Pediatric Respiratory Distress: Croup, Asthma and Bronchiolitis

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Associate Professor of Pediatrics and Emergency Medicine
I have nothing to disclose
Objectives

1. Recognize differences between the pediatric and adult airway
2. Recognize respiratory distress in the pediatric population
3. Recognize presentation and manage croup in the pediatric population
4. Recognition of and management of pediatric asthma
5. Recognize and treatment of bronchiolitis in the pediatric population
Introduction

• Infants and young kids have small airways compared to adults
• Can quickly develop clinically significant airway obstruction
• Acute airway obstruction- whatever the etiology- can be life threatening
• Complete obstruction will lead to respiratory failure → progress to cardiac arrest in minutes
• Prompt recognition and management of airway compromise is critical to good outcome
Pathophysiology

• Small caliber of airway makes it vulnerable for occlusion

• **Exponential rise in airway resistance** and **WOB** with any process that narrows airway

• Infant is nasal breather- any obstruction of nasopharynx significantly increases WOB

• Large tongue can occlude airway especially increased ICP loss muscle tone due to decreased GCS

• **Cricoid ring is narrowest part upper airway- often site occlusion in FB**
# Pediatric vs Adult Airway

## TABLE 3-1 Comparison of Infant and Adult Airways

<table>
<thead>
<tr>
<th></th>
<th>Infant</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>Large prominent occiput resulting in sniffing position</td>
<td>Flat occiput</td>
</tr>
<tr>
<td>Tongue</td>
<td>Relatively larger</td>
<td>Relatively smaller</td>
</tr>
<tr>
<td>Larynx</td>
<td>Cephalad position, opposite C2 and C3 vertebrae</td>
<td>Opposite C4 to C6</td>
</tr>
<tr>
<td>Epiglottis</td>
<td>Ω shaped, soft</td>
<td>Flat, flexible</td>
</tr>
<tr>
<td>Vocal cords</td>
<td>Short, concave</td>
<td>Horizontal</td>
</tr>
<tr>
<td>Smallest diameter</td>
<td>Cricoid ring, below cords</td>
<td>Vocal cords</td>
</tr>
<tr>
<td>Cartilage</td>
<td>Soft, less calcified</td>
<td>Firm, calcified</td>
</tr>
<tr>
<td>Lower airway</td>
<td>Smaller, less developed</td>
<td>Larger, more cartilage</td>
</tr>
</tbody>
</table>

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**CHILD**
- Proportionately larger head
- Infants are obligate nose breathers
- Larynx more superior and anterior
- Larger, more flaccid tongue
- Epiglottis more cephalad, elongated, and flexible
- Cricoid cartilage, narrowest part of the funnel-shaped airway
- Loosely attached mucous membranes

Infants and young children rely on the diaphragm to breathe more than adults do.

**ADULT**
- Nose
- Tongue
- Cricoid cartilage
- Trachea
Anatomy

- Infant larynx:
  - More superior in neck
  - Epiglottis shorter, angled more over glottis
  - Vocal cords slanted: anterior commissure more inferior
    - Vocal process 50% of length
    - Larynx cone-shaped: **narrowest at subglottic cricoid ring**
    - Softer, more pliable: may be gently flexed or rotated anteriorly
- Infant tongue is larger
- Head is naturally flexed
Evaluation

• Begins with rapid assessment of respiratory status
• “Who needs resuscitation”?
• Focus:
  upper airway patency
  degree respiratory effort
  efficiency of respiratory function
• History: onset of symptoms and presence of fever
• Context of Pediatric Assessment Triangle
Pediatric Assessment Triangle

- Observational assessment
- Formalizes the “general impression”
- Establishes the severity of illness or injury
- Determines the urgency of intervention
- Identifies general category of physiologic abnormality or state
- SICK OR NOT SICK
Appearance
Breathing

- Tachypnea
- Work of breathing
- Abnormal sounds
- Position of comfort
Retractions

- Suprasternal
- Supraclavicular
- Intercostal
- Subcostal
- Nasal flaring
Observing retractions

When you observe retractions in infants and children, be sure to note their exact location—an important clue to the cause and severity of respiratory distress. For example, subcostal and substernal retractions usually result from lower respiratory tract disorders; suprasternal retractions, from upper respiratory tract disorders.

Mild intercostal retractions alone may be normal. However, intercostal retractions accompanied by subcostal and substernal retractions may indicate moderate respiratory distress. Deep suprasternal retractions typically indicate severe distress.
Abnormal Sounds

• Grunting
  – Noted at end expiration
  – Voluntary closure of glottis
  – Physiologically generates PEEP
  – Worrisome sign

• Stridor

• Audible wheezing
Stridor

- Musical, high pitched inspiratory sound
- Hallmark of partial airway obstruction
- Pattern can localize the lesion

- **Supraglottic disease = inspiratory stridor**
  - lesion at or above the cords
  - Inspiration: loose tissues collapse inward
  - Expiration: airway enlarges, tissues move

- **Subglottic disease = biphasic stridor**
  - lesion at or below vocal cords
  - Inspiration: loose tissues move inward
  - Expiration: fixed lumen size impedes air flow
Stridor

• **Age of pt important**
  - Infants - congenital problems
  - Toddlers - foreign body
• Older child = bigger airway → complete obstruction less likely

• **Fever** implies **infectious** etiology

• **Sudden onset** suggests:
  - Some infections
  - Foreign body
  - Anaphylaxis/ allergic rxn

• Other non infectious causes:
  - Anaphylaxis
  - Trauma/ caustic ingestion
  - Burn/ thermal injury
Position of Comfort

- **Lower airway disease**
  - Upright posture
  - leaning forward and support of upper thorax by arms
  - Tripoding

- **Upper airway disease**
  - Upright posture, leaning forward
  - self-generation of jaw thrust and chin lift
  - “Sniffing” position
Signs of Distress

- Retractions
- Tachypnea
- Grunting
- Position of comfort
- Color
- Head bobbing

https://www.youtube.com/watch?v=Zkau4yHsLLM&list=PL7EA9354BC2DD8B67&index=2
Circulation

- Capillary refill
- Distal vs central pulses
- Temperature of extremities
- Color
  - Pink
  - Pale
  - Blue (central cyanosis vs acrocyanosis)
  - Mottled
Capillary Refill
Respiratory Distress

Defined as inability to maintain gas exchange

- Multiple etiologies leading to distress
- Signs/symptoms varied - dependent on age
- Abnormal respirations
- Tachypnea
- Bradypnea
- Apnea
- Retractions/accessory muscle use
- Head bobbing, position of comfort
- Nasal flaring
- Grunting
- Color change - pale or cyanotic
- Poor aeration
- Altered mental status
Impending Respiratory Failure

- Presence of acidosis
- PCO2 > 50 mm Hg
- PaO2 < 50 mm Hg
- "Normal" blood gas in face of tachypnea and distress
- Diagnosis based primarily clinically
- Definitive airway should not be delayed waiting for labs or xray
Case 1

• 18 mo presents to ED w/ difficulty breathing
  – h/o rhinorrhea and fever for 3 days
  – Awoke in middle of the night w/ barking cough and noisy breathing
  – Symptoms worsen when agitated
• VS: T 102.5, HR 160, RR 40, O2 Sat 95%
  – Hoarse cry, Audible stridor, supraclavicular and suprasternal retractions

• How sick is this child?
• What is causing his symptoms?
Your First Clue: Croup

- Prodromal symptoms mimic upper respiratory infection.
- Fever is usually low grade (50%).
- Barky cough and stridor (90%) are common.
- Hoarseness and retractions may also occur.

Croup’s distinctive barking cough is caused by swelling of the tissue around the voice box and windpipe. This swelling may affect the child’s breathing also.
Croup

- Accounts for 90% of stridor with fever
- Children 1 to 3 years old
- Generally nontoxic presentation (38° to 40°C)
- Gradual onset of cough (barking) with varying degrees of stridor
- Viral pathogens
- Seasonal and temporal variations
- Clinical diagnosis
Croup/ Laryngeotracheobronchitis

- Most common cause for stridor in febrile infant
- Mostly kids < 2 yrs of age
- Affects 6 mths – 6 yrs
- Incidence 3-5/100 children
- Male predominance 2:1
- Peak in second year of life- mean age 18 mths
- Seasonal: Occurs more late fall and early winter

Viral etiology:

- Parainfluenza virus (60%)
- Influenza A- severe disease
- RSV (“croupiolitis”- wheeze and stridor)
- Adenovirus
- Coxsackievirus
- Mycoplasma pneumoniae
Croup

- Acute viral infection
- Characterized by:
  - **Bark like cough**
  - Hoarseness
  - Inspiratory stridor
- Symptoms worse at night- typically last 4-7 days
- Spectrum of respiratory distress
- Mild to resp failure requiring intubation
- Disease most often self limited
- Rarely can lead to severe obstruction and death (< 2%)
Westley croup score most common
Tool to describe severity of obstruction
Higher the score, the greater the risk for resp failure

<table>
<thead>
<tr>
<th>TABLE 3-5 Clinical Croup Score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Cyanosis</td>
</tr>
<tr>
<td>Inspiratory breath sounds</td>
</tr>
<tr>
<td>Stridor</td>
</tr>
<tr>
<td>Cough</td>
</tr>
<tr>
<td>Retractions and flaring</td>
</tr>
</tbody>
</table>

*A score of ≥4 indicates moderately severe airway obstruction. A score of ≥7, particularly when associated with PaCO₂ of >45 and PaO₂ of <70 (in room air), indicates impending respiratory failure.
Diagnostic Studies

- Croup is a clinical diagnosis.
- Routine laboratory / radiological studies are not necessary.
- Films only if diagnosis uncertain
- May see “Steeple Sign”
Croup- Management

• Avoid agitation
• Position of comfort
• Provide cool mist – if tolerated
• Aerosolized epinephrine
  – Racemic EPI 0.5 ml in 3 ml NS
  – When: Stridor /retractions at rest
• Steroids
  – Dexamethasone 0.6 mg/kg IM/po
  – Methylprednisolone 2 mg/kg PO
• Prepare airway equipment in severe cases
• Heliox may prevent intubation
• Airway radiographs not necessary
Management

- Minimize anxiety
- Oxygen
- Humidified mist:
  - Anecdotally effective
  - Literature shows no proven benefit
  - Can use if tolerated
  - Cool mist safer
  - Just as effective as warm mist
Steroids

• Faster improvement croup score
• Decrease need for intubation and PICU
• Decrease hospitalization rates
• Shorter hospital stay if admitted
• Multiple studies have proven benefit- even mild cases (Bjornson, et al. NEJM 2004)
• Dexamethasone or oral prednisolone both efficacious
• Dexamethasone- better compliance
  usually only single dose required
  cheap, easy to administer
  IM = PO efficacy
  standard dose 0.6 mg/kg - max 10 mg
  recent studies show that lower dose may be ok
  (0.15- 0.3 mg/kg)
• Nebulized budesonide (Pulmicort) better than placebo, not as good as Dex or prednisolone (Klassen, NEJM 1994)
• No added benefit if added to Dexamethasone
Racemic Epinephrine

- Indications:
  - stridor at rest
  - retractions
  - moderate – severe distress
- Duration 90-120 minutes
- “Rebound effect” - myth only
- Must observe 2-4 hrs after treatment
- Dosing:
  - 0.5 mg in 2-3 cc NSS
Admission Criteria

• Inability to drink
• Cyanosis
• Hypoxia
• Stridor at rest
• Poor response to or multiple racemic epinephrine treatments
• Social concerns
• Lack of follow up
• Young age- consider for < 1 yr
Differential Diagnosis: What Else Could it Be?

- Epiglottitis (rare)
- Bacterial tracheitis
- Peritonsillar abscess
- Uvulitis
- Allergic reaction
- Foreign body aspiration
- Neoplasm

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**Differential Diagnosis for Croup**

The pharmacist should be wary of assuming all stridor is croup-related. The patient may have epiglottitis—a serious condition without the barking cough but with abrupt onset of high fever, drooling, dysphagia, and protrusion of the tongue. The child may have aspirated a foreign body that is causing acute stridor. Stridor may also be caused by psychological problems, hypocalcemia, or angioneurotic edema. With these serious conditions in mind, the pharmacist would be best advised to refer all cases of stridor to a physician for a full evaluation.
STRIDOR

Apply oxygen
Position comfortably
Attain intravenous access, if tolerated
Withhold laboratory studies

Complete obstruction?
Yes
Airway clearance maneuver
Fails
Attempt at endotracheal intubation
Fails
Needle cricothyotomy
Fails
Surgical tracheostomy

No
Probable epiglottitis?
Yes
Arrange for operating room to establish airway
Consider lateral neck X-ray
Give cefotaxime

No
Consider history, examination
? Lateral neck X-ray, chest X-ray

Foreign body
Bronchoscopy

Group
Racemic epinephrine
Steroids

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STILL WITH ME?

HEY LOOK, PIG... IT'S THAT GUY YOU SEE ON THOSE TV COMMERCIALS. THE ONE YOU POKE IN THE BELLY AND HE GIGGLES. HEY, YOU'RE RIGHT. I'LL TRY IT.

GUESS HE'S DIFFERENT IN PERSON.

THIS WILL BE GRREAT!

I WORRY ABOUT THAT ONES NATURAL INSTINCTS.
Case 2

- 3 mth old
- Ex 31 week premie, short NICU stay
- 2 day hx cough, nasal congestion
- Breathing “funny” per mom
- Vitals hr 195 rr 80 T 38 Sat 93% r/a
- Wt 4 kg
Physical Exam

- Pale, small, ill appearing
- Slightly sunken eyes, dry mouth
- No stridor, thick rhinorrhea and congestion, and flaring
- Marked intercostal and subcostal retractions
- Diffuse wheeze, rhonchi, and crackles
- Good aeration
- No murmur, tachycardic
- Cap refill 3 sec, cool skin, mottled
- Crying, anxious, consolable

Further history- mom states “baby turned blue, stopped crying, stopped breathing” twice past 3 hrs. Lasted “ forever” but baby better after mom picked baby up and rubbed back
“Is this important? “ mom asks
Impression- sick or not sick? What do you want to do?
Interventions and Actions

- ABC’s
- Oxygen
- Suction
- IV access, IVFP, check blood sugar
- Initial trial albuterol
- Consider Racemic Epinephrine
- Call for chest film
- Prepare for intubation
Case Progression

- Little change with albuterol
- Called stat into room, baby “not breathing” and blue
- Apneic, HR 90, sats 74%
- Emergently intubated
- Transferred to PICU
Bronchiolitis

- Viral infection medium and small airways
- **RSV 85%**
- parainfluenza, adenovirus, influenza A, rhinovirus
- Seasonal disease
- Peak: winter and early spring
- Most children infected by 3 yrs age
- 10% of kids have clinical bronchiolitis w/in 1\textsuperscript{st} year of life
- Peak incidence 2-6 mths
- Majority mild illness
- Cough may persist for weeks
- Highly contagious- WASH HANDS!
RSV

- Respiratory syncytial virus (RSV) is the most common cause of lower respiratory tract infections among young children in the United States and worldwide.
- Most infants are infected before 1 year of age.
- Virtually everyone gets an RSV infection by 2 years of age.
- Each year in the United States, RSV leads to:
  - 57,527 hospitalizations among children < 5 yrs of age.
  - 2.1 million outpatient visits among children < 5 yrs.
  - 177,000 hospitalizations and 14,000 deaths among adults older than 65 years.
- RSV infections occur primarily during fall, winter, and spring (US/similar climates).
Bronchiolitis Pathophysiology

Normal Bronchial Tubes
- Normal epithelium
- Normal tissue

Bronchial Tube During Bronchiolitis
- Necrosis and loss of epithelium
- Mucus buildup
- Inflamed tissue
- Smooth muscle tightening around bronchial tubes
- Collapsed alveoli
- Alveoli over-inflated with trapped air
Clinical Description and Diagnosis - Infants

- RSV infection can cause a variety of respiratory illnesses
- These illnesses sometimes cause fever
- RSV infection most commonly causes a cold-like illness
- Can also cause croup and lower respiratory infections like bronchiolitis and pneumonia
- Of every 100 infants and young children with RSV infection, 25 to 40 (25% to 40%) will show signs of pneumonia or bronchiolitis
- Premature infants, very young infants, and those with chronic lung or heart disease or with suppressed (weakened) immune systems have greater chance of having a more severe infection
- Infants typically have runny nose and decreased appetite prior to other symptoms
- Cough develops 1 to 3 days later
- Subsequent sneezing, fever, and wheezing may occur after cough develops
- In very young infants, irritability, decreased activity, and apnea may be the only symptoms of infection.
- Most healthy infants infected with RSV do not need hospitalization
- Those who are hospitalized may require oxygen, intubation, and/or mechanical ventilation
- Most improve with supportive care and discharged in a few days

There is no specific treatment for RSV infection
Clinical Manifestations

• URI symptoms
• Gradual progression over 3-4 days
• Fever
• Tachypnea
• Wheezing
• Retractions/flaring
• Dehydration, secondary otitis media, pneumonia
• Apnea- especially infants < 3 mths
Risk Factors for Severe Disease

- Age
- Prematurity
- Underlying Disease
- **Most common complication = APNEA**
- Occurs early in illness, may be presenting symptom
- **Most at risk - very young, premature, chronically ill**
- Smaller, more easily obstructed airway
- Decreased ability to clear secretions

![Preemie Lungs, Heightened Risk](image)

A baby born earlier than 36 weeks' gestation lacks the defenses to prevent serious infection from a common virus called RSV.

- Full Term
  - RSV infection is more likely to take root in premature lungs where developing airways are narrower and especially fragile.
  - Premature babies carry fewer virus-fighting antibodies - a process gift from mom that all infants need while their own immune systems mature after birth.

- Preterm
  - RSV infection is the leading cause of hospitalization among infants in the U.S.

- The average RSV related hospital costs were $2.5 times greater for preterm infants compared with full term infants.

![RSV by the Numbers](chart)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Preterm</th>
<th>Full Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSV Severity</td>
<td>256,520</td>
<td>194,750</td>
</tr>
<tr>
<td>Severe/Death</td>
<td>59,318</td>
<td>36,187</td>
</tr>
<tr>
<td>Preterm-related hospital costs</td>
<td>$16,634</td>
<td>$6,037</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>age</strong></td>
<td>&lt; 3 mths</td>
<td>&lt; 3 mths</td>
</tr>
<tr>
<td><strong>gestation</strong></td>
<td>&gt; 37 wks</td>
<td>34-36 wks</td>
</tr>
<tr>
<td><strong>appearance</strong></td>
<td>well</td>
<td>ill</td>
</tr>
<tr>
<td><strong>Resp rate</strong></td>
<td>&lt; 60</td>
<td>60-69</td>
</tr>
<tr>
<td><strong>atelectasis</strong></td>
<td>absent</td>
<td>present</td>
</tr>
<tr>
<td><strong>Pulse ox</strong></td>
<td>&gt; 97</td>
<td>95-96</td>
</tr>
</tbody>
</table>

Bronchiolitis score

*score 3 or more higher risk for severe disease*
Management

- Supportive care
- Fluids
- Oxygen
- Monitoring
- Pulmonary toilet
- Ventilatory support
- Prevention - Respigam, Synagis

### Respiratory syncytial virus immunoprophylaxis for infants and young children with congenital heart disease*

<table>
<thead>
<tr>
<th>Most likely to benefit from immunoprophylaxis:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants receiving medication to control heart failure</td>
</tr>
<tr>
<td>Infants with moderate to severe pulmonary hypertension</td>
</tr>
<tr>
<td>Infants with cyanotic heart disease</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Not indicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants with hemodynamically insignificant heart disease:</td>
</tr>
<tr>
<td>Secundum atrial septal defect</td>
</tr>
<tr>
<td>Small ventricular septal defect</td>
</tr>
<tr>
<td>Pulmonic stenosis</td>
</tr>
<tr>
<td>Uncomplicated aortic stenosis</td>
</tr>
<tr>
<td>MILD coarctation of the aorta</td>
</tr>
<tr>
<td>Patent ductus arteriosus</td>
</tr>
</tbody>
</table>

Infants with lesions adequately corrected by surgery unless they continue to require medication
Infants with mild cardiomyopathy who are not receiving medical therapy

* Palivizumab is the only RSV immunoprophylactic agent approved for infants with congenital heart disease.
  Adapted from selected initiatives for the use of palivizumab and respiratory syncytial virus immunoprophylaxis for the prevention of respiratory syncytial virus infections. Pediatrics 2007; 112;2-84G.
Management Controversies

- Efficacy of bronchodilators
- Benefits of steroids
- Risk SBI in bronchiolitic with fever
Cochrane collaboration systematic review of studies that assessed the difference in rate of improvement after β2-agonist bronchodilators or placebo among children with bronchiolitis.

Zorc J J, Hall C B Pediatrics 2010;125:342-349

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Corticosteroids

- Again, studies inconclusive, unclear benefit in bronchiolitis
- Recent meta-analysis Garrison, et al 2000- suggest statistically significant improvement clinical symptoms, LOS, DOS hospitalized pts
- Schuh, et al 2002 – compared large dose Dex (1mg/kg) vs placebo in ED
- 4 hrs after med, improved clinical scores, decreased admit rates, no change sats/ rr
  - infants with acute moderate-to-severe bronchiolitis who were treated in the emergency department, a single dose of 1 mg of oral dexamethasone per kilogram did not significantly alter the rate of hospital admission, the respiratory status after 4 hours of observation, or later outcomes.
Recent multicenter research on therapy for bronchiolitis supports previous AAP recommendations against the routine use of bronchodilators or corticosteroids.
# Summary of Recent Evidence for Therapies Used for Bronchiolitis

*Pediatrics February 1, 2010 vol. 125 no. 2 342-349*

<table>
<thead>
<tr>
<th>Therapy</th>
<th>Summary</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronchodilators</td>
<td>No improvement in duration of illness or hospitalization&lt;sup&gt;58,59&lt;/sup&gt;</td>
<td>No routine use</td>
</tr>
<tr>
<td></td>
<td>May improve short-term clinical scores in a subset of children&lt;sup&gt;58&lt;/sup&gt;</td>
<td>Use only after proven benefit in a trial of therapy, if chosen as an option</td>
</tr>
<tr>
<td>Corticosteroids</td>
<td>No improvement in duration of illness or hospitalization&lt;sup&gt;7,63&lt;/sup&gt;</td>
<td>No routine use</td>
</tr>
<tr>
<td>Leukotriene receptor antagonists</td>
<td>No improvement in duration of illness&lt;sup&gt;67,75&lt;/sup&gt;</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Nebulized hypertonic saline</td>
<td>May reduce length of inpatient hospitalization&lt;sup&gt;70&lt;/sup&gt;</td>
<td>None</td>
</tr>
</tbody>
</table>
Algorithm for Acute Bronchiolitis Management

1. Obtain patient’s medical history
2. Complete physician exam with vital signs and pulse oximetry
3. Assess hydration status

Assess severity by considering:
1. Any history of apnea
2. Respiratory rate
3. Work of breathing
4. Mental status
5. Pulse oximetry
6. Ability to feed/drink

First-Line Therapies:
- May consider oxygen to maintain \(\text{O}_2\) saturation >90%
- Consider nasal suctioning (if signs of nasal obstruction)
- Maintain hydration status (if needed, via IV, or nasogastric feedings)

Discharge Criteria
- Patients must meet the following criteria:
  1. \(\text{O}_2\) saturation 100% awake
  2. No more than mild/moderate respiratory distress
  3. Ability to maintain hydration
  4. Ability to obtain reliable follow-up care

Meets discharge criteria?

Stable and/or improving?

Yes

No

No

Observe/admit

Yes

Discharge home

Adjunct Therapies
- High flow nasal cannula
- Consider nebulized epinephrine
- Manage as appropriate to clinical findings

Routine use of chest radiographs, viral testing, and blood/urine test are NOT recommended.

The above diagnostic testing MAY be considered in the case of severe or atypical presentation – or consider for congenital or acquired heart disease.

Based on the “Clinical Algorithm for Bronchiolitis in the Emergency Department Setting” publication by the American Academy of Pediatrics’ (AAP) Section on Emergency Medicine Committee on Quality Transformation (Ralston S et al. Pediatrics (2014), PMID 25430140) Updated 11-6-16
Serious Bacterial Infection

- Defined as bacteremia, UTI, meningitis
- What is risk for concurrent SBI in infant < 2 mths, febrile, with bronchiolitis?
- Kupperman, et al 1997 showed substantial risk for UTI in febrile infant - rate unchanged whether concurrent bronchiolitis
- Levin, et al 2004 PECARN study - risk SBI still high in neonate (<28 days) w/ bronchiolitis - need FSWU
  - 29-60 day - still high risk for UTI even with RSV
Bronchiolitis and the Febrile Young Infant

Prevalence of Serious Bacterial Infections in Febrile Infants With Respiratory Syncytial Virus Infection

M. Olivia Titus, MD, and Seth W. Wright, MD, MPH

TABLE 2: Culture Results in Patients With and Without RSV Infection

<table>
<thead>
<tr>
<th></th>
<th>RSV Positive</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>(No. Positive/ No. Tested)</td>
<td>(No. Positive/ No. Tested)</td>
<td></td>
</tr>
<tr>
<td>Bacteremia</td>
<td>0/170</td>
<td>5/171</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>2/117</td>
<td>17/166</td>
</tr>
<tr>
<td>Meningitis</td>
<td>0/111</td>
<td>1/153</td>
</tr>
<tr>
<td>Overall serious bacterial illness</td>
<td>2/174</td>
<td>22/174*</td>
</tr>
</tbody>
</table>

* One patient had a positive culture from both blood and spinal fluid.

Titus MO et al. Pediatrics 2003

Risk of Serious Bacterial Infection in Young Febrile Infants With Respiratory Syncytial Virus Infections

Deborah A. Levine, MD; Shari L. Platt, MD; Peter S. Dayan, MD; Charles G. Macias, MD; Joseph J. Zoren, MD; William Kreis, MD; Jeffrey Scher, MD; David Bank, MD; Nancy Hoffman, MD; Kathy N. Shaw, MD; MSC; and Nathan Kuppermann, MD, MPH, for the Multicenter RSV-SBI Study Group of the Pediatric Emergency Medicine Collaborative Research Committee of the American Academy of Pediatrics

1248 febrile patients ≤60 days enrolled into prospective cross-sectional study

7% SBI rate for RSV+ infants vs. 12.5% SBI rate for RSV- infants

Levine DA et al. Pediatrics 2004

TABLE 2: SBI by RSV Status

<table>
<thead>
<tr>
<th>Variable</th>
<th>RSV Positive (n = 273)</th>
<th>RSV Negative (n = 236)</th>
<th>SBI (n = 509)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any SBI</td>
<td>27/244</td>
<td>12/212</td>
<td>39/290</td>
</tr>
<tr>
<td>UTI</td>
<td>1/33 (3.0%)</td>
<td>4/212 (1.8%)</td>
<td>5/290 (1.7%)</td>
</tr>
<tr>
<td>Bacteremia</td>
<td>11/244 (4.5%)</td>
<td>10/212 (4.7%)</td>
<td>21/290 (7.1%)</td>
</tr>
<tr>
<td>Meningitis</td>
<td>0/244 (0.0%)</td>
<td>0/212 (0.0%)</td>
<td>0/290 (0.0%)</td>
</tr>
</tbody>
</table>

5.5% of RSV+ infants had UTI

Febrile infants with RSV are less likely to have SBIs but its probably wise to get a urine culture on these kids

Levine DA et al. Pediatrics 2004
Serious Bacterial Infection

- Febrile infants with bronchiolitis may be at lower risk for SBI
- However, reduced risk for bacteremia and meningitis is not zero—especially neonate
- Rate for UTI, predominant SBI, remains significant despite having bronchiolitis

**Still check for UTI in febrile infant with bronchiolitis**
Admission

- High risk pts more disposed to severe disease
- Chronic lung disease
- Congenital heart disease
- Immunocompromised
- Infants < 3 mths age, especially if < 37 gestation
- Resp distress- rr > 70, Sats < 95%
- Any history of apnea
- Poor po/ decreased urine output/ concerns hydration status
- Concerns re : follow up or compliance
- Parental anxiety/ fear
Prevention of RSV

- Research development RSV vaccines, but **none is available** yet

- Steps can be taken to help prevent the spread of RSV:
  - Cover coughs and sneezes
  - Wash hands frequently and correctly (with soap and water for 20 seconds)
  - Avoid sharing cups and eating utensils with others
  - Refrain from kissing others

- Cleaning contaminated surfaces (such as doorknobs) may help stop the spread of RSV

- Protect high risk kids - premature infants, children younger than 2 years of age with chronic lung or heart conditions, and children with weakened immune systems - most likely to develop severe disease

- **Palivizumab (Synagis)** is available to prevent severe RSV illness in specific group of infants/ children at high risk:
  - prophylaxis may be administered to infants born before 29 weeks
  - prophylaxis may be considered during the RSV season during the first year of life for preterm infants who develop CLD of prematurity defined as gestational age <32 weeks and a requirement for >21% oxygen for at least the first 28 days after birth
  - 12 months or younger with hemodynamically significant CHD may benefit from prophylaxis

Prophylaxis for Alaska Native and American Indian Infants

Can help prevent development of serious RSV disease

**Can not cure or treat children already with RSV**

**Can not prevent infection with RSV**
PROTECT YOUR CHILD from RSV

Avoid close contact with sick people
Cover your coughs & sneezes
Wash your hands often
Clean & disinfect surfaces
Avoid touching your face with unwashed hands
Stay home when you’re sick

www.cdc.gov/rsv
Conclusions

- Apnea may be 1st and only symptom bronchiolitis
- More likely early in course, < 3 mths age
- Admit kids at risk for more severe disease
- **Treatment is supportive**
- May be small subset that benefit from steroids and bronchodilators
- Neonate with bronchiolitis - still consider FSWU
- Febrile infant with bronchiolitis - risk UTI
Case 3

• 12 yr old male
• URI symptoms x 3 days, non productive cough
• Increased distress past 6 hours
• Long hx asthma
• Multiple admissions, PICU x 2, never intubated
• Ran out of Albuterol- used 1 MDI past week
• Flovent “as needed”, but ran out 1 mth ago
• Mom smokes, but “not in house”
• Doesn’t know what peak flow meter is

NRB placed, sats up to 95 % on 100% FIO2
Albuterol started at triage
Pt still in distress
What do you want to do?
Where will this pt go?
Does he need blood gas?
Will chest film change your management?
Pediatric Asthma

- 10 million missed school days annually
- Loss of parent productivity- $1 billion/year
- Health care costs- > $6 billion/year
- 13 million outpt vists/yr
- 1.6 million annual ED visits
- > 5000 deaths/year
Prevalence Rates

- Boys 50% > girls
- African Americans 44% > white/ hispanics
- 12% greater if below poverty line
- **Highest at risk**: poor, black, male
Pediatric Asthma Mortality

- Rates more than doubled since 1980
- Black child 4x higher risk of dying
- Urban adolescent highest risk group
- Limited access to care
- Delay in seeking care
- Over use albuterol/ rescue meds
- Under use steroids
- Major risk factor for death = prior intubation
Definition

- Chronic inflammatory disease
- Frequent exacerbations
- Reversible airflow obstruction w/ meds
- **Multiple triggers** - viral URI, mycoplasma, exercise, allergies, environmental (tobacco, dust, roaches)
- Manifested:
  - shortness of breath
  - cough
  - wheeze
  - chest tightness
History

• Current flare- onset/ severity symptoms
• Prior flares- PICU, intubation, near fatal episodes
• Baseline severity of disease- ED visits, last steroids, peak flow, hospitalization
• Social issues: followup, compliance with meds, ability to pay for meds, distance to ED
• Even those with mild RAD can present with sudden, severe, life threatening attack

Physical exam

Pressured speech
Tachypnea
Tachycardia
Accessory muscle use
Wheezing
Aeration
Prolongation expiratory phase
Pulse oximetry
Subtle changes in mentation
- Inhaled Beta agonists
- Nebulized Anticholinergic Agents
- Corticosteroids
- Magnesium sulfate
- Heliox
- Intubation
Inhaled Beta Agonists

- Standard 1\textsuperscript{st} line therapy
- Most effective way to relieve airflow obstruction
- Rapid onset of action (5 minutes)
- Albuterol - relaxes smooth muscle to relieve bronchospasm
- Delivery - MDI vs Nebulizer
- Dosing - intermittent vs continuous
Albuterol Delivery- MDI or Nebulizer

- **Multiple studies demonstrate equivalent efficacy as long as MDI used with spacer/ mask**
  

- MDI/ spacer:
  
  more efficient delivery of meds
  
  portable
  
  able to be incorporated for home use

- Optimal dose not well established
  
  most 4 puffs = 1 nebulized tx

- Nebulizer can deliver humidified oxygen

- Nebulizer best for severely ill
Albuterol Dosing

- NAEPP recommendation is nebulized albuterol q 20 minutes x 3 treatments
- < 50 kg - 2.5 mg (0.5cc)
- > 50 kg - 5.0 mg (1 cc)
- Essentially the same as continuous tx
- Continuous albuterol safe and effective
- Promptly initiate severe flare/impending resp failure, little response to initial therapy
- 0.5 mg/kg/hr (max-15-20 mg/hr)
• Derivative of atropine
• Onset quick- 15 minutes, peak 40-60 minutes
• Weak bronchodilator itself
• Adjunctive med to be used with beta agonist (Schuh, 1995, Qureshi, 1998, Zorc, 1999)
• Use mod –severe attacks
• Administer concurrently with 1st 3 albuterol treatments
• Frequency/ efficacy further treatments after initial hour not established
Corticosteroids

- Indicated for **most pts in ED** with asthma exacerbation
- Multiple studies have shown decreased hospitalization rate when given steroids early in ED course (Scarfone, 1993, Rowe, 1992, Tal, 1990)
- Effective within 2-4 hrs of administration - 2mg/kg
- IV and po route equivalent
- PO route preferred- short course safe and effective
- Severe distress, emesis may force IV
- Qureshi, 2001 – 2 doses Dexamethasone = 5 days prednisone (0.6 mg/kg, max 16 mg)
- Compliance improved, can give IM if pt fails po
CONCLUSIONS:
Practitioners should consider single or 2-dose regimens of dexamethasone as a viable alternative to a 5-day course of prednisone/prednisolone.
Inhaled Steroids

- Mainstay of chronic asthma management
- **Inhaled corticosteroids are the most effective drugs for asthma control**
  - reduce asthma mortality
  - decrease hospital visits and exacerbations
  - improve quality of life
- Potential use in acute setting ambivalent
- Initial studies-( Scarfone, 1995- nebulized dex, Devidal, 1998, budesomide) encouraging
- However, Schuh, 2000 showed inhaled fluticasone to be less effective than oral prednisone in kids with severe attack in ED
- If not on chronic control meds, consider starting maintenance inhaled steroid regimen from ED
- Controversy re effects on growth with prolonged use
Magnesium Sulfate

- Bronchodilation- smooth muscle relaxant
- Effective IV route only
- Effects 20 minutes after infusion, can last up to 3 hrs
- Limited pediatric data but most suggest beneficial- especially severe attack (Ciarallo, 1996, 2000, Scarfone, 2000)

- 50-75 mg/ kg, Max dose 2 grams, IV over 20 minutes

- Severely ill asthmatics, potential PICU admission, not responsive to aggressive conventional treatment have greatest benefit
Heliox

- Mixture helium and oxygen
- Reduces turbulent flow and airway resistance
- Use in upper airway obstruction well established
- Efficacy in lower airway disease controversial
- Need 60% helium to be effective
- Hypoxemia limits its usefulness
Mechanical Ventilation

- Should be avoided if at all possible
- Should be “last resort”
- Increases airway hyper-responsiveness
- Increased risk barotrauma
- Increased risk circulatory depression/arrest
- Early recognition poor response to therapy/potential PICU admission
- Indications include:
  - severe hypoxia
  - altered mentation
  - fatigue
  - resp or cardiac arrest
- Rising CO2 in face of distress or fatigue
- Ketamine if intubation required
Ancillary Studies

- Peak flow, especially in comparison from baseline
- ABG—painful, invasive, not routine
- Decision to intubate never made based on ABG result alone—look at pt!
- Baseline CBC, Basic not routinely needed
- VBG—be wary if normal in context of distress/tachypnea
- Continuous albuterol—watch hypokalemia
- Mod—severe asthmatics may be dry—decreased po, emesis from meds, insensible losses—may need IVF
- Chest film—reserve for:
  1. 1st time wheezers
  2. clinically suspected pneumonia/pneumomediastinum/pneumothorax
- PICU player
Most asthmatics require at least 2 hrs assessment and treatment in ED
Must observe for at least 1 hr after initial 3 treatments/ steroids given
Reassessment critical
Consider likelihood follow up, compliance with meds, triggers
Admit if:
  - can’t tolerate po
distress/ hypoxic
comorbidities
PICU admission or intubation in past
poor social situation/ non compliance
Child Asthma Action Plan
Ages 0-5 Years Old
Review and update at each doctor's visit

Child is Well
... and has no asthma symptoms, even during play.

Child is Not Well
... and has asthma symptoms that may include:
- Coughing
- Wheezing
- Runny nose or other cold symptoms
- Breathing harder or faster
- Waking due to coughing or difficulty breathing
- Sleeping less than usual
Other symptoms that could indicate that your child is having difficulty breathing may include:difficulty breathing, gasping sounds, poor sitting, changes in sleep patterns, cranky and tired, decreased appetite

Green Zone

Caution, asthma symptoms are present:
- Give 4 puffs or nebulizer, every 20 minutes up to 1 hour, as needed
- If your child feels better and is back in the Green Zone continue the Green Zone medicines

Yellow Zone

DANGER! Get help immediately:
- Give a nebulizer
- Call your doctor's office now.
- If you can't reach them, go to the hospital

Red Zone

Child Feels Awful!

Yellow Zone

Other symptoms that could indicate that your child is having difficulty breathing may include:
- Difficulty breathing
- Sleeplessness
- Difficulty sitting
- Increased coughing
- Diarrhea or sore throat
- Cold or flu symptoms

Green Zone

If your child's symptoms worsen call your doctor

Optional Instructions:
- At the onset of respiratory illness, Give __________ times a day for _______ days

Prevent asthma symptoms everyday:
- Avoid things that make your child's asthma worse
- Give your child the controller medicines everyday

Medicine
Corticosteroids
Inhale

Patient Name:
DOB:
Healthcare Provider's Name:
Healthcare Provider's Phone #:

Parent Signature: __________________________ Date: __________
Physician Signature: __________________________ Date: __________
Risk Factors for Fatal Flare

- Hx of severe sudden exacerbation
- Prior PICU admission or intubation
- > 2 Hospitalizations past year
- > 3 ED visits past year
- > 2 MDI/mth
- Current steroid or recent wean
- Medical comorbidities
- Low socioeconomic status, urban setting
- Adolescent- poor perception of symptoms
Conclusions

• Respiratory distress multiple etiologies
• Goal- prevent progression to resp failure and cardiac arrest
• Age and season can guide diagnosis and tx
• Younger the pt, more likely to be viral- RSV
• Treat asthma aggressively
• Start steroids early in ED course
• Dexamethasone improves compliance
• Early recognition of need for PICU
• MDI/spacer/ mask more efficient than nebulizer- incorporate for home use
• Be wary of risk factors for fatal attack
A 4 mth male presents to the ED with a fever 102.4, runny nose, cough, and wheeze for the past 2+ days
Mom reports no color changes
RR 48, SATS 96% R/A HR 150’S
He is social, easily consolable, and in no distress
He is taking the bottle as you exam him
Appropriate management includes:

A. Give him albuterol
B. Give a dose of dexamethasone
C. Get an xray
D. Admit to the hospital
E. Check a catheterized urine sample/ cx
14 yr old known asthmatic with 3 days non productive cough
Afebrile
Has gone through an inhaler past 3 weeks
His parents smoke but "not in house"
He does not know what a peak flow meter is
He thinks he had steroids when he was admitted to the PICU 2 mths ago
He is 97 kg
Rr 28 with pressured speech
Diffuse wheeze
Intercostal and subcostal retractions
Exp >>> insp phase
Sats 98 % ra

All are true except:

a. He is increased risk for fatal flare
b. He needs a chest xray
c. Steroids should be started immediately
d. Continuous albuterol may needed
e. Magnesium sulfate may be helpful