



## Chapter 168 – Pediatric Respiratory Emergencies: Lower Airway Obstruction

**Key concepts** (words in bold are those that were podcasted)

*“An infant younger than 12 months has an oxygen consumption index double that of an adult. An infant with bronchospasm due to asthma or bronchiolitis may rapidly develop hypoxemia, bradycardia, and cardiopulmonary arrest.*

- *No single asthma score has been universally adopted to assess degree of illness or treatment responses. However, Most asthma **scores include some combination of respiratory rate, degree of wheezing, inspiratory-to-expiratory ratio, use of accessory muscles, and oxygen saturation.***
- *It should not be a routine practice to obtain a chest x-ray for wheezing children, even for those who are febrile, wheezing for the first time, or require hospitalization. Chest x-rays are indicated for those with a history of choking, focal chest findings, extreme distress, or subcutaneous emphysema.*
- *Albuterol is the drug of choice in the ED treatment of acute asthma of any severity. Albuterol delivered by MDI's is as effective as that delivered by nebulizer for children with acute asthma. The mode of delivery is largely chosen on the basis of cost and ability to adhere to the goal of three treatments within the first hour of care.*
- *Almost all children treated in the ED for asthma will require systemic corticosteroids. However, children with mild exacerbations who respond promptly to a single SABA treatment may be managed without systemic corticosteroids.*
- *To date, most studies have failed to demonstrate that levalbuterol leads to better ED outcomes compared with racemic albuterol. Racemic albuterol, at a substantially lower cost, should remain the drug of choice for children with acute asthma exacerbations.*
- *Continuously nebulized albuterol, CS, magnesium sulfate, and IV SABA are cornerstones of therapy for moderately to severely ill children with asthma.*
- *National guidelines recommend that emergency clinicians initiate controller therapy (eg, inhaled corticosteroids) for children with persistent asthma at ED discharge.*
- *Asthma is the condition that has the most clinical overlap with bronchiolitis. Physical examination findings alone cannot distinguish the two. Younger age, presentation during the winter months, antecedent URI symptoms, and absence of prior or family history of atopic disease and wheezing suggest bronchiolitis as the cause of wheezing in an individual patient.*
- *Bronchiolitis is a clinical diagnosis based on a history of prodromal URI symptoms in a young infant, followed by findings on physical examination of wheezing and increased work of breathing. The value of diagnostic imaging and laboratory evaluation is limited, and these measures should not be used routinely.*



- ***A urinalysis and culture should be performed for febrile infants between 1 and 2 months of age who are known to be RSV-positive or have clinical bronchiolitis. The decision to obtain blood or cerebrospinal fluid cultures and give empirical antibiotics should be made on an individual basis.***
- ***All febrile infants in the first month of life should undergo testing and evaluation for SBIs and be empirically treated with antibiotics, regardless of RSV status or presence of clinical bronchiolitis.***
- ***The management of infants with bronchiolitis focuses largely on supportive measures, and most patients able to tolerate oral hydration can be managed as outpatients. There are currently no consistently effective pharmacologic therapies for bronchiolitis.***
- ***Despite reports that more than 50% of infants may be prescribed corticosteroids when diagnosed with bronchiolitis, well-designed controlled trials have demonstrated no benefit for [corticosteroid] use in [bronchiolitis in] terms of rate of admission, clinical score, or any other clinical outcome.***
- ***Disposition from the ED for bronchiolitis depends on the assessment of multiple risk factors, including young age, prematurity, significant hypoxemia, and severe tachypnea, which may predict a more severe clinical course.***

## Episode overview

- 1) Excluding asthma, list 8 causes of wheeze
- 2) Outline the pathophysiology of asthma.
- 3) What are the features of mild, moderate and severe asthma?
  - a. Describe the PRAM score
- 4) List 8 medications for asthma treatment with doses
- 5) What is the typical ED management for a pts with an asthma exacerbation?
- 6) Describe adjunctive therapies that might be used in a patient with refractory symptoms.
- 7) How are PO corticosteroids used in the management of asthma?
- 8) When should children be started on inhaled corticosteroids?
- 9) Outline a plan for disposition of a pt presenting to the ED with an acute asthma exacerbation.
- 10) What are risk factors for sudden death in a patient with asthma?
- 11) List risk factors for bronchiolitis.
- 12) What are the typical pathogens of bronchiolitis?
- 13) What is the pathophysiology of bronchiolitis?
- 14) How is bronchiolitis managed?
- 15) Which children with bronchiolitis should be admitted to hospital?
- 16) List potential complications of RSV.



## Wisecracks

- 1) What's the natural history of infants/toddlers who wheeze?
- 2) What is a peak flow? What is the FEV1? What are the advantages to measuring peak flow? What are the disadvantages?
- 3) Risk factors for death in bronchiolitis

## Rosen's In Perspective:

- Asthma is on the rise (doubling in prevalence in the last 3 decades)
- *“Because children have compliant chest walls and horizontally located ribs, their ability to use the thorax to increase tidal volume is limited; thus, ventilation is highly dependent on diaphragmatic movement.*
  - *Also, minute ventilation is largely rate-dependent and may quickly lead to fatigue. An infant younger than 12 months has an oxygen consumption index that is double that of an adult.*
  - *Increased airway resistance and a compliant chest wall predispose infants to tachypnea, increased work of breathing, and increased oxygen consumption. As a result, the infant with respiratory distress may rapidly develop hypoxemia, bradycardia, and cardiopulmonary arrest.”* – Rosen's 9<sup>th</sup> ed.
    - These kids:
      - Are dependent on diaphragm movement for oxygen/ventilation
      - Depend on a fast RR
      - Consume much more O<sub>2</sub> and glucose than adults

## Core questions

### 1) Excluding asthma, list 8 causes of wheeze

*“palpation of the chest and neck may reveal subcutaneous air associated with a pneumomediastinum or pneumothorax. Severely ill children may have wheezing that is audible without a stethoscope or no wheezing due to poor aeration. Asymmetric wheezing suggests pneumonia, pneumothorax, or a foreign body.”* – Rosen's 9<sup>th</sup> Ed.

- See Rosen's table 168.1 for original differential diagnosis with distinguishing characteristics
- Infectious
  - Bronchiolitis (infant, preceding upper resp. infection, seasonal, no history of atopy, no family history of asthma)
  - Laryngotracheobronchitis/croup (inspiratory stridor, barking cough, fever, response to humidified air)
  - Pneumonia (focal wheezing, rhonchi, rales, grunting, fever)
  - Tuberculosis (diffuse adenopathy, weight loss, prolonged fever)



- Bronchiolitis obliterans (prolonged cough/chest pain, inhalational exposure to toxin)
- Anatomic or congenital
  - Gastroesophageal reflux (frequent emesis, weight loss, aspiration)
  - Cystic fibrosis (diarrhoea, weight loss, chronic cough, salty sweat)
  - Congestive heart failure (rales, murmur, gallop, hepatosplenomegaly, cardiomegaly or pulmonary vascular congestion on chest radiograph)
  - Tracheoesophageal fistula (choking, coughing, cyanosis with feeds)
  - Mediastinal mass (chest pain, mediastinal density on chest radiograph)
  - Vascular ring (stridor, cyanosis, apnoea, high-pitched brassy cough, dysphagia)
- Acquired
  - Foreign body aspiration (history of choking, toddler, asymmetric pulmonary exam, unilateral hyperinflation on chest radiograph)
  - Anaphylaxis (abrupt onset, urticarial rash, angioedema, history of allergies)

## 2) Outline the pathophysiology of asthma.

*“Asthma is a lower airway disease marked by bronchoconstriction, mucosal edema, and pulmonary secretions.” – Rosen’s 9<sup>th</sup> ed.*

Often asthma is triggered by a viral URTI

## 3) What are the features of mild, moderate and severe asthma?

### **mild exacerbation:**

- *alertness,*
- *slight tachypnea,*
- *expiratory wheezing only,*
- *mildly prolonged expiratory phase,*
- *minimal accessory muscle use,*
- *and oxygen saturation of greater than 95%.*

### **moderate exacerbation:**

- *alert tachypneic children who have wheezing throughout expiration*
- *An inspiratory-to-expiratory ratio of 1:2*
- *significant use of accessory muscles.*
- *Typically, the oxygen saturation will be 92% to 95% and the PEFV will be 41% to 70% of personal best.*

### **severe exacerbation:**

- *restlessness or lethargy,*
- *extreme tachypnea and tachycardia,*



- *audible wheezing,*
- *inspiratory-to-expiratory ratio exceeding 1:2*
- *significant use of accessory muscles,*
- *oxygen saturation less than 92%.*
- Silent chest on auscultation

*Some older children with a severe exacerbation may have bradypnea due to a prolonged expiratory phase, and auscultated wheezing may be absent with markedly decreased aeration.*

*The PEFV will typically be less than 40% predicted, although most children will be too ill to use a peak flow meter.*

**a. Describe the PRAM score**

<b>Emergent &amp; Urgent Care Asthma Clinical Score (PRAM)*</b>				
<b>Signs</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>Suprasternal Indrawing</b>	absent		present	
<b>Scalene Retractions</b>	absent		present	
<b>Wheezing</b>	absent	expiratory only	inspiratory and expiratory	audible without stethoscope/ silent chest with minimal air entry
<b>Air entry</b>	normal	decreased at bases	widespread decrease	absent/ minimal
<b>Oxygen saturation on room air</b>	> 93%	90% - 93%	< 90%	

  

<b>Severity Classification</b>	<b>PRAM CLINICAL Score</b>
Mild	0 - 4
Moderate	5 - 8
Severe	9 - 12
Impending Respiratory Failure	12+ following lethargy, cyanosis, decreasing respiratory effort, and/or rising pCO <sub>2</sub>

**\*Modified to adjust for higher altitude** **JUNE 2008**  
 Chalut D, Ducharme F, Davis G *Journal of Pediatrics* 2000;137:762-768



See <http://www.ucalgary.ca/icancontrolasthma/files/icancontrolasthma/emergentbrochure.pdf>

#### 4) List 8 medications for asthma treatment with doses

1. Short acting beta2 agonist: albuterol - ventolin
  - a. *Racemic albuterol has become the SABA of choice for treatment of children with acute asthma either via nebulizer or MDI (with a spacer)*
  - b. *MDI w. Spacers are generally better than nebulizers!\**
    - i. *greater reduction in wheezing and lower hospitalization rates, especially in children 1-4 yrs*
    - ii. *Less systemic absorption*
  - c. MDI w spacer:
    - i. <20 kg - 5 puffs q 20 min
    - ii. >20 kg - 10 puffs q 20 mins
  - d. NEB:
    - i. < 20 kg - 2.5 mg q 20 mins
    - ii. > 20 kg - 5 mg q 20 mins
2. Ipratropium bromide
  - a. *IB, an anticholinergic agent, blocks reflex bronchoconstriction caused by stimulation of airway cholinergic receptors.*
  - b. *May take up to one hour to work.*
  - c. Recommended synergistic action with salbutamol. Recommend at least 3 doses
  - d. MDI-S = 5 puffs q 20 mins x 3
  - e. NEB = 250 mcg with each NEB treatment (combined with salbutamol)
3. Corticosteroid
  - a. PO is the go to - unless in failure or vomiting:
    - i. Dexamethasone
      1. • Use parenteral solution • 0.15-0.30mg/kg per dose, max dose 10mg • Causes less vomiting than prednisone/prednisolone
    - ii. • Prednisone/Prednisolone • 1-2mg/kg per dose, max dose 60mg
  - b. IV:
    - i. Use oral corticosteroids unless patient is vomiting or is in impending respiratory failure
    - ii. • Methylprednisolone 1-2mg/kg, max dose 80mg
    - iii. • Hydrocortisone 4-8 mg/kg, max dose 400mg
4. Oxygen
  - a. To keep SpO<sub>2</sub> > 95%
5. Magnesium
  - a. Administer MgSO<sub>4</sub> 25mg/kg IV bolus over 20 minutes (max dose 2 grams)



- b. Use only in severe asthma unresponsive to aerosolized bronchodilators
6. IV salbutamol
  - a. • Mix 5ml of 1mg/ml solution diluted in 500ml of D5W (10mcg/ml)
  - b. • Infusion: Start at 1mcg/kg/minute (6ml/kg/hour) & titrate upwards in 1mcg/kg/minute increments as necessary
  - c. Use only in severe asthma unresponsive to aerosolized bronchodilators or impending respiratory failure
7. Epinephrine IM / IV
  - a. Epinephrine • IV 0.1ml/kg of 1/10,000 • IM 0.01ml/kg of 1/1,000
  - b. Use only in impending respiratory failure
8. Heliox (severely ill children that are unresponsive to other therapies)
9. Ketamine (for sedation and analgesia pre-intubation)
10. Mechanical ventilation with inhaled anesthetics

*“NEBs provide a passive means of receiving aerosolized medication because precise coordination between respiration and aerosol delivery is not needed; additionally anticholinergic medication and humidified oxygen may be delivered concurrently. **However, delivery is inefficient, with only about 10% of the drug delivered to the small airways.** Also administration takes about 10 minutes, increasing respiratory therapy time and costs.*

*On the other hand, spacers used with a MDI provide a reservoir of medication that is available to be inhaled. Therefore, precise coordination between actuation and inhalation is not needed, and there is no need for breath-holding. After each actuation, children should take five to eight breaths. Drug deposition in the oropharynx and systemic absorption are reduced with the use of a spacer, and decreased administration time may result in reduced costs.” – Rosen’s 9<sup>th</sup> ed*

### **5) What is the typical ED management for a pts with an asthma exacerbation?**

Assess severity

- MOVIE if sick!
- ALL severe exacerbations should get continuous NEB treatment

Begin treatment - start SABA and anticholinergic: given q20 min x 3 for everyone!

Give steroids by the 1 hour mark

Re-assess!

- By one hour - patient should have improved or he/she will require continuous NEB treatment.
- Usually observation for 3-4 hrs is needed to ensure patient’s don’t deteriorate

See Rosen’s Fig 168.1 for Emergency department management of acute asthma

See <http://www.ucalgary.ca/icancontrolasthma/pathwayall> and <http://www.albertahealthservices.ca/frm-18562-sample.pdf> for meds, dosing and management.



Other great AHS resources: order set, assessment form, patient asthma education checklist, and discharge prescription! <http://www.albertahealthservices.ca/scns/Page13147.aspx>

**6) Describe adjunctive therapies that might be used in a patient with refractory symptoms.**

- IM terbutaline or epinephrine
  - For patients in severe respiratory failure - agitation, unresponsive to continuous therapy, uncooperative with nebulization.
    - *severe exacerbations and poor inspiratory flow or anxious, young children who are uncooperative with or have suboptimal response to initial aerosolized therapy*
  - *The dose of subcutaneous or intramuscular **terbutaline** for bronchodilation is 0.01 mg/kg/dose (0.01 mL/kg of a 1 mg/mL solution), with a maximum dose of 0.4 mg (0.4 mL). The dose of subcutaneous or intramuscular **epinephrine** for bronchodilation is 0.01 mg/kg (0.01 mL/kg of 1:1000 solution [1 mg/mL]), with a maximum dose of 0.4 mL (0.4 mg). The dose may be repeated every 20 minutes for three doses unless significant side effects (eg, extreme hypertension, persistent emesis) develop, although most patients are switched to an intravenous medication (eg, **magnesium sulfate**, terbutaline) if they do not respond after the second dose of subcutaneous or intramuscular terbutaline or epinephrine. (Uptodate)*
- MgSO<sub>4</sub> IV
  - Should not be given unless the patient is unresponsive to continuous NEB and steroids:
  - *Magnesium is inexpensive and has minimal adverse effects. It has been found to be efficacious when added to a regimen of SABA and CS therapy. Hypotension may be minimized by slowly infusing the dose over 20 minutes. Magnesium (50–75 mg/kg over 20 minutes; maximum, 2.5 g) should be given to moderately ill patients who have a suboptimal response to SABAs, IB, and CS, as well as for all severely ill children.*

**Unproven therapies:**

- Heliox
  - *In theory, a mixture of helium and oxygen may enhance beta-agonist delivery because the lower gas density should result in decreased flow resistance. The 2007 NAEPP guidelines suggest administration of beta-agonists with heliox in patients with life-threatening exacerbations or who are not responding to conventional therapy [1]. However, the use of heliox should not delay intubation once it is considered necessary. - Uptodate*
- Ketamine



- *Due to its bronchodilating properties, the dissociative agent **ketamine** is the drug of choice to provide sedation and analgesia before intubating a child with asthma. Although several small case series of nonintubated children treated with ketamine suggest that ketamine improves acute asthma [77,78], the one randomized trial found that ketamine was no better than standard therapy in nonintubated children with severe acute asthma [79,80]. - Uptodate*
- **Leukotriene receptor antagonists**
  - *The data do not support the routine use of LTRA therapy to treat children with acute asthma exacerbations requiring urgent or emergent care [81]. LTRA add-on therapy in acute asthma has shown promise in adults [82,83]. However, it does not appear to provide additional benefit in children when added to standard therapy for acute asthma - Uptodate*
- **IV salbutamol**
  - *There are insufficient data to make recommendations for the use of IV SABAs; a systematic review of randomized controlled trials has failed to support this practice. Potential adverse effects from the use of IV SABAs are substantial and include dysrhythmias, hypertension, and hypokalemia. IV SABAs should not be used, except for impending respiratory failure, where the risk-benefit ratio shifts toward their use.*
- **Mechanical ventilation**

**One should assess the entire clinical picture, including illness severity, response to therapy, and ABG results.** However, the ABG results should not be used alone. The child with an initial pH of 7.10 and a Paco<sub>2</sub> of 55 mm Hg who shows marked improvement with IV SABA therapy may not require ventilatory assistance, whereas the child with a pH of 7.18 and Paco<sub>2</sub> of 50 mm Hg **who appears fatigued and is not responding to therapy will likely need mechanical support.**

**Ketamine is a bronchodilator and is the drug of choice for sedation and analgesia of the asthmatic child who requires intubation.** Mechanical ventilation can result in air trapping with resultant, and enough expiratory time must be allowed for air exit from the lungs. Permissive hypercapnia describes a strategy to prevent barotrauma. It minimizes tidal volumes and respiratory rates to decrease peak inspiratory pressures.

## 7) How are PO corticosteroids used in the management of asthma?

*If CS therapy was administered in the ED, it should be continued as 3 to 5 days of prednisone (1 mg/kg once or twice per day; maximum, 60 mg) or 1 or 2 days of dexamethasone (0.6 mg/kg once per day with a maximum 8 to 16 mg).*



*Children should continue all other asthma controller medications, including inhaled corticosteroids.*

PO Dex has fewer side effects, better compliance and only requires two doses!

### **8) When should children be started on inhaled corticosteroids?**

*Rather than preventing ED relapse, ICS should be prescribed to help achieve long-term goals for patients with persistent disease. These patients have frequent symptoms—coughing or wheezing, frequent exacerbations requiring the use of SABA, or recurrent visits to the ED. ICS are safe and well tolerated at recommended doses and may be given concurrently with systemic CS. Longitudinal studies have shown that daily use of inhaled corticosteroids may decrease growth velocity, but these changes are small and reversible.*

### **9) Outline a plan for disposition of a pt presenting to the ED with an acute asthma exacerbation.**

Aggressive continuous ventolin and ipratropium bromide for the first 1 hour is crucial to prevent the asthma exacerbation from worsening.

Ipratropium takes at least 1 hour to work, and the steroids kick in at 2-6 hours. By 90-120 mins children should have declared their degree of responsiveness to treatment.

*To avoid unnecessary hospitalizations, we recommend observing patients who do not otherwise decline for a total of 3 to 4 hours prior to the decision to admit.*

*After initiating therapy, a more comprehensive history should include questions about asthma triggers, such as URIs, cigarette smoke, allergies, and exercise.*

*A child with persistent asthma marked by frequent symptoms should receive daily anti-inflammatory therapy; those older than 5 years should monitor symptoms with a peak flow meter. Family and social histories should focus on asthma, cystic fibrosis, or atopic disease and on the adequacy of support systems at home.*

Ideally, they get thorough follow-up and asthma education!

### **10) What are risk factors for sudden death in a patient with asthma?**

- Recent exacerbating symptoms and nonadherence to medications
  - > 2 blue canisters per month
  - Recent oral steroids
- Prior history of intubation



- Prior history of CPR
- Prior history of ICU admission
- African american children (non-white)
- Urban living
- Low income

### 11) List risk factors for bronchiolitis.

*Bronchiolitis is an acute infectious disease that results in inflammation of the **small airways in children younger than 2 years**. This process is manifested clinically as **wheezing and increased work of breathing**, along with the **typical signs and symptoms of a URI**.*

*Nearly all children are affected by the viruses that cause bronchiolitis at least once during their first 2 years of life, but it is more common for infants younger than 12 months to manifest clinical signs of bronchiolitis.*

- < 2 yrs of age
- Temperate climates from Nov-April
- Preceding URI
- No family hx of atopic disease

*Younger age, presentation during the winter months, antecedent URI symptoms, and absence of a prior or family history of atopic disease and wheezing suggest bronchiolitis as the cause of wheezing in an individual patient.*

### 12) What are the typical pathogens of bronchiolitis?

- Respiratory syncytial virus (RSV) = > 70%
- parainfluenza, human metapneumovirus, influenza, adenovirus, bocavirus, and rhinovirus.

### 13) What is the pathophysiology of bronchiolitis?

Shed up to a week before symptoms begin, with a 2-6 day incubation period.

*transmitted from one host to another by fomites spread from hand to nose or by droplets produced by sneezing or coughing of respiratory secretions.*



*In an infected patient, viral replication often begins in the epithelial cells of the upper airway before spreading to the mucosal surfaces of the lower respiratory tract. The infected epithelial cells are generally destroyed by lysis or apoptosis, which results in the desquamation of these cells and release of host inflammatory mediators.*

*Affected lungs demonstrate epithelial cell necrosis, monocytic inflammation and edema of the peribronchial tissues, and mucus and fibrin plugging of the distal airways on histologic examination.*

*These findings translate into the clinical findings of wheezing and lower airway obstruction in an infant with bronchiolitis. Younger infants, whose distal airways are of smaller caliber and whose immune systems lack active immunity to most respiratory viruses, are prone to more severe clinical symptoms.*

*Severe lower airway obstruction leads to air trapping and atelectasis, resulting in mismatched ventilation and perfusion and hypoxemia. In addition, younger infants are at increased risk for fatigue, leading to hypercarbia and respiratory failure.*

#### **14) How is bronchiolitis managed?**

Three things:

##### **1) Imminent management of the disease**

- Pulmonary toilet ---> suctioning (nasal bulb, NPA suction, parent-assisted)
- Hydration (IV fluids for severely ill children; PO for the rest)
- Oxygen for saturation <91%

What about those other medications?

- *“the American Academy of Pediatrics does not recommend the routine use of SABAs for bronchiolitis; instead, emergency clinicians should consider a trial of such medications to determine if a patient has a beneficial clinical response, especially if it is unclear whether the patient has asthma or bronchiolitis.*
- *We recommend that a **trial of nebulized epinephrine be considered for children with moderate to severe distress who might otherwise require more invasive interventions (eg, endotracheal intubation)** secondary to disease severity. As with SABAs, nebulized epinephrine should be continued only for those patients who demonstrate a clinical benefit. There is currently no sufficient evidence to recommend the use of other bronchodilators, such as anticholinergic agents, for young children with wheezing and suspected bronchiolitis.” – Uptodate*
- Insufficient evidence to support the ED use of:
  - Oral corticosteroids



- Nebulized hypertonic saline
- Chest physiotherapy
- No role for antibiotics unless there is a proven bacterial infection

Monoclonal antibodies against RSV helpful if:

- *It is recommended for most children younger than 24 months with chronic lung disease, congenital heart disease, or prematurity and is administered as a monthly intramuscular injection during the high-prevalence months.*

## 2) Anticipated course

- Days 4-6 are usually the worst
  - Duration of illness is up to 12 days
  - Cough and noisy breathing may last up to 4 weeks
- Consider the infant's risk for dehydration and apnea
  - *Risk factors for the development of in-hospital apnea include corrected age younger than 8 weeks, low birth weight, significant tachypnea or bradypnea, hypoxia, and history of apnea before admission.*
- See also Effect of Oximetry on Hospitalization in Bronchiolitis A Randomized Clinical Trial *JAMA*. 2014;312(7):712-718. doi:10.1001/jama.2014.8637.

## 3) Think beyond just bronchiolitis

**\*\*need to think about other potential concurrent infectious illnesses\*\***

Infants and children with bronchiolitis can also have acute bacterial otitis media (up to 60%) or may have a bacterial UTI. *In one study of more than 2000 children hospitalized with RSV bronchiolitis, approximately 1% also had a urinary tract infection (UTI);*

- **Children <61 days should undergo a partial - to - full septic workup.**
  - *In infants with documented RSV infection or clinical bronchiolitis at the time of ED presentation, the incidence of an SBI is substantially lower. In a large prospective, multicenter study, **7% of febrile infants younger than 61 days who were RSV-positive had a concurrent SBI**, compared with 12.5% of those who were RSV negative. Of the patients with SBIs, **most (82%) had a UTI**. Bacteremia was rare and occurred only in infants younger than 1 month. None of the RSV-positive infants had bacterial meningitis. As a result, for infants between 1 and 2 months of age who are known to be RSV-positive or have clinical bronchiolitis, we recommend catheterized urinalysis and culture. Additional testing to obtain culture specimens of cerebrospinal fluid and blood may be done selectively. All infants < 30 days should be STRONGLY considered for a full septic workup despite concurrent RSV.*



### 15) Which children with bronchiolitis should be admitted to hospital?

See Rosen's table 168.4 for Suggested Bronchiolitis Assessment Tool

Admission considerations:

- Inability to stay hydrated (due to fatigue or respiratory distress around feeds)
- Inadequate social supports or follow up
- Copious secretions requiring deep suctioning
- *age younger than 12 weeks,*
- *History of prematurity,*
- *ill appearance,*
- *hypoxemia (Sao<sub>2</sub> < 92%) ← relative indication, not necessarily true in higher altitude areas*
- *tachypnea (>70 breaths/min)*
- *significant atelectasis on the chest radiograph (when obtained).*
- *history of hemodynamically significant congenital heart disease, chronic lung disease, and immunocompromised state have been associated with higher morbidity and mortality among inpatients.*

### 16) List potential complications of RSV.

- Apnea
- Respiratory failure
- Dehydration
- Hospitalization
- Secondary bacterial infection (otitis media, UTI, bacteremia, meningitis)
- Over investigation and overtreatment with antibiotics

## Wisecracks

### 1. What's the natural history of infants/toddlers who wheeze?

Traditionally we thought you couldn't make the slam dx of asthma until after age 6. (the exception would be a child who present with recurrent bouts of wheezing - "persistent wheezer", clear atopy (eczema, allergic rhinitis), a strong family history of asthma, maternal smoking, high IgE level).

However the CPS and CTS just released a new guideline, here are some notes from it: ([Can Respir J](#). 2015 May-Jun;22(3):135-43. Epub 2015 Apr 20.)

Summary:

1. *Asthma can be diagnosed in children 1-5 years of age*
2. *The diagnosis of asthma requires:*
  1. *Documentation of signs or symptoms of airflow obstruction*



2. *Reversibility of obstruction (improvement in these signs or symptoms with asthma therapy)*
3. *No clinical suspicion of an alternative diagnosis*
3. *Bronchiolitis usually presents as the first episode of wheezing < 1 yo*
4. *The diagnosis of asthma should be considered in children 1-5 yo with recurrent asthma-like symptoms or exacerbations, even if triggered by via infections*
5. *In Children 1-5 yo with recurrent (2 or more) episodes of asthma-like symptoms and wheezing on presentation, direct observation of improvement with inhaled bronchodilator (with or without oral corticosteroids) by a physician confirms the diagnosis*
6. *Children 1-5 yo with recurrent (2 or more) episodes of asthma-like symptoms, no wheezing on presentation, frequent symptoms or any moderate or severe exacerbation warrant a 3 month therapeutic trial with a medium daily dose ICS (with as needed SABA). Clear consistent improvement in the frequency and severity of symptoms and/or exacerbations confirms the diagnosis*
7. *Children 1-5 yo with recurrent (2 or more) episodes of asthma-like symptoms, no wheezing on presentation, infrequent symptoms, and mild exacerbations can be monitored and re-assessed by a health care practitioner when symptomatic. Alternatively, a therapeutic trial with as-neded SABA is suggested. Convincing parental report of a rapid and repeatedly observed response to SABA suggests the diagnosis*
8. *To adequately interpret a therapeutic trial, clinicians should ascertain adherence to asthma therapy, inhalation technique and parental report of monitored symptoms, at an appropriately timed medical reassessment.*
9. *When to Refer to a Specialist: Recommended in children 1-5 yo with diagnostic uncertainty, suspicion of comorbidity, poor symptom and exacerbation control despite ICS at daily doses of 200-250 mpg, a life-threatening event (requiring ICU / intubation) and/or allergy testing to assess the possible role of environmental allergens*
10. *Daily ICS at the lowest effective dose is the preferred first-line management for asthma once the diagnosis is confirmed and control has been achieved*

*For most children, wheezing before the age of six years is probably a benign condition reflecting smaller airways that will improve or resolve in a few years. Many infants wheeze early in life, but three of four school-aged children outgrow asthma by adulthood.*

*A subgroup of children with wheezing before age six will have persistence of symptoms and will eventually develop clinical asthma. This subgroup is characterized by the atopic state, relatively severe and persistent symptoms at a young age, and a maternal history of asthma. Maternal smoking may also contribute.*

Also see Uptodate: <https://www.uptodate.com/contents/natural-history-of-asthma>



## 2. What is a peak flow? What is the FEV1? What are the advantages to measuring peak flow? What are the disadvantages?

*“The peak expiratory flow rate (PEFR, also known as a peak flow) is the maximal rate that a person can exhale during a short maximal expiratory effort after a full inspiration. In patients with asthma, the PEFR percent predicted correlates reasonably well with the percent predicted value for the forced expiratory volume in one second (FEV1).*

*FEV1 - is the volume of air that can forcibly be blown out in one second, after full inspiration. Usually measured in stable patients who are undergoing spirometry.*

*Measurement of the peak expiratory flow rate (PEFR) is a means of obtaining an objective assessment of exacerbation severity.*

*However, up to two-thirds of children older than 5 years are unable to complete PEFR testing during an asthma exacerbation. When feasible, the PEFR should be measured with the child standing and the best of three attempts recorded.” – Uptodate*

### Advantages:

- Inexpensive
- Real-time
- patient-driven
- Useful for measuring trends in a patient's asthma control
- Doesn't require a spirometer

### Disadvantages:

- Huge testing variability based on patient cooperation/effort
- Hard for ER physicians to interpret if we don't know the patient's “best” PEFR over time
  - *An individual patient's normal PEFR range is defined as 80 and 100 percent of their personal best.*
- *patient adherence to PEFR monitoring is highly variable (not as useful for patients how are non-adherent or without good follow up)*
- *the accuracy of a single peak flow measurement to detect the presence of airflow obstruction is limited, given the large variability of PEFR among healthy individuals of the same age, height, and gender ( $\pm 20$  percent)*

## 3. Risk factors for death in bronchiolitis

Breast-feeding appears to be associated with a less severe clinical course. Conversely, the following are associated with an increased risk of death

- Low birth weight (<2500 g),

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- low 5-minute Apgar score,
- high birth order (1st or 2nd born)
- young maternal age

