



James M. Anderson Center for Health
Systems Excellence

Evidence-Based Care Guideline
**Management of first time episode
Bronchiolitis
in infants less than 1 year of age**

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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

Introduction

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

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]).

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 inpatient 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 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], Muething 2004 [4a], Kotagal 2002 [4a], Harrison 2001 [4a], Perlstein 2000 [4a], Perlstein 1999 [4a]).

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.

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], Youmt 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.
 - color change
 - nasal flaring
 - wheezing

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], Krasinski 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 safety
- patient tolerability
- fit
- 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], Modl 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 (*Petruszella 2010 [3b]*). After 21 days approximately 18% to 28% will remain ill (*Robbins 2006 [3a]*, *Swingler 2000 [3a]*, *Petruszella 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

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

Nutritional Status

- patient is dehydrated
- patient is unable to maintain oral feedings at a level to prevent dehydration

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 (*Summer 2010 [2a]*). Efficacy, safety and applicability of this approach have not been established (*Fernandes 2010 [1a]*).

Note 2: No effect on prevention of post-bronchiolitic 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]*))

- recombinant human deoxyribonuclease (rhDNase)
(No Improvement (*Boogaard 2007 [1a]*))
- inhaled furosemide
(No Improvement (*Bar 2008 [2b]*)).

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]*, *Kernan 2000 [4a]*, *FDA 2008 [5a]*) and lack of demonstrated efficacy (*Smith 2010 [1a]*, *Ralston 2008 [2b]*, *AAPCommitteeOnDrugs 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
- bromopheniramine
- 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 2008b [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]*).

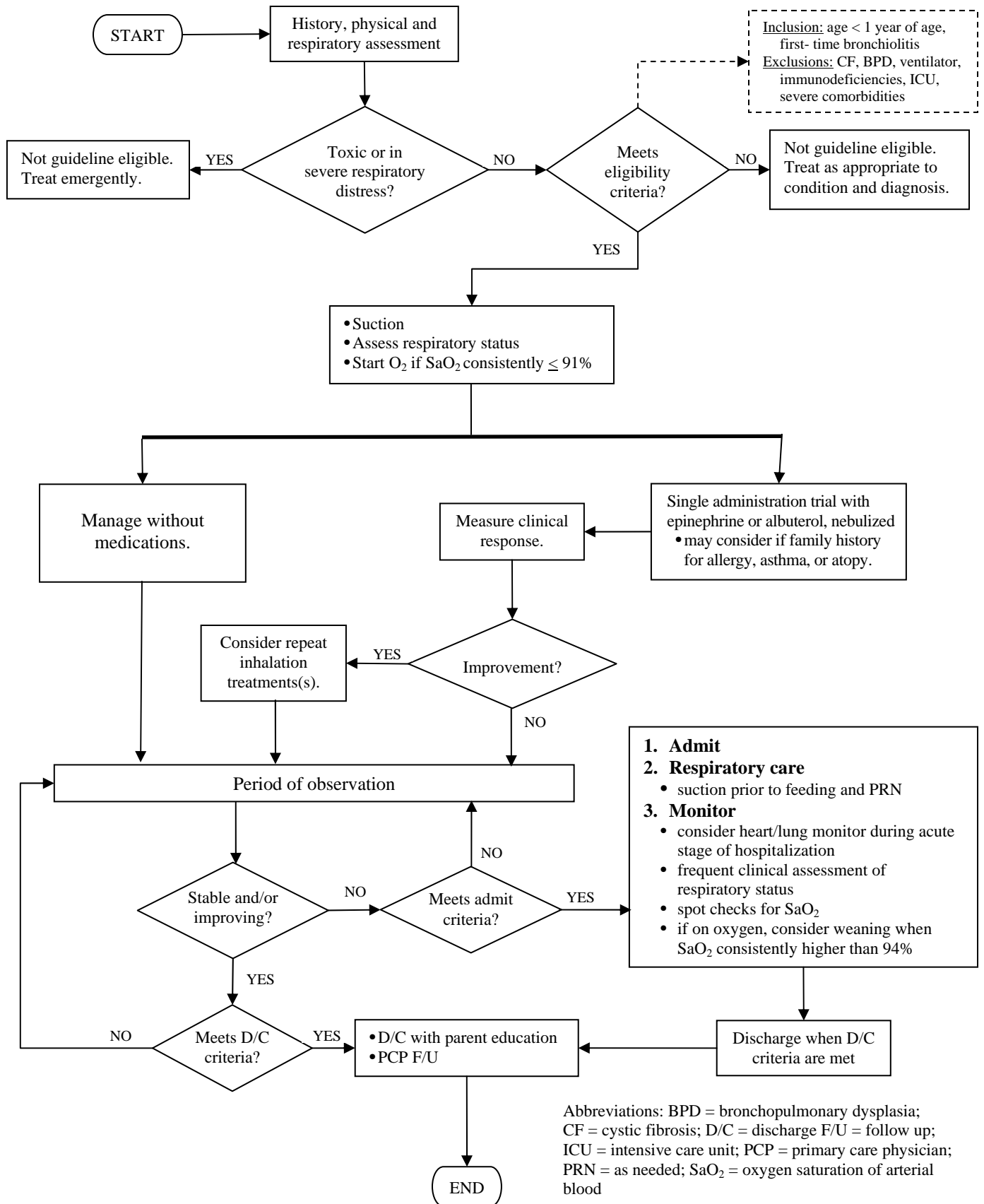
Future Research Agenda

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



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

Attachment**Aerosolized Drugs and Dosages for Trial Inhalation**

Medication (formulation)	Dose (< 1 year of age)	Notes
Inhaled Short-Acting Beta₂-Agonists (SABA)		
Albuterol Nebulizer solution (2.5 mg/3mL, 5 mg/mL)	2.5 mg for one dose, repeat ONLY for measured clinical improvement	For optimal delivery, dilute aerosols to minimum of 3 mL at gas flow of 6 to 8 L/minute.
Inhaled Beta Adrenergic Agonist		
Epinephrine, racemic Nebulizer solution (2.25%, 0.5 mL)	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 (<i>Wainwright 2003 [2a], Langley 2005 [2b]</i>)).	For optimal delivery, dilute aerosols to minimum of 3 mL at gas flow of 6 to 8 L/minute.

Abbreviations: L = liters, mg = milligrams, mL = milliliters

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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 a 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.

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Note: When using the electronic version of this document,  indicates 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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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)

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

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

Table of Recommendation Strength (see note above)

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

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