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STATEMENT OF FINANCIAL DISCLOSURE

To reveal any potential bias in this publication, and in accordance with Accreditation Council for Continuing Medical Education guidelines, we disclose that Dr. Dietrich (editor), Dr. Skrainka (CME question reviewer), Dr. Migliaccio (author), Dr. Imler (author), Dr. Wang (author), Dr. Leetch (peer reviewer), Ms. Coplin (executive editor), and Ms. Hamlin (managing editor) report no relationships with companies related to the field of study covered by this CME activity.

AHC Media

Bronchiolitis

Bronchiolitis is a common clinical condition encountered by practitioners. In 2014 the American Academy of Pediatrics endorsed and updated the clinical practice guideline for the diagnosis, testing, and management of bronchiolitis with significant changes in recommendations for the evaluation and treatment of these children. The authors present a thorough review of these guidelines to assist the practicing clinician with an understanding of the current national standard for care of these patients.

— Ann M. Dietrich, MD, Editor

Case: A 10-month-old female presents to the emergency department (ED) with a fever, cough, and copious rhinorrhea. She has been febrile to 38.5° C (101.3° F). Oxygen saturation is 89% on room air while asleep. On physical exam she has significant rhinorrhea. Auscultation of the lungs demonstrates diffuse wheezes and crackles. Chest X-ray shows increased atelectasis in the lower lobes.

What evaluation is necessary? Is laboratory testing or a urinalysis needed? Are pediatric bronchiolitis algorithms useful in determining the course of evaluation? Is a chest X-ray indicated? What treatments work? What should we consider trying in the ED? Which patients should be admitted? Is there a subset of patients at risk for apnea?

Definition and Etiology

Bronchiolitis is an acute inflammatory process of the lower respiratory system occurring mostly in children between the ages of 1 month and 2 years. The most commonly implicated pathogen is the respiratory syncytial virus (RSV). However, multiple other pathogens can lead to the same constellation of symptoms, including adenovirus, bocavirus, human metapneumovirus, influenza virus, and parainfluenza virus.[1]

Epidemiology

Bronchiolitis is the most common cause of hospitalization among infants during the first year of life. Approximately 100,000 bronchiolitis admissions occur annually in the United States.[2] According to the Centers for Disease Control and Prevention, almost all children will have an RSV infection by the time they are 2 years old, with 25-40% demonstrating signs or symptoms of respiratory illness.[3] Bronchiolitis most commonly affects children younger than 2 years of age. However, adults — especially the elderly, immunocompromised, and adults with lung disease — can be infected with RSV and demonstrate a range of illness from simple upper respiratory symptoms to pneumonia and respiratory failure.[4]

EXECUTIVE SUMMARY

- The diagnosis of bronchiolitis should be based on clinical assessment alone, without the need for supporting lab or radiologic studies. Blood work, virology testing, and chest X-rays are not recommended by the American Academy of Pediatrics in the workup of a child with suspected uncomplicated bronchiolitis.
- The mainstay of therapy for bronchiolitis is supportive care, which involves oxygen, appropriate nasal suctioning, and ensuring an adequate hydration status/ability to feed.
- Many of the currently used therapeutic interventions have not demonstrated efficacious improvement in clinically relevant outcomes in Cochrane reviews and meta-analyses. The American Academy of Pediatrics recommends against the use of bronchodilator therapy, corticosteroids, antibiotics, or inhaled nebulized hypertonic saline.
- Scoring systems and algorithms may aid in the disposition of a child with bronchiolitis; however, none has been adequately validated.

A prospective, population-based study found an average RSV hospitalization rate of 5.2 per 1000 children younger than 24 months of age between the years 2000-2005, with age being the most important risk factor for hospitalization.[5] The highest age-specific rate of RSV hospitalization occurred between 30 days and 60 days of age (25.9 per 1000 children). The admission rate was found to be similar in term vs preterm infants (< 37 weeks' gestational age), although for extreme preterm infants (< 32 weeks' gestational age), there was an inverse relationship between gestational age and hospital admission (13.9% vs 4.4% for infants born at ≤ 26 weeks' gestation vs those born at 30-32 weeks' gestation, respectively).

Other children at risk for hospitalization from acute bronchiolitis include children with congenital heart disease, as well as those with chronic lung disease, as both populations have diminished pulmonary reserve.[6] Children with compromised immune function are also more likely candidates for hospital admission from bronchiolitis.[7]

Pathophysiology

Although the most common virus implicated in bronchiolitis is RSV, more than 30% of patients will have multiple pathogens identified.[8,9] The disease process typically begins with an acute upper respiratory tract infection and spreads to the lower airways within a few days. The infection results in small airway inflammation, edema, increased mucus production, and eventual epithelial cell necrosis. This response causes airflow obstruction and atelectasis leading to an increased work of breathing along with the symptoms of wheezing, crackles, and/or rales.[10]

RSV was first isolated in 1956 from a chimpanzee and was initially known as the chimpanzee coryza agent; it came to be known as RSV to reflect the giant cells or syncytia that formed among respiratory cells infected with the virus. However, humans are the only known reservoir of the virus.[11] Human RSV is an enveloped RNA virus and is a member of the family Paramyxoviridae. Infection is normally confined to the respiratory mucosa, as the virus has a predilection for respiratory cells. The virus is spread primarily via person-to-person contact (with respiratory secretions) and can live on environmental surfaces for up to 8 hours. Immunity to reinfection, even with the same strain of RSV, is incomplete and short-lived, with reinfections from antigenically similar strains occurring throughout life.[12] Secondary RSV infections tend to be milder, which suggests at least partial immunity.[13] However, severe disease can still occur in young children from a secondary RSV infection, indicating that age is the most important factor in disease severity.[14]

An unsuccessful attempt to create a vaccine against RSV occurred in the 1960s, using a formalin-inactivated-RSV (FI-RSV) vaccine. Children who were inoculated with the FI-RSV vaccine had an exaggerated immune response and had a far higher incidence of severe disease, with two deaths occurring secondary to vaccination.[15] Recently palivizumab, a genetically engineered humanized monoclonal antibody, has been used for passive immunization in certain populations. It is crucial to note that while prophylaxis decreases the risk of hospitalization with RSV in these children, significant disease can still occur.[16]

Apnea occurs in a small number of children with RSV, with a rate of approximately 3%.[17] Apnea usually occurs within the first 2-3 days after the onset of typical upper respiratory infection symptoms, such as rhinorrhea and cough.[18] However, the cause of apnea remains unknown. Proposed mechanisms include local pulmonary neurotransmitters[19] as well as disruptions in the neural control pathways.[20] The risk of apnea in children with RSV is related to age. In a retrospective study, Willwerth et al developed certain clinical risk criteria to seek out those infants who are at risk of apnea and require admission.[18] The criteria they used to determine high risk for apnea include 1) born at full term and were younger than 1 month, 2) born preterm and younger than 48 weeks post-conception, or 3) the child's parents or a clinician had already witnessed an apnea episode with this illness before inpatient admission. They found that 19 of 691 patients had apnea during hospitalization and all were identified by the above risk criteria (100% sensitivity; 1-sided 97.5% confidence interval 82% to 100%), with a 100% negative predictive value, as none of the infants considered low risk for apnea went on to develop apnea. Apnea, in turn, has been associated with increased risk for prolonged hospitalization, intensive care admissions, and mechanical ventilation.[21]

Clinical Course

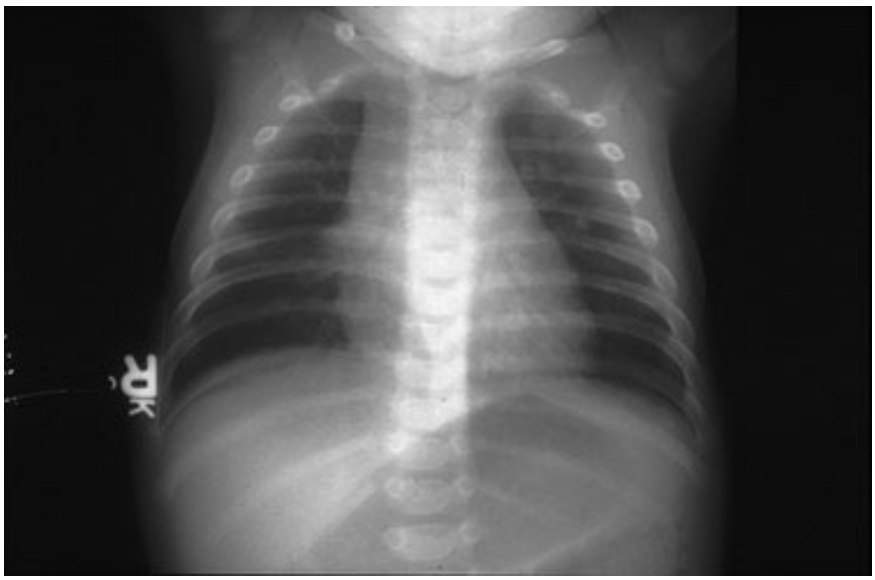
The typical progression of bronchiolitis consists of a viral prodrome with rhinitis, fever, and cough. Subsequently, the child develops increased respiratory effort secondary to the lower airway edema and mucus obstruction. This can present as audible grunting, nasal flaring, and/or intercostal/subcostal retractions. On physical exam, these children typically have varying degrees of tachypnea, hypoxemia, wheezing, and crackles. These symptoms typically peak within 3-4 days of symptom onset. Mean resolution of fever is 5 days and cough between days 5-15 (90% resolved by day 21). The mean resolution of symptoms is about 12 days, with the last symptom to dissipate being the excess mucus production.[22] Symptoms of bronchiolitis are dynamic and are largely due to mucus plugging and inflammation of the airways. Thus, children need continued pulmonary toilet and reassessment in the ED. The dynamic nature of the illness can explain why it has been difficult to correlate pulse oximetry readings to disease severity.[23] In fact, pulse oximetry in the clinical assessment of children has actually led to increased hospital length of stay without being able to predict clinical outcomes.[24] However, most emergency medicine physicians believe it is reasonable to admit infants with oxygen saturation that is persistently below 88% while asleep and 90% while awake after observation in the ED.

Fortunately, severe adverse clinical outcomes, such as respiratory failure requiring intubation and mechanical ventilation, are rare and range from 3 to 5 per 100,000 children.[25,26,27]

Diagnostic Studies

The American Academy of Pediatrics (AAP) endorses that the diagnosis of bronchiolitis is purely clinical. The AAP updated the clinical practice guideline for the diagnosis, testing, and management of bronchiolitis in 2014.[28] The use of chest X-ray is common in the workup of bronchiolitis, but it is not recommended by the AAP, as they do not correlate with disease severity and do not guide management (*see Figure 1*).[29] Shuh et al found that performing a chest X-ray in children with bronchiolitis made physicians more likely to treat with antibiotics.[30] Atelectasis, which is common in viral bronchiolitis, may be misinterpreted as consolidation and treated as pneumonia (*see Figure 2*). However, a chest X-ray may be indicated when the diagnosis of bronchiolitis is uncertain or the presentation is atypical/the patient is very ill (respiratory failure). Specifically, a chest X-ray is useful when there is no prodromal history or there is concern for a foreign body aspiration.

Figure 1. Radiograph of Infant with Bronchiolitis



In contrast, testing for serious bacterial infection concomitant with bronchiolitis still remains controversial. It is well-accepted that infants younger than 30 days of age with fever necessitate a full septic workup (including a lumbar puncture) and empiric antibiotics, as the risk of serious bacterial illness (SBI) in this population is substantial.[31] Infants older than 60 days of age with bronchiolitis may have a decreased risk of concomitant serious bacterial infection and may not warrant cultures and extensive testing.[32] Levine et al found an overall decreased risk of SBI in RSV-positive infants as compared to RSV-negative infants. However, the workup of infants who presented between 30-60 days of life remains in the "gray zone."[33,34] The most implicated infection that has been associated with RSV bronchiolitis has been urinary tract infections (UTIs).[35] Kuppermann et al found a 2% prevalence of urinary tract infection with concomitant RSV infection. However, this is similar to the baseline rate of culture-positive urine in asymptomatic children under the age of 3 years, randomly selected for testing.[36] Similarly, Ralston et al found the rate of UTI to be 1% in children with bronchiolitis.[37]

In addition, the AAP endorses that viral serology testing is not routinely recommended in the workup of children with bronchiolitis, as it does not alter clinical management.[23,38] A recent Cochrane review found that immunofluorescence or polymerase chain reaction (PCR) did not lead to changes in antibiotic use, ED length of stay, or clinically relevant changes in outcomes.[39] In addition, the children who are thought to have bronchiolitis will require isolation regardless of the virus involved. However, a positive viral test is useful in admitted infants; the probability of bacterial infection is decreased and, in theory, this would reduce the incidence of unnecessary antibiotics.[40] If diagnostic studies are to be conducted, respiratory virus PCR testing for common pathogens

provides the greatest sensitivity, specificity, and convenience (*see Table 1*).[41] Further, the AAP states that infants who are receiving monthly palivizumab prophylaxis and are hospitalized should be tested, as a breakthrough RSV infection would lead to discontinuation of the drug.

Clinical Prediction Rules for Disease Severity and Admission

Children's hospitals across the nation have adopted different scoring systems in an attempt to streamline decision making in the management of bronchiolitis. Namely, they attempt to quantify respiratory distress utilizing such parameters as respiratory rate, accessory muscle use, wheezing, cyanosis, and oxygen saturation. The AAP does not endorse any particular scoring system, as studies attempting to determine scoring system validity have failed to demonstrate significant construct validity.[42,43] For instance, McCallum et al present 15 different scoring systems, only five of which had any validation, limited to interrater agreement. Table 2 includes an example of the scoring system used at Stanford University Hospital with the acronym W.A.R.M. (Wheeze, Air Exchange, Respiratory rate, Muscle use) and it will be used in the disposition algorithm presented in this paper.[44,45]

Management

It is important to first consider the ABCs (airway, breathing, and circulation) in children who have respiratory symptoms. Once the diagnosis of bronchiolitis is established, the AAP clinical guidelines have given clear recommendations regarding treatment. The therapeutic interventions that have been used in the past are many and include bronchodilators, corticosteroids, antibiotics and antivirals, hypertonic saline, and nasal suction. The AAP emphasizes supportive care, including suctioning, oxygenation, and hydration in their newly published guidelines.[28] The management pathway presented in this paper is adopted from Dr. Dan Imler, pediatric emergency medicine physician at the Lucille Packard Children's Hospital pediatric department. Lastly, it is important to provide materials at discharge, including thorough return precautions and techniques for suctioning the child at home. These instructions should stress adequate hydration and monitoring of the child's work of breathing. One technique that can be offered is to utilize 2-3 drops of warm water placed in each nostril prior to bulb suctioning and repeat multiple times.

Figure 2. Radiograph of Infant with Bronchiolitis and Atelectasis

I. Bronchodilators

It has been common practice to provide a "trial" of albuterol in children with suspected bronchiolitis. However, the 2014 AAP guidelines discourage the use of albuterol in patients diagnosed with bronchiolitis. Multiple meta-analyses and systematic reviews have demonstrated that while bronchodilators may improve clinical symptom scores, they do not affect disease resolution, need for admission to the hospital, or length of stay (LOS).[1,46] As per the AAP, "Although it is true that a small subset of children with bronchiolitis may have reversible airway obstruction resulting from smooth muscle constriction, attempts to define a subgroup of responders have not been successful to date." The AAP holds strongly to the principle of bronchiolitis being a clinical diagnosis, and does not recommend a trial of albuterol as a diagnostic test. A recent Cochrane review of the available data on the use of beta-agonists for children with recurrent wheezing presenting with bronchiolitis

Table 1. Testing for Common Pathogens

Test	Sensitivity	Specificity	Optimal Timing	Advantages	Disadvantages
Rapid antigen direct tests (RADTs)	50-98%	93-99%	Within 3 days	Results within 15-30 minutes	Lower sensitivity than RT-PCR
RT- PCR	72-94%	95-100%	Within 1 week	More rapid/ sensitive than viral cultures, 1-2 days.	High limits of detection
Direct fluorescent antibody testing (DFA)	80%	94-99%	Within 1 week	Results within 30-60 minutes	Not readily available Human error, fading of dyes
Viral culture	40-60%	100%	Within 4 days	Very specific	Low sensitivity, 7-10 day delay between specimen collection and diagnosis

Adapted from: Current Best Practices for Respiratory Virus Testing[41]

Table 2. W.A.R.M. Score

Variable	0 Points	1 Point	2 Points
Wheeze	None	End expiratory	Entire expiratory/any inspiratory
Air Exchange (assess all 4 chest areas; left/right front and left/right back)	Normal	One area decreased	More than one area decreased
Respiratory rate			
≤ 2 months	≤ 60	> 60	
2-12 months	≤ 50	> 50	
1-2 years	≤ 40	> 40	
Muscle Use/Retractions	None	Subcostal or intercostal	2 of the following: subcostal, intercostal, substernal OR nasal flaring, trachial tugging, or abdominal breathing

Adapted from: Cincinnati Children's Hospital and clinical pathway from curbsideup.com [44,45]

demonstrated no clear benefit in this population.[47] Of note, children with severe disease were often excluded from these trials. In these patients, treatment with beta-agonists may be indicated depending on the clinical scenario.

II. Racemic Epinephrine

Multiple meta-analyses have found no evidence to support the use of epinephrine in the treatment of bronchiolitis.[48] This is further supported by large randomized, controlled trials, and the AAP endorses against utilization of epinephrine in the treatment of bronchiolitis.[48,49]

II. Corticosteroids

The use of steroids in children diagnosed with bronchiolitis seems intuitive considering the largely inflammatory nature of bronchiolitis. In fact, two recent studies have shown a decreased LOS with administration of steroids.[50,51] Moreover, in children with preexisting asthma/recurrent wheezing, limited evidence demonstrates a decreased LOS.[51] However, in large studies and reviews, systemic glucocorticoids and combination bronchodilators-glucocorticoids do not improve hospitalization rates or disease progression.[52,53] Thus, their use is *not* recommended by the AAP.

III. Nebulized Hypertonic Saline

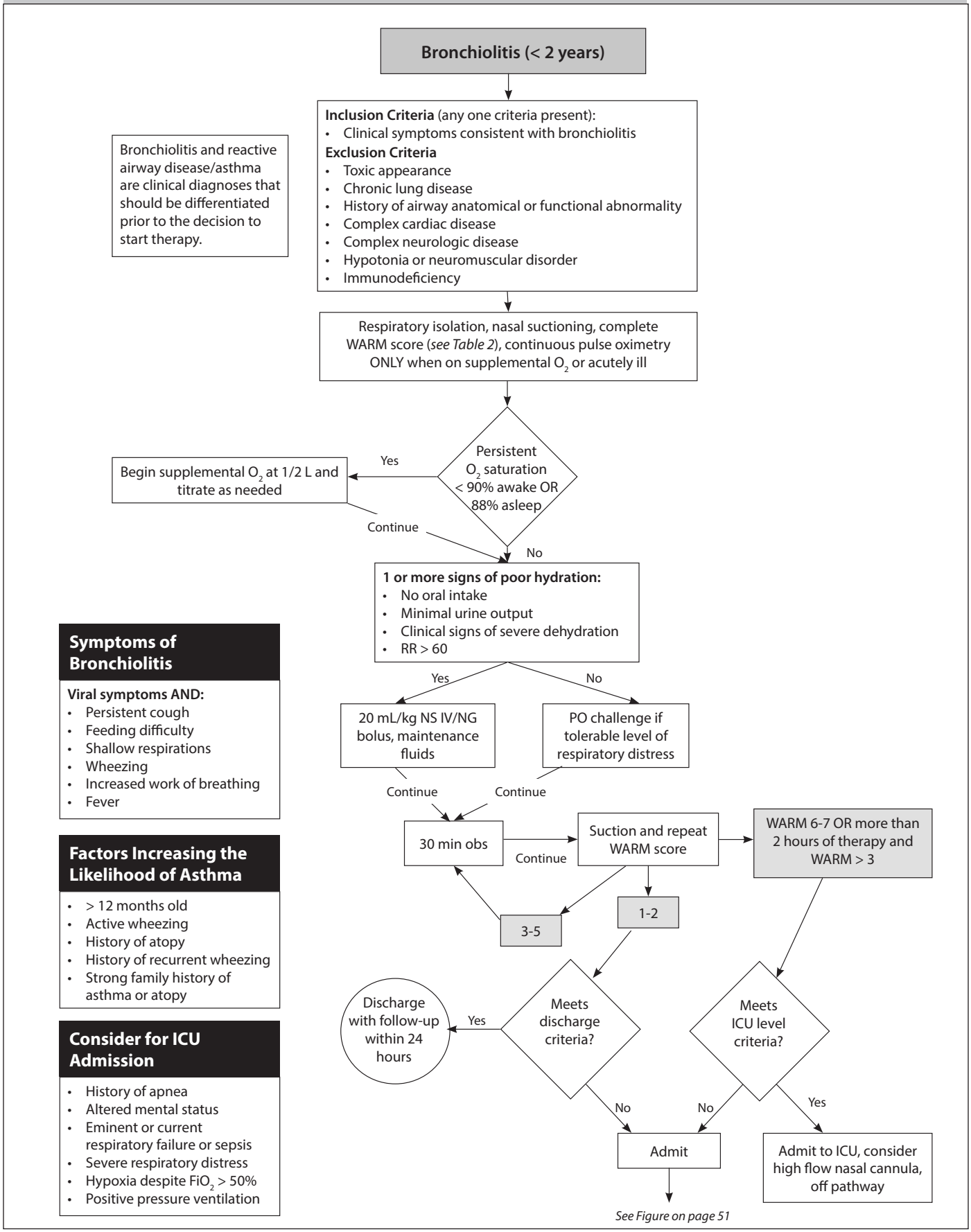
The relative cost and safety of nebulized hypertonic saline has made it a topic of recent debate. In theory, hypertonic saline breaks up the mucus and pulls fluid in from the vascular system, thinning secretions while also irritating the airways and stimulating coughing.[54] A Cochrane review performed by Zhang et al found a significantly reduced LOS (by 1.2 days) and improved clinical severity score.[55] However, there are numerous other studies that demonstrate that it does not improve hospitalization rates or disease progression.[56,57] Therefore, its use is not recommended by the AAP guidelines in the emergency department, but it may be considered in the inpatient setting.

IV. Antibiotics/antivirals

As previously mentioned, the risk of SBI, such as bacteremia, meningitis, and urinary tract infection, is rare in children diagnosed with bronchiolitis.[37,58] Therefore, the AAP strongly recommends against the use of antibiotics in these children. Antibiotics

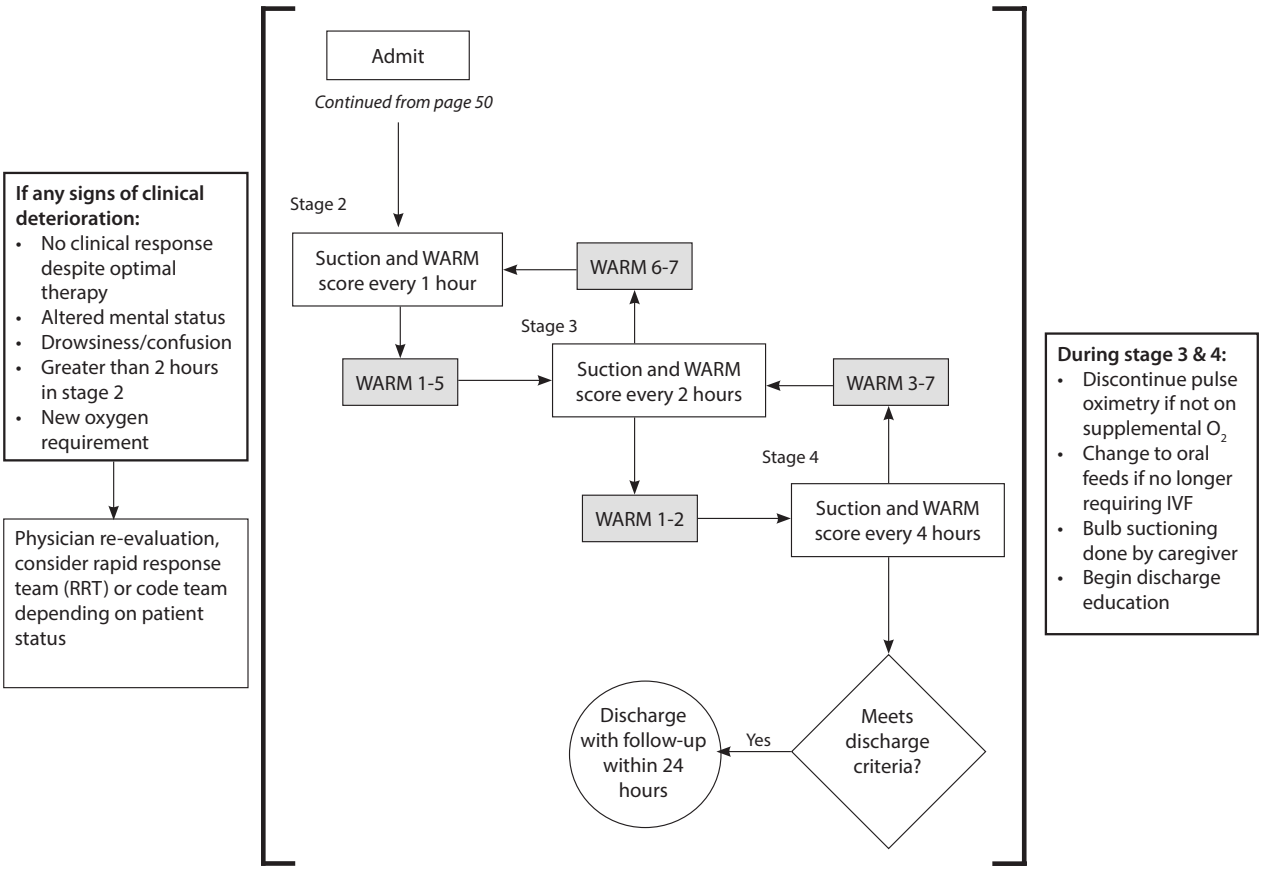
Continued on page 52

Figure 3. Scoring Criteria to Discharge or Admit Children with Bronchiolitis[44,45]



See Figure on page 51

Figure 3. Scoring Criteria to Discharge or Admit Children with Bronchiolitis[44,45] (*cont.*)



Discharge Criteria

ED/Clinic Specific
- WARM score < 3 for at least 1 hour
- May consider admission if corrected gestational age < 48 weeks
- No signs or history of apnea

Inpatient Specific
- WARM score < 3 for at least 12 hours
- No suctioning needs for at least 4 hours
- Off oxygen therapy for at least 12 hours
- No history of apnea in the previous 48 hours

Any Environment
- Respiratory rate < 70
- Reassuring vital signs
- No O_2 requirement to maintain SpO_2 > 90% awake OR 88% asleep
- Tolerating PO
- Well-appearing
- No social/family concerns
- Reliable follow-up in 24 hours
- Parents comfortable and understand discharge plan
- Provider comfortable with outpatient therapy

Special Notes

Inhaled bronchodilator (albuterol) trial
- No conclusive evidence that a bronchodilator trial is useful in bronchiolitis

Racemic Epinephrine
- No conclusive evidence that epinephrine improves the treatment of bronchiolitis

Nebulized Hypertonic Saline
- No conclusive evidence that hypertonic saline improves the treatment of bronchiolitis in the emergency setting, but may be used in the inpatient setting

Systemic Glucocorticoids
- No conclusive evidence that steroids improve the treatment of bronchiolitis

Leukotriene-receptor Antagonists (i.e., Montelukast)
- No conclusive evidence of benefit in bronchiolitis

Antibiotics/Antivirals
- No conclusive evidence for improvement in the routine treatment of bronchiolitis

Chest X-rays
- No conclusive evidence that X-rays improve the treatment of bronchiolitis

Virologic Studies
- Not routinely indicated for bronchiolitis patients

Chest Physiotherapy (CPT)
- No conclusive evidence that CPT improves the treatment of bronchiolitis

Apnea
- Patients at high risk for apnea should be admitted to an ICU

Heliox
- Not routinely indicated for bronchiolitis patients

High Flow Nasal Cannula
- May be useful for patients with severe symptoms of bronchiolitis

Continued from page 49

are only indicated if a concomitant bacterial infection is suspected utilizing features in the patient history and physical exam.[59,60] However, children who present with severe bronchiolitis and are critically ill, such as those in respiratory failure, may warrant empiric antibiotics.[61] Similarly, the AAP recommends against the use of ribavirin in children, as research regarding the efficacy of the drug on positive clinical outcomes remains ambiguous.[62]

V. Special Populations

Morbidity and mortality in bronchiolitis are highest in premature infants and children with underlying medical illnesses. These children may warrant a trial of the aforementioned treatments depending on the clinical scenario. Moreover, some of these children may benefit from passive immunization with palivizumab. However, its cost and need for monthly injections make it inopportune to use in the general population.

A. Prematurity — According to the AAP, monthly palivizumab prophylaxis should be given to infants born before 29 weeks' gestation, as the risk for hospitalization equalizes after that age.[63]

B. Congenital heart disease/chronic lung disease — Although there is limited evidence regarding the benefit of prophylaxis in children with congenital heart disease, the AAP recommends its use in children with "hemodynamically significant heart disease."[16] In addition, it recommends prophylaxis for infants younger than 1 year of age who develop chronic lung disease of prematurity.

C. Other conditions — There is insufficient research to endorse use of prophylaxis in children with Down syndrome,[64] cystic fibrosis,[65] neuromuscular disease,[66] or children who are immunocompromised.[67] The decision to provide prophylaxis in these children should be reviewed on a case-by-case basis.

Disposition

Many scoring criteria have been created to facilitate the decision to discharge or admit children with bronchiolitis similar to that proposed in the pathway (*see Figure 3*, which displays a summary of various criteria used by Hospital for Sick Children, Cincinnati's Children's Hospital Medical Center, Lucille Packard's Children's Hospital, and the AAP).[68,69,70] It is extremely important to assess the ability of the child to feed and maintain good hydration. If there is continued difficulty in being able to stay well-hydrated after therapy, intravenous fluid therapy and hospitalization should be considered. Similarly, the physician needs to assess the ability of the family to care for the child and return for further care. (*See Table 3.*)

Table 3. Guide to Disposition of Bronchiolitis Patients

Consider critical care admission	• Recurrent apnea • Severe respiratory distress, concern for impending respiratory failure • Increasing oxygen requirements
Consider hospitalization	• Age less than <12 weeks • Tachypnea (age adjusted) • Signs of respiratory distress including episodes of cyanosis • Dehydration with failure to take oral fluids • Major co-morbidity (congenital heart disease, preexisting lung or immune disorder) • Unclear diagnosis (i.e., concern for pneumonia) • Poor follow up • Concerns over care at home • Persistent oxygen saturations below 89-90 %

Conclusion

Indeed, the evaluation and treatment of bronchiolitis continues to differ significantly among practitioners. However, adherence to the AAP clinical practice guideline can minimize unnecessary diagnostic testing and unproductive and sometimes costly treatments. Following the path set out by the AAP ensures the use of evidence-based practice in the management of children with bronchiolitis.

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CME Questions

1. What is the diagnostic test of choice in the workup of children with suspected bronchiolitis?
   a. Bronchodilator challenge
   b. Virology testing
   c. Chest X-ray
   d. History and physical exam

2. A 4-month-old infant presents to the emergency department with cough and fever. The infant has been sick for 4 days, but symptoms worsened in severity during the past 24 hours. Past medical history is otherwise negative. Vital signs include a rectal temperature of 100.6° F, pulse of 120 beats/minute, blood pressure within normal limits, and respiratory rate of 60 breaths/minute. The infant is well hydrated and does not appear ill. There is no grunting, nasal flaring, intercostal retractions, and no evidence of increased respiratory effort. Wheezing and crackles are noted on physical examination. The patient is given a clinical diagnosis of bronchiolitis. Which of these factors helps to exclude other diagnoses?
   a. Wheezing and crackles on exam
   b. Presence of upper respiratory symptoms and prodromal symptoms
   c. Acute onset of symptoms
   d. Family history of reactive airway disease

3. A 6-month-old female is brought in to the emrgency department for fever and decreased oral intake over the past 2 days. She was born full term and has no past medical history. Vital signs on presentation are: heart rate 120, blood pressure 95/65, respiratory rate 50, oxygen saturation 92% on room air, and temperature of 100.8° degrees F. Physical exam reveals significant rhinorrhea, subcostal retractions, and intermittent wheezing throughout the lung fields. Which of the following is true regarding testing the urine in this patient?
   a. Urine should be tested because children at this age poorly localize infections and are high risk for concomitant UTI
   b. Urine should be tested because children with positive urine testing will do significantly worse
   c. Urine should not be tested as several studies found that the incidence of UTI in patients with bronchiolitis was no different than that of asymptomatic children
   d. Urine testing is needed all the time in the workup of bronchiolitis

4. A 19-month-old female is brought in to the emergency department for cough, fever, and nasal congestion for the past 2 days. It has now progressed to shortness of breath. Vital signs on presentation are: heart rate 140, respiratory rate 60, oxygen saturation 91% on room air, and temperature 101.0° degrees F. Physical exam reveals a tachypneic child with significant rhinorrhea, minimal subcostal retractions and expiratory wheezing. Which of the following interventions is most likely to improve this patient's clinical condition?
   a. Nasal suctioning
   b. Inhaled bronchodilators
   c. Hypertonic saline
   d. Racemic epinephrine

5. Which inhaled medication has been demonstrated to decrease disease severity, decrease hospital admission rates, and lead to improved outcomes in children with bronchiolitis?
   a. Albuterol
   b. Epinephrine
   c. Corticosteroids
   d. No inhaled medication has been able to improve clinically important outcomes

6. Which antibiotic is indicated in a child with atelectasis on chest X-ray, suspected bronchiolitis, and who is well hydrated on exam?
   a. Erythromycin
   b. Amoxicillin
   c. Augmentin

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   d. No antibiotics are indicated

7. Which of the following mildly ill patients with bronchiolitis is at risk for apnea and requires admission for monitoring?
   a. 2-week-old male born at full term with no other medical problems
   b. 9-month-old female who was born 5 weeks premature at 35 weeks
   c. 4-month-old male with reliable parents
   d. 6-month-old female with a family history of asthma

8. When should ICU admission be considered for a child with bronchiolitis?
   a. An episode of apnea while in the emergency room
   b. Decreased oral intake
   c. An oxygen saturation of 88 % on room air
   d. A past medical history significant for a VSD in an otherwise well appearing child

9. Regarding the WARM algorithm presented in this paper:
   a. It stands for wheeze, air exchange, respiratory rate, muscle use and it is recommended by the AAP for its reliability and validity
   b. It stands for wheeze, air exchange, respiratory rate, muscle use and it has not been adequately validated but can be used in determining clinical status
   c. It stands for work of breathing, air exchange, respiratory rate and miscellaneous clinical features and it is recommended by the AAP for its reliability and validity
   d. It stands for work of breathing, air exchange, respiratory rate and miscellaneous clinical features and it has not been adequately validated but can be used in determining clinical status

10. Which of the following is a significant contributing factor in the disposition of a child with bronchiolitis in the emergency department?
   a. Poor follow-up
   b. Oxygen saturation of 92% on room air while feeding
   c. Decreased oral intake but no clinical findings of dehydration on exam
   d. Significant mucus accumulation in the nasopharynx

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- describe the epidemiology, etiology, pathophysiology, historical and examination findings associated with conditions in pediatric patients presenting to the emergency department;
- formulate a differential diagnosis and perform necessary diagnostic tests;
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