Bronchiolitis is Back…

Clinical Updates 2021-22

Jessica Bailey, MD
Division of Pediatric Emergency Medicine

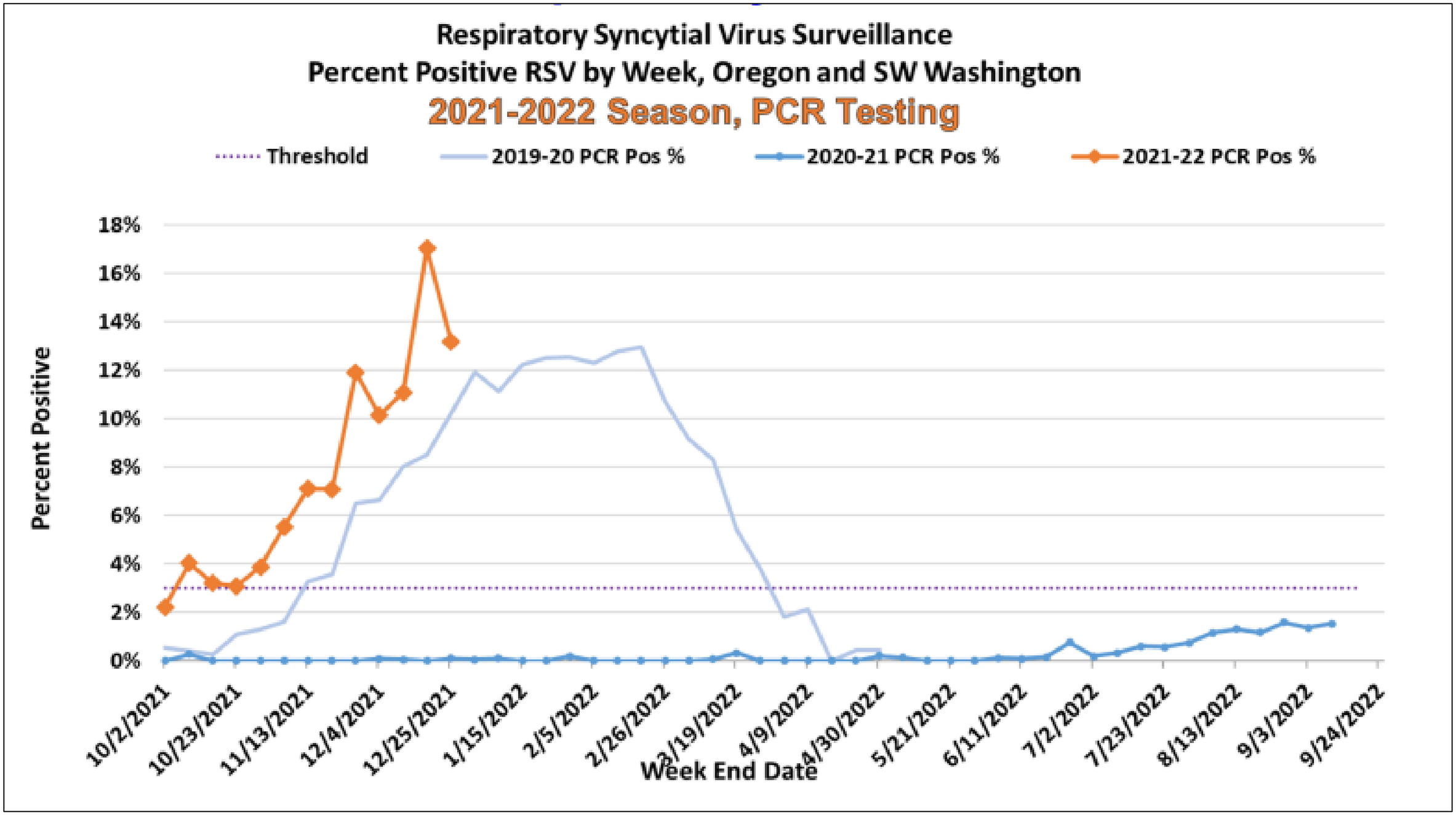
Kate Felmet, MD
Division of Critical Care Medicine

Michelle Noelck, MD
Division of Pediatric Hospitalist Medicine

Today's Objectives:

- Describe the epidemiology and pathophysiology of RSV bronchiolitis
- Understand the emergency department evaluation and treatment of a patient with bronchiolitis
- Recognize a child with severe bronchiolitis and describe appropriate inpatient and critical care interventions

- Link to video education series: https://vimeo.com/bronchiolitis



OHA weekly RSV surveillance Report

- Week 51 data (December 19-25 2021)
- 13.2% PCR tests and 11.1% Ag tests detected RSV

https://www.oregon.gov/oha/PH/DISEASESCONDITIONS/COMMUNICABLEDISEASE/DISEASESURVEILLANCEDATA/Documents/RSV/RSV_Oregon.pdf

Respiratory Syncytial Virus (RSV) in Oregon

- About 1500 cases since October 1st 2021
- 4000 cases between Dec 1 and April 1 in 2019-2020
- In the week ending 12/5:

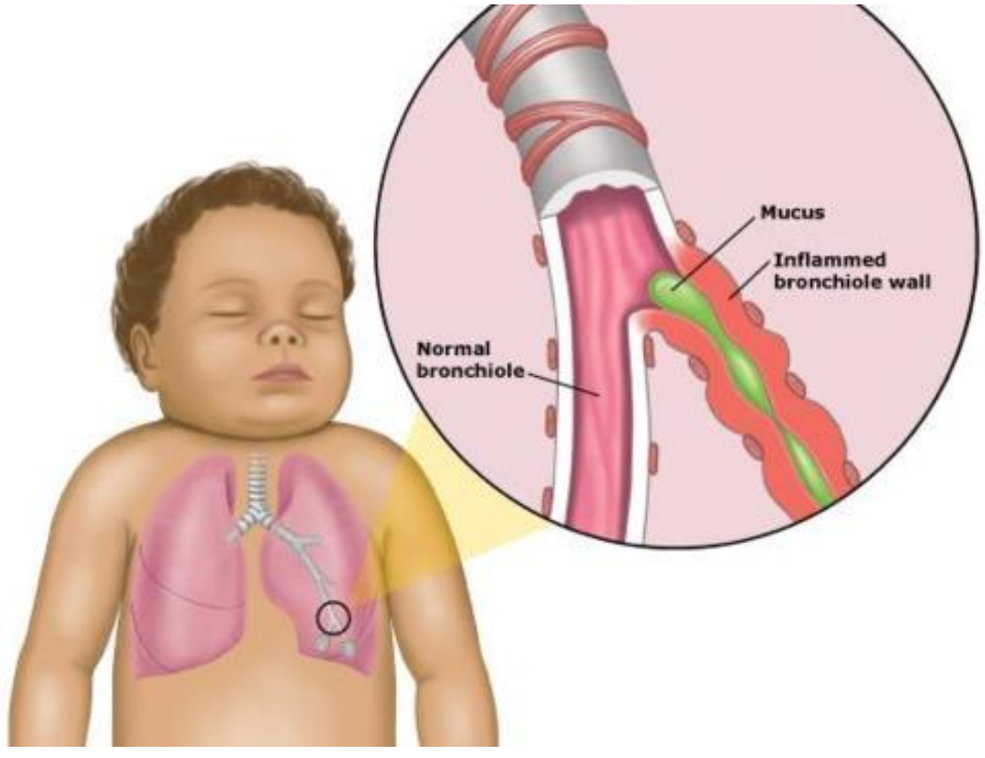
PCR tests 10 % positive with a rising trend

Why is RSV so important?

RSV & Bronchiolitis

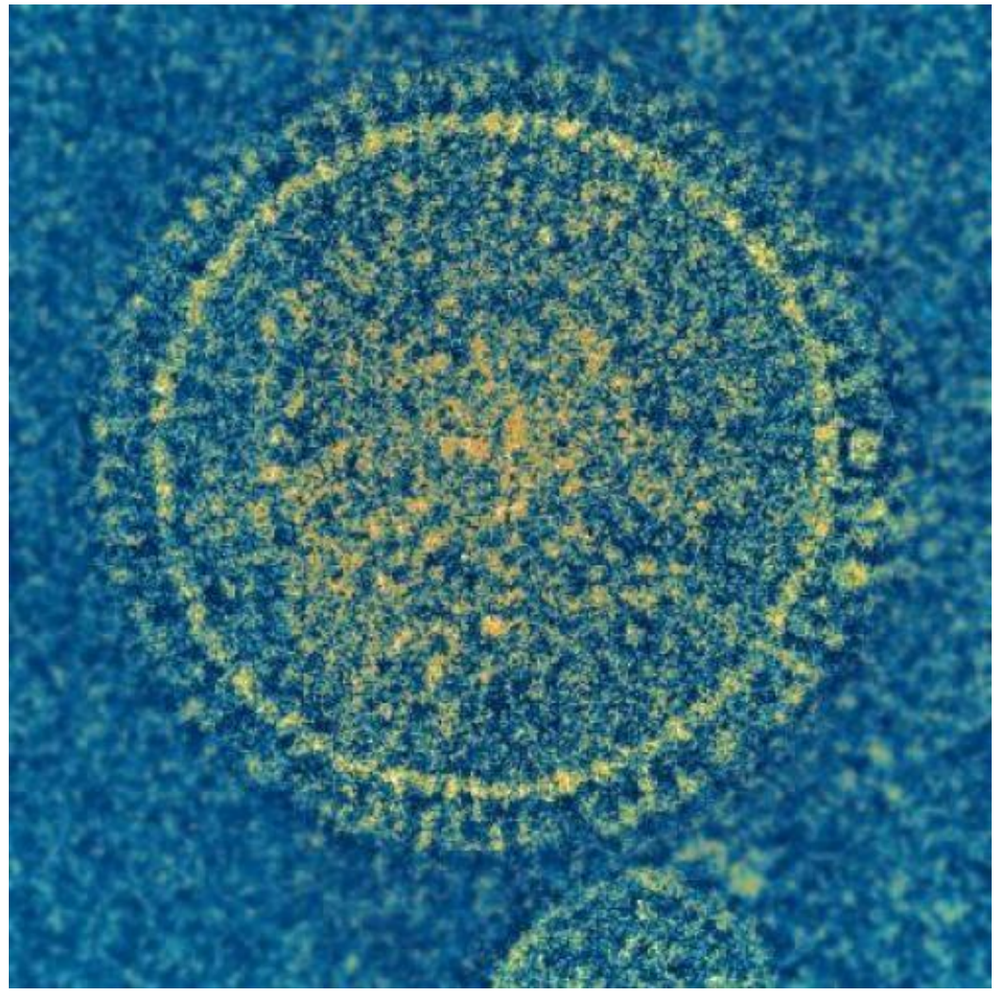
Bronchiolitis is a lower respiratory tract illness in young children, characterized by:

- Acute inflammation, edema, and necrosis of epithelial cells lining the small airways
- Increased mucous production
- Presents as:
  - Rhinitis & cough
  - Can progress to:
    - Tachypnea
    - Wheezing and/or rales
    - Use of accessory muscles



Viral Viral Viral!

- RSV
  - Usually prominent December to March (North America)
  - 90% children have RSV in first 2 years of life
  - Infection does not grant immunity = reinfection common
- Other virus culprits:
  - Rhino/enterovirus
  - Human metapneumovirus
  - Influenza
  - Adenovirus
  - Coronavirus
  - Parainfluenza
  - Co-infection



Bronchiolitis Impact on Hospitals

- Bronchiolitis is the **most common cause** of hospitalization in first 12 months of life!
- >100,000 bronchiolitis admissions in US/year
- Responsible for 20% of infant hospitalizations
- Highest rate: infants 30-60 days of age
- Increased severity in preemies

RSV in the 2021-22 Season

- Traditional RSV cycle has been altered = many more cases in late fall & early winter than usual
- Babies may not be receiving robust maternal antibody protection against RSV
- Toddlers who didn't get RSV as infants in 2020-21 (due to COVID-19 precautions/isolation) are still susceptible
- Will RSV severity be worse this year?
  - We have seen more intubated infants with RSV than normal
  - Some patients have elements of systemic shock

Bronchiolitis Basics

RSV Clinical Course

- Initially: runny nose indistinguishable from a cold
- Usually afebrile or low-grade fever early on
- Respiratory distress peaks on days 3-5 of the illness
- Secondary issues: poor feeding → dehydration
- Usually back to normal by 10 days

* Note: Improvement and recrudescence with prominent fever suggests potential bacterial superinfection

RSV Pathophysiology

- Nasal congestion
- Airway edema
- Interstitial edema
- Mucous plugging
- Exhaustion of respiratory muscles
- Increased cardiac work
- Risk for viral sepsis

Upper Respiratory Issues

Airway Edema + Mucus = Severe Nasal Congestion

- Infants are obligate nasal breathers until 6 months =
  - *Congestion can cause significant respiratory distress in infants*
- Infants have poor coordination between breathing and oropharyngeal control =
  - *Congestion can cause poor feeding and dehydration*

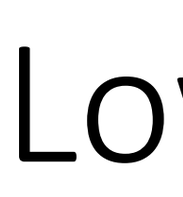
Lower Respiratory Issues

Airway Edema + Mucus = Atelectasis

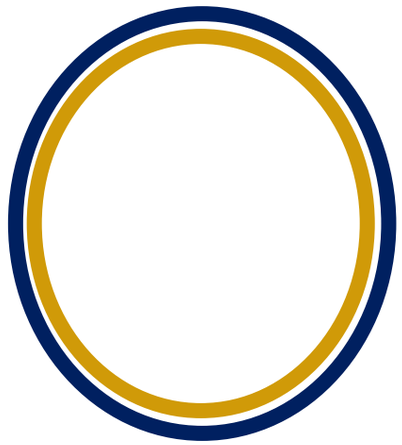
- Infants are more prone to atelectasis compared with adults
- Smaller airways are more likely to have mucus plugs
- Smaller alveolar diameter predisposes to collapse
- Lack of collateral ventilation channels
- Peripheral airways more prone to airway resistance
  - Adult 20%
  - Child 50%

Lower Respiratory Issues

Poiseuille's Law



$$R = \frac{8\,n\,l}{\Pi\,r^4}$$



If radius is halved, resistance increases 16x

Lower Respiratory Issues

An infant's work of breathing is inefficient

- Interstitial edema in RSV decreases lung compliance
- Chest wall is not rigid at baseline:
  - Muscle work goes into stabilizing the floppy chest wall
  - Muscle work is required to maintain FRC
  - Respiratory muscles are more prone to exhaustion
  - When lung compliance is poor, 50% of cardiac output feeds muscles of respiration!

Lower Respiratory Issues

RSV can present as apnea in neonates

In babies < 1 month and older premature infants,

RSV can present with central apnea alone

BEFORE

the development of other respiratory symptoms…

Bronchiolitis Diagnosis

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Guidance for the Clinician in Rendering Pediatric Care

CLINICAL PRACTICE GUIDELINE

Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis

- Oct 2014 (update from 2006)
- Applies to children 1-23 months

AAP Guidelines on Diagnosis

Bronchiolitis is a **CLINICAL DIAGNOSIS!**

- Variation in clinical findings minute to minute- mucus cleared by coughing, sleep, agitation
- Variation can confound assessment

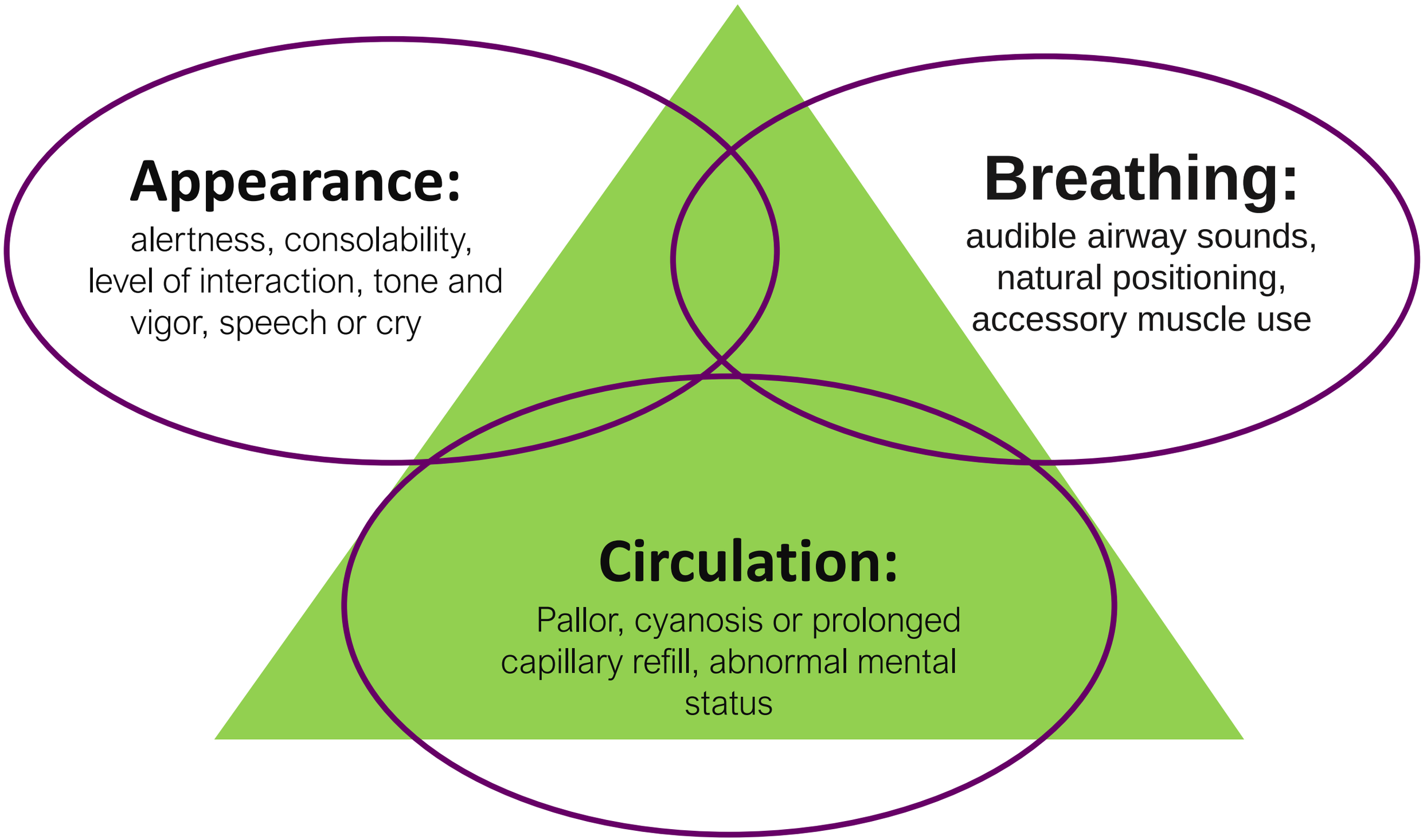
Risk factors should be considered:

- <12 weeks, prematurity, cardiopulmonary disease, immunodeficiency, neuromuscular disease

X-rays and labs are not necessary

- COVID testing for isolation needs
- Viral testing necessary?
  - Will it impact management?
  - Do we need results for public health?

Doorway Assessment



Assessment of Respiratory Distress

- Assess tone & mental status (alertness, response to IV start)
  - Don’t trust babies!
  - Babies will not show the anxiety of early hypercarbia and may not appear drowsy until very later hypercarbia
  - Beware the infant who is awake but so focused on breathing that they won’t suck
- Assess Hydration: assess fontanelles, capillary refill, mucous membranes
- Assess Respiratory Rate:
  - Tachypnea may be difficult to assess when crying!

Assessment of Respiratory Distress

Normal Respiratory Rates:

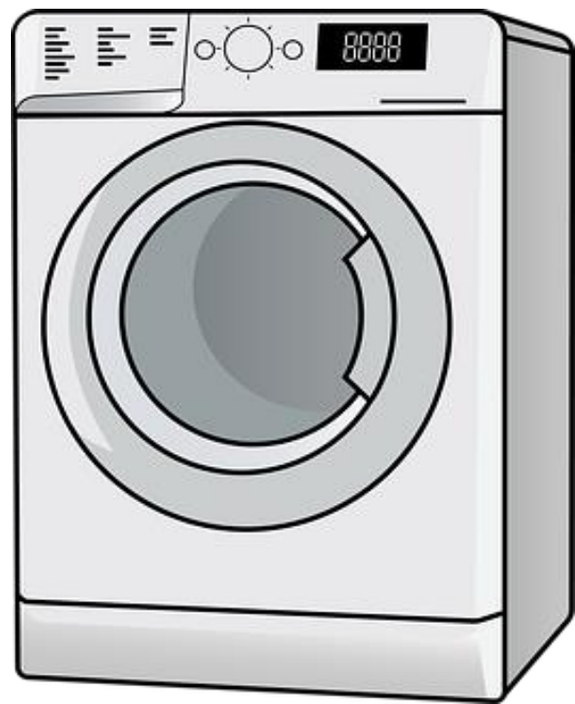
Infant	< 60 / min
Toddler	< 40 / min
Preschooler	<35 / min

*A child can breathe 2-3x their normal respiratory rate for 2-3 days…

Assessment of Respiratory Distress

- Auscultation reveals a combination of sounds:
  - Wet cough
  - Coarse rhonchi
  - Fine rales
  - Opening “pops”
  - Wheezing (occasionally prolonged expiratory phase)
  - Transmitted upper airway noises from congestion

- Lung findings are usually bilateral
  - Unilateral findings should prompt consideration of other diagnoses



Bronchiolitis Treatment

AAP guidelines on Treatment

- No albuterol
- No steroids
- No racemic epinephrine
- No chest physiotherapy
- No hypertonic saline in the ED
- No antibiotics unless concomitant bacterial infection or high suspicion
- If sats >90%, may not need oxygen
- Ok to NOT use continuous pulse ox
- Use NG feeds (preferred) or IVFs if poor PO

Usual RSV treatment in infants

- Treatment is supportive!
  - Suction, suction, suction
  - Support hydration
  - Antipyretic/comfort
  - Oxygen support if indicated
    - Local SpO2 threshold
    - Consider LFNC before escalating to HFNC in patient with mild to moderate disease

Home Management Mainstays

- Parental education!
- Suctioning
  - bulb suction vs nose freida devices
  - saline drops & spray
- Frequent feedings
- Anticipatory Guidance and return precautions
  - How to monitor for signs of respiratory distress

Admission Criteria

- Unable to maintain oxygen saturation above 90% on RA
- Unable to maintain hydration orally
- Concern that infant may decompensate before appropriate follow up can be arranged
- Requiring frequent suctioning and cares that cannot be adequately addressed at home
- Clinical judgment of provider

I know what the AAP says…

- But when might it be appropriate?
  - Albuterol
  - CXR
  - HFNC
- Patients with severe distress as evidenced by:
  - Altered mental status, lethargy
  - Significant tachycardia
  - Significant hypoxia
  - Consideration of ICU level care

Heated High Flow Nasal Cannula

- Delivers higher flows of oxygen →
  - usually to 1-2L/kg/min
- Heated, humidified
- Does NOT provide consistent or measurable positive end expiratory pressure (PEEP)
- MAY help with dead space ventilation
- MAY benefit patients with more severe disease
  - Reduce severity scores
  - Reduced rates of intubation in observational studies

HHFNC: Early Evidence

- Cochrane systematic review
  - No clear difference in duration of O2 therapy, LOS (Beggs 2014)
- RCT of 72 pts w bronchiolitis found NO improvement in resp distress, O2 needs (Hathorn et al 2014)
  - Trend towards lower clinical scores in 1st 3 hrs after initiation
- Observational study w 27 infants, moderate to severe disease
  - Improvements in median SpO2, ETCO2, RR after 3 hrs (Bressen 2013)
- Retrospective chart reviews found reduced need for intubation for infants in PICU (McKiernan 2010, Schibler 2011)

HHFNC: RCTs

ORIGINAL ARTICLE

A Randomized Trial of High-Flow Oxygen Therapy in Infants with Bronchiolitis

Donna Franklin, B.N., M.B.A., Franz E. Babl, M.D., M.P.H., Luregn J. Schlapbach, M.D., Ed Oakley, M.B., B.S., Simon Craig, M.B., B.S., M.H.P.E., M.P.H., Jocelyn Neutze, M.B., Ch.B., Jeremy Furyk, M.B., B.S., M.P.H.&T.M., John F. Fraser, M.B., Ch.B., Ph.D., Mark Jones, Ph.D., Jennifer A. Whitty, B.Pharm., Grad.Dip.Clin.Pharm., Ph.D., Stuart R. Dalziel, M.B., Ch.B., Ph.D., and Andreas Schibler, M.D.

NEJM 2018

- 1472 pts <12mo, Australia and New Zealand
  - Hypoxemia threshold 92-94%
- Randomized to either “standard therapy” (2L simple NC) or high flow nasal cannula at 2L/kg/min
- Outcomes
  - Primary: treatment failure→ escalation of support
  - Secondary: total time on oxygen, LOS, intubation rates, ICU txfr, AE
- Results
  - Escalation of support occurred in 23% of standard therapy pts, and 12% of HFNC therapy pts ($p<0.001$)
  - No significant differences in secondary outcomes

Summary of Australian/NZ RCTs:

- Early vs. Rescue use of HFNC does not change any meaningful patient outcomes in 1674 infants studied
- “Treatment Failure” as defined in these studies does not predict important outcomes but rather could be seen to predict “need” for HFNC in standard care arm
- 67% to 77% of patients treated with standard care successfully (i.e. did not experience treatment failure)
- High-flow is 16 times more expensive and not more effective when used early, thus should be reserved for sicker patients

Kepretoes 2017, Franklin 2018

Era of systematic reviews and meta data…

‘Rational use of high-flow therapy in infants with bronchiolitis. What do the latest trials tell us?’ A Paediatric Research in Emergency Departments International Collaborative perspective

Sharon O’Brien,[1,2] Simon Craig,[3,4] Franz E Babl,[5,6,7] Meredith L Borland,[1,8] Ed Oakley[5,6,7,9] and Stuart R Dalziel;[10,11,12] on behalf of the Paediatric Research in Emergency Departments International Collaborative (PREDICT) Network, Australasia

High flow nasal cannula as respiratory support in treating infant bronchiolitis: a systematic review

Lien Moreel[1] · Marijke Proesmans[2]

Original article

High-flow nasal cannula therapy for children with bronchiolitis: a systematic review and meta-analysis

Jilei Lin,[1,2] Yin Zhang,[1,2] Limei Xiong,[1,2] Sha Liu,[1] Caihui Gong,[1] Jihong Dai[1,2]

Conclusion:

Early vs rescue use of HFNC for the treatment of mild to moderate bronchiolitis does not alter disease course or impact meaningful patient outcomes

- Use as first line therapy is not supported by evidence

Severe Respiratory Distress

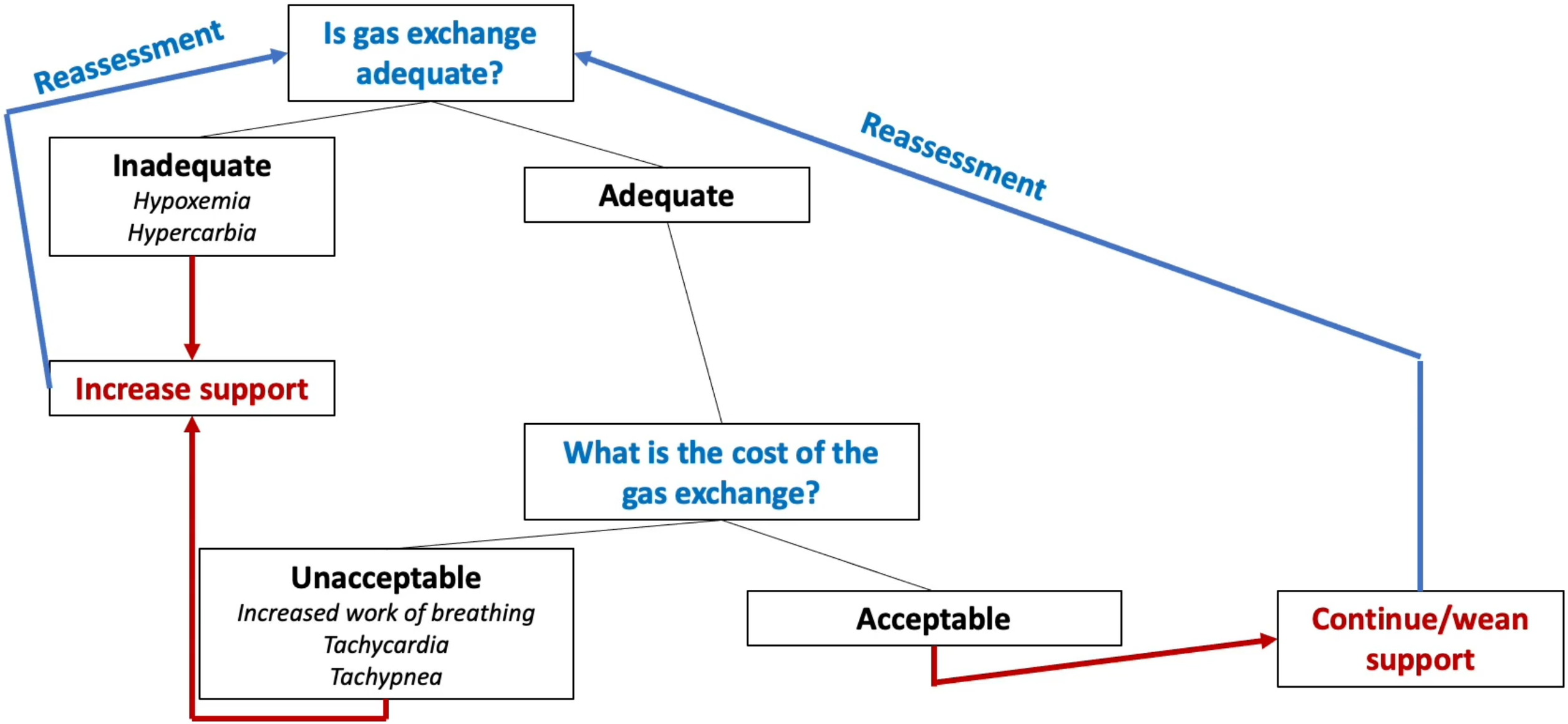
- Bronchiolitis is one of the most common reasons a child can develop respiratory failure
- May require high levels of respiratory support
  - High Flow Nasal Cannula
  - Non-invasive ventilation
  - Invasive ventilation
- Approximately 3% of all children with bronchiolitis admitted to a children's hospital require invasive ventilation (Pelletier, 2021)

Elements to consider:

	Reassuring	Somewhat concerning	Very concerning
Heart rate	Normal	Mild tachycardia	Severe tachycardia or bradycardia
Respiratory rate	Normal	Mild tachypnea	Severe tachypnea or bradypnea
Pulse oximetry	Normal SpO2	Mild desaturation	Severe desaturation
Work of breathing	Normal	Mild nasal flaring and/or retractions	Severe nasal flaring, retractions, head bobbing, grunting
Level of interaction	Normal	Less interactive than normal, fussy but consolable	Obtunded, inconsolably fussy/irritable
Perfusion	Normal	Cool distal extremities, mildly delayed cap refill	Cold extremities, very delayed cap refill

https://vimeo.com/bronchiolitis

Adequacy and cost of gas exchange



https://vimeo.com/bronchiolitis

Interventions: Severe Disease

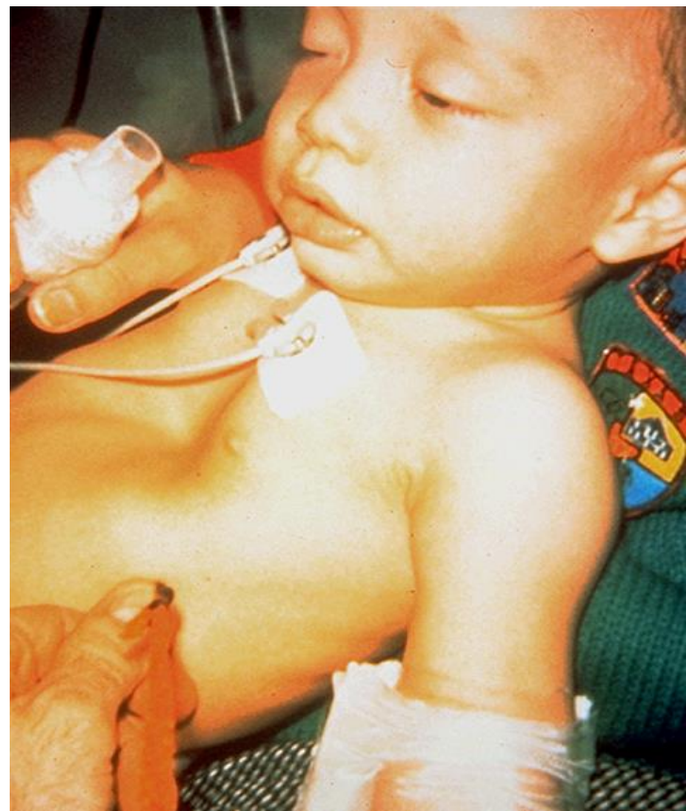
- Aggressive suction
- Tylenol
- Address Hydration
- Consideration of LFNC
- Escalation of respiratory support if indicated
    - High Flow Nasal Cannula
    - Can provide intermittent positive pressure to maintain FRC at higher flow rates
        - Initial flow rates of 1-2 L/kg/min
        - Titrate oxygen separately
- Admission to inpatient vs ICU setting

Shock in infants with RSV

- Many causes:
  - Hypovolemia- poor PO and high insensible losses
  - Muscles of respiration can consume up to 50 % of cardiac output in babies
  - Viremia/viral sepsis
  - Secondary infection causing sepsis
    - Consider UTI
- Treatment:
  - Bolus fluids
  - Epinephrine for BP support
  - Intubation if in respiratory failure or failed previous respiratory support

Intubation in Severe Disease

- Potential Indications for intubation:
  - Hypoxia unresponsive to oxygen
  - Poor mental status
  - Unsustainable work of breathing
  - Hypercarbic acidosis that does not improve with suction, nebs or high flow
  - Shock



In summary

- Already a busy bronchiolitis season…
- Bronchiolitis is a clinical diagnosis
  - COVID testing as indicated
- Supportive care is the mainstay of treatment!
  - Suction, suction, suction
  - Hydration
  - O2 support- can start with LFNC and escalate as needed
- Frequent reassessment is key!

Objectives

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Go forth…and suction