:

A. Oximetry will be conducted as follows:

1. All patients bronchiolitis protocols will receive spot check oximetry by the RT with each assessment until removed from RT services or discharged and spot checks by the nurse when vital signs are recorded or at a minimum of every four hours.

2. Continuous oximetry will be initiated only if specifically ordered by physician.

V. When to Contact Physician:

A. When patient requires greater than 3 LPM oxygen by NC to maintain SaO\textsubscript{2} 90% or above.

B. Patient develops a new or increasing oxygen requirement after admission.

C. RT/Nurse not able to wean patient off $\text{O}_2$ within 24 hours of oxygen initiation.
Identification of Tobacco Smoke Exposure (TSE)

A. Identify TSE-children by asking in non-judgmental, open-ended ways
   a. “Does your child live with anyone who smokes cigarettes?”
   b. “Do you ever smell cigarette smoke in your home?”
   c. If positive, then try to assess exposure:
      i. “Who smokes cigarettes and how often are they with your child?”
      ii. “Where do they smoke cigarettes?”
      iii. Ask specifically if they smoke in the home or vehicle.
   d. Adopt standardized documentation of TSE at your institution

B. If you have an Electronic Health Record (EHR) or Computerized Prescriber Order Entry (CPOE):
   a. Add identification questions to nursing intake form.
      i. Note: If positive response, trigger automatic actions by nursing staff
   b. Add identification questions to electronic HPI forms for bronchiolitis.
   c. Add asking identification questions to Bronchiolitis order set

C. If you do not have EHR:
   a. Add identification questions to nursing intake form.
   b. Institute policy of making it another “vital” sign for bronchiolitis

D. Education for multidisciplinary staff
   a. Find champions among Respiratory therapists, Social workers, bedside nurses, nurse clinicians, and physicians
   b. Training for champions
      i. Basic training [http://www2.aap.org/richmondcenter/Training_CME_Courses.html]
      ii. Advanced training: To become a certified tobacco treatment specialist training [http://www.attud.org/findprog.php]
   c. Online resources for further information
      i. AAP Richmond Center [http://www2.aap.org/richmondcenter/index.html]
      ii. American Lung Association [http://www.lung.org/]
      iii. Smokefree.gov [http://www.smokefree.gov/]
Interventions for family and caretakers with child identified as having Tobacco Smoke Exposure

A. The 5 A’s: Ask, Advise, Assess, Assist and Arrange
   a. Ask:
      i. Identification of TSE
   b. Advise: Consider motivational interviewing techniques
      i. Offer suggestions, not rules personalized to patient.
      ii. Give clear recommendation to stop smoking
         “As your child’s pediatrician, the best thing you can do for your child’s health is to stop smoking”
   c. Assess: Assess readiness to quit.
      i. “Are you interested in cutting down or quitting smoking cigarettes?”
      ii. “On a scale of 1-10, how ready are you to quit smoking?”
   d. Assist:
      i. Provide state quitline number (1-800-QUIT-NOW)
      ii. Provide community and internet resources
      iii. Offer every family with child exposed to Tobacco Smoke and/or tobacco user brochure or information about quitting and effects of TSE on children
         a. DVD “Smoking and Kids Don’t Mix” (will provide)
         b. Brochures
            http://www2.aap.org/richmondcenter/pdfs/helpsmokers.pdf
            http://www2.aap.org/richmondcenter/pdfs/QuittingHelpsYouHeal.pdf
            http://www2.aap.org/richmondcenter/pdfs/You_Can_Quit_Smoking.pdf
      iv. Assist in setting quit date
      v. Recommend use of pharmacotherapy
         a. Over the counter: Nicotine Replacement Therapy: gum, patch, and lozenge
         b. Prescription: Buproprion (zyban) or varenicline (chantix)
   e. Arrange:
      i. Follow-up by phone or in office with PMD

B. The 2 A’s and R: Ask, Advise and Refer
   a. Ask:
      i. Identification of TSE
   b. Advise: Consider motivational interviewing techniques
      i. Offer suggestions, not rules personalized to patient.
      ii. Give clear recommendation to stop smoking
         “As your child’s pediatrician, the best thing you can do for your child’s health is to stop smoking”
   c. Refer:
      i. Give state quitline number
ii. Provide community and internet resources

iii. Offer every family with child exposed to Tobacco Smoke and/or tobacco user brochure or information about quitting and effects of TSE on children
   a. DVD “Smoking and Kids Don’t Mix” (will provide)
   b. Brochures

http://www2.aap.org/richmondcen/pdfs/helpsmokers.pdf
http://www2.aap.org/richmondcen/pdfs/QuittingHelpsYouHeal.pdf
http://www2.aap.org/richmondcen/pdfs/You_Can_Quit_Smoking.pdf

C. Standardize documentation and billing that smoking cessation intervention was performed
   http://www2.aap.org/richmondcen/CodingPayment.html
   ICD-9-CM examples:
   E869.4 Accidental poisoning by secondhand smoke
   V65.49 Other specified counseling

D. Counsel the family and caretakers on behaviors to decrease Tobacco Smoke Exposure
   a. Reduction of Second and Third-Hand Smoke exposure
   b. Home and vehicle smoking ban

E. Find champions among Respiratory therapists, Social workers, bedside nurses, nurse clinicians, and physicians
   a. Training for champions
      i. Basic training http://www2.aap.org/richmondcen/Training_CME_Courses.html
      ii. Advanced training: To become a certified tobacco treatment specialist training
          http://www.attud.org/findprog.php
   b. Online resources for further information
      i. AAP Richmond Center
          http://www2.aap.org/richmondcen/index.html
      ii. American Lung Association
          http://www.lung.org/
      iii. Smokefree.gov
          http://www.smokefree.gov/
Bronchiolitis

**What is bronchiolitis?**
Bronchiolitis is a viral infection of the lungs that usually affects infants. There is swelling in the smaller airways or bronchioles of the lung, which causes coughing and wheezing. Bronchiolitis is the most common reason for children under 1 year old to be admitted to the hospital.

**What are the symptoms of bronchiolitis?**
The following are the most common symptoms of bronchiolitis. However, each child may experience symptoms differently. Symptoms may include:
- Runny nose or nasal congestion
- Fever
- Cough
- Changes in breathing patterns (wheezing and breathing fast are common)
• Decreased appetite
• Fussiness
• Vomiting

What causes bronchiolitis?
The most common cause of bronchiolitis is a virus, most frequently the Respiratory Syncytial Virus (RSV). However, many other viruses have been involved, including:
• Parainfluenza virus.
• Rhinovirus.
• Human metapneumovirus.

Initially, the virus causes an infection in the upper respiratory tract, and then spreads downward into the lower tract. The virus causes inflammation and even death of the cells inside the respiratory tract. This leads to obstruction of airflow in and out of the child's lungs.

How is bronchiolitis diagnosed?
Bronchiolitis is usually diagnosed solely on the history and physical examination of the child. Some tests may be ordered to rule out other diseases, such as pneumonia or asthma.

Treatment for bronchiolitis:
Because there is no cure for the disease, the goal of treatment is supportive of the symptoms. Antibiotics are ineffective in the treatment of bronchiolitis. While in the hospital, treatment may include:
• Oxygen therapy.
• Frequent suctioning of your child's nose and mouth (to help get rid of thick secretions).
• Breathing treatments, as ordered by your child's physician.
• Intravenous (IV) fluids if your child is unable to drink well.

Children with bronchiolitis have wheezing, which is the same sound made by children with asthma; however, bronchiolitis is not asthma and does not respond to the same medications. This is why asthma medications such as albuterol and steroids are not routinely used in bronchiolitis.

When your child's physician feels your child is stable enough to be treated at home, the following treatment is recommended:
• Increased fluid intake.
• Frequent suctioning (with a bulb syringe) of your child's nose and mouth (to help get rid of thick secretions).
• Elevation of the child's head while sleeping.

What to watch for at home:

Bronchiolitis often lasts for two weeks and there is no treatment which can shorten the duration of cough. Cough medicines generally do not work or are not safe for children. Your child should get better slowly on his or her own, but there is a small chance of worsening.

If you notice any of these things, seek medical evaluation immediately:

• Signs of dehydration like: dry mouth and cracked lips, urinating less than usual, crying without tears
• Bluish color to lips or nails
• Working too hard to breathe
• Breathing too fast (generally more than 60 breaths per minute is too fast).
Dear Dr. XYZ,

We hope this letter finds you surviving another busy winter respiratory viral season. We are writing to inform you of an initiative to improve the value of care that we provide for your patients admitted with the diagnosis of bronchiolitis at X Hospital and to enlist your support in this endeavor.

As you are aware, there is a wealth of literature published addressing the limited usefulness of many interventions in the care of a patient with bronchiolitis and the immense variability of the care provided among pediatric practitioners. This variability in practice often results in an increase in cost of care and an overutilization of resources without any real benefit to the patient. The American Academy of Pediatrics published a guideline on bronchiolitis care in 2006. Recently, our hospital joined a quality improvement collaborative sponsored by the AAP in order to increase compliance with the recommendations published in this guideline. This effort is primarily focused on decreasing the use of ineffective therapies such as bronchodilators and steroids as well as increasing our provision of smoking cessation messages for parents.

We’ve convened a task force consisting of physicians, respiratory therapists and nurses and looked at how we could improve our care. The mainstay of the changes we’ve implemented is the use of an objective respiratory scoring tool to evaluate the benefits of bronchodilators on each patient< 2 years of age presenting with the clinical syndrome of bronchiolitis. If the scoring tool does not demonstrate an improvement, bronchodilators are not continued. When a child needs admission to the hospital, the mainstays of therapy they will receive are nasal suctioning, oxygen, and hydration support if necessary. We are monitoring our data closely for any change in the outcome of our care. While the patients you see in follow-up from the hospital may still have symptoms of bronchiolitis, you may notice that most of them will not be sent home on continued bronchodilators or steroids and we wanted to make you aware of this change in practice.

I have included for your review our clinical scoring tool and admission order sets. If you have any further questions we would be more than happy to talk with you personally. Again, thank you for your time and support with this endeavor.
My Name is: _________________________

I had a bronchodilator trial on __________ at ______

I DO / DO NOT respond to Albuterol / Racemic.

My RT is ____________.

My RT checked on me last at __________ on __________.

My last pre suction score: ____________

My last post suction score was: ____________

My RT will be back in about _______ hours.

The last things my RT did for me were:
_____ O2 Wean (Pass / Fail)
_____ Increase O2
_____ Suction
_____ Neb with __________

### KCH Modified Wang Bronchiolitis Severity Scoring

<table>
<thead>
<tr>
<th>RR</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
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<tbody>
<tr>
<td>&lt; 1 month</td>
<td>&lt; 50</td>
<td>31-45</td>
<td>50-60</td>
<td>&gt;70</td>
</tr>
<tr>
<td>1 month – 1 yr</td>
<td>40-50</td>
<td>51-60</td>
<td>46-60</td>
<td>&gt;60</td>
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<tr>
<td>1 yr – 2 yea</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wheeze</th>
<th>None</th>
<th>Terminal exp</th>
<th>Only with stethoscope or throughout expiration</th>
<th>1 &amp; E wheezes or audible without stethoscope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retraction</td>
<td>None</td>
<td>Intercoastal only</td>
<td>Tracheosternal</td>
<td>Severe with nasal flaring</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General Condition</th>
<th>No issues</th>
<th>Feeding well</th>
<th>PO feeding</th>
<th>PO feeding / IV fluid supplements</th>
<th>IV fluids only: will not PO feed at all; or lethargic</th>
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### Day Shift

<table>
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<tr>
<th>Date: ____________</th>
<th>Time:</th>
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<tr>
<td></td>
<td>Pre / Post suction/ (Post neb if indicated)</td>
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### Night Shift

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<th>Date: ____________</th>
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<tr>
<td></td>
<td>Pre / Post suction/ (Post neb if indicated)</td>
</tr>
<tr>
<td>Presenting Challenge</td>
<td>Solutions and Results</td>
</tr>
<tr>
<td>----------------------</td>
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<tr>
<td>A major barrier to implementing a respiratory score in one institution was that the RT workload for floor level patients was calculated based on number and frequency of nebulized therapies (based on the hospital billing system).</td>
<td>We had to establish a process for RTs to get institutional “credit” for performing the bronchiolitis score and nasal suctioning and NOT giving a neb that would not penalize the RT group in terms of hospital-measured productivity. It was an unexpected challenge for a physician to understand; however, being able to solve it created a great foundation for our relationship with RTs and allowed them to wholeheartedly support the changes being implemented.</td>
</tr>
<tr>
<td>Turnover was fairly high at the institution amongst all staff (nursing, MD, and RT) so how did one keep everyone updated and consistent during implementation and subsequently.</td>
<td>PPT with voiceover was developed that included pathophys explanations, AAP guidelines, protocol, order set, etc. and was placed on a teaching cite, Healthstream, for all staff to complete by a certain date. We now ask RT to do this every year and I personally update the new residents each year.</td>
</tr>
<tr>
<td>At the beginning of implementation of a respiratory scoring system the RTs documented in a different computer system which did not connect/cross over to EPIC so documenting the resp score and intervention/non-intervention actually required them to double document.</td>
<td>Obviously, this was not will received by the RTs across all shifts. Once the value of the scoring system and the fact that the bronchiolitis carepath is RT run was demonstrated there was wide acceptance. Over the time RTs became quite invested in developing a comprehensive long term solution to this problem. Now we have an EPIC-based bronchiolitis documentation flowsheet which is easily viewable by all providers.</td>
</tr>
<tr>
<td>Our experience in translating the scoring system to the ER was hampered primarily by the perceived threat this “new work” represented in the minds of the RTs and nurses who work there. On reflection, it is understandable that any change is going to threaten people who are already often working at 100% or greater capacity. Our initial idea was to provide education in the form of workshops. We described our process design linking scores to actions, and we honestly thought it would be embraced since it would result in fewer nebs which we thought meant less overall work.</td>
<td>Important background: The ER RTs are a shared resource with the adult ER and are racing back and forth to accomplish tasks (which include performing all of the ECGs). What they actually needed was help when they were overwhelmed with kids (duh, bronchiolitis season!). The breakthrough came when our RTs and nurses were deployed to help at times of volume stress. This was ad hoc at best, since we often didn't have people to spare ourselves. However, the demonstration of shared commitment opened doors to interest and acceptance. It is noteworthy that this is now resulting in a new initiative to embed our RTs in the pediatric ER (this initiative was defeated in the past due to cost, but now has demonstrable value).</td>
</tr>
<tr>
<td><strong>Presenting Challenge</strong></td>
<td><strong>Solutions and Results</strong></td>
</tr>
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<tr>
<td>Don't forget the &quot;culture&quot; of your community providers. Your efforts will be quickly undermined by patient satisfaction if you live in a community with a high percentage of providers whose practice is to &quot;do something&quot; by liberally prescribing aerosol treatments.</td>
<td>Our initial approach was to craft a letter to our community data which focused on reviewing the evidence for proven therapies and sharing our data and emphasizing that we were outliers in our utilization &quot;non-evidence based therapies&quot; without any change in our outcomes. We asked for their partnership in improving the value of care we were delivering to their patients. We followed the letter with &quot;a road trip&quot; to the PCPs offices to review our protocol and answer any questions or concerns. Our clinical nurse specialist and respiratory therapist also did the same with their visits to PCP offices. While we still have outliers, we have seen a decrease in utilization and a greater acceptance of our discharge plan. One of the best affirmations we have had is for a practice to ask for assistance in implementing a score in their office!</td>
</tr>
<tr>
<td><strong>Emergency Department:</strong> Often are the providers who initiate bronchodilators without scoring, give steroids routinely if wheezing heard on auscultation, and order CXR routinely</td>
<td>Include ED nurses, RT, physicians/Pas, and radiology in your multidisciplinary planning group at the beginning to get their support and engagement and provide them with regular, real time feedback on performance early in the project</td>
</tr>
<tr>
<td><strong>Team work:</strong> It was often confusing as to who was to do conservative treatment, when it was done, etc</td>
<td>Designed a flow sheet for scoring and interventions that was placed at the bedside and eventually in the EMR so that the team would know last scoring and interventions if doing routine care or called to bedside. This helped during really busy times and at change of shift</td>
</tr>
<tr>
<td>Pathway adoption and using evidenced based care and avoiding CPT, etc.</td>
<td>Developed order set that drove providers to easily order bronchiolitis clinical pathway and not options for other care. We also trained RTs not to do CPT and how to discuss with providers who wanted it. Also, early feedback to the team and physicians that we had made improvements without harming patients really built momentum to use pathway.</td>
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Quality Improvement Basics and B-QIP: Real Life Application

Susan Walley, MD
Division of Pediatric Hospital Medicine
August 15, 2013

Introductions and Roll Call

Susan Walley, MD, FAAP
Children’s of Alabama

Matthew Garber, MD, FHM, FAAP
University of South Carolina

The Quality Collaborative for Improving Hospitalist Compliance with the AAP Bronchiolitis Guideline (B-QIP) is funded by the AAP Quality Improvement Innovation Networks (QuIN)
Objectives

- Review quality improvement concepts
- Discuss the Model for Improvement
- Use a B-QIP example in the Model for Improvement
- Review key QI tools

What is Quality Medical Care?

- The Institute of Medicine (IOM) defines healthcare quality as care that is:
  - Safe
  - Effective
  - Patient Centered
  - Efficient
  - Timely
  - Equitable
Why should we care about quality?

1. Patients get hurt due to medical errors

An estimated 44,000-98,000 people die each year from medical errors.

Equal to a 747 jet crashing every day.
Why should we care about quality?

1. Patients get hurt due to medical errors
2. Medical care has lots of variability

---

**Figure 2.** Variation in hospital-level resource utilization (median and interquartile range).

Why should we care about quality?

1. Patients get hurt due to medical errors
2. Medical care has lots of variability
3. The cost is unsustainable
Why should we care about quality?

1. Patients get hurt due to medical errors
2. Medical care has lots of variability
3. The cost is unsustainable
   
   50% hospital expenditures are related to waste.

James, et al 2006

Figure. Proposed “Wedges” Model for US Health Care, With Theoretical Spending Reduction Targets for 6 Categories of Waste

What is Quality Improvement?

- Focus on improving processes of care
- Getting to care that is:
  - Safe
  - Effective
  - Patient Centered
  - Efficient
  - Timely
  - Equitable

The Model for Improvement

- Established by the Institute for Healthcare Improvement (IHI)
- Serves as a framework for Quality Improvement Projects

![Diagram of the Model for Improvement](image-url)
The Model for Improvement

- Starts with an AIM
- Aim = goal = objective
- The aim sets up your whole project
- Global Aim
- Specific Aim

SMART Aims
- Specific
- Measurable
- Actionable
- Realistic
- Timely
The Model for Improvement

- Measures = Data
- If you can’t measure it, you can’t improve it
- Process measures
- Outcome measures
- Balancing measures

Changes = Interventions
What can be changed to improve care?
The Model for Improvement

- PDSA Cycle
  - Plan
  - Do
  - Study
  - Act
- Testing for Change

The Model for Improvement

- PDSA cycle
- How do you know if the intervention causes a change?
- How do you determine if the change improves care?
The Model for Improvement: PDSA

- PLAN the Change
- Often, the most time consuming step
- Use of baseline measures can drive plan
- QI tools often useful in the planning phase to graphically display information

The Model for Improvement

- DO
- The fun part
- Institute interventions that you believe will lead to change
The Model for Improvement

- **STUDY**
  - Measure results of interventions
  - Data will drive further PDSA cycles

The Model for Improvement

- **ACT**
  - Reassess and institute new interventions
  - OR in some cases, sustaining the improvements
Putting it into Practice!

- Working in collaboration saves time in planning
- Each hospital has already formed teams
- B-QIP has done much of the planning and background work

Aim: B-QIP Example

- **Global Aim:** Improve the care of children with bronchiolitis by increasing compliance with the AAP clinical practice guideline on bronchiolitis.
Aim: B-QIP Example

- **Specific Aim:**
  By March 2014, B-QIP Hospital #1 will achieve 90% compliance with screening and interventions for secondhand smoke exposure in children admitted with bronchiolitis.

Measures: B-QIP Example

- Retrospective chart review using the B-QIP bronchiolitis chart review tool
- 20 patient charts per month from January-March 2013
- Data entry into QIDA
- Serves as baseline data
Measures: B-QIP Example

- Collect 2 data elements:
  - If patient was screened for SHS exposure (yes/no)
  - If screen positive, if patient/caregiver received advice to quit or recommendation to decrease child’s SHS exposure

Changes: B-QIP Example

- Change Package Examples for Specific Aim
  - Education of admitting physicians of importance of documenting SHS exposure
  - Add screening question in H&P template for SHS
  - Add question to nursing intake documentation
PDSA Cycle: B-QIP Example

- **PLAN the Change**
  - Baseline data from Hospital #1 showed mostly undocumented screens
  - BUT if there was a positive screen documented, there was also documentation of reduction of SHS exposure counseling

PDSA Cycle: B-QIP Example

- **DO**
  - Educational lecture given in December 2013 at resident noon conference
  - Faculty were educated about documentation of SHS exposure in December 2013
PDSA Cycle: B-QIP Example

STUDY
- Perform chart review of 20 patient charts January 2014
- QIDA to generate run chart

PDSA Cycle: B-QIP Example

STUDY
- What if there’s change?
PDSA Cycle: B-QIP Example

**STUDY**
- What if there’s change?
  - OR more likely
- What is there’s no change
  - OR (worse)
- Change in the wrong direction?

**ACT**
- Reassess
  - Education is one of the least effective interventions to change behavior
- Next step: Systems change
2nd PDSA Cycle: B-QIP Example

Plan:
- Create bronchiolitis H&P template with screening question for SHS exposure embedded

Do:
- Institute H&P template February 2014
2nd PDSA Cycle: B-QIP Example

Study:
- Review 20 patient charts in March 2013
- 90% charts have documentation of SHS exposure
- 80% of positive screens document advice or recommendations

Act:
- Sustain the gain in screening for SHS
- Consider 3rd PDSA cycle to achieve aim of 90% children with positive screens for SHS given advice for reduction of SHS
Quality Improvement Tools

- Cause and effect diagram
- Driver diagram
- Conceptual flow diagram
- Run chart
- Control chart

QI Tools:
Cause and Effect Diagram

- Also called fishbone or Ishikawa diagram
- Graphical display of an organized list of possible causes, solutions, or factors focused on one topic or objective
- Used to quickly organize and categorize ideas generated
Causes of Patient Identification Band Errors

- Hospital Staff:
  - Not empowered or motivated to fix problem
  - Unaware of importance and correct procedure
  - Poor access to correct PIB components

- Patient and Family:
  - Not empowered to report problem
  - Unaware of importance
  - Ability to comprehend

- Admission Processes:
  - Admission from COA ER
  - Direct admission from Access Center
  - Direct admission from COA clinic
  - Afterhours admissions

- Medical Records:
  - PIB interferes with care and needs to be removed
  - Information incorrect
  - Information cannot be changed during hospitalization

- Hospital Processes:
  - Mechanical and IT processes
    - Comfort and fit of PIB
    - Integrity of PIB
    - Computer and printer reliability
  - Nonstandard processes
    - Multiple variations of bands and labels

QI Tools: Driver diagrams

- Helps outline possible cause and effect relationships
- Links improvement aims to possible interventions

![Driver Diagram for an Improvement Project](image-url)
Aim: Steroids

Parent Expectations

Clinical Staff Expectations

Standardized use of steroids for infants in distress?

Admission handout that explains AAP guideline (checklist format)

Video about all of the aims?

Scripting to talk with parents

Outreach to external providers

Learning Modules (self directed)

Physician Champion attend nursing meetings

Set of power point slides for presentation (by champions)

Letter to referring providers

Quarterly meeting with ED

Order set manipulation

Adopt a measure that would be reported hospital-wide to the QI Committee

Institutional guidelines (example included in change package)?

Aims

Key Drivers

QI Tools: Conceptual Flow diagram

- Also known as process map or flow chart
- Depicts steps of process in chronological order to help identify problems
- Demonstrates hierarchical processes
QI Tool: Run Chart

- Graphs are always better than tables of numbers
- Single line plotting a value over time
- Can easily visualize upward and downward trends and a general picture of a process

International Comparison of Spending on Health, 1980–2009

Average spending on health per capita (SUS PPP*)

- United States
- Canada
- Germany
- France
- Australia
- United Kingdom

Total expenditures on health as percent of GDP

* PPP=Purchasing Power Parity


Source: Commonwealth Fund National Scorecard on U.S. Health System Performance, 2011.
Run Chart Example from QIDA

QI Tool: Control Chart

- Run chart with additional information:
  - Average
  - Control limits
  - Intervention points
- QI 202: most likely most of you will not be making your own control charts
Quality Improvement Resources

For QI resources & tools, check out Section F in the B-QIP Project Orientation Packet or visit: http://quiin.aap.org for QI resources and examples
Free QI Resources

- AAP PediaLink –
  - Hot Topics: Getting Started with Quality Improvement
- Institute for Healthcare Improvement (IHI)
  - Free “On Demand” courses
  - Open Courses (free if your institution has subscription or you can purchase individual)

Quality Improvement Resources

- Centers for Disease and Control
- Agency for Healthcare Research and Quality (AHRQ)
- Joint Commission
- National Committee for Quality Assurance
- National Quality Forum
- Centers for Medicaid and Medicare Services (CMS)
Summary

- Reviewed QI concepts
- Discussed the Institute for Healthcare (IHI) Model for Improvement
- Gave a B-QIP specific example
- Discussed selected QI tools

Questions?
Bronchiolitis: The journey towards evidence-based care.

Presenters:
Jeanann P. Pardue, MD, FAAP
Shawn Ralston, MD, FAAP

B-QIP Learning Session Webinar
August 20, 2013

Roll Call and Introductions
Those of you serving as the Local Lead Physicians for ABP MOC Part 4:
• Please note that you are attending via the “Question” chat box. You do not need to share your hospital code. Thank you!

Jeanann Pardue, MD, FAAP
East Tennessee Children’s Hospital

Shawn Ralston, MD, FAAP
Dartmouth Hitchcock Medical Center

The Quality Collaborative for Improving Hospitalist Compliance with the AAP Bronchiolitis Guideline (B-QIP) is funded by the AAP Quality Improvement Innovation Networks (QuIIN)
Agenda

<table>
<thead>
<tr>
<th>Agenda Item</th>
<th>Moderator</th>
<th>Time</th>
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<tbody>
<tr>
<td>Welcome and Introductions</td>
<td>Liz Rice-Conboy</td>
<td>5 min</td>
</tr>
<tr>
<td>Bronchiolitis: Diagnosis and management overview</td>
<td>Jeanann Pardue, MD, FAAP</td>
<td>5 min</td>
</tr>
<tr>
<td>Guideline Recommendations: Review of the evidence</td>
<td>Jeanann Pardue, MD, FAAP &amp; Shawn Ralston, MD, FAAP</td>
<td>30 min</td>
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<tr>
<td>The evidence for evidence-based pathways</td>
<td>Shawn Ralston, MD, FAAP</td>
<td>5 min</td>
</tr>
<tr>
<td>Next steps</td>
<td>Shawn Ralston, MD, FAAP</td>
<td>5 min</td>
</tr>
<tr>
<td>Questions and Answers</td>
<td>All</td>
<td>10 min</td>
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Learning Objectives

- Gain a clear understanding the evidence supporting the AAP guidelines
- Evaluate potential roadblocks to the implementation of an evidence based pathway of care
- Gain an understanding of the evidence supporting evidence based guideline implementation.
Bronchiolitis: a disorder most commonly caused in infants by viral LRTI; it is the most common lower respiratory infection in this age group and is characterized by acute inflammation, edema and necrosis of epithelial cells lining small airways, increased mucus production, and bronchospasm.
“Since acute viral bronchiolitis is thus a self-limited disease of relatively good prognosis, the principle of *primum non nocere* should temper frustrated anxiety to do something—anything—to relieve severe dyspnea. Simple physical exhaustion may determine the fate of an infant laboring to meet his metabolic requirements for oxygen. His energies should not be frittered away by the annoyance of unnecessary or futile medications and procedures. Rest should be treasured.”

*Pediatrics*, 1965
RECOMMENDATION 1a
Clinical should diagnose bronchiolitis and assess disease severity on the basis of history and physical examination. Clinicians should not routinely order laboratory and radiologic studies for diagnosis (recommendation: evidence level B; diagnostic studies with minor limitations and observational studies with consistent findings; preponderance of benefits over harms and costs).

RECOMMENDATION 1b
Clinicians should assess risk factors for severe disease such as age less than 12 weeks, a history of prematurity, underlying cardiopulmonary disease, or immunodeficiency when making decisions about evaluation and management of children with bronchiolitis (recommendation: evidence level B; observational studies with consistent findings; preponderance of benefits over harms).

The Question
How do I provide evidence–based high value care for bronchiolitis?
The Answer

What works?

The baby goes with the nose

Nose suction is the most common, yet unstudied, intervention for bronchiolitis
Suctioning and Length of Stay in Infants Hospitalized With Bronchiolitis

Grant M. Massman, MD; Michelle W. Parker, MD; Angela Statile, MD;
Heidi Sucharew, PhD; Patrick W. Brady, MD, MSc

JAMA Pediatrics
Formerly Archives of Pediatrics & Adolescent Medicine

JAMA PEDIATR/VOL 167 (NO. 5), MAY 2013

• To determine if frequent non-invasive suctioning improves clinical outcomes

• To determine if repeated nasopharyngeal suctioning ("deep suction") produces worse outcomes ("is harmful") when compared to noninvasive suctioning

• Scheduled, non-invasive nasal suctioning may have a positive impact on length of stay
• Nasopharyngeal suctioning may have negative impact on outcomes & may prolong LOS.*
  - "Confounding by indication for deep suctioning may be a source of systematic error...results should be interpreted with caution in this context."

• Retrospective cohort study:
  - Cincinnati Children’s (CHMC) & Satellite Facility
  - 2-12 month-old infants hospitalized with bronchiolitis; January 2010 - April 2011
  - Exclusion: < 2mo old; ICU admit; tracheostomy

• Charts reviewed for:
  - Time lapses in suctioning (>4hrs)
  - Suction Device type

• Primary Outcome Measure: Length of Stay (LOS)
Basic Elements of Evidence –based care for Bronchiolitis.

- Airway clearance: suction first, last, and as needed
- Nutritional Support: Often overlooked
- Oxygen: recommendations for its use and clear guidelines for its discontinuation.
- Eliminate the utilization of unnecessary resources with the implementation of an objective scoring tool to validate the effectiveness and the need for continuation of an intervention.

1. Bronchodilators
2. Steroids
3. CPT
4. Pulse oximetry
The diagnosis should be made clinically
Bronchodilators are not recommended
Corticosteroids are not recommended
Ribavirin is not recommended
Antibiotics are not recommended
Chest physiotherapy is not recommended, oral rehydration is preferred
Oxygen saturation threshold is 90% and continuous monitoring not necessary
Prophylaxis is recommended for particular subsets of patients
Hand hygiene with alcohol hand gel is preferred
Secondhand smoke exposure is bad and should be addressed
Ask about use of alternative medicine

Bronchodilators are not recommended

**RECOMMENDATION 2a**
Bronchodilators should not be used routinely in the management of bronchiolitis (recommendation: evidence level B; RCTs with limitations; preponderance of harm of use over benefit).

**RECOMMENDATION 2b**
A carefully monitored trial of $\alpha$-adrenergic or $\beta$-adrenergic medication is an option. Inhaled bronchodilators should be continued only if there is a documented positive clinical response to the trial using an objective means of evaluation (option: evidence level B; RCTs with limitations and expert opinion; balance of benefit and harm).

---

**Bronchodilators in infants**

- Infants have airway tone and responsiveness to $\beta$-agonists similar to older children & adults  

- Responsiveness to bronchodilators in bronchiolitis is not age dependent  

- Short acting beta-agonists have no clear benefit in children less than 2 years old  

- 1-2% of nebulized dose reaches lungs of infants  
Bronchodilators continued

• α / β-agonist epinephrine has no clear benefit in inpatients with bronchiolitis

• RSV may reduce β-agonist responsiveness of human airway smooth muscle

New meta-analyses since last guideline


Hospitalization rates:
9 studies over 600 patients… RCT placebo vs bronchodilators

Changes in Clinical Score:
8 inpatient studies with over 300 patients
11 outpatient studies with over 500 patients… RCT

LOS:
6 studies over 300 patients… RCT

No significant clinical difference


Authors’ conclusions:

› Bronchodilators do not improve oxygen saturation, do not reduce hospital admission after outpatient treatment, do not shorten the duration of hospitalization and do not reduce the time to resolution of illness at home.

› The small improvements in clinical scores for outpatients must be weighed against the costs and adverse effects of bronchodilators.
Author’s Conclusions:

- This review demonstrates the superiority of epinephrine compared to placebo for short-term outcomes for outpatients, particularly in the first 24 hours of care.

- *Exploratory evidence from a single study suggests benefits of epinephrine and steroid combined for later time points. More research is required to confirm the benefits of combined epinephrine and steroids among outpatients.*

- There is no evidence of effectiveness for repeated dose or prolonged use of epinephrine or epinephrine and dexamethasone combined among inpatients.
Why do you need an objective clinical score?


Corticosteroids are not recommended

**RECOMMENDATION 3**
Corticosteroid medications should not be used routinely in the management of bronchiolitis (recommendation: evidence level B; based on RCTs with limitations and a preponderance of risk over benefit).
1. Randomized, double-blind, placebo controlled trial
2. 5 day course of prednisolone or placebo
3. 700 enrolled, ages 10 months-60 months
4. Primary outcome: LOS
5. Secondary outcomes: Score on Preschool Respiratory Assessment Measure; Albuterol use; 7 day symptom score

CONCLUSIONS
In preschool children presenting to a hospital with mild-to-moderate wheezing associated with a viral infection, oral prednisolone was not superior to placebo. (Current Controlled Trials number, ISRCTN58363576.)

**Author’s Conclusions:**

- Current evidence does not support a clinically relevant effect of systemic or inhaled glucocorticoids on admissions or length of hospitalization.

- Combined dexamethasone and epinephrine may reduce outpatient admissions, but results are exploratory and safety data limited.
Chest physiotherapy is not recommended, oral rehydration is preferred

**RECOMMENDATION 6a**
Clinicians should assess hydration and ability to take fluids orally (strong recommendation: evidence level X; validating studies cannot be performed; clear preponderance of benefit over harm).

**RECOMMENDATION 6b**
Chest physiotherapy should not be used routinely in the management of bronchiolitis (recommendation: evidence level B; RCTs with limitations; preponderance of harm over benefit).

Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old


- Meta-analysis of 3 RCT’s (n=172)
  - Outcome measures (ALOS, severity scores) showed no benefit from percussion/vibration and postural drainage techniques
  - Authors conclude that chest physiotherapy cannot be recommended in the management of bronchiolitis
Oxygen saturation threshold is 90% and continuous monitoring not necessary

RECOMMENDATION 7a
Supplemental oxygen is indicated if oxyhemoglobin saturation ($\text{SpO}_2$) falls persistently below 90% in previously healthy infants. If the $\text{SpO}_2$ does persistently fall below 90%, adequate supplemental oxygen should be used to maintain $\text{SpO}_2$ at or above 90%. Oxygen may be discontinued if $\text{SpO}_2$ is at or above 90% and the infant is feeding well and has minimal respiratory distress (option: evidence level D; expert opinion and reasoning from first principles; some benefit over harm).

RECOMMENDATION 7b
As the child’s clinical course improves, continuous measurement of $\text{SpO}_2$ is not routinely needed (option: evidence level D; expert opinion; balance of benefit and harm).

RECOMMENDATION 7c
Infants with a known history of hemodynamically significant heart or lung disease and premature infants require close monitoring as the oxygen is being weaned (strong recommendation: evidence level B; observational studies with consistent findings; preponderance of benefit over harm).

Figure 1. Bronchiolitis Hospitalizations Among US Children Younger Than 1 Year or 1 to 4 Years, by Month and Year of Discharge, 1980-1996

Shay et al. JAMA, 1999
Why have hospitalization rates increased?

- ? Increased survival of children with comorbidities
- ? Virulence
- ? Increase in daycare
- Changes in hospitalization criteria

ED physician survey

<table>
<thead>
<tr>
<th></th>
<th>SPO2 = 94% RR = 50 (n=119)</th>
<th>SPO2 = 94% RR = 65 (n=125)</th>
<th>SPO2 = 92% RR = 50 (n=124)</th>
<th>SPO2 = 92% RR = 65 (n=117)</th>
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<tbody>
<tr>
<td>Would admit (%)</td>
<td>43</td>
<td>58</td>
<td>83</td>
<td>85</td>
</tr>
<tr>
<td>Bronchodilator (%)</td>
<td>92</td>
<td>95</td>
<td>97</td>
<td>98</td>
</tr>
<tr>
<td>O2 (%)</td>
<td>34</td>
<td>39</td>
<td>79</td>
<td>81</td>
</tr>
<tr>
<td>Nasal Suction (%)</td>
<td>80</td>
<td>82</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>Steroids (%)</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Abx (%)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Effect on LOS

- Prolonged in 26% - 57% of hospitalized patients [Schroeder, Archives 2004; Unger, Pediatrics 2008]

- Ongoing RCT of continuous vs intermittent pulse oximetry showing no differences in outcomes
Secondhand smoke exposure should be addressed

RECOMMENDATION 10a
Infants should not be exposed to passive smoking (strong recommendation: evidence level B; observational studies with consistent results; strong preponderance of benefit over harm).

RECOMMENDATION 10b
Breastfeeding is recommended to decrease a child’s risk of having lower respiratory tract disease (LRTD) (recommendation: evidence level C; observational studies; preponderance of benefit over harm).

Tobacco Smoke Exposure & Bronchiolitis

A series of meta-analyses by Strachan and Cook\(^1\) concluded Tobacco Smoke Exposure (TSE) caused a range of diseases, including acute lower respiratory infections


Meta-analysis of TSE on acute lower respiratory infections in 2011\(^2\) demonstrated TSE increases risk for LRI, most significantly bronchiolitis (OR 2.51 95% CI 1.96 to 3.21)


**Other pertinent studies**


5. Semple MG, Taylor-Robinson DC, Lane S, Smyth RL. Household Tobacco Smoke and Admission Weight Predict Severe Bronchiolitis in Infants Independent of Deprivation: Prospective Cohort Study. 2011; PLoS ONE 6(7): e22425.

---

**Epidemiology**

- Inpatient admission screening (nurse or physician) identified 24% children with TSE compared to 46% children with TSE by cotinine level.
- 55% children in an urban outpatient setting had evidence of TSE by testing cotinine levels, a biomarker of tobacco exposure, in comparison to 13% TSE by parental report.
- In an urban pediatric ER study, 41% parents of children with asthma/bronchiolitis were self-reported smokers.
- Study in the UK of infants admitted with bronchiolitis demonstrated 53-84% infants had a self-reported household tobacco smoker.


One time clinical interventions for reduction of TSE appear marginally effective with repeated minimal interventions showing some positive outcomes.

Meta-analysis by Rosen on parental smoking cessation concluded interventions targeted to parents can be successful


Limited intervention studies have been performed on addressing parental smoking during acute illness visits:


Does quality improvement work in bronchiolitis?

How to improve outcomes and eliminate waste.
## Table: Estimates of Annual US Health Care Waste, by Category

<table>
<thead>
<tr>
<th>Author</th>
<th>Intervention/ Location</th>
<th>Outcomes</th>
</tr>
</thead>
</table>
| Adcock 1998 | Local Guideline, Kosair Children’s Hospital, Louisville, Kentucky | • RSV testing  
• Bronchodilator utilization  
• Isolation precautions  
• Readmission rates  
• Antibiotic utilization  
• LOS |
| Perlstein 1999 | Local Guideline, Children’s Hospital Medical Center Cincinnati, Ohio | • Admission rates  
• LOS  
• Beta-agonist utilization  
• RSV testing  
• Chest radiographs  
• Cost |
| Perlstein 2000 | Local Guideline (same as above), Children’s Hospital Medical Center Cincinnati, Ohio | • Admission rates  
• LOS  
• Beta-agonist utilization  
• RSV testing  
• Chest radiographs  
• Cost |
| Harrison 2001 | Local Guideline, Syracuse, NY | • Albuterol utilization  
• Documentation of response to albuterol  
• Discharged on albuterol  
• Utilization of oxygen  
• Utilization of cardiorespiratory monitoring |
<table>
<thead>
<tr>
<th>Study</th>
<th>Intervention/Location</th>
<th>Outcomes</th>
</tr>
</thead>
</table>
| Kotagal 2002     | Local Guidelines, Eleven children's hospitals in the Child Health Accountability Initiative | • Bronchodilator usage  
• Steroid use  
• LOS                                                                 |
| Todd 2002        | Local Guideline and Respiratory Distress Score, The Children's Hospital, Denver, Colorado | • Bronchodilator utilization  
• Antibiotic utilization  
• Chest physiotherapy  
• RSV testing  
• Ribavirin utilization  
• Nosocomial infection rate |
| Muething 2004    | ED care algorithm, admission order set, respiratory score; Children's Hospital Medical Center Cincinnati, Ohio | • Bronchodilator Utilization  
• RSV testing  
• Chest radiographs  
• LOS                                                                 |
| Cheney 2005      | Multi-center Pathway, Four hospitals in Australia                                       | • Readmission rates  
• IV fluid utilization  
• Steroid utilization                                                                 |
| King 2007        | CPOE decision support, Children's Hospital of Eastern Ontario                           | • Albuterol utilization  
• Antibiotic utilization                                                                 |


![Figure 1. Frequency and intensity of bronchodilator treatments](image)

80% of patients get an average of 10 doses per patient

Figure 1. Frequency and intensity of bronchodilator treatments

- Our journey has led us to use simpler supportive therapies
  - Nasal saline irrigation and suction
  - Always feed the child
  - Oxygen per protocol
  - Bedside staff empowered to adjust treatment

- The bronchiolitis score is the centerpiece
  - Guides us and families on status and response
  - Provides standardized approach allowing bedside staff to apply protocol
  - Improves communication among provider teams and across units

- This approach is more efficient and effective

Jeffrey S. Bennett, MD, FHM, FAAP
Kentucky Children’s Hospital
2,860 published studies later…

Evidence on the horizon

- New AAP guideline currently being developed and will be published in mid to late 2014

- Will not change the basic recommendations in the 2006 guideline but will be a little clearer about not routine using albuterol and what to trial – evidence favors epi over albuterol

- Will not recommend hypertonic saline
Diagnosis and Management of Bronchiolitis
Subcommittee on Diagnosis and Management of Bronchiolitis

*Pediatrics* 2006;118;1774
DOI: 10.1542/peds.2006-2223

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://pediatrics.aappublications.org/content/118/4/1774.full.html
ABSTRACT
Bronchiolitis is a disorder most commonly caused in infants by viral lower respiratory tract infection. It is the most common lower respiratory infection in this age group. It is characterized by acute inflammation, edema, and necrosis of epithelial cells lining small airways, increased mucus production, and bronchospasm.

The American Academy of Pediatrics convened a committee composed of primary care physicians and specialists in the fields of pulmonology, infectious disease, emergency medicine, epidemiology, and medical informatics. The committee partnered with the Agency for Healthcare Research and Quality and the RTI International-University of North Carolina Evidence-Based Practice Center to develop a comprehensive review of the evidence-based literature related to the diagnosis, management, and prevention of bronchiolitis. The resulting evidence report and other sources of data were used to formulate clinical practice guideline recommendations.

This guideline addresses the diagnosis of bronchiolitis as well as various therapeutic interventions including bronchodilators, corticosteroids, antiviral and antibacterial agents, hydration, chest physiotherapy, and oxygen. Recommendations are made for prevention of respiratory syncytial virus infection with palivizumab and the control of nosocomial spread of infection. Decisions were made on the basis of a systematic grading of the quality of evidence and strength of recommendation. The clinical practice guideline underwent comprehensive peer review before it was approved by the American Academy of Pediatrics.

This clinical practice guideline is not intended as a sole source of guidance in the management of children with bronchiolitis. Rather, it is intended to assist clinicians in decision-making. It is not intended to replace clinical judgment or establish a protocol for the care of all children with this condition. These recommendations may not provide the only appropriate approach to the management of children with bronchiolitis.

INTRODUCTION
THIS GUIDELINE EXAMINES the published evidence on diagnosis and acute management of the child with bronchiolitis in both outpatient and hospital settings, including the roles of supportive therapy, oxygen, bronchodilators, antiinflammatory agents, antibacterial agents, and antiviral agents and make recommendations to influence clinician behavior on the basis of the evidence. Methods of prevention...
are reviewed, as is the potential role of complementary and alternative medicine (CAM).

The goal of this guideline is to provide an evidence-based approach to the diagnosis, management, and prevention of bronchiolitis in children from 1 month to 2 years of age. The guideline is intended for pediatricians, family physicians, emergency medicine specialists, hospitalists, nurse practitioners, and physician assistants who care for these children. The guideline does not apply to children with immunodeficiencies including HIV, organ or bone marrow transplants, or congenital immunodeficiencies. Children with underlying respiratory illnesses such as chronic neonatal lung disease (CLD; also known as bronchopulmonary dysplasia) and those with significant congenital heart disease are excluded from the sections on management unless otherwise noted but are included in the discussion of prevention. This guideline will not address long-term sequelae of bronchiolitis, such as recurrent wheezing, which is a field with distinct literature of its own.

Bronchiolitis is a disorder most commonly caused in infants by viral lower respiratory tract infection (LRTI). It is the most common lower respiratory infection in this age group. It is characterized by acute inflammation, edema and necrosis of epithelial cells lining small airways, increased mucus production, and bronchospasm. Signs and symptoms are typically rhinitis, tachypnea, wheezing, cough, crackles, use of accessory muscles, and/or nasal flaring. Many viruses cause the same constellation of symptoms and signs. The most common etiology is the respiratory syncytial virus (RSV), with the highest incidence of RSV infection occurring between December and March. Ninety percent of children are infected with RSV in the first 2 years of life, and up to 40% of them will have lower respiratory infection. Infection with RSV does not grant permanent or long-term immunity. Reinfections are common and may be experienced throughout life. Other viruses identified as causing bronchiolitis are human metapneumovirus, influenza, adenovirus, and parainfluenza. RSV infection leads to more than 90,000 hospitalizations annually. Mortality resulting from RSV has decreased from 4500 deaths annually in 1985 in the United States to an estimated 510 RSV-associated deaths in 1997 and 390 in 1999. The cost of hospitalization for bronchiolitis in children less than 1 year old is estimated to be more than $700 million per year.

Several studies have shown a wide variation in how bronchiolitis is diagnosed and treated. Studies in the United States, Canada, and the Netherlands showed variations that correlated more with hospital or individual preferences than with patient severity. In addition, length of hospitalization in some countries averages twice that of others. This variable pattern suggests a lack of consensus among clinicians as to best practices. In addition to morbidity and mortality during the acute illness, infants hospitalized with bronchiolitis are more likely to have respiratory problems as older children, especially recurrent wheezing, compared with those who did not have severe disease. Severe disease is characterized by persistently increased respiratory effort, apnea, or the need for intravenous hydration, supplemental oxygen, or mechanical ventilation. It is unclear whether severe viral illness early in life predisposes children to develop recurrent wheezing or if infants who experience severe bronchiolitis have an underlying predisposition to recurrent wheezing.

METHODS
To develop the clinical practice guideline on the diagnosis and management of bronchiolitis, the American Academy of Pediatrics (AAP) convened the Subcommittee on Diagnosis and Management of Bronchiolitis with the support of the American Academy of Family Physicians (AAFP), the American Thoracic Society, the American College of Chest Physicians, and the European Respiratory Society. The subcommittee was chaired by a primary care pediatrician with expertise in clinical pulmonology and included experts in the fields of general pediatrics, pulmonology, infectious disease, emergency medicine, epidemiology, and medical informatics. All panel members reviewed the AAP Policy on Conflict of Interest and Voluntary Disclosure and were given an opportunity to declare any potential conflicts.

The AAP and AAFP partnered with the AHRQ and the RTI International-University of North Carolina Evidence-Based Practice Center (EPC) to develop an evidence report, which served as a major source of information for these practice guideline recommendations. Specific clinical questions addressed in the AHRQ evidence report were the (1) effectiveness of diagnostic tools for diagnosing bronchiolitis in infants and children, (2) efficacy of pharmaceutical therapies for treatment of bronchiolitis, (3) role of prophylaxis in prevention of bronchiolitis, and (4) cost-effectiveness of prophylaxis for management of bronchiolitis. EPC project staff searched Medline, the Cochrane Collaboration, and the Health Economics Database. Additional articles were identified by review of reference lists of relevant articles and ongoing studies recommended by a technical expert advisory group. To answer the question on diagnosis, both prospective studies and randomized, controlled trials (RCTs) were used. For questions related to treatment and prophylaxis in the AHRQ report, only RCTs were considered. For the cost-effectiveness of prophylaxis, studies that used economic analysis were reviewed. For all studies, key inclusion criteria included outcomes that were both clinically relevant and able to be abstracted. Initially, 744 abstracts were identified for possible inclusion, of which 83 were retained for systematic review. Results of the literature review were presented in evidence tables and published in the final evidence report.
An additional literature search of Medline and the Cochrane Database of Systematic Reviews was performed in July 2004 by using search terms submitted by the members of the Subcommittee on the Diagnosis and Management of Bronchiolitis. The methodologic quality of the research was appraised by an epidemiologist before consideration by the subcommittee. The evidence-based approach to guideline development requires that the evidence in support of a policy be identified, appraised, and summarized and that an explicit link between evidence and recommendations be defined. Evidence-based recommendations reflect the quality of evidence and the balance of benefit and harm that is anticipated when the recommendation is followed. The AAP policy statement “Classifying Recommendations for Clinical Practice Guidelines” was followed in designating levels of recommendation (Fig 1; Table 1).

A draft version of this clinical practice guideline underwent extensive peer review by committees and sections within the AAP, American Thoracic Society, European Respiratory Society, American College of Chest Physicians, and AAFP, outside organizations, and other individuals identified by the subcommittee as experts in the field. Members of the subcommittee were invited to distribute the draft to other representatives and committees within their specialty organizations. The resulting comments were reviewed by the subcommittee and, when appropriate, incorporated into the guideline.

This clinical practice guideline is not intended as a sole source of guidance in the management of children with bronchiolitis. Rather, it is intended to assist clinicians in decision-making. It is not intended to replace clinical judgment or establish a protocol for the care of all children with this condition. These recommendations may not provide the only appropriate approach to the management of children with bronchiolitis.

All AAP guidelines are reviewed every 5 years. Definitions used in the guideline are:

- Bronchiolitis: a disorder most commonly caused in infants by viral LRTI; it is the most common lower respiratory infection in this age group and is characterized by acute inflammation, edema and necrosis of epithelial cells lining small airways, increased mucus production, and bronchospasm.
- CLD, also known as bronchopulmonary dysplasia: an infant less than 32 weeks’ gestation evaluated at 36 weeks’ postmenstrual age or one of more than 32 weeks’ gestation evaluated at more than 28 days but less than 56 days of age who has been receiving supplemental oxygen for more than 28 days.
- Routine: a set of customary and often-performed procedures such as might be found in a routine admission order set for children with bronchiolitis.
- Severe disease: signs and symptoms associated with poor feeding and respiratory distress characterized by tachypnea, nasal flaring, and hypoxemia.
- Hemodynamically significant congenital heart disease: children with congenital heart disease who are receiving medication to control congestive heart failure, have moderate to severe pulmonary hypertension, or have cyanotic heart disease.

**RECOMMENDATION 1a**
Clinicians should diagnose bronchiolitis and assess disease severity on the basis of history and physical examination. Clinicians should not routinely order laboratory and radiologic studies for diagnosis (recommendation: evidence level B; diagnostic studies with minor limitations and observational studies with consistent findings; preponderance of benefits over harms and cost).

**RECOMMENDATION 1b**
Clinicians should assess risk factors for severe disease such as age less than 12 weeks, a history of prematurity, underlying cardiopulmonary disease, or immunodeficiency when making decisions about evaluation and management of children with bronchiolitis (recommendation: evidence level B; observational studies with consistent findings; preponderance of benefits over harms).

The 2 goals in the history and physical examination of infants presenting with cough and/or wheeze, particularly in the winter season, are the differentiation of infants with probable bronchiolitis from those with other disorders and the estimation of the severity of illness. Most clinicians recognize bronchiolitis as a constellation of clinical symptoms and signs including a viral upper respiratory prodrome followed by increased respi-
obstruction may contribute to work of breathing. Nasal flaring, and intercostal and/or subcostal retractions.

Increased respiratory effort manifested as grunting, nasal flaring, and intercostal and/or subcostal retractions.

Respiratory rate in otherwise healthy children ranging from transient events such as apnea or mucus plugging to progressive respiratory distress from lower airway obstruction. Important issues to assess include the impact of respiratory symptoms on feeding and hydration and the response, if any, to therapy. The ability of the family to care for the child and return for further care should be assessed. History of underlying conditions such as prematurity, cardiac or pulmonary disease, immunodeficiency, or previous episodes of wheezing should be identified.

The physical examination reflects the variability in the disease state and may require serial observations over time to fully assess the child’s status. Upper airway obstruction may contribute to work of breathing. Nasal suctioning and positioning of the child may affect the assessment. Physical examination findings of importance include respiratory rate, increased work of breathing as evidenced by accessory muscle use or retractions, and auscultatory findings such as wheezes or crackles.

The evidence relating the presence of specific findings in the assessment of bronchiolitis to clinical outcomes is limited. Most studies are retrospective and lack valid and unbiased measurement of baseline and outcome variables. Most studies designed to identify the risk of severe adverse outcomes such as requirement for intensive care or mechanical ventilation have focused on inpatient. These events are relatively rare among all children with bronchiolitis and limit the power of these studies to detect clinically important risk factors associated with disease progression.

Several studies have associated premature birth (less than 37 weeks) and young age of the child (less than 6–12 weeks) with an increased risk of severe disease. Young infants with bronchiolitis may develop apnea, which has been associated with an increased risk for prolonged hospitalization, admission to intensive care, and mechanical ventilation. Other underlying conditions that have been associated with an increased risk of progression to severe disease or mortality include hemodynamically significant congenital heart disease, chronic lung disease (bronchopulmonary dysplasia, cystic fibrosis, congenital anomaly), and the presence of an immunocompromised state.

Findings on physical examination have been less consistently associated with outcomes of bronchiolitis. Tachypnea, defined as a respiratory rate of 70 or more breaths per minute, has been associated with increased risk for severe disease in some studies but not oth-

<table>
<thead>
<tr>
<th>Statement</th>
<th>Definition</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong recommendation</td>
<td>A strong recommendation in favor of a particular action is made when the anticipated benefits of the recommended intervention clearly exceed the harms (as a strong recommendation against an action is made when the anticipated harms clearly exceed the benefits) and the quality of the supporting evidence is excellent. In some clearly identified circumstances, strong recommendations may be made when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.</td>
<td>Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.</td>
</tr>
<tr>
<td>Recommendation</td>
<td>A recommendation in favor of a particular action is made when the anticipated benefits exceed the harms but the quality of evidence is not as strong. Again, in some clearly identified circumstances, recommendations may be made when high-quality evidence is impossible to obtain but the anticipated benefits outweigh the harms.</td>
<td>Clinicians would be prudent to follow a recommendation but should remain alert to new information and sensitive to patient preferences.</td>
</tr>
<tr>
<td>Option</td>
<td>Options define courses that may be taken when either the quality of evidence is suspect or carefully performed studies have shown little clear advantage to one approach over another.</td>
<td>Clinicians should consider the option in their decision-making, and patient preference may have a substantial role.</td>
</tr>
<tr>
<td>No recommendation</td>
<td>No recommendation indicates that there is a lack of pertinent published evidence and that the anticipated balance of benefits and harms is presently unclear.</td>
<td>Clinicians should be alert to new published evidence that clarifies the balance of benefit versus harm.</td>
</tr>
</tbody>
</table>
An AHRQ report\(^1\) found 43 of 52 treatment trials that used clinical scores, all of which included measures of respiratory rate, respiratory effort, severity of wheezing, and oxygenation. The lack of uniformity of scoring systems made comparison between studies difficult.\(^1\) The most widely used clinical score, the Respiratory Distress Assessment Instrument,\(^3\) is reliable with respect to scoring but has not been validated for clinical predictive value in bronchiolitis. None of the other clinical scores used in the various studies have been assessed for reliability and validity. Studies that have assessed other physical examination findings have not found clinically useful associations with outcomes.\(^2\)\(^7\)\(^3\)\(^2\) The substantial temporal variability in physical findings as well as potential differences in response to therapy may account for this lack of association. Repeated observation over a period of time rather than a single examination may provide a more valid overall assessment.

Pulse oximetry has been rapidly adopted into clinical assessment of children with bronchiolitis on the basis of data suggesting that it can reliably detect hypoxemia that is not suspected on physical examination.\(^2\)\(^7\)\(^3\)\(^4\)\(^5\) Few studies have assessed the effectiveness of pulse oximetry to predict clinical outcomes. Among inpatients, perceived need for supplemental oxygen that is based on pulse oximetry has been associated with higher risk of prolonged hospitalization, ICU admission, and mechanical ventilation.\(^2\)\(^4\)\(^6\)\(^2\)\(^6\) Among outpatients, available evidence differs on whether mild reductions in pulse oximetry (less than 95% on room air) predict progression of disease or need for a return visit for care.\(^2\)\(^7\)\(^3\)\(^4\)

Radiography may be useful when the hospitalized child does not improve at the expected rate, if the severity of disease requires further evaluation, or if another diagnosis is suspected. Although many infants with bronchiolitis have abnormalities that show on chest radiographs, data are insufficient to demonstrate that chest radiograph abnormalities correlate well with disease severity.\(^4\)\(^6\) Two studies suggest that the presence of consolidation and atelectasis on a chest radiograph is associated with increased risk for severe disease.\(^2\)\(^6\)\(^7\)\(^8\) One study showed no correlation between chest radiograph findings and baseline severity of disease.\(^7\) In prospective studies including 1 randomized trial, children with suspected LRTI who received radiographs were more likely to receive antibiotics without any difference in time to recovery.\(^3\)\(^7\)\(^8\) Current evidence does not support routine radiography in children with bronchiolitis.

The clinical utility of diagnostic testing in infants with suspected bronchiolitis is not well supported by evidence.\(^3\)\(^9\)\(^4\)\(^1\) The occurrence of serious bacterial infections (SBIs; eg, urinary tract infections [UTIs], sepsis, meningitis) is very low.\(^4\)\(^2\)\(^3\)\(^4\) The use of complete blood counts has not been shown to be useful in either diagnosing bronchiolitis or guiding its therapy.\(^1\)

Virologic tests for RSV, if obtained during peak RSV season, demonstrate a high predictive value. However, the knowledge gained from such testing rarely alters management decisions or outcomes for the vast majority of children with clinically diagnosed bronchiolitis.\(^1\) Virologic testing may be useful when cohorting of patients is feasible.

**Evidence Profile 1a: Diagnosis**

- **Benefit:** Improved care of patients with risk factors for severe disease
- **Harm:** Increased costs, increased radiation and blood testing
- **Policy level:** Recommendation

**Evidence Profile 1b: Risk Factors**

- **Benefit:** Prevention of bronchiolitis (recommendation: evidence level B; RCTs with limitations and expert opinion; balance of benefit and harm)
- **Aggregated evidence quality:** B; observational studies with consistent findings
- **Harm:** Risk of misdiagnosis
- **Policy level:** Recommendation

**RECOMMENDATION 2a**

Bronchodilators should not be used routinely in the management of bronchiolitis (recommendation: evidence level B; RCTs with limitations; preponderance of harm over benefit).

**RECOMMENDATION 2b**

A carefully monitored trial of \(\alpha\)-adrenergic or \(\beta\)-adrenergic medication is an option. Inhaled bronchodilators should be continued only if there is a documented positive clinical response to the trial using an objective means of evaluation (option: evidence level B; RCTs with limitations and expert opinion; balance of benefit and harm).

The use of bronchodilator agents continues to be controversial. RCTs have failed to demonstrate a consistent benefit from \(\alpha\)-adrenergic or \(\beta\)-adrenergic agents. Several studies and reviews have evaluated the use of bronchodilator medications for viral bronchiolitis. A Cochrane systematic review\(^4\) found 8 RCTs involving 394 children.\(^3\)\(^4\)\(^5\)\(^6\) Some of the studies included infants who had a history of previous wheezing. Several used agents other than albuterol/salbutamol or epinephrine/adrenaline (eg, ipratropium and metaproterenol). Overall, results of the meta-analysis indicated that, at most, 1 in 4
children treated with bronchodilators might have a transient improvement in clinical score of unclear clinical significance. This needs to be weighed against the potential adverse effects and cost of these agents and the fact that most children treated with bronchodilators will not benefit from their use. Studies assessing the impact of bronchodilators on long-term outcomes have found no impact on the overall course of the illness.\textsuperscript{1,44,51}

**Albuterol/Salbutamol**

Some outpatient studies have demonstrated modest improvement in oxygen saturation and/or clinical scores. Schweich et al\textsuperscript{52} and Schuh et al\textsuperscript{53} evaluated clinical scores and oxygen saturation after 2 treatments of nebulized albuterol. Each study showed improvement in the clinical score and oxygen saturation shortly after completion of the treatment. Neither measured outcomes over time. Klassen et al\textsuperscript{47} evaluated clinical score and oxygen saturation 30 and 60 minutes after a single salbutamol treatment. Clinical score, but not oxygen saturation, was significantly improved at 30 minutes, but no difference was demonstrated 60 minutes after a treatment. Gadomski et al\textsuperscript{54} showed no difference between those in groups on albuterol or placebo after 2 nebulized treatments given 30 minutes apart.

Studies of inpatients have not shown a clinical change that would justify recommending albuterol for routine care. Dobson et al\textsuperscript{55} conducted a randomized clinical trial in infants who were hospitalized with moderately severe viral bronchiolitis and failed to demonstrate clinical improvement resulting in enhanced recovery or an attenuation of the severity of illness. Two meta-analyses\textsuperscript{1,36} could not directly compare inpatient studies of albuterol because of widely differing methodology. Overall, the studies reviewed did not show the use of albuterol in infants with bronchiolitis to be beneficial in shortening duration of illness or length of hospital stay.

**Epinephrine/Adrenaline**

The AHRQ evidence report\textsuperscript{1} notes that the reviewed studies show that nebulized epinephrine has “some potential for being efficacious.” In contrast, a later multicenter controlled trial by Wainwright et al\textsuperscript{51} concluded that epinephrine did not impact the overall course of the illness as measured by hospital length of stay. Analysis of outpatient studies favors nebulized epinephrine over placebo in terms of clinical score, oxygen saturation, and respiratory rate at 60 minutes\textsuperscript{57} and heart rate at 90 minutes.\textsuperscript{58} However, the differences were small, and it could not be established that they are clinically significant in altering the course of the illness. One study\textsuperscript{59} found significant improvement in airway resistance (but no change in oxygen need), suggesting that a trial of this agent may be reasonable for such infants.

Several studies have compared epinephrine to albuterol (salbutamol) or epinephrine to placebo. Racemic epinephrine has demonstrated slightly better clinical effect than albuterol. It is possible that the improvement is related to the α effect of the medication.\textsuperscript{60} Hartling et al\textsuperscript{61} performed a meta-analysis of studies comparing epinephrine to albuterol and also participated in the Cochrane review of epinephrine.\textsuperscript{62} The Cochrane report concluded: “There is insufficient evidence to support the use of epinephrine for the treatment of bronchiolitis among inpatients. There is some evidence to suggest that epinephrine may be favorable to salbutamol (albuterol) and placebo among outpatients.”

Although there is no evidence from RCTs to justify routine use of bronchodilators, clinical experience suggests that, in selected infants, there is an improvement in the clinical condition after bronchodilator administration.\textsuperscript{47,52,53,57,58} It may be reasonable to administer a nebulized bronchodilator and evaluate clinical response. Individuals and institutions should assess the patient and document pretherapy and posttherapy changes using an objective means of evaluation. Some of the documentation tools that have been used can be found in articles by Alario et al,\textsuperscript{45} Bierman and Pierson,\textsuperscript{63} Gadomski et al,\textsuperscript{54} Lowell et al,\textsuperscript{33} Wainwright et al,\textsuperscript{51} Schuh et al,\textsuperscript{64} and Gorelick et al.\textsuperscript{65} In addition, a documentation tool has been developed by Cincinnati Children’s Hospital (Cincinnati, OH).\textsuperscript{66}

Extrapolation from the studies discussed above suggests that epinephrine may be the preferred bronchodilator for this trial in the emergency department and in hospitalized patients. In the event that there is documented clinical improvement, there is justification for continuing the nebulized bronchodilator treatments. In the absence of a clinical response, the treatment should not be continued.

Because of a lack of studies, short duration of action, and potential adverse effects, epinephrine is usually not used in the home setting. Therefore, it would be more appropriate that a bronchodilator trial in the office or clinic setting use albuterol/salbutamol rather than racemic epinephrine. Parameters to measure its effectiveness include improvements in wheezing, respiratory rate, respiratory effort, and oxygen saturation.

Anticholinergic agents such as ipratropium have not been shown to alter the course of viral bronchiolitis. Although a minority of individual patients may show a positive clinical response to anticholinergic agents, studies have shown that the groups as a whole showed no significant improvement. At this point there is no justification for using anticholinergic agents, either alone or in combination with β-adrenergic agents, for viral bronchiolitis.\textsuperscript{57–69}

**Evidence Profile 2a: Routine Use of Bronchodilators**

- Aggregate evidence quality: B; RCTs with limitations
- Benefit: short-term improvement in clinical symptoms
Harm: adverse effects, cost of medications, cost to administer
- Benefits-harms assessment: preponderance of harm over benefit
- Policy level: recommendation

**Evidence Profile 2b: Trial of Bronchodilators**

- Aggregate evidence quality: B; RCTs with limitations
- Benefit: some patients with significant symptomatic improvement
- Harm: adverse effects, cost of medications, cost to administer
- Benefits-harms assessment: preponderance of benefit over harm in select patients
- Policy level: option

**RECOMMENDATION 3**

Corticosteroid medications should not be used routinely in the management of bronchiolitis (recommendation: evidence level B; based on RCTs with limitations and a preponderance of risk over benefit).

Reports indicate that up to 60% of infants admitted to the hospital for bronchiolitis receive corticosteroid therapy. Systematic review and meta-analyses of RCTs involving close to 1200 children with viral bronchiolitis have not shown sufficient evidence to support the use of steroids in this illness.

A Cochrane database review on the use of glucocorticoids for acute bronchiolitis included 13 studies. The 1198 patients showed a pooled decrease in length of stay of 0.38 days. However, this decrease was not statistically significant. The review concluded: “No benefits were found in either LOS [length of stay] or clinical score in infants and young children treated with systemic glucocorticoids as compared with placebo. There were no differences in these outcomes between treatment groups; either in the pooled analysis or in any of the sub analyses. Among the three studies evaluating hospital admission rates following the initial hospital visit there was no difference between treatment groups. There were no differences found in respiratory rate, hemoglobin oxygen saturation, or hospital revisit or readmission rates. Subgroup analyses were significantly limited by the low number of studies in each comparison. Specific data on the harm of corticosteroid therapy in this patient population are lacking. Available evidence suggests that corticosteroid therapy is not of benefit in this patient group.”

The 2 available studies that evaluated inhaled corticosteroids in bronchiolitis showed no benefit in the course of the acute disease. Because the safety of high-dose inhaled corticosteroids in infants is still not clear, their use should be avoided unless there is a clear likelihood of benefit.

There are insufficient data to make a recommendation regarding the use of leukotriene modifiers in bronchiolitis. Until additional randomized clinical trials are completed, no conclusions can be drawn.

**Evidence Profile 3: Corticosteroids**

- Aggregate evidence quality: B; randomized clinical trials with limitations
- Benefit: possibility that corticosteroid may be of some benefit
- Harm: exposure to unnecessary medication
- Benefits-harms assessment: preponderance of harm over benefit
- Policy level: recommendation

**RECOMMENDATION 4**

Ribavirin should not be used routinely in children with bronchiolitis (recommendation: evidence level B; RCTs with limitations and observational studies; preponderance of harm over benefit).

The indications for specific antiviral therapy for bronchiolitis are controversial. A recent review of 11 randomized clinical trials of ribavirin therapy for RSV LRTIs, including bronchiolitis, summarized the reported outcomes. Nine of the studies measured the effect of ribavirin in the acute phase of illness. Two evaluated the effect on long-term wheezing and/or pulmonary function. Three additional studies were identified with similar results. Two of these evaluated effectiveness in the acute phase and one on subsequent respiratory status.

Each of the 11 studies that addressed the acute treatment effects of ribavirin included a small sample size ranging from 26 to 53 patients and cumulatively totaling 375 subjects. Study designs and outcomes measured were varied and inconsistent. Seven of the trials demonstrated some improvement in outcome attributed to ribavirin therapy, and 4 did not. Of those showing benefit, 4 documented improved objective outcomes (eg, better oxygenation, shorter length of stay), and 3 reported improvement in subjective findings such as respiratory scores or subjective clinical assessment. The quality of the studies was highly variable.

Of the studies that focused on long-term pulmonary function, one was an RCT assessing the number of subsequent wheezing episodes and LRTIs over a 1-year period. Two others were follow-up studies of previous randomized trials and measured subsequent pulmonary function as well as wheezing episodes. The first study found fewer episodes of wheezing and infections in the ribavirin-treated patients, and the latter 2 studies found no significant differences between groups.
No randomized studies of other antiviral therapies of bronchiolitis were identified.

Specific antiviral therapy for RSV bronchiolitis remains controversial because of the marginal benefit, if any, for most patients. In addition, cumbersome delivery requirements, potential health risks for caregivers, and high cost serve as disincentives for use in the majority of patients. Nevertheless, ribavirin may be considered for use in highly selected situations involving documented RSV bronchiolitis with severe disease or in those who are at risk for severe disease (eg, immunocompromised and/or hemodynamically significant cardio pulmonary disease).

Evidence Profile 4: Ribavirin

- Aggregate evidence quality: B; RCTs with limitations and observational studies
- Benefit: some improvement in outcome
- Harm: cost, delivery method, potential health risks to caregivers
- Benefits-harms assessment: preponderance of harm over benefit
- Policy level: recommendation

**RECOMMENDATION 5**

Antibacterial medications should be used only in children with bronchiolitis who have specific indications of the coexistence of a bacterial infection. When present, bacterial infection should be treated in the same manner as in the absence of bronchiolitis (recommendation: evidence level B; RCTs and observational studies; preponderance of benefit over harm).

Children with bronchiolitis frequently receive antibacterial therapy because of fever, young age, or the concern over secondary bacterial infection. Early RCTs showed no benefit from antibacterial treatment of bronchiolitis. However, concern remains regarding the possibility of bacterial infections in young infants with bronchiolitis; thus, antibacterial agents continue to be used.

Several retrospective studies identified low rates of SBI (0%-3.7%) in patients with bronchiolitis and/or infections with RSV. When SBI was present, it was more likely to be a UTI than bacteremia or meningitis. In a study of 2396 infants with RSV bronchiolitis, 69% of the 39 patients with SBI had a UTI.

Three prospective studies of SBI in patients with bronchiolitis and/or RSV infections also demonstrated low rates of SBI (1%-12%). One large study of febrile infants less than 60 days of age with bronchiolitis and/or RSV infections demonstrated that the overall risk of SBI in infants less than 28 days of age, although significant, was not different between RSV-positive and RSV-negative groups (10.1% and 14.2%, respectively). All SBIs in children between 29 and 60 days of age with RSV-positive bronchiolitis were UTIs. The rate of UTIs in RSV-positive patients between 28 and 60 days old was significantly lower than those who were RSV-negative (5.5% vs 11.7%).

Approximately 25% of hospitalized infants with bronchiolitis will have radiographic evidence of atelectasis or infiltrates, often misinterpreted as possible bacterial infection. Bacterial pneumonia in infants with bronchiolitis without consolidation is unusual.

Although acute otitis media (AOM) in bronchiolitic infants may be caused by RSV alone, there are no clinical features that permit viral AOM to be differentiated from bacterial. Two studies address the frequency of AOM in patients with bronchiolitis. Andrade et al prospectively identified AOM in 62% of 42 patients who presented with bronchiolitis. AOM was present in 50% on entry to the study and developed in an additional 12% within 10 days. Bacterial pathogens were isolated from 94% of middle-ear aspirates, with Streptococcus pneumoniae, Haemophilus influenzae, and Moraxella catarrhalis being the most frequent isolates. A subsequent report followed 150 children hospitalized for bronchiolitis for the development of AOM. Seventy-nine (53%) developed AOM, two thirds within the first 2 days of hospitalization. Tympanocentesis was performed on 64 children with AOM, and 33 middle-ear aspirates yielded pathogens. H influenzae, S pneumoniae, and M catarrhalis were the ones most commonly found. AOM did not influence the clinical course or laboratory findings of bronchiolitis. When found, AOM should be managed according to the AAP/AAFP guidelines for diagnosis and management of AOM.

Evidence Profile 5: Antibacterial Therapy

- Aggregate evidence quality: B; RCTs and observational studies with consistent results
- Benefit: appropriate treatment of bacterial infections, decreased exposure to unnecessary medications and their adverse effects when a bacterial infection is not present, decreased risk of development of resistant bacteria
- Harm: potential to not treat patient with bacterial infection
- Benefits-harms assessment: preponderance of benefit over harm
- Policy level: recommendation

**RECOMMENDATION 6a**

Clinicians should assess hydration and ability to take fluids orally (strong recommendation: evidence level X; validating studies cannot be performed; clear preponderance of benefit over harm).
RECOMMENDATION 6b
Chest physiotherapy should not be used routinely in the management of bronchiolitis (recommendation: evidence level B; RCTs with limitations; preponderance of harm over benefit).

The level of respiratory distress caused by bronchiolitis guides the indications for use of other treatments.

Intravenous Fluids
Infants with mild respiratory distress may require only observation, particularly if feeding remains unaffected. When the respiratory rate exceeds 60 to 70 breaths per minute, feeding may be compromised, particularly if nasal secretions are copious. Infants with respiratory difficulty may develop nasal flaring, increased intercostal retraction, and prolonged expiratory wheezing and be at increased risk of aspiration of food into the lungs.120 Children who have difficulty feeding safely because of respiratory distress should be given intravenous fluids. The possibility of fluid retention related to production of antidiuretic hormone has been reported in patients with bronchiolitis.121,122 Clinicians should adjust fluid management accordingly.

Airway Clearance
Bronchiolitis is associated with airway edema and sloughing of the respiratory epithelium into airways, which results in generalized hyperinflation of the lungs. Lobar atelectasis is not characteristic of this disease, although it can be seen on occasion. A Cochrane review123 found 3 RCTs that evaluated chest physiotherapy in hospitalized patients with bronchiolitis.124–126 No clinical benefit was found using vibration and percussion techniques. Suctioning of the nares may provide temporary relief of nasal congestion. There is no evidence to support routine “deep” suctioning of the lower pharynx or larynx.

Evidence Profile 6a: Fluids
- Aggregate evidence quality: evidence level X; validating studies cannot be performed
- Benefit: prevention of dehydration
- Harm: overhydration, especially if syndrome of inappropriate secretion of antidiuretic hormone (SIADH) is present
- Benefits-harms assessment: clear preponderance of benefit over harm
- Policy level: strong recommendation

Evidence Profile 6b: Chest Physiotherapy
- Aggregate evidence quality: B; RCTs with limitations
- Benefit: clearance of secretions, prevention of atelectasis
- Harm: stress to infant during procedure, cost of administering chest physiotherapy
- Benefits-harms assessment: preponderance of harm over benefit
- Policy level: recommendation

RECOMMENDATION 7a
Supplemental oxygen is indicated if oxyhemoglobin saturation (SpO₂) falls persistently below 90% in previously healthy infants. If the SpO₂ does persistently fall below 90%, adequate supplemental oxygen should be used to maintain SpO₂ at or above 90%. Oxygen may be discontinued if SpO₂ is at or above 90% and the infant is feeding well and has minimal respiratory distress (option: evidence level D; expert opinion and reasoning from first principles; some benefit over harm).

RECOMMENDATION 7b
As the child’s clinical course improves, continuous measurement of SpO₂ is not routinely needed (option: evidence level D; expert opinion; balance of benefit and harm).

RECOMMENDATION 7c
Infants with a known history of hemodynamically significant heart or lung disease and premature infants require close monitoring as the oxygen is being weaned (strong recommendation: evidence level B; observational studies with consistent findings; preponderance of benefit over harm).

Healthy infants have an SpO₂ greater than 95% on room air, although transient decreases to an SpO₂ of less than 89% occur. In bronchiolitis, airway edema and sloughing of respiratory epithelial cells cause mismatching of ventilation and perfusion and subsequent reductions in oxygenation (PaO₂ and SpO₂).

In the clinical setting, pulse oximeters are convenient, safe tools to measure oxygenation status. Clinicians ordering pulse oximetry should understand that the shape of the oxyhemoglobin dissociation curve dictates that when SpO₂ is above 90%, large increases in PaO₂ are associated with small increases in SpO₂. In contrast, when SpO₂ is below 90%, a small decrease in PaO₂ is associated with large decreases in SpO₂ (Fig 2). This raises the question of whether there is a single value for SpO₂ that can serve as a decision point to hospitalize or initiate supplemental oxygen in infants with bronchiolitis.

In studies that examined treatment for bronchiolitis in hospitalized infants, some investigators started supplemental oxygen when SpO₂ fell below 90%, and others started oxygen before the SpO₂ reached 90%. Although data are lacking to codify a single value of SpO₂ to be used as a cutoff point for initiating or discontinuing supplemental oxygen, these studies and the relationship between PaO₂ and SpO₂ support the position that otherwise healthy infants with bronchiolitis who have SpO₂ at or above 90% at sea level while breathing...
room air likely gain little benefit from increasing PaO2 with supplemental oxygen, particularly in the absence of respiratory distress and feeding difficulties. Because several factors including fever, acidosis, and some hemoglobinopathies shift the oxyhemoglobin dissociation curve so that large decreases in PaO2 begin to occur at an SpO2 of more than 90%, clinicians should consider maintaining a higher SpO2 in children with these risk factors.130,131 Although widely used pulse oximeters have some shortcomings, under normal circumstances the accuracy of SpO2 may vary slightly (most oximeters are accurate to ±2%). More importantly, poorly placed probes and motion artifact will lead to inaccurate measurements and false readings and alarms.132 Before instituting O2 therapy, the accuracy of the initial reading should be verified by repositioning the probe and repeating the measurement. The infant’s nose and, if necessary, oral airway should be suctioned. If SpO2 remains below 90%, O2 should be administered. The infant’s clinical work of breathing should also be assessed and may be considered as a factor in a decision to use oxygen supplementation.

Premature or low birth weight infants and infants with bronchopulmonary dysplasia or hemodynamically significant congenital heart disease merit special attention because they are at risk to develop severe illness that requires hospitalization, often in the ICU.7,29,133–135 These infants often have abnormal baseline oxygenation coupled with an inability to cope with the pulmonary inflammation seen in bronchiolitis. This can result in more severe and prolonged hypoxia compared with normal infants, and clinicians should take this into account when developing strategies for using and weaning supplemental oxygen.

Evidence Profile 7a: Supplemental Oxygen
- Aggregate evidence quality: D; expert opinion and reasoning from first principles
- Benefit: use of supplemental oxygen only when beneficial, shorter hospitalization
- Harm: inadequate oxygenation
- Benefits-harms assessment: some benefit over harm
- Policy level: option

Evidence Profile 7b: Measurement of SpO2
- Aggregate evidence quality: D; expert opinion
- Benefit: shorter hospitalization
- Harm: inadequate oxygenation between measurements
- Benefits-harms assessment: some benefit over harm
- Policy level: option

Evidence Profile 7c: High-Risk Infants
- Aggregate evidence quality: B; observational studies with consistent findings
- Benefit: improved care of high-risk infants
- Harm: longer hospitalization, use of oxygen when not beneficial
- Benefits-harms assessment: preponderance of benefit over harm
- Policy level: Strong recommendation

RECOMMENDATION 8a
Clinicians may administer palivizumab prophylaxis to selected infants and children with CLD or a history of prematurity (recommendation: evidence level A; RCT; preponderance of benefit over harm).

RECOMMENDATION 8b
When given, prophylaxis with palivizumab should be given in 5 monthly doses, usually beginning in November or December, at a dose of 15 mg/kg per dose administered intramuscularly (recommendation: evidence level C; observational studies and expert opinion; preponderance of benefit over cost).

The 2006 Report of the Committee on Infectious Disease (Red Book) included the following recommendations for the use of palivizumab:
- Palivizumab prophylaxis should be considered for infants and children younger than 24 months of age with chronic lung disease of prematurity who have...
required medical therapy (supplemental oxygen, bronchodilator or diuretic or corticosteroid therapy) for CLD within 6 months before the start of the RSV season. Patients with more severe CLD who continue to require medical therapy may benefit from prophylaxis during a second RSV season. Data are limited regarding the effectiveness of palivizumab during the second year of life. Individual patients may benefit from decisions made in consultation with neonatologists, pediatric intensivists, pulmonologists, or infectious disease specialists.

- Infants born at 32 weeks of gestation or earlier may benefit from RSV prophylaxis, even if they do not have CLD. For these infants, major risk factors to consider include their gestational age and chronologic age at the start of the RSV season. Infants born at 28 weeks of gestation or earlier may benefit from prophylaxis during their first RSV season, whenever that occurs during the first 12 months of life. Infants born at 29 to 32 weeks of gestation may benefit most from prophylaxis up to 6 months of age. For the purpose of this recommendation, 32 weeks’ gestation refers to an infant born on or before the 32nd week of gestation (ie, 32 weeks, 0 days). Once a child qualifies for initiation of prophylaxis at the start of the RSV season, administration should continue throughout the season and not stop at the point an infant reaches either 6 months or 12 months of age.

- Although palivizumab has been shown to decrease the likelihood of hospitalization in infants born between 32 and 35 weeks of gestation (ie, between 32 weeks, 1 day and 35 weeks, 0 days), the cost of administering prophylaxis to this large group of infants must be considered carefully. Therefore, most experts recommend that prophylaxis should be reserved for infants in this group who are at greatest risk of severe infection and who are younger than 6 months of age at the start of the RSV season. Epidemiologic data suggest that RSV infection is more likely to lead to hospitalization for these infants when the following risk factor are present: child care attendance, school-aged siblings, exposure to environmental air pollutants, congenital abnormalities of the airways, or severe neuromuscular disease. However, no single risk factor causes a very large increase in the rate of hospitalization, and the risk is additive as the number of risk factors for an individual infant increases. Therefore, prophylaxis should be considered for infants between 32 and 35 weeks of gestation only if 2 or more of these risk factors are present. Passive household exposure to tobacco smoke has not been associated with an increased risk of RSV hospitalization on a consistent basis. Furthermore, exposure to tobacco smoke is a risk factor that can be controlled by the family of an infant at increased risk of severe RSV disease, and preventive measures will be far less costly than palivizumab prophylaxis. High-risk infants never should be exposed to tobacco smoke. In contrast to the well-documented beneficial effect of breastfeeding against many viral illnesses, existing data are conflicting regarding the specific protective effect of breastfeeding against RSV infection. High-risk infants should be kept away from crowds and from situations in which exposure to infected individuals cannot be controlled. Participation in group child care should be restricted during the RSV season for high-risk infants whenever feasible. Parents should be instructed on the importance of careful hand hygiene. In addition, all high-risk infants and their contacts should be immunized against influenza beginning at 6 months of age.

- In the Northern hemisphere and particularly within the United States, RSV circulates predominantly between November and March. The inevitability of the RSV season is predictable, but the severity of the season, the time of onset, the peak of activity, and the end of the season cannot be predicted precisely. There can be substantial variation in timing of community outbreaks of RSV disease from year to year in the same community and between communities in the same year, even in the same region. These variations, however, occur within the overall pattern of RSV outbreaks, usually beginning in November or December, peaking in January or February, and ending by the end of March or sometime in April. Communities in the southern United States tend to experience the earliest onset of RSV activity, and Midwestern states tend to experience the latest. The duration of the season for western and northeast regions typically occurs between that noted in the South and the Midwest. In recent years, the national median duration of the RSV season has been 15 weeks and even in the South, with a seasonal duration of 16 weeks, the range is 13 to 20 weeks. Results from clinical trials indicate that palivizumab trough serum concentrations >30 days after the fifth dose will be well above the protective concentration for most infants. If the first dose is administered in November, 5 monthly doses of palivizumab will provide substantially more than 20 weeks of protective serum antibody concentrations for most of the RSV season, even with variation in season onset and end. Changes from this recommendation of 5 monthly doses require careful consideration of the benefits and costs.

- Children who are 24 months of age or younger with hemodynamically significant cyanotic and acyanotic congenital heart disease will benefit from palivizumab prophylaxis. Decisions regarding prophylaxis with palivizumab in children with congenital heart disease should be made on the basis of the degree of physiologic cardiovascular compromise. Children younger
than 24 months of age with congenital heart disease who are most likely to benefit from immunoprophylaxis include:

- Infants who are receiving medication to control congestive heart failure
- Infants with moderate to severe pulmonary hypertension
- Infants with cyanotic heart disease

Results from 2 blinded, randomized, placebo-controlled trials with palivizumab involving 2789 infants and children with prematurity, CLD, or congenital heart disease demonstrated a reduction in RSV hospitalization rates of 39% to 78% in different groups.\textsuperscript{137,138} Results from postlicensure observational studies suggest that monthly immunoprophylaxis may reduce hospitalization from RSV in different high-risk groups.\textsuperscript{139} Palivizumab is not effective in the treatment of RSV disease and is not approved for this indication.

Several economic analyses of RSV immunoprophylaxis have been published.\textsuperscript{140–147} The primary benefit of immunoprophylaxis with palivizumab is a decrease in the rate of RSV-associated hospitalization. None of the 5 clinical RCTs have demonstrated a significant decrease in the rate of mortality attributable to RSV infection in infants who receive prophylaxis. Most of the economic analyses fail to demonstrate overall savings in health care dollars because of the high cost if all at-risk children were to receive prophylaxis. Estimates of cost per hospitalization prevented have been inconsistent because of considerable variation in the baseline rate of hospitalization attributable to RSV in different high-risk groups. Other considerations that will influence results include the effect of prophylaxis on outpatient costs and a resolution of the question of whether prevention of RSV infection in infancy decreases wheezing and lower respiratory tract problems later in childhood.

**Evidence Profile 8a: Palivizumab Prophylaxis**

- Aggregate evidence quality: A; RCTs
- Benefit: prevention of morbidity and mortality in high-risk infants
- Harm: cost
- Benefits-harms assessment: preponderance of benefit over harm
- Policy level: recommendation

**Evidence Profile 8b: Five-Dose Regimen**

- Aggregate evidence quality: C; observational studies and expert opinion
- Benefit: decreased cost resulting from using minimal number of needed doses
- Harm: risk of illness from RSV outside the usual season
- Benefits-harms assessment: preponderance of benefit over harm
- Policy level: recommendation

**RECOMMENDATION 9a**

Hand decontamination is the most important step in preventing nosocomial spread of RSV. Hands should be decontaminated before and after direct contact with patients, after contact with inanimate objects in the direct vicinity of the patient, and after removing gloves (strong recommendation: evidence level B; observational studies with consistent results; strong preponderance of benefit over harm).

**RECOMMENDATION 9b**

Alcohol-based rubs are preferred for hand decontamination. An alternative is hand-washing with antimicrobial soap (recommendation: evidence level B; observational studies with consistent results; preponderance of benefit over harm).

**RECOMMENDATION 9c**

Clinicians should educate personnel and family members on hand sanitation (recommendation: evidence level C; observational studies; preponderance of benefit over harm).

Efforts should be made to decrease the spread of RSV and other causative agents of bronchiolitis in medical settings, especially in the hospital. RSV RNA has been identified in air samples as much as 22 feet from the patient’s bedside.\textsuperscript{148} Secretions from infected patients can be found on beds, crib railings, tabletops, and toys. Organisms on fomites may remain viable and contagious for several hours.\textsuperscript{149}

It has been shown that RSV as well as many other viruses can be carried and spread to others on the hands of caregivers.\textsuperscript{150} Frequent hand-washing by health care workers has been shown to reduce RSV’s nosocomial spread.\textsuperscript{150} The Centers for Disease Control and Prevention published an extensive review of the hand-hygiene literature and made recommendations as to indications for hand-washing and hand antisepsis.\textsuperscript{151} Among the recommendations are that hands should be decontaminated before and after direct contact with patients, after contact with inanimate objects in the direct vicinity of the patient, and after removing gloves. If hands are not visibly soiled, an alcohol-based rub is preferred. An alternative is to wash hands with an antimicrobial soap. The guideline also describes the appropriate technique for using these products.

Other methods that have been shown to be effective in controlling the spread of RSV are education of personnel and family members; surveillance for the onset of RSV season; use of gloves, with frequent changes to avoid the spread of organisms on the gloves; and wearing gowns for direct contact with the patient. It has not
been clearly shown that wearing masks offers additional benefit to the above-listed measures.\textsuperscript{149} Isolation and/or cohorting of RSV-positive patients, including assignment of personnel to care only for these patients, is effective\textsuperscript{152,153} but may not be feasible. Strict hand decontamination and education of staff and families about prevention of spread of organisms is essential regardless of whether isolation is used.

Programs that implement the above-mentioned principles have been shown to decrease the nosocomial spread of RSV. Johns Hopkins Hospital (Baltimore, MD) instituted a program of pediatric droplet precaution for all children less than 2 years old with respiratory symptoms during RSV season until the child is shown to not have RSV. Nosocomial transmission of RSV decreased by approximately 50%. Before intervention, a patient was 2.6 times more likely to have nosocomially transmitted RSV than after the intervention.\textsuperscript{154} A similar program at Children’s Hospital of Philadelphia (Philadelphia, PA) resulted in a decrease of nosocomial RSV infections of 39%.\textsuperscript{155}

**Evidence Profile 9a: Hand Decontamination**
- Aggregate evidence quality: B; observational studies with consistent findings
- Benefit: decreased spread of infection
- Harm: time
- Benefits-harms assessment: strong preponderance of benefit over harm
- Policy level: strong recommendation

**Evidence Profile 9b: Alcohol-Based Rubs**
- Aggregate evidence quality: B; observational studies with consistent findings
- Benefit: decreased spread of infection
- Harm: irritative effect of alcohol-based rubs
- Benefits-harms assessment: preponderance of benefit over harm
- Policy level: recommendation

**Evidence Profile 9c: Education**
- Aggregate evidence quality: C; observational studies
- Benefit: decreased spread of infection
- Harm: time, cost of gloves and gowns if used, barriers to parental contact with patient
- Benefits-harms assessment: preponderance of benefit over harm
- Policy level: recommendation

**Evidence Profile 10a: Secondhand Smoke**
- Aggregate evidence quality: B; observational studies with consistent findings
- Benefit: decreased risk of LRTI

**RECOMMENDATION 10a**
Infants should not be exposed to passive smoking (strong recommendation: evidence level B; observational studies with consistent results; strong preponderance of benefit over harm).

**RECOMMENDATION 10b**
Breastfeeding is recommended to decrease a child’s risk of having lower respiratory tract disease (LRTD) (recommendation: evidence level C; observational studies; preponderance of benefit over harm).

**Tobacco Smoke**
Passive smoking increases the risk of having an RSV infection with a reported odds ratio of 3.87.\textsuperscript{156} There have been numerous studies on the effect of passive smoking on respiratory illness in infants and children. In a systematic review of passive smoking and lower respiratory illness in infants and children, Strachan and Cook\textsuperscript{157} showed a pooled odds ratio of 1.57 if either parent smoked and an odds ratio of 1.72 if the mother smoked. Stocks and Dezateux\textsuperscript{158} reviewed 20 studies of pulmonary function in infants. These studies showed a significant decrease in pulmonary function in infants of mothers who smoked during and after pregnancy. Forced expiratory flow was decreased by approximately 20%. Other measures of pulmonary function were likewise abnormal.

Paternal smoking also has an effect. The prevalence of upper respiratory tract illness increased from 81.6% to 95.2% in infants under 1 year of age in households where only the father smoked.\textsuperscript{159}

**Breastfeeding**
Breast milk has been shown to have immune factors to RSV including immunoglobulin G and A antibodies\textsuperscript{160} and interferon-\textalpha.\textsuperscript{161} Breast milk has also been shown to have neutralizing activity against RSV.\textsuperscript{162} In one study the relative risk of hospital admission with RSV was 2.2 in children who were not being breastfed.\textsuperscript{163} In another study, 8 (7%) of 115 children hospitalized with RSV were breastfed, and 46 (27%) of 167 controls were breastfed.\textsuperscript{164}

A meta-analysis of the relationship of breastfeeding and hospitalization for LRTD in early infancy\textsuperscript{165} examined 33 studies, all of which showed a protective association between breastfeeding and the risk of hospitalization for LRTD. Nine studies met all inclusion criteria for analysis. The conclusion was that infants who were not breastfed had almost a threefold greater risk of being hospitalized for LRTD than those exclusively breastfed for 4 months (risk ratio: 0.28).

**Evidence Profile 10a: Secondhand Smoke**
- Aggregate evidence quality: B; observational studies with consistent findings
- Benefit: decreased risk of LRTI
Evidence Profile 11: Asking About CAM

- Harm: none
- Benefits-harms assessment: strong preponderance of benefit over harm
- Policy level: strong recommendation

Evidence Profile 10b: Breastfeeding

- Aggregate evidence quality: C; observational studies
- Benefit: improved immunity, decreased risk of LRTI, improved nutrition
- Harm: implied inadequacy of mothers who cannot or prefer to not breastfeed
- Benefits-harms assessment: preponderance of benefit over harm
- Policy level: recommendation

RECOMMENDATION 11

Clinicians should inquire about use of CAM (option: evidence level D; expert opinion; some benefit over harm).

No recommendations for CAM for treatment of bronchiolitis are made because of limited data. Clinicians now recognize that an increasing number of parents/caregivers are using various forms of nonconventional treatment for their children. Treatments that have been used specifically for bronchiolitis include homeopathy, herbal remedies, osteopathic manipulation, and applied kinesiology. Substantially more data are available regarding the use of homeopathic and herbal remedies for the treatment of bronchiolitis and the common cold. Whether these therapies would prevent the development of bronchiolitis is unknown. A single recent trial indicated that an herbal preparation containing *Echinacea*, propolis, and vitamin C prevented the development of upper respiratory infections in children between the ages of 1 and 5 years. Bronchiolitis was not specifically studied.

To date, there are no studies that conclusively show a beneficial effect of alternative therapies used for the treatment of bronchiolitis. Recent interest in the use of CAM has led to research efforts to investigate its efficacy. It is difficult to design and conduct studies on certain forms of CAM because of the unique nature of the treatment. Any study conducted will need to show proof of effectiveness of a specific therapy when compared with the natural history of the disease. Conclusions regarding CAM cannot be made until research evidence is available. However, because of the widespread use of CAM, clinicians should ask parents what alternative forms of treatment they are using and be ready to discuss potential benefits or risks.

Evidence Profile 11: Asking About CAM

- Aggregate evidence quality: D; expert opinion
- Benefit: improved parent-physician communication, awareness of other, possibly harmful treatments being used
- Harm: time required for discussion, lack of knowledge about CAM by many pediatricians
- Benefits-harms assessment: some benefit over harm
- Policy level: option

FUTURE RESEARCH

The AHRQ evidence report points out that outcomes measured in future studies of bronchiolitis should be clinically relevant and of interest to parents, clinicians, and health systems. Among the recommended outcomes are rates of hospitalization, need for more intensive services in the hospital, costs of care, and parental satisfaction with treatment. One of the difficulties with the bronchiolitis literature is the absence of validated clinical scoring scales that are objective, replicable, and can be easily be performed in the hospital, emergency department, and outpatient settings. Studies should also be of sufficient size to be able to draw meaningful conclusions for the above-mentioned outcomes. Because bronchiolitis is a self-limited disease, large numbers of patients would need to be enrolled to observe small changes in outcome. This would necessitate large multicenter study protocols. Currently, such multicentered studies are being conducted in the United States and Canada on the use of corticosteroids in the emergency department.

Future research should include:

- development of rapid, cost-effective tests for viruses other than RSV that may also play a role in bronchiolitis;
- studies to determine if there are selected patients who may benefit from bronchodilators or corticosteroids;
- clinical studies of the target SpO2 for the most efficient use of oxygen and oxygen monitoring;
- development of new therapies including new antiviral medications;
- continued research into the development of an RSV vaccine; and
- continued development of immunoprophylaxis that would require fewer doses and decreased cost.

SUMMARY

This clinical practice guideline provides evidence-based recommendations on the diagnosis and management of bronchiolitis in infants less than 2 years of age. It emphasizes using only diagnostic and management modalities that have been shown to affect clinical outcomes.

Bronchiolitis is a clinical diagnosis that does not require diagnostic testing. Many of the commonly used management modalities have not been shown to be effective in improving the clinical course of the illness. This includes the routine use of bronchodilators, cortic-
corticosteroids, ribavirin, antibiotics, chest physiotherapy, and complementary and alternative therapies. Options for the appropriate use of oxygen and oxygen monitoring have been presented. Specific prevention with palivizumab and general prevention, particularly the use of hand decontamination to prevent nosocomial spread, were also discussed.

CONCLUSIONS

1a. Clinicians should diagnose bronchiolitis and assess disease severity on the basis of history and physical examination. Clinicians should not routinely order laboratory and radiologic studies for diagnosis (recommendation).

1b. Clinicians should assess risk factors for severe disease such as age less than 12 weeks, a history of prematurity, underlying cardiopulmonary disease, or immunodeficiency when making decisions about evaluation and management of children with bronchiolitis (recommendation).

2a. Bronchodilators should not be used routinely in the management of bronchiolitis (recommendation).

2b. A carefully monitored trial of α-adrenergic or β-adrenergic medication is an option. Inhaled bronchodilators should be continued only if there is a documented positive clinical response to the trial using an objective means of evaluation (option).

3. Corticosteroid medications should not be used routinely in the management of bronchiolitis (recommendation).

4. Ribavirin should not be used routinely in children with bronchiolitis (recommendation).

5. Antibacterial medications should only be used in children with bronchiolitis who have specific indications of the coexistence of a bacterial infection. When present, bacterial infection should be treated in the same manner as in the absence of bronchiolitis (recommendation).

6a. Clinicians should assess hydration and ability to take fluids orally (strong recommendation).

6b. Chest physiotherapy should not be used routinely in the management of bronchiolitis (recommendation).

7a. Supplemental oxygen is indicated if SpO₂ falls persistently below 90% in previously healthy infants. If the SpO₂ does persistently fall below 90%, adequate supplemental oxygen should be used to maintain an SpO₂ at or above 90%. Oxygen may be discontinued if SpO₂ is at or above 90% and the infant is feeding well and has minimal respiratory distress (option).

7b. As the child’s clinical course improves, continuous measurement of SpO₂ is not routinely needed (option).

7c. Infants with a known history of hemodynamically significant heart or lung disease and premature infants require close monitoring as oxygen is being weaned (strong recommendation).

8a. Clinicians may administer palivizumab prophylaxis for selected infants and children with CLD or a history of prematurity (less than 35 weeks’ gestation) or with congenital heart disease (recommendation).

8b. When given, prophylaxis with palivizumab should be given in 5 monthly doses, usually beginning in November or December, at a dose of 15 mg/kg per dose administered intramuscularly (recommendation).

9a. Hand decontamination is the most important step in preventing nosocomial spread of RSV. Hands should be decontaminated before and after direct contact with patients, after contact with inanimate objects in the direct vicinity of the patient, and after removing gloves (strong recommendation).

9b. Alcohol-based rubs are preferred for hand decontamination. An alternative is hand-washing with antimicrobial soap (recommendation).

9c. Clinicians should educate personnel and family members on hand sanitation (recommendation).

10a. Infants should not be exposed to passive smoking (strong recommendation).

10b. Breastfeeding is recommended to decrease a child’s risk of having LRTD (recommendation).

11. Clinicians should inquire about use of CAM (option).

SUBCOMMITTEE ON THE DIAGNOSIS AND MANAGEMENT OF BRONCHIOLITIS, 2004–2006

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**Evidence-Based Care Guideline**

**Bronchiolitis**

**Management of first time episode**

**Bronchiolitis in infants less than 1 year of age**

In the target population, the objectives of this guideline are to:

- avoid the use of unnecessary diagnostic studies
- decrease the use of medications and respiratory therapy without observed improvement
- improve the rate of appropriate admission
- decrease the rate of nosocomial infection
- improve the use of appropriate monitoring activities
- maintain or improve the length of stay.

Bronchiolitis is an acute inflammatory disease of the lower respiratory tract, resulting from obstruction of small airways. It is initiated by infection of the upper respiratory tract by any one of a number of seasonal viruses. The most common virus responsible for bronchiolitis is respiratory syncytial virus (RSV) (Andreoletti 2000 [3b], Miron 2010 [4a], CDC-MMWR 2007 [4a], AAP 2006 [5a], Williams 2004 [5a], Hall 2001 [5a], Stark 1991 [5a]). RSV also accounts for the highest severity of this condition (Marguet 2009 [4a], Corsello 2008 [4a], Williams 2004 [5a]).

References in parentheses ( ). Evidence strengths in [ ]. (See last page for definitions.)

**Target Population**

**Inclusion:** Intended primarily for use in children:
- age less than 1 year and presenting for the first time with bronchiolitis typical in presentation and clinical course

**Exclusion:** Not intended for use in children:
- with a history of cystic fibrosis (CF)
- with a history of bronchopulmonary dysplasia (BPD)
- with immunodeficiencies
- admitted to an intensive care unit (ICU)
- requiring ventilator care
- with other severe comorbid conditions complicating care

**Target Users**

Includes but is not limited to (in alphabetical order):
- Patient / family
- Patient care staff
- Physicians

Bronchiolitis is the number one cause of hospitalizations in U.S. infants less than one year of age. Total annual costs for bronchiolitis-related hospitalizations were $543 million, with a mean cost of $3799 per hospitalization when analyzed by the 2002 Health-Care Utilization Project (Pelletier 2006 [4a]). These hospitalizations account for 1.4 million infant care days and 718,008 Emergency Department visits. The national average duration of hospitalization is 3.9 days. Local experience at the time of publication is 2.0 days. RSV-associated deaths account for less than 400 infant deaths per year in the U.S. The risk factors for death from bronchiolitis are prematurity, low birth weight, black race, young maternal age, and smoking during pregnancy (data analysis via the National Hospital Discharge Survey data; National Hospital Ambulatory Medical Care Survey data; National Hospital Discharge Survey data, 1997 to 2000 and Perinatal Mortality Linked Files 1998 to 1999) (Leader 2003 [4a]).

Most infants who contract bronchiolitis recover without sequelae; however, subsequent wheezing episodes have been found in older children who were hospitalized for bronchiolitis in infancy (van Woensel 2000 [2b], Sigurs 2004 [3a], Sigurs 2002 [3a]). It is still not known, however, whether RSV bronchiolitis in infancy by itself causes the post-bronchiolitic wheezing symptoms or whether some inherent factor in the child contributes both to the bronchiolitis and to the subsequent wheezing (Sigurs 2004 [3a], Panitch 2007 [5a]).

Despite the commonality of bronchiolitis, considerable confusion and variability with respect to the clinical management of these infants remains (Knapp 2010 [4a], Knapp 2008 [4a], Conway 2006 [4a], Christakis 2005 [4a]). Typical bronchiolitis in infants is a self-limited viral disease that is little modified by aggressive evaluations, use of antibiotics or other therapies (Knapp 2008 [4a], Christakis 2005 [4a], Mansbach 2005 [4a]). Several studies on the use of clinical guidelines for the management of infant bronchiolitis have shown a reduction in unnecessary resource utilization with streamlining of medical care for these infants (Barben 2008 [4a], Muelting 2004 [4a], Kotagal 2002 [4a], Harrison 2001 [4a], Perlie 2000 [4a], Perlstein 1999 [4a]).
Guideline Recommendations

Prevention

Prevention of hospitalization and significant morbidity is a high priority in the management of this lower respiratory tract infection. Infants less than three months of age, premature infants (< 35 weeks gestation), and infants with chronic lung disease, congenital heart disease, or immune deficiency syndromes who are diagnosed with bronchiolitis may be at particular risk for hospitalization and significant morbidity (Koehoorn 2008 [4a], Shay 2001 [4a], Boyce 2000 [4a], Church 1984 [4a]).

Prevention Measures

Community

1. It is recommended that measures to prevent acute bronchiolitis be reviewed with parents of newborns prior to discharge from the hospital and at follow-up visits in the first years of life. These specific measures include:
   - an emphasis on hand washing in all settings (Luby 2005 [2a], Hall 2007 [3a], AAP 2006 [5a])
   - eliminating exposure to environmental tobacco smoke or pollution exposure (Bradley 2005 [3a], Karr 2009 [4a], Koehoorn 2008 [4a], Karr 2007 [4a], Mahabee-Gittens 2002 [4a], AAP 2006 [5a])
   - limiting exposure to contagious settings and siblings (e.g. daycare centers) (Celedon 1999 [3a], Wald 1991 [3a], Koehoorn 2008 [4a])
   - protective benefits of breastfeeding for 6 months (Dornelles 2007 [3a], Koehoorn 2008 [4a], AAP 2006 [5a])
   - preventive medical therapies such as palivizumab (Synagis®, MedImmune); may be considered for selected high-risk patients (Robinson 2010 [1a], Impact-RSVStudyGroup 1998 [2a], Romero 2003 [5a]).

   Note: Although palivizumab (Synagis®, MedImmune) has been shown to reduce rates of hospitalization while remaining safe (Impact-RSVStudyGroup 1998 [2a], Chang 2010 [4a], Mitchell 2006 [4a]), its use has not demonstrated cost-effectiveness for all infants due to the high cost of the medication and persistently low mortality rates associated with RSV-bronchiolitis and warrants further review (Rackham 2005 [1a], Yount 2004 [1a], Joffe 1999 [2a], Wegner 2004 [3a], Heikkinen 2005 [4a]).

Hospital

2. It is recommended, in patients with documented bronchiolitis, that respiratory-contact isolation policies be observed for protection of all patients from nosocomial infections: (Hall 2007 [3a], Langley 1997 [3a], CCHMC ICRM-735 [Local Consensus])

   Note: Airborne droplets were not the major mode of transmission of nosocomial infection during respiratory season on one infants’ ward, suggesting that effective infection control depends on infection control policy compliance and awareness of the risks of nosocomial infection for both patients and personnel (Hall 2007 [3a]).

Emergency Department / Inpatient Management

Assessment and Diagnosis

The diagnosis of bronchiolitis and its severity is rooted in the clinician's interpretation of the constellation of characteristic findings and is not dependent on any specific clinical finding or diagnostic test (Bordley 2004 [1a]). Infants with acute bronchiolitis may present with a wide range of clinical symptoms and severity, from mild upper respiratory infections to impending respiratory failure.

3. It is recommended that the clinical history and physical examination be the basis for a diagnosis of bronchiolitis (AAP 2006 [5a]). Diagnostic criteria for bronchiolitis include, but are not limited to, the following:
   - preceding upper respiratory illness and/or rhinorrhea
   - exposure to persons with viral upper respiratory infection
   - signs of respiratory illness which may include the following common respiratory symptoms:
     - tachypnea
     - retractions
     - shortness of breath
     - low O₂ saturation.

General

The basic management of typical bronchiolitis is anchored in the provision of therapies that assures the patient is clinically stable, well oxygenated, and well hydrated. The main benefits of hospitalization of infants with acute bronchiolitis are: (Klassen 1997 [1b], AAP 2006 [5a], Lugo 1993 [5a], Panitch 1993 [5a], Nicolai 1990 [5a], LocalConsensus [5a])

   - the careful monitoring of clinical status,
   - maintenance of a patent airway (through positioning, suctioning, and mucus clearance),
   - maintenance of adequate hydration, and
   - parental education.

Monitoring

4. It is recommended that repeated clinical assessment be conducted, as this is the most important aspect of monitoring for deteriorating respiratory status (LocalConsensus [5a]).

5. It is recommended to consider cardiac and respiratory rate monitoring in hospitalized patients during the acute stage of bronchiolitis when the risk...
of apnea and/or bradycardia is greatest (Anas 1982 [3b], Church 1984 [4a]).

**Note 1:** Premature infants, infants with underlying chronic conditions predisposing to apnea, infants with a witnessed episode of apnea, and infants less than three months of age who contract RSV are at particular risk of severe complications such as apnea and mechanical ventilation (Wang 1995 [3a], Anas 1982 [3b], Willwerth 2006 [4a], Church 1984 [4a], Krassinski 1985 [4b]). There is not enough available data to precisely quantify other risks of apnea attributable to RSV infection (Ralston 2009 [1a]).

**Note 2:** Several studies have reported more severe progression of disease in children with bronchiolitis who present with low initial oxygen saturations (Wang 1995 [3a], Shaw 1991 [3a], Mulholland 1990 [3b]).

### Oxygen and Medications

6. It is recommended to administer supplemental oxygen when the saturation remains less than 91% and consider weaning oxygen when saturation remains higher than 94% (NAEPP 2007 [5a], AAP 2006 [5a], LocalConsensus [5a]).

**Note:** There is not enough evidence to determine which of the non-invasive delivery methods available are best to be used in the treatment of hypoxemia in children with lower respiratory tract infections. Factors to consider when choosing an oxygen delivery method include: (Rojas-Reyes 2009 [1a], Sung 2008 [4b])

- efficacy
- patient tolerability
- availability
- cost.

7. It is recommended that a single trial inhalation using epinephrine or albuterol be considered on an individual basis, such as when there is a family history of allergy, asthma, or atopy. (Hartling 2004 [1a], Klassen 1997 [1b], Mood 2005 [3b], Numa 2001 [3b], AAP 2006 [5a]). (see Attachment – Aerosolized drugs and dosages for trial inhalation).

**Note 1:** It is expected if a trial inhalation is used that a measured clinical improvement be demonstrated for this therapy to be continued. In one study, inhalation therapies were continued on average, 50% of the time (Emergency Department and inpatient) despite documented non-response to the therapy, exposing the patient to unnecessary therapy and cost (Lugo 1998 [4b]).

**Note 2:** Nebulized racemic epinephrine demonstrates better short-term improvement in pulmonary physiology and clinical scores compared with albuterol or placebo (Hartling 2003 [1a], Walsh 2008 [2a], Wainwright 2003 [2a], Langley 2005 [2b], Numa 2001 [3b]).

### Respiratory Care Therapy

8. It is recommended the infant be suctioned, when clinically indicated: (LocalConsensus [5a])

- before feedings,
- as needed (PRN),
- prior to each inhalation therapy.

**Note 1:** In order to appropriately measure improvement in clinical status due to the therapeutic effects of the medication, the following reasons for suctioning are considered:

- Suctioning itself may improve respiratory status such that inhalation therapy is not necessary. Thus, it is important to document the pre-and post-suction clinical score prior to treatment.
- Suctioning may improve the delivery of the inhalation treatment (LocalConsensus [5a]).
- Suctioning of the nares may provide relief of nasal congestion (AAP 2006 [5a]).

**Note 2:** Normal saline nose drops may be used prior to suctioning (LocalConsensus [5a]).

9. It is recommended that spot checks of pulse oximetry be conducted in infants with bronchiolitis as clinically indicated (LocalConsensus [5a]).

**Note 1:** At CCHMC, a spot check is performed at any point a clinical need is assessed, before and after suctioning, and before and after any inhalation to determine consistent oxygen level, or any improvement from therapies (LocalConsensus [5a]).

**Note 2:** Continuous oximetry measurement has been associated with mean increased length of stay (Unger 2008 [4a]) of 1.6 days (95% CI 1.1 to 2.0) (Schroeder 2004 [4b]).

**Note 3:** Wide variability has been demonstrated in the manner in which clinicians use and interpret pulse oximetry readings in children with bronchiolitis. This variability results in increased preferences for hospital admission and increased length of stay for children admitted with bronchiolitis (Mallory 2003 [2a], Unger 2008 [4a], Schroeder 2004 [4b]).

**Note 3:** Transient oxygen desaturation episodes have been documented in studies of healthy, term infants and determined to be representative of normal breathing and oxygenation behavior (Poets 2009 [2a], Hunt 1999 [3b]).
Education

10. It is recommended that the family be educated on the following topics regarding the care of a child with bronchiolitis:

- to call their primary care provider if the following signs of worsening clinical status are observed: (LocalConsensus [5a])
  - increasing respiratory rate and/or work of breathing as indicated by use of accessory muscle
  - inability to maintain adequate hydration
  - worsening general appearance
- basic pathophysiology and expected clinical course of bronchiolitis including lingering symptoms which may continue to disrupt child and family routines (Robbins 2006 [3a]).

Note: The median duration of illness for children < 1 year of age with bronchiolitis has been shown to be 12 days (Petruzella 2010 [3b]). After 21 days approximately 18% to 28% will remain ill (Robbins 2006 [3a], Swingler 2000 [3a], Petruzella 2010 [3b]).
- proper techniques for suctioning the nose and making breathing easier (LocalConsensus [5a]).
- screening over-the-counter (OTC) drug labels to avoid misuse of drugs not recommended for use in this age group (Carr 2006 [5a])(see Recommendation #18).

11. It is recommended that the family be educated on the following topics regarding prevention of respiratory infection in infants:

- eliminating exposure to environmental tobacco smoke (Mahabee-Gittens 2002 [4a])
- limiting exposure to contagious settings and siblings (e.g. daycare centers) (Celedon 1999 [3a])
- an emphasis on hand washing in all settings (Hall 1981 [3b]).

Admission Criteria

12. It is recommended that every patient be individually assessed for admission status as there have been no findings from physical examination that have been consistently associated with outcomes of bronchiolitis (AAP 2006 [5a], LocalConsensus [5a]). Admission criteria remain a clinical judgment weighing numerous factors rather than applying a discrete set of criteria. (LocalConsensus [5a])

The following includes factors to consider:

**Respiratory Status**

- respiratory distress, apnea, respirations greater than 70 per minute and/or clinical evidence of increased work of breathing
- patient requires oxygen supplementation

**Nutritional Status**

- patient requires continuous clinical assessment of airway clearance and maintenance using bulb suctioning

**Social**

- parent or guardian is not prepared to provide care at home
- family education is not complete
- home resources are inadequate to support the use of any necessary home therapies

Discharge Criteria

13. It is recommended that individualized discharge planning begin on admission. Although studied, there is no clear evidence as to what constitutes risk for readmission following a bronchiolitis visit/hospitalization (Mansbach 2008 [3a], Kemper 2005 [4a]), therefore discharge criteria remain a clinical judgment weighing numerous factors rather than applying a discrete set of criteria. The following includes factors to consider individually and are intended to prepare the family for a timely and safe discharge: (LocalConsensus [5a]).

**Respiratory Status**

- respirations less than 70 per minute and/or no clinical evidence of increased work of breathing or distress
- parent can clear the infant’s airway using bulb suctioning
- patient’s oxygen saturation remains >91% on room air

**Nutritional Status**

- the patient is on oral feedings at a level to prevent dehydration

**Social**

- home resources are adequate to support the use of any necessary home therapies
- parent or guardian is confident they can provide care at home
- family education complete

**Follow Up**

- when indicated, home care and durable medical supply (DMS) agencies have been notified and arrangements for visits finalized
- primary care provider identified, notified, and agrees with discharge decision
- follow-up appointments have been scheduled.
Therapies NOT Routinely Recommended

Inhalations

14. It is recommended that scheduled or serial inhalation therapies **not** be used routinely nor repeated if there is no measured improvement in clinical outcome after a *trial* inhalation. In the majority of cases the use of inhalation and other therapies will not be efficacious for treating the airway edema typical of bronchiolitis (Gadomski 2009 [1a], King 2004 [1a], Gupta 2008 [2a], Patel 2003 [2a], Wainwright 2003 [2a], Beck 2007 [2b], Ralston 2005 [2b], Conway 2004 [3a], Lenney 1978 [3b], AAP 2006 [5a]).

**Note 1:** Some cases of bronchiolitis may be a prelude to asthma (Sigurs 2004 [3a], Sigurs 2002 [3a], Martinez 1995 [3a], Stark 1991 [5a]) and several studies using bronchodilators in children with bronchiolitis have demonstrated an improvement of clinical scores; however, decrease in hospitalization rates or LOS have not been shown (Gadomski 2009 [1a], Hartling 2004 [1a], Flores 1997 [1a], Klassen 1997 [1b], Karadag 2008 [2b], Langley 2005 [2b]) and improvement results are not consistent.

**Note 2:** Deterioration and desaturation have been associated with inhalation therapies (Dobson 1998 [2b], Ho 1991 [2b], Numa 2001 [3b]).

Hypertonic Saline Inhalations

15. It is recommended that hypertonic saline inhalations **not** be given for the routine treatment of bronchiolitis due to inconsistent evidence regarding its effectiveness.

**Note 1:** Studies exploring the use of hypertonic saline in children with bronchiolitis have not been homogeneous enough to validate this therapy.

No Improvement: (Anil 2010 [2a], Grewal 2009 [2b])

Improvement: (Zhang 2008 [1a]).

**Note 2:** Given the difficulty in distinguishing between asthma and viral bronchiolitis in infants, the possibility of acute bronchospasm induced by the use of hypertonic saline alone in potential asthmatics remains a concern and deserves continued attention (Zhang 2008 [1a]).

One study looking at the use of 3% saline solution without adjunctive bronchodilators had a low overall adverse event rate of 1% (95% confidence interval [CI]: 0.3%, 2.8%).

Event rate for bronchospasm was 0.3% (95% CI: 0.01%, 1.6%) Additional clinical trials are warranted (Ralston 2010 [4a]).

Corticosteroids

16. It is recommended that steroid therapy **not** be given (as inhalations, intravenously, orally, or intramuscularly) as one time or repeated treatment (Fernandes 2010 [1a], King 2004 [1a], Panickar 2009 [2a], Panickar 2008a [5a], AAP 2006 [5a]).

**Note:** When comparing glucocorticoids to placebo, a recent systematic review found no differences for either hospital admissions, length of stay, or benefit in other health outcomes. Exploratory results from one large high-quality trial suggest that combined treatment of systemic glucocorticoids (dexamethasone) and bronchodilators (epinephrine) may significantly reduce hospital admissions (Fernandes 2010 [1a], Plint 2009 [2a]). No relevant short-term adverse effects due to steroids were seen; however, long-term safety was not assessed. One large randomized economic analysis demonstrated dexamethasone with epinephrine resulted in a societal cost savings when compared to placebo or either component alone (Sumner 2010 [2a]). Efficacy, safety and applicability of this approach have not been established (Fernandes 2010 [1a]).

**Note 2:** No effect on prevention of post-bronchiolitis wheezing was found when inhaled corticosteroids were given during the acute phase of bronchiolitis (Blom 2009 [1a]).

Antibiotics

17. It is recommended that antibiotics **not** be used in the absence of an identified bacterial focus (Spurling 2009 [1b], Kabir 2009 [2a], Friis 1984 [2a], AAP 2006 [5a]).

**Note:** Previously healthy, febrile children 24 months or younger with bronchiolitis evaluated as outpatients are unlikely to have bacteremia; risk of urinary tract infection is also small (<2%) (Kuppermann 1997 [3a], Purcell 2004 [4a], Purcell 2002 [4a], Liebelt 1999 [4a], Antonow 1998 [4a]). If antibiotics are used, exercise caution and consider potential side effects, cost to the patient and the community, and increasing bacterial resistance to antibiotics (Spurling 2009 [1b]).

Other Medications

18. It is recommended that the following drugs **not** be used in the treatment of bronchiolitis at this time. There has not been sufficient nor consistent proven benefit over supportive therapies necessitating further studies:

- antibodies (immunoglobulins) (Fuller 2009 [1a])
- montelukast (Singulair®)
  (No Improvement (Amirav 2008 [2b]))
  (Improvement (Zedan 2010 [2b]))
Evidence-Based Care Guideline For Infants with Bronchiolitis

Over-the-Counter Remedies

19. It is recommended that antihistamines, oral decongestants, and nasal vasoconstrictors not be used for routine therapy due to potentially life-threatening side effects (Vassilev 2009 [4a], Kernen 2000 [4a], FDA 2008 [5a]) and lack of demonstrated efficacy (Smith 2010 [1a], Ralston 2008 [2b], AAP Committee on Drugs 1997 [5a], Gadomski 1992 [5b]).

Note 1: On January 17, 2008 the Food and Drug Administration (FDA) issued a public health advisory titled: FDA Recommends that Over-the-Counter Cough and Cold Products not be used for Children under Two-Years-of-Age because serious and potentially life-threatening side effects can occur (FDA 2008 [5a]).

Note 2: A survey of parents and physicians in a Midwest community found that despite safety warnings and noted lack of efficacy of these medications to reduce cough or congestion in infants with upper and lower respiratory tract infections, parents are still giving their young children OTC cough and cold medications. This may be due to a lack of awareness of the FDA recommendations (Yaghmai 2010 [4a]) or label confusion (Lokker 2009 [4a]) and may contribute to childhood morbidity and mortality (Yaghmai 2010 [4a]).

Note 3: Parent education may include information about drugs in OTC cold and cough remedies which are not recommended for this age population: (Smith 2010 [1a], FDA 2008 [5a], Carr 2006 [5a])

- diphenhydramine
- brompheniramine
- chlorpheniramine
- dextromethorphan
- pseudoephedrine
- phenylephrine
- guaifenesin

Other Respiratory Support Therapies

20. It is recommended that other respiratory care therapies not be used routinely, as they have not been found to be helpful (AAP 2006 [5a]). These include:

- aerosol therapy with saline (Gadomski 1994 [2a], Chowdhury 1995 [2b], Ho 1991 [2b]).
- chest physiotherapy (CPT) (Perrotta 2007 [1a], Panickar 2008 [5a]).

Note: Although rare, a correlation between CPT and rib fracture in infants 4 weeks to 2 years of age with bronchiolitis or pneumonia (1:1000) was found in one study (Chalumeau 2002 [4a]).

Diagnostic Studies

21. It is recommended that diagnostic studies (RSV swab, chest X-rays, cultures, capillary or arterial blood gases, rapid influenza or other rapid viral studies) not be performed routinely to determine viral infection status or to rule out serious bacterial infections. Such studies are not generally helpful and may result in increased rates of unnecessary admission, further testing, and unnecessary therapies (Bordley 2004 [1a], Swingler 1998 [2a], Kuppermann 1997 [3a], Henrickson 2007 [4a], Liebelt 1999 [4a], Antonow 1998 [4a], AAP 2006 [5a]).

Note 1: For infants with typical bronchiolitis omitting radiography is cost-saving without compromising diagnostic accuracy of alternate diagnoses and of associated pneumonia (Yong 2009 [3a]). Chest X-rays may be obtained as clinically indicated when the diagnosis of bronchiolitis is not clear (Bordley 2004 [1a], Swingler 1998 [2a], Schuh 2007 [3a], El-Radhi 1999 [3a]).

Note 2: In selected very young infants, establishing a source through rapid viral testing may prevent unnecessary additional workup (Bordley 2004 [1a], Liebelt 1999 [4a]).

Future Research Agenda

Clinical questions related to guideline recommendations and of potential interest in the management of infants less than 1 year of age with bronchiolitis:

- Does suctioning affect hospitalization rates or length of stay?
- Does the use of continuous versus spot check pulse oximetry decrease length of stay and maintain a safe hospitalization?
- Does the use of epinephrine in the outpatient setting decrease emergency department visits or hospitalization rates?
- Does the use of beta2-agonists decrease the length of stay?
- Does the use of epinephrine versus albuterol versus supportive care decrease the length of stay?
• Does the use of corticosteroids plus epinephrine decrease length of stay or duration of symptoms?

• Does the use of respiratory scoring decrease unnecessary use of inhalation therapies?

• Does the use of hypertonic saline inhalations in first time wheezing infants less than 1 year of age improve clinical outcomes of interest, including length of stay:

• If improvements are found with use of hypertonic saline inhalations in wheezing infants less than 1 of age what administration frequency is optimal?
Algorithm for medical management of Bronchiolitis
in infants less than 1 year of age presenting with a first time episode

START

History, physical and respiratory assessment

Toxic or in severe respiratory distress?

Meets eligibility criteria?

NO

YES

Suction

Assess respiratory status

Start O2 if SaO2 consistently ≤ 91%

NO

YES

Single administration trial with epinephrine or albuterol, nebulized

• may consider if family history for allergy, asthma, or atopy.

Manage without medications.

Consider repeat inhalation treatments(s).

Improvement?

YES

Measure clinical response.

NO

Period of observation

Stable and/or improving?

Meets admit criteria?

NO

YES

NO

YES

Meets D/C criteria?

• D/C with parent education

• PCP F/U

END

Inclusion: age < 1 year of age, first-time bronchiolitis
Exclusions: CF, BPD, ventilator, immunodeficiencies, ICU, severe comorbidities

Abbreviations: BPD = bronchopulmonary dysplasia; CF = cystic fibrosis; D/C = discharge F/U = follow up; ICU = intensive care unit; PCP = primary care physician; PRN = as needed; SaO2 = oxygen saturation of arterial blood

### Aerosolized Drugs and Dosages for Trial Inhalation

<table>
<thead>
<tr>
<th>Medication (formulation)</th>
<th>Dose (&lt; 1 year of age)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inhaled Short-Acting Beta₂-Agonists (SABA)</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Albuterol</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution (2.5 mg/3mL, 5 mg/mL)</td>
<td>2.5 mg for one dose, repeat ONLY for measured clinical improvement</td>
<td>For optimal delivery, dilute aerosols to minimum of 3 mL at gas flow of 6 to 8 L/minute.</td>
</tr>
<tr>
<td><strong>Inhaled Beta Adrenergic Agonist</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Epinephrine, racemic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution (2.25%, 0.5 mL)</td>
<td>0.25 to 0.5 mL for one dose, repeat ONLY for measured clinical improvement (frequency for continued use when improvement assessed varies in reported studies from every 1 to 4 hours <em>Wainwright 2003 [2a], Langley 2005 [2b]</em>).</td>
<td>For optimal delivery, dilute aerosols to minimum of 3 mL at gas flow of 6 to 8 L/minute.</td>
</tr>
</tbody>
</table>

Abbreviations: L = liters, mg = milligrams, mL = milliliters
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*Member of previous Bronchiolitis Team*

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**Development Process**

The process by which this guideline was developed is documented in the Guideline Development Process Manual; an electronic file maintains the Team process and other relevant development materials. The recommendations contained in this guideline were formulated by an interdisciplinary working group which performed systematic search and critical appraisal of the literature, using the Table of Evidence Levels described following the references, and examined current local clinical practices.

To select evidence for critical appraisal by the group for this guideline, the Medline, EmBase and the Cochrane databases were searched for dates of May, 2005 to May, 2010 to generate an unrefined, “combined evidence” database using a search strategy focused on answering clinical questions relevant to bronchiolitis and employing a combination of Boolean searching on human-indexed thesaurus terms (MeSH headings using an OVID Medline interface) and “natural language” searching on words in the title, abstract, and indexing terms. The citations were reduced by: eliminating duplicates, review articles, non-English articles, and adult articles. The resulting abstracts were reviewed by a methodologist to eliminate low quality and irrelevant citations. During the course of the guideline development, additional clinical questions were generated and subjected to the search process, and some relevant review articles were identified. May, 2006 was the last date for which literature was reviewed for the previous version of this guideline. The details of that review strategy are filed electronically. All previous citations were reviewed for appropriateness to this revision. Experience with the implementation of earlier publications of this guideline has provided learnings which have been incorporated into this revision.

Once the guideline has been in place for five years, a development team reconvenes to explore the continued validity of the guideline. This phase can be initiated at any point that evidence indicates a critical change is needed. A needed change is revealed via biannual literature scanning for the topic.

Recommendations have been formulated by a consensus process directed by best evidence, patient and family preference and clinical expertise. During formulation of these recommendations, the team members have remained cognizant of controversies and disagreements over the management of these patients. They have tried to resolve controversial issues by consensus where possible and, when not possible, to offer optional approaches to care in the form of information that includes best supporting evidence of efficacy for alternative choices.

The guideline has been reviewed and approved by clinical experts not involved in the development process, distributed to senior management, and other parties as appropriate to their intended purposes.

The guideline was developed without external funding. All Team Members and AC support staff listed have declared whether they have any conflict of interest and none were identified.

Copies of this Evidence-Based Care Guideline (EBCG) and any available implementation tools are available online and may be distributed by any organization for the global purpose of improving child health outcomes. Website address: http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/ev-based/default.htm

Examples of approved uses of the EBCG include the following:  
• copies may be provided to anyone involved in the organization’s process for developing and implementing evidence-based care guidelines;  
• hyperlinks to the CCHMC website may be placed on the organization’s website;  
• the EBCG may be adopted or adapted for use within the organization, provided that CCHMC receives appropriate attribution on all written or electronic documents; and  
• copies may be provided to patients and the clinicians who manage their care.

Notification of CCHMC at HPCEinfo@cchmc.org for any EBCG, or its companion documents, adopted, adapted, implemented or hyperlinked by the organization is appreciated.

**NOTE: These recommendations result from review of literature and practices current at the time of their formulations. This guideline does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the recommendations to meet the specific and unique requirements of individual patients. Adherence to this guideline is voluntary. The clinician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.**

For more information about this guideline, its supporting evidence and the guideline development process, contact the Health Policy & Clinical Effectiveness office at: 513-636-2501 or HPCEinfo@cchmc.org.
References

Note: When using the electronic version of this document, indicating a hyperlink to the PubMed abstract. A hyperlink following this symbol goes to the article PDF when the user is within the CCHMC network.

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17. CCHMC: Respiratory Contact Isolation Infection Control Manual IRM-735 [Local Consensus]


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119. Sigurs, N.: Does bronchiolitis caused by RSV predispose to atopic asthma? *Revue Française d’Allergologie et*
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123. Stark, J., and Busse, W.: Respiratory virus infection and airway hyperreactivity in children Pediatric Allergy and Immunology, 2: 95-110, 1991, [5a] 


Note: Full tables of evidence grading system available in separate document:

- Table of Evidence Levels of Individual Studies by Domain, Study Design, & Quality (abbreviated table below)
- Grading a Body of Evidence to Answer a Clinical Question
- Judging the Strength of a Recommendation (abbreviated table below)

### Table of Evidence Levels (see note above)

<table>
<thead>
<tr>
<th>Quality level</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a† or 1b†</td>
<td>Systematic review, meta-analysis, or meta-synthesis of multiple studies</td>
</tr>
<tr>
<td>2a or 2b</td>
<td>Best study design for domain</td>
</tr>
<tr>
<td>3a or 3b</td>
<td>Fair study design for domain</td>
</tr>
<tr>
<td>4a or 4b</td>
<td>Weak study design for domain</td>
</tr>
<tr>
<td>5a or 5b</td>
<td>Other: General review, expert opinion, case report, consensus report, or guideline</td>
</tr>
<tr>
<td>5</td>
<td>Local Consensus</td>
</tr>
</tbody>
</table>

†a = good quality study; b = lesser quality study

### Table of Recommendation Strength (see note above)

<table>
<thead>
<tr>
<th>Strength</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Strongly recommended”</td>
<td>There is consensus that benefits clearly outweigh risks and burdens (or visa-versa for negative recommendations).</td>
</tr>
<tr>
<td>“Recommended”</td>
<td>There is consensus that benefits are closely balanced with risks and burdens.</td>
</tr>
<tr>
<td>No recommendation made</td>
<td>There is lack of consensus to direct development of a recommendation.</td>
</tr>
</tbody>
</table>

**Dimensions:** In determining the strength of a recommendation, the development group makes a considered judgment in a consensus process that incorporates critically appraised evidence, clinical experience, and other dimensions as listed below.

1. Grade of the Body of Evidence (see note above)
2. Safety / Harm
3. Health benefit to patient (direct benefit)
4. Burden to patient of adherence to recommendation (cost, hassle, discomfort, pain, motivation, ability to adhere, time)
5. Cost-effectiveness to healthcare system (balance of cost / savings of resources, staff time, and supplies based on published studies or onsite analysis)
6. Directness (the extent to which the body of evidence directly answers the clinical question [population/problem, intervention, comparison, outcome])
7. Impact on morbidity/mortality or quality of life