Bronchiolitis

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Practice Gaps

1. Clinicians should be able to identify and diagnose patients with a clinical presentation of bronchiolitis, limiting the use of extensive diagnostic testing.
2. Although bronchiolitis is a condition commonly encountered in pediatrics, there is no single effective therapeutic agent; therefore, with an aim to provide high-value and high-quality care, clinicians should be aware that the main treatment plan for bronchiolitis is supportive care.

Objectives

After completing this article, readers should be able to:

1. Evaluate and diagnose patients with bronchiolitis.
2. Summarize the 2014 American Academy of Pediatrics guidelines for the management and prevention of bronchiolitis.
3. Identify potential current therapies as well as interventions not recommended for routine use in bronchiolitis.
4. Discuss prevention measures for bronchiolitis.
5. Describe the prognosis for patients diagnosed as having bronchiolitis.

INTRODUCTION

Acute bronchiolitis refers to airway inflammation and obstruction of the lower respiratory tract and is caused almost exclusively by viral infection in children younger than 2 years. Commonly, symptoms of bronchiolitis begin with rhinitis or congestion and cough and may develop into symptoms of increasing respiratory distress (tachypnea, wheezing, and accessory muscle use). (1) Severity of bronchiolitis can vary from mild symptoms that can be managed at home to acute respiratory failure requiring invasive ventilation. There is wide variation in care for infants admitted to the hospital with bronchiolitis, which persists despite the existence of guidelines. (2)(3)(4) In 2014, the American Academy of Pediatrics (AAP) published the "Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis" (1) (summarized in Table 1), an updated, revised version of a previous 2006 AAP guideline. (5) The strength of these recommendations are explained in Table 2. (1) Pediatricians should be familiar with these guidelines as well as evidence behind available diagnostic and treatment modalities. Greater

AUTHOR DISCLOSURE Drs Silver and Nazif have disclosed no financial relationships relevant to this article. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

ABBREVIATIONS

AAP	American Academy of Pediatrics
LOS	length of stay
RSV	respiratory syncytial virus

TABLE 1. **Summary of the American Academy of Pediatrics Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis**

KEY ACTION STATEMENT	STATEMENT	RECOMMENDATION STRENGTH	LEVEL OF EVIDENCE QUALITY[a]
1a	Clinicians should diagnose bronchiolitis and assess disease severity on the basis of history and physical examination findings	Strong	B
1b	Clinicians should assess risk factors for severe disease, such as age <12 wk, a history of prematurity, underlying cardiopulmonary disease, or immunodeficiency when making decisions about evaluation and management of children with bronchiolitis	Moderate	B
1c	When clinicians diagnose bronchiolitis on the basis of history and physical examination findings, radiographic or laboratory studies should not be obtained routinely	Strong	B
2	Clinicians should not administer albuterol (or salbutamol) to infants and children with a diagnosis of bronchiolitis	Strong	B
3	Clinicians should not administer epinephrine to infants and children with a diagnosis of bronchiolitis	Strong	B
4a	Nebulized hypertonic saline should not be administered to infants with a diagnosis of bronchiolitis in the emergency department	Moderate	B
4b	Clinicians may administer nebulized hypertonic saline to infants and children hospitalized for bronchiolitis	Weak (based on randomized controlled trials with inconsistent findings)	B
5	Clinicians should not administer systemic corticosteroids to infants with a diagnosis of bronchiolitis in any setting	Strong	A
6a	Clinicians may choose not to administer supplemental oxygen if the oxyhemoglobin saturation exceeds 90% in infants and children with a diagnosis of bronchiolitis	Weak (based on low-level evidence and reasoning from first principles)	D
6b	Clinicians may choose not to use continuous pulse oximetry for infants and children with a diagnosis of bronchiolitis	Weak (based on lower-level evidence)	C
7	Clinicians should not use chest physiotherapy for infants and children with a diagnosis of bronchiolitis	Moderate	B
8	Clinicians should not administer antibacterial medications to infants and children with a diagnosis of bronchiolitis unless there is a concomitant bacterial infection, or a strong suspicion of one	Strong	B
9	Clinicians should administer nasogastric or intravenous fluids for infants with a diagnosis of bronchiolitis who cannot maintain hydration orally	Strong	X
10a	Clinicians should not administer palivizumab to otherwise healthy infants with a gestational age of 29 weeks, 0 days or greater	Strong	B
10b	Clinicians should administer palivizumab during the first year of life to infants with hemodynamically significant heart disease or chronic lung disease of prematurity defined as preterm infants on >21% oxygen for at least the first 28 days of age	Moderate	B
10c	Clinicians should administer a maximum of 5 monthly doses (15 mg/kg per dose) of palivizumab during the respiratory syncytial virus season to infants who qualify for palivizumab in the first year of life	Moderate	B
11a	All people should disinfect hands before and after direct contact with patients, after contact with inanimate objects in the direct vicinity of the patient, and after removing gloves	Strong	B
11b	All people should use alcohol-based rubs for hand decontamination when caring for children with bronchiolitis. When alcohol-based rubs are not available, individuals should wash their hands with soap and water	Strong	B

Continued

TABLE 1. (Continued)

KEY ACTION STATEMENT	STATEMENT	RECOMMENDATION STRENGTH	LEVEL OF EVIDENCE QUALITY[a]
12a	Clinicians should inquire about the exposure of the infant or child to tobacco smoke when assessing infants and children for bronchiolitis	Moderate	C
12b	Clinicians should counsel caregivers about exposing the infant or child to environmental tobacco smoke and about smoking cessation when assessing a child for bronchiolitis	Strong	B
13	Clinicians should encourage exclusive breastfeeding for ≥6 mo to decrease the morbidity of respiratory infections	Moderate	B
14	Clinicians and nurses should educate personnel and family members on evidence-based diagnosis, treatment, and prevention of bronchiolitis	Moderate	C

[a]*Level A = Intervention: Well-designed and conducted trials, meta-analyses on applicable populations. Diagnosis: Independent gold standard studies of applicable populations. Level B = Trials or diagnostic studies with minor limitations; consistent findings from multiple observed studies. Level C = Single or few observational studies or multiple studies with inconsistent findings or major limitations. Level D = Expert opinion, case reports, reasoning from first principles. Level X = Exceptional situations where validating studies cannot be performed and there is a clear preponderance of benefit or harm. Reprinted with permission from Ralston SL, Lieberthal AS, Meissner HC; American Academy of Pediatrics, et al. Clinical practice guideline: the diagnosis, management, and prevention of bronchiolitis.* Pediatrics. *2014;134(5):e1474–e1502.*

adherence to clinical practice guidelines can help to minimize unwanted variation in care (such as varying rates of albuterol use), which can have unintended consequences (such as the adverse effects of tachycardia and jitteriness or increased length of stay [LOS]), and can help to improve high-value, high-quality care, with improvement in clinically important outcomes for patients. (3)(6)

EPIDEMIOLOGY

As the leading reason for hospitalization in the first year of life, bronchiolitis is responsible for approximately 100,000 hospital admissions annually in the United States. Although the number of admissions declined from 2000 to 2009, the number of emergency department visits, disease severity, use of noninvasive or invasive mechanical ventilation, and hospital charges all increased during this time. Nationwide, hospital charges for patients with bronchiolitis exceeded $1.7 billion in 2009. (7)

Use of molecular detection techniques has made it possible to identify a variety of causative viral agents for bronchiolitis. Respiratory syncytial virus (RSV) is by far the most commonly identified virus, detected in up to 80% of patients, followed by human rhinovirus. Clinical features of bronchiolitis caused by individual viruses are generally similar, although each virus demonstrates slight variation in seasonality and geographic distribution, and there are some data to suggest that RSV may be associated with a more severe illness course. (8) Some studies also point to greater disease severity in infants with co-infection by 2 or more viruses, although data are conflicting. (9) In the United States, RSV bronchiolitis accounts for fewer than 100 deaths annually, although mortality due to bronchiolitis is significantly higher in resource-limited countries. (9)

The epidemiology of RSV differs globally based on meteorologic conditions. In temperate climates, illness from RSV occurs in epidemics based on colder temperatures. In the Northern Hemisphere, infection rates increase from late October through April and peak in January or February. (8) This is followed by wintertime epidemics in the Southern Hemisphere from May to September. (10) During these peak times, viral transmission and disease severity are thought to be facilitated by indoor crowding, the impairment of ciliary function by cold air, and the temperature dependence of innate antiviral immune responses. (8) Alternatively, in tropical or semitropical climates, RSV outbreaks tend to be more common during the rainy season. (10)

PATHOGENESIS

The pathogenesis of bronchiolitis involves a combination of airway edema, increased mucus production, and necrosis of airway epithelial cells due to direct cytotoxic injury. (8) RSV transmission occurs from person to person either by direct inoculation of nasal mucosa with contaminated secretions or by inhalation of large infectious droplets. Virus replicates in the nasal epithelium, and an exaggerated immune response occurs, with an influx of natural killer cells, lymphocytes, and granulocytes into the epithelium. After an incubation period of 4 to 6 days from transmission, upper respiratory tract symptoms appear, including nasal congestion and rhinorrhea. (9)

In approximately one-third of infected patients, infection then spreads to the lower respiratory tract by sloughing and

aspiration of necrotic nasopharyngeal epithelial cells. (9) Viral replication subsequently occurs in the mucosal epithelial cells of the bronchioles. Similar to the upper respiratory tract, the resultant immune response in the lower tract leads to edema, further sloughing of epithelial cells, and mucus secretion. This leads to airway narrowing and obstruction, further worsened by impaired ciliary function. Cough, wheezing, tachypnea, nasal flaring, and retractions are the clinical manifestations of the airway obstruction. Distal air trapping causes hyperinflation and localized atelectasis. Mismatching of ventilation and perfusion leads to further increased work of breathing and hypoxemia. Fever is not universal, occurring in approximately 50% of patients. An uncomplicated illness may last 1 to 3 weeks before all symptoms are completely resolved, although viral shedding may last up to 4 weeks, especially in very young or immunocompromised patients. Unfortunately, despite the robust immune response, RSV infections occur throughout life, even in the absence of detectable antigenic change. (9)

RISK FACTORS

For most previously well infants, bronchiolitis is generally a self-limited disease. However, a subset of patients may be at risk for more severe disease, with several host and environmental factors contributing to severity risk. Age is the most important predictor of disease severity, with greatest risk between 1 and 3 months, when protective maternal antibodies wane. (9) Similarly, preterm infants, especially those less than 29 weeks of gestation who miss the window of greatest transplacental transfer of antibodies, are at higher risk for severe disease. Other severity risk factors include chronic lung disease of prematurity and hemodynamically significant congenital heart disease, especially in patients with pulmonary hypertension or congestive heart failure. Trisomy 21, lower weight, and neuromuscular disorders have also been described as independent predictors of severe bronchiolitis. (11) Sex may also play a role, with boys seeming to be at higher risk for severe illness than girls. There does not seem to be a disparity in rate of hospitalization between African American and white infants; data for other racial and ethnic groups are limited. (9)

Several recent studies have focused on preventable environmental risk factors for severe bronchiolitis. Although the mechanism is not completely understood, cigarette smoke has been shown to affect the incidence and severity of bronchiolitis. Infants with in utero tobacco smoke exposure were more likely to be admitted to the ICU for bronchiolitis in one study, (12) and in another, postnatal tobacco smoke exposure was associated with significantly increased odds of developing severe disease. (13) Other research suggests that air pollution, even at levels widely accepted as "safe," may increase bronchiolitis risk. (14)

CLINICAL ASPECTS

The diagnosis of bronchiolitis is made primarily based on history and physical examination findings. AAP guidelines recommend against the routine use of laboratory or radiographic testing. Patients often present with a history of a few days of initial upper respiratory symptoms (rhinorrhea, congestion) and fever, progressing into lower respiratory tract symptoms. Prominent lower respiratory tract symptoms include cough, wheezing, tachypnea, and signs of

TABLE 2. **Guideline Definitions for Evidence-Based Statements**

STATEMENT	DEFINITION	IMPLICATION
Strong recommendation	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), and quality of evidence is excellent or unobtainable.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Moderate recommendation	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), and the quality of evidence is good but not excellent (or is unobtainable).	Clinicians would be prudent to follow a moderate recommendation but should remain alert to new information and sensitive to patient preferences.
Weak recommendation (based on low-quality evidence)	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), but the quality of evidence is weak.	Clinicians would be prudent to follow a weak recommendation but should remain alert to new information and very sensitive to patient preferences.
Weak recommendation (based on balance of benefits and harms)	Weak recommendation is provided when the aggregate database shows evidence of both benefit and harm that seem similar in magnitude for any available courses of action.	Clinicians should consider the options in their decision making, but patient preference may have a substantial role.

increased work of breathing (intercostal, subcostal, or supraclavicular retractions; nasal flaring; head bobbing; or grunting). (9) Apnea alone may also be an initial presentation of bronchiolitis, particularly in infants younger than 2 months. Risk of apnea in young infants varies in studies from less than 1% to 24%. (9)(15) Infants can present with difficulty feeding and dehydration due to upper respiratory tract obstruction from mucus production and airway edema.

Physical examination findings vary from mild, with tachypnea, to severe, with complete respiratory failure. Vital sign changes include tachypnea, hypoxemia, and tachycardia (due to dehydration or as a reflection of hypoxemia). (16) Other physical findings include varying measures of increased work of breathing, including varying degrees of retractions, head bobbing, nasal flaring, and grunting. Signs of dehydration may also be seen on examination, including delayed capillary refill, sunken fontanelle, dry mucous membranes, and poor skin turgor. Findings on auscultation can include diffuse wheezing, crackles, coarse prolonged expiratory phase, and transmitted upper airway sounds.

The course of illness can be varied and dynamic, changing from moment to moment. The typical course of illness peaks at approximately day 3 to 4 of illness (16); however, this can have significant variation. Similarly, in assessing patients with bronchiolitis, physical examination findings may vary from moment to moment so that often-repeated observations are helpful to truly assess clinical severity. The nature of inherent variability in children with bronchiolitis has made it difficult for a single clinical severity scoring system to be widely accepted in predicting severity or clinical disposition. (17)

The AAP clinical practice guideline specifically recommends against the routine use of chest radiography for the evaluation of bronchiolitis. (1) Most patients with bronchiolitis have chest radiographs with hyperinflation, possibly with atelectasis or infiltrates, which often do not correlate with disease severity or aid with management. (18) Abnormal findings may lead to increased use of antibiotics without true underlying bacterial pneumonia, increasing both potential harms to the patient and health-care costs. (19)(20) Similarly, the AAP clinical practice guideline recommends against routine viral testing given that identification of a given virus does not alter management. (1) The only circumstance for which it could be considered is in the setting of suspected potential influenza infection if the clinical presentation as well as current community epidemiologic factors support the possibility of influenza infection, and, therefore, influenza antiviral agents could be considered. (16)

MANAGEMENT

The management of bronchiolitis is largely supportive; despite numerous trials of various medical therapeutic interventions, no clear single therapy has been found to be significantly beneficial. The mainstay of therapy begins with an assessment of need for supportive care by assessing hydration status and oxygenation. Dehydration can occur due to increased insensible losses with tachypnea, fever, and increased secretions or due to decreased oral intake in the setting of decreased energy, increased work of breathing, or congestion impeding oral intake. Support for dehydration can be provided in the form of encouraging frequent small aliquots of oral, nasogastric, or intravenous hydration, without a single modality being superior to the others. Severe bronchiolitis may be associated with greater potential for hyponatremia, (21) and management with hypotonic fluids may also be associated with less favorable outcomes. (22)

Hypoxemia may also accompany bronchiolitis, and it may be intermittent or variable due to the intermittent nature of plugging of bronchioles by mucus resulting in ventilation-perfusion mismatch. Whereas in the past there has been debate about acceptable levels of oxygen saturation, the most recent AAP clinical practice guideline suggests that clinicians may choose to not give supplemental oxygen therapy if saturations are greater than 90%. (1) Similarly, for children hospitalized with bronchiolitis, clinicians may choose not to use continuous pulse oximetry for those who do not require supplemental oxygen. Both of these recommendations have been shown to be safe compared with previous oxygen targets and pulse oximetry measurement practices. (23)(24) The use of continuous pulse oximetry is not only potentially associated with increased LOS but also occasionally feeds into the plight of overdiagnosis due to frequent false alarms, which can additionally lead to subsequent decreased rest for patients and families. (25)(26)

Although a common measure of supportive care, there is currently insufficient evidence to recommend for or against nasal suctioning as a potential intervention to help with upper airway obstruction due to mucus production. However, there is evidence to recommend against deep suctioning because it can prolong LOS in infants hospitalized with bronchiolitis. (27) Possible explanations for this finding are that deep suctioning may cause more airway trauma and, therefore, edema and irritation, inadvertently prolonging symptoms, or, alternatively, that the use of a larger-caliber catheter for nasopharyngeal suctioning may be more effective in clearing nasal secretions and, thus, improve symptoms sooner. (27) Similarly, chest physiotherapy has been examined as a potential supportive measure that overall has

been shown to be ineffective at improving outcomes such as LOS or disease severity; however, there are some conflicting more recent studies that may suggest benefit, specifically using passive expiratory techniques, such as providing bimanual thoracic and abdominal pressure during expiration and holding the pressure for a few respiratory cycles. (28)(29) There is some potentially conflicting evidence on this topic due to the heterogeneity of studies in the sense that the severity of illness in patients included in these studies varies, as well as the chest physiotherapy techniques vary between studies. (29) However, currently there is not enough benefit shown in any particular group or method to warrant general recommendation.

Various studies and systematic reviews (30)(31)(32) have demonstrated that neither albuterol nor any other β-agonist bronchodilators should be used to treat children with bronchiolitis, concluding that the adverse effects and costs supersede possible benefits. (1) Similarly, racemic epinephrine and other α receptor agonists should not be used to treat bronchiolitis. (33) One study's findings conflict with this statement; the study showed some potential benefit when combining racemic epinephrine with corticosteroids specifically in the emergency department setting. (34) However, this has not been conclusively determined. Similarly, corticosteroids have been shown to be ineffective in the routine treatment of bronchiolitis. (35)

Nebulized hypertonic saline is a treatment option that has received recent attention due to conflicting clinical trial results, the conflict coming from reported widely varying LOSs, particularly in studies conducted outside the United States; but even when solely examining studies conducted in the United States, differences exist. (36)(37)(38) Several meta-analyses and systematic reviews have also come to different conclusions. (39)(40)(41)(42) The most recent publication using a more novel method, trial sequence analysis, has concluded that results from previous meta-analyses that show a benefit likely represent a type I error (concluding that a statistically significant treatment exists, when one does not exist in reality). Therefore, clear benefit from hypertonic saline cannot be concluded. (43)

Heated humidified high-flow nasal cannula oxygen is a treatment modality that has more recently gained popularity in use for the treatment of infants with bronchiolitis, although its efficacy has not been conclusively proved. There are data to suggest that heated humidified high-flow nasal cannula oxygen may decrease respiratory effort and work of breathing, as well as some potential evidence of decreasing need for escalation of care; however, again, conflicting data exist. (44)(45)(46) All of these studies, as well as additional studies focusing on potential safety issues, including feeding while on high-flow nasal cannula, suggest that heated humidified high-flow nasal cannula oxygen therapy is a safe treatment modality. (47)

Antibiotic drug therapy is not recommended for the treatment of bronchiolitis unless an identified concomitant bacterial infection (such as acute otitis media or urinary tract infection) is confirmed or suspected. Studies vary on the potential risk of serious bacterial infection in infants with bronchiolitis, which also differs by the age of the patient in question. Although bacteremia and meningitis are extremely rare, infections such as urinary tract infection or acute otitis media may be more common. (48)(49) Laboratory testing to confirm concomitant bacterial infection when suspected should be obtained before initiating antibiotic drug use. Antiviral drug therapy is not recommended unless specifically in the setting of influenza infection, as noted previously herein. (16)

Measures to prevent bronchiolitis are important for the pediatric provider to be familiar with to assist in treating patients and educating families and caregivers. (1) Premature infants or infants with comorbidities (such as hemodynamically significant heart disease, immunodeficiency, or neuromuscular disease) should receive prophylaxis with palivizumab as appropriate during the RSV season, as per AAP guidelines, which may vary year to year as to eligibility and specific recommendations, with the most recent recommendations referenced. (50) In the clinical setting, appropriate isolation precaution measures should be used to minimize spread of infection to other patients or caregivers. When speaking with families and caregivers of young infants and children, clinicians should also emphasize measures that will decrease risk of developing or spreading bronchiolitis, such as appropriate hand hygiene (using alcohol-based hand rubs or, when not available, soap and water) and decreasing exposure of young infants in particular to others who are ill. Other measures that may decrease both the occurrence and severity of bronchiolitis are decreasing tobacco smoke exposure as well as encouraging breastfeeding.

When specifically discussing emergency department or inpatient management of bronchiolitis, differences in care practices have been shown to correlate with differences in hospital costs and LOS. Overuse of resources that are not supported by the AAP guidelines has been associated with increased LOS without the benefit of decreased readmission. (3) Clinical pathways that reinforce the conservative approach (eg, not using bronchodilators) have been associated with decreased LOS, (51) decreased use of ineffective therapies (such as bronchodilators or corticosteroids), and decreased LOS without affecting readmissions. (52)

The existence of the AAP clinical practice guideline has allowed for significant opportunity to implement various quality improvement initiatives, such as using clinical pathways at an institution level, and to implement initiatives that have resulted from national collaboratives. (53)(54)(55)(56) Potential initiatives could target various outcomes (such as LOS) or reduce evaluation or treatment measures that are not routinely recommended (such as chest radiography or bronchodilators, respectively).

PROGNOSIS

By nature, bronchiolitis is a self-limited disease with a relatively good prognosis. Mortality risk is relatively low and declining in otherwise healthy children, including those younger than 1 year, with recent analysis revealing an odds ratio of 0.25 in the United States when examining in-hospital mortality out of all patients hospitalized with bronchiolitis, comparing 2009 and 2000 mortality data, which approximates fewer than 100 deaths annually. (7)(9) The most common sequela attributed to bronchiolitis is the development of reactive airway disease or asthma later in childhood. Although the reported risk varies from 20% to 60%, infants with severe bronchiolitis, such as those requiring hospitalization (particularly infants <6 months of age), have a higher risk of developing asthma later in life. (57)(58) Asthma may occur with increased frequency in infants with a personal or family history of atopy. Therefore, counseling to all families after the initial episode of bronchiolitis should include advice to be attentive to the potential for wheezing or increased respiratory distress if the child develops another viral respiratory illness in the future.

Summary

- Specific evidence is summarized in Table 1.
- Based on strong research evidence, bronchiolitis is a clinical diagnosis and, therefore, clinicians should not routinely use chest radiography or laboratory tests to evaluate. (1)
- Based on some research as well as consensus, (1) clinicians may choose not to use continuous pulse oximetry to monitor hospitalized patients with bronchiolitis and may choose to provide only supplemental oxygen therapy for oxygen saturations less than 90%. (23)(24)
- Based on strong research evidence, treatment of bronchiolitis should not routinely include the use of bronchodilators, corticosteroids, or antibiotics. (1)(31)(32) Although there has been early conflicting evidence on the utility of nebulized hypertonic saline, more recent analyses, particularly in US populations, lean toward recommending against its use for routine treatment of bronchiolitis. (40)(43)
- Based on strong research evidence, as well as some consensus, clinicians should educate and counsel families about bronchiolitis and ways to minimize risk, including proper hand hygiene, decreasing tobacco smoke exposure, and encouraging breastfeeding. (1)
- Strong research evidence supports that clinicians should use palivizumab prophylaxis in specific populations based on specific annual recommendations. (50)
- Based on some research evidence, clinicians could consider using clinical pathways incorporating American Academy of Pediatrics clinical practice guidelines to help minimize variation of care, improve outcomes for patients, and prevent overuse of therapies not routinely recommended. (53)(54)(55)(56)
- Overall prognosis for infants and children with bronchiolitis is good because it is a self-limited illness. (1) Based on some research evidence and consensus, given the association with potential for future risk of wheezing and development of asthma, providers and caregivers should remain vigilant for future signs and symptoms consistent with asthma. (57)(58)

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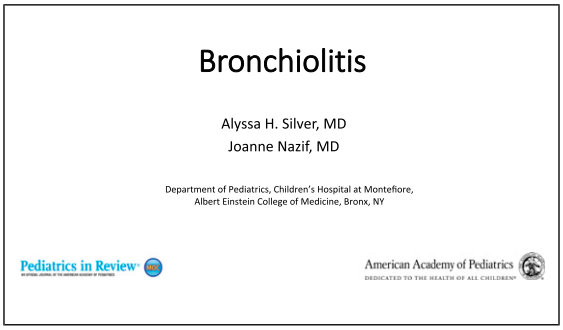

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1. A previously healthy 2-month-old boy presents to the clinic with a 12-hour history of "breathing fast," rhinorrhea, congestion, and cough. He has been breastfeeding normally until this morning, when he was noted to stop latching on due to congestion and cough. The baby was born at 38 weeks' gestation but was small for gestational age due to placental insufficiency. The mother had an uneventful pregnancy. She smoked in the first trimester but stopped smoking when she learned she was pregnant. Family history is significant for asthma. The baby is diagnosed as having bronchiolitis. You explain to the family that because it is early in the course of the disease, the clinical course could potentially worsen. Which of the following is the most important predictor of disease severity in this patient?
   A. Age.
   B. Being born small for gestational age.
   C. Breastfeeding.
   D. Family history of asthma.
   E. Male sex.
2. Physical examination of the patient in the vignette in question 1 shows a temperature of 100.4°F (38.0°C), respiratory rate of 50 breaths/min, heart rate of 140 beats/min, and oxygen saturation of 95% on room air. On physical examination the baby is alert and awake but in mild respiratory distress with subcostal retractions. There is no head bobbing but there is nasal flaring and nasal congestion. On lung auscultation, mild end expiratory wheezing is diffusely heard. He has moist mucous membranes, and his cardiac examination findings are normal. The rest of the examination findings are normal. In evaluating the respiratory illness in this patient, which of the following is the most useful method in making the diagnosis of bronchiolitis?
   A. Acute and convalescent serum specimens.
   B. Chest radiography.
   C. Complete blood cell count.
   D. History and physical examination.
   E. Nasopharyngeal swab for viral culture.
3. A 4-month-old infant presents to the emergency department (ED) in respiratory distress in January. She was born at 36 weeks' gestation without complications. She does attend child care, where there are multiple other children with "colds." Her mother reports that the baby has had 2 days of increasing difficulty breathing, with nasal congestion, rhinorrhea, and low-grade fever. This morning the mother noted significant work of breathing, with nasal flaring and retractions, and brought the baby to the ED. On physical examination the baby has a temperature of 99.7°F (37.6°C), respiratory rate of 65 breaths/min, heart rate of 180 beats/min, and oxygen saturation of 88% on room air. Blood pressure is within normal values. The infant appears well-developed, but she is in moderate respiratory distress. There is thick nasal discharge. On examination some head bobbing and occasional grunting are noted. On auscultation there are diffuse wheezes and a prolonged expiratory phase. A diagnosis of viral bronchiolitis is made. In addition to deep nasal suctioning, which of the following is the next best step in management in this patient?
   A. Administer a nebulized albuterol treatment.
   B. Begin supplemental oxygen.
   C. Obtain a chest radiograph.
   D. Order a complete blood cell count and a blood culture.
   E. Start empirical broad spectrum antibiotics.

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4. A 6-month-old boy is brought to the clinic by his parents for follow-up after discharge from the hospital where he was admitted for 72 hours for respiratory syncytial virus (RSV) bronchiolitis. The parents are very concerned about their 2 older children in the home getting sick and ask how they might best prevent the spread of the illness. Which of the following is the most effective measure to decrease the risk of RSV transmission?

    A. Administer palivizumab to the 6-month-old.
    B. Begin prophylactic antibiotics for the other children.
    C. Emphasize appropriate hand hygiene.
    D. Ensure that all household members are up-to-date with recommended vaccines.
    E. Keep the older children home from school for 7 days.

5. The parents of the infant described in the vignette in question 4 are concerned whether this RSV episode would result in late and long-term sequelae. They seek information from the clinician during this visit. The clinician reassures the parents that the overall prognosis for infants and children with bronchiolitis is good with minimal later sequelae in low-risk patients. In explaining the potential long-term sequelae reported in children after bronchiolitis episodes, the clinician will most likely mention which of the following as a common sequela attributed to bronchiolitis?

    A. Chronic obstructive pulmonary disease.
    B. Epilepsy.
    C. Reactive airway disease.
    D. Recurrent pneumonia.
    E. Sinusitis.

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Pediatrics in Review 2019;40;568
DOI: 10.1542/pir.2018-0260

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