BRONCHIOLITIS

INTRODUCTION (DEBORAH LEVINE, M.D. 9/2016)
The American Academy of Pediatrics defines bronchiolitis as “a constellation of clinical symptoms and signs including a viral upper respiratory prodrome followed by increased respiratory effort and wheezing in children less than 2 years of age”

ETIOLOGY
Respiratory Syncitial Virus (#1)
Rhinovirus (#2)
Human metapneumovirus
Influenza
Adenovirus
Parainfluenza type 3
Enterovirus
Herpes Simplex

Bronchiolitis is an acute, viral-induced inflammation and edema of the airways of the lower respiratory tract resulting in airway obstruction. Smooth muscle constriction appears to play a limited role. It is the most common lower respiratory tract infection in children under 2 years of age, with a peak age between 2 and 6 months. Each year approximately 12% of infants develop bronchiolitis and RSV bronchiolitis is a leading cause of infant hospitalization. Bronchiolitis can lead to death, especially in infants. Respiratory Syncytial virus (RSV) causes the majority of cases of bronchiolitis but many other viruses have been implicated. In temperate climates disease is most common in the late fall and winter seasons. Co-infection with more than one virus may occur in up to 30% of cases and a viral infection with a concomitant bacterial infection can also occur.

Apnea can occur in 20% of hospitalized infants. Infants born prematurely (< 37 weeks), neonates (< 6 weeks), those with congenital heart disease, or chronic lung disease such as: cystic fibrosis, bronchopulmonary dysplasia, congenital pulmonary anomaly, those who have a primary immunodeficiency or receiving immunosuppressant therapy are at risk of a severe course of bronchiolitis. Severity of disease is associated with longer hospitalization stays, intensive care admission and need for mechanical ventilation.

CLINICAL FINDINGS
Bronchiolitis usually presents with symptoms of an upper respiratory infection, such as cough and coryza for 1-2 days. Upper respiratory illness progresses to lower respiratory illness including wheezing, worsening cough and tachypnea on days 5-7 and then gradually resolves. Cough typically resolves at 2 weeks but complete resolution can take up to 4 weeks. Fever may also be present. The degree of respiratory symptoms can cause poor feeding and lead to dehydration. Co-infections may include: conjunctivitis, pharyngitis and otitis media.

Significant accessory muscle use, nasal flaring and head bobbing in younger infants indicate respiratory distress and the potential for pending respiratory failure. Auscultation finding can include expiratory wheezing, prolonged expiration and both fine and coarse rales.

DIAGNOSIS
Bronchiolitis is a clinical diagnosis based on signs and symptoms. Rapid viral testing is of limited usefulness except for epidemiological surveillance, cohorting on inpatient wards to reduce nosocomial spread and perhaps for designating a patient at lower risk for concurrent serious bacterial infection.

Oxygen saturation and end-tidal CO_2 monitoring in conjunction with respiratory rate, respiratory effort and mental status can be used to determine the presence of respiratory failure and the need for mechanical ventilation

It is important to recognize that the differential diagnosis of tachypnea in the infant includes cardiac disease such as myocarditis, compensation for metabolic acidosis, central nervous system disorders that alter the control of ventilation and toxins such as salicylates.

DIFFERENTIAL DIAGNOSIS OF WHEEZING	
Respiratory	Asthma, cystic fibrosis, aspirated foreign body
Cardiac	Congestive heart failure may present with pulmonary edema manifested as wheezing. Viral myocarditis is a particular concern.
Gastrointestinal	Reflux or tracheao-esophageal fistula can cause bronchospasm or pneumonia
Infections	*Mycoplasma pneumoniae*, pertussis or *Chlamydia trachomatis* can cause paroxysmal cough and mild wheezing in some infants
Allergies	Anaphylaxis
Foreign body	Gastrointestinal or pulmonary
Congenital	Rings, webs or pulmonary sequestrations, laryngotrachealmalacia
Toxins	Organophosphates (bronchorhea) and hydrocarbons (chemical pneumonitis), others (noncardiogenic pulmonary edema)

RADIOGRAPHY: Chest radiographs are not routinely recommended to diagnose bronchiolitis but can exclude other disease processes that may present with wheezing such as foreign body aspiration, pneumonia or congestive heart failure. Chest XRAY findings in bronchiolitis may include: hyperventilation with increased interstitial markings, peribronchial cuffing and patchy infiltrates or atelectasis. Routine utilization of chest XRAYS leads to the over diagnosis of pneumonia (when atelectasis is present) and the unnecessary use of antibiotics.

LABORATORY TESTING: Testing may be helpful in detecting co-infection with bacterial pathogens in febrile infants. Infants less than 60 days with fever should be evaluated for serious bacterial infection such as urinary tract infection. The prevalence of bacteremia (1-2%) and UTI (1-5%) are lower than those without bronchiolitis.

MANAGEMENT FOR EMS/HOSPITAL PROVIDERS
Bronchiolitis is a self-limited illness, typically requiring only supportive care such as adequate oxygenation and hydration until the disease abates.

AAP BRONCHIOLITIS RECOMMENDATIONS RELATED TO ED CARE: 2014	
1a	Clinical diagnosis
1b	Assess risk factors for severe disease
1c	Radiologic and laboratory testing should not be obtained routinely
2a	Bronchodilators should not be used
3	Epinephrine should not be used
4a	Hypertonic saline should not be used in the ED
4b	Hypertonic saline may be used in admitted patients
5	Systemic corticosteroids should not be used
6a	May choose not to use supplemental oxygen for oxygen saturation > 90%
6b	May choose not to use continuous pulse oximetry
7	Should not use chest physiotherapy
8	Should not administer antibiotics unless concomitant bacterial infection
9	Administer IV or NG hydration in infants who cannot maintain hydration orally

OXYGEN: The American Academy of Pediatrics recommends that practitioners may chose to not use supplemental oxygen for patients with oxygen saturation greater than 90%. Oxygen should be provided in the least invasive method possible to maintain oxygen saturation greater than 90%.

A recent study (Shuh, JAMA 2014) demonstrated that artificially elevated oxygen saturations by 3% resulted in lower admission rates without an increase in complications. A study of infants discharged from the emergency department with home oxygen saturations monitors with the display and alarms turned out revealed that a majority of infants (64%) had desaturations to less than 90% for > 1 minute (Principi, JAMA Pediatrics 2016, PubMed ID: 26928704). The presence of desaturations did not result in an increase in unscheduled health care visits or hospitalization. In the regression analysis, only previous medical visits were independently associated with desaturation indicating the those with desaturation could not have been predicted at the time of ED discharge. The authors conclude that: “these findings challenge the concept that infants with desaturations are sicker and suggest that pulse oximetry is not an effective tool to predict morbidity leading to escalated return for care”.

HYDRATION: Hydration is an important component of supportive care and can be administered orally, via a nasogastric tube or intravenously. Bronchiolitis is associated with an increase in antidiuretic hormone resulting in fluid overload and hyponatremia. Hypotonic intravenous solutions may exacerbate this process and should be avoided.

BRONCHODILATORS: Beta-agonists including Albuterol and Epinephrine have been studies extensively with often conflicting results. The literature suggests that the routine use of nebulized bronchodilators does not alter clinical course. The AAP recommendations for a trial of bronchodilators was changed in the 2014 guidelines from "should not routinely be used" to "should not be used".

HYPERTONIC SALINE: The 2014 AAP Guidelines recommend that nebulized hypertonic saline may be administered in inpatients but should not be administered in the emergency department. This is consistent with a 2011 Cochrane meta-analysis. A recent meta-analysis of hypertonic saline for acute bronchiolitis (Zhang Peds 2015) calls into question the current AAP recommendation. 7 clinical trails including 951 outpatients were included. The pooled relative risk of admission (hypertonic saline/normal saline) was 0.8 95% CI (0.67-0.96) indicating a decreased risk of admission. The decrease was greatest in those receiving more the two treatments. The authors report a relative reduction of admission of 20% 95% CI (7-38%) and an absolute reduction of in 7.9% 95% CI (2.1-13.6%). This corresponds to a number needed to treat of 12. 12 patients would need to be treated with nebulized hypertonic saline to prevent 1 additional admission.

ADDITIONAL THERAPIES: Treat with Oseltamivir if influenza positive and > 2 weeks of age and within 48-72 hours of symptom onset. There is no data to support the use of corticosteroids in bronchiolitis. There is insufficient evidence to routinely recommend the use of chest physiotherapy or Heliox.

NONINVASIVE VENTILATION (see PEM Guide: Procedures: Noninvasive Ventilation)

CPAP: CONTINUOUS POSITIVE AIRWAY PRESSURE

CPAP delivers a constant level of pressure support (inspiratory and expiratory) without regard to the respiratory cycle. It may be delivered through a variety of interfaces. Short bi-nasal prongs are preferred in neonates and infants due to the difficulty of maintaining an adequate facemask fit and seal.

CPAP SETTINGS
Pressure is usually started at 5cm H_20
Increased by 1 cm H_20 as needed and tolerated
Typical levels are 5-10 cm H_20 with a maximum of 15 cm H_20

HHFNC: HUMIDIFIED HIGH FLOW NASAL CANNULA

Warm (35-37 C) and humidified nasal oxygen is better tolerated than normal wall oxygen. The pressure from high flow rates can open the soft palate by separating it from the posterior pharyngeal wall. It also provides an oxygen reservoir in the nasopharynx. When HHFNC is used in conjunction with a non-rebreather facemask it can increase the fraction of inspired oxygen (FiO_2) to 100%.

HHFNC SETTINGS
Infants: Start at 2-4 liters/min
Increase as needed and tolerated to 8 Liters/min
Older children and Adults – Up to 40 liters/min

DISPOSITION

Criteria for discharge, admission and admission to the pediatric ICU are included below. For discharged patients, parents should be educated about signs and symptoms of concern that would warrant seeking care. They should be informed of the risk of passive smoking, proper hand washing techniques and proper bulb suctioning prior to feeding. A follow up appointment with their primary care provider should be made

DISCHARGE CRITERIA
Respiratory rate < 60 breaths/minute
No signs of increased work of breathing
Oxygen saturation > 90% on room air
Feedings tolerated, no signs of dehydration

ADMISSION CRITERIA
Respiratory rate > 60 and < 80
Evidence of increased work of breathing
Oxygen saturation < 90% on room air
Feedings not tolerated or patient clinically dehydrated
Parent/Guardian unable to provide care at home
High risk: prematurity, chronic lung/heart disease, immunodeficiency

ADMISSION TO PICU CRITERIA
Respiratory rate > 80
> 40 ml/kg fluid boluses given without systemic response
Impending respiratory failure or apnea
Need for cardiovascular monitoring
Need for non-invasive or mechanical ventilation