Wheezin' Season: Pediatric Respiratory Emergencies

Kelley Roswell, MD
Associate Professor Pediatrics
Section of Pediatric Emergency Medicine
University of Colorado SOM

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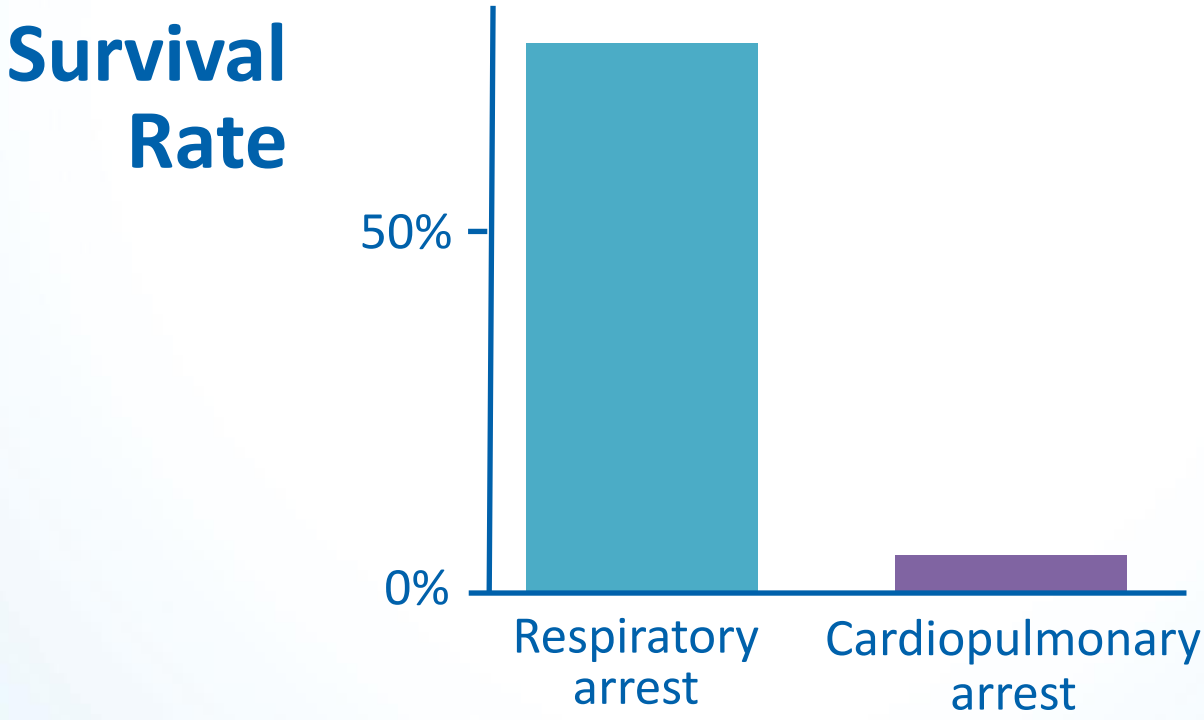
Why Is This Topic Important?

- Respiratory arrest is the most common cause of cardiopulmonary arrest in children
- Failure to manage airway is the leading cause of preventable death
- Early recognition is key
- Simple Interventions can work

Survival Following Respiratory Arrest vs. Cardiopulmonary Arrest in Children



Objectives

- Discuss options for early interventions to increase success in managing pediatric patient in respiratory distress
- Discuss signs of respiratory distress in pediatric patients
- Discuss how if unrecognized, respiratory distress will lead to respiratory failure
- Review selected upper vs lower respiratory emergencies

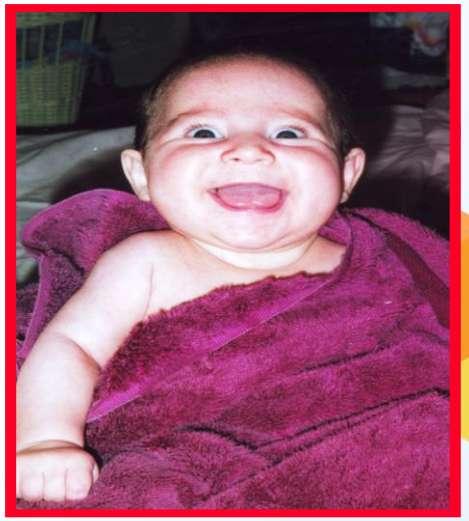
Pediatric Keys to Success

Prevent **HYPOXEMIA** !!

Basic treatments save lives:

STAY CALM!

- Get Vital Signs (no matter how young)
- Intervene and **Reassess**
  - **Remember kids can change**
- Decide where intervention should occur



Airway Management Options

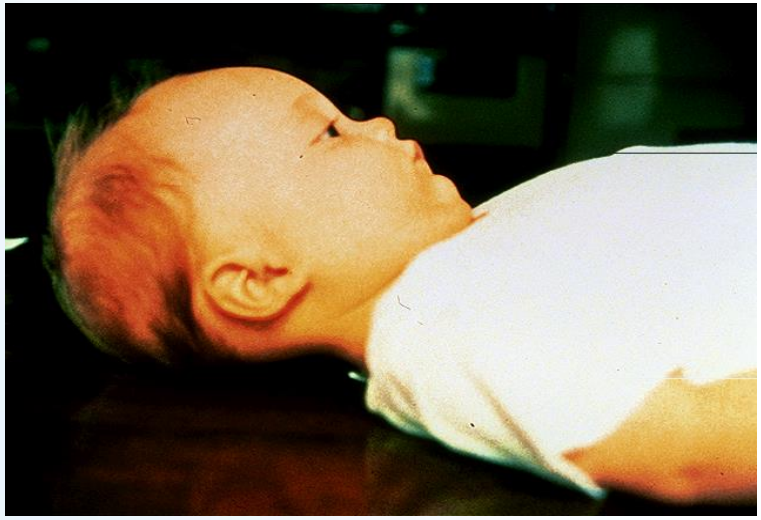
- Suction
- Positioning/calming
- Supplemental oxygen
- Nebulized medications
- Oral or nasal airways
- Bag-mask ventilation
- Positive Pressure Treatment
- Advanced airway
- Rescue Techniques

Nasal suction= LIFESAVER

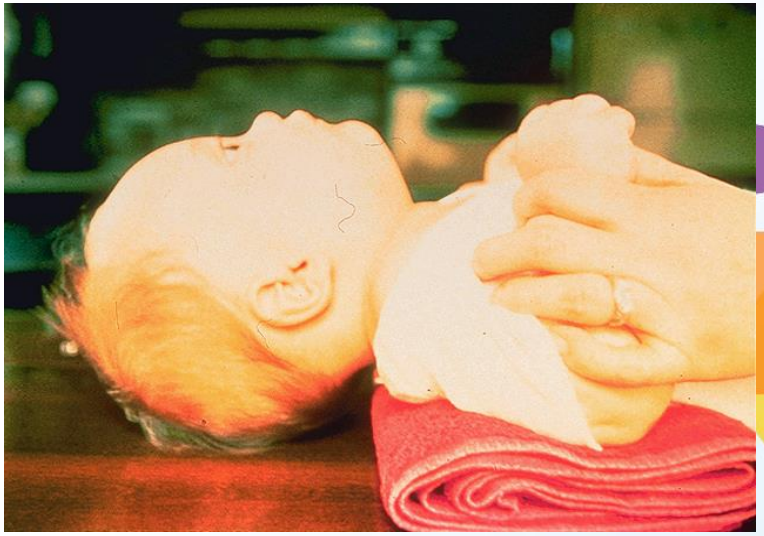
Positioning

Proportionally larger head, particularly the occiput (up to ~8yrs)

Laying flat will obstruct the airway



Positioning with towel rolls can straighten the neck and open the airway



Positioning

- Put head of bed up if helps
  - Tripod position
- Place in car seat
- Sit on parent's lap (calm patient)
  - Position of comfort

Supplemental Oxygen

Nasal Cannula

Simple mask

Non-rebreather

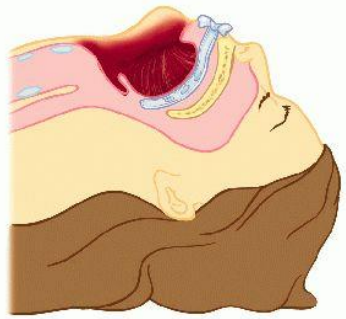
Nebulized Medications

- Albuterol
- Atrovent
- Epinephrine
- Mist

Airway Adjuncts

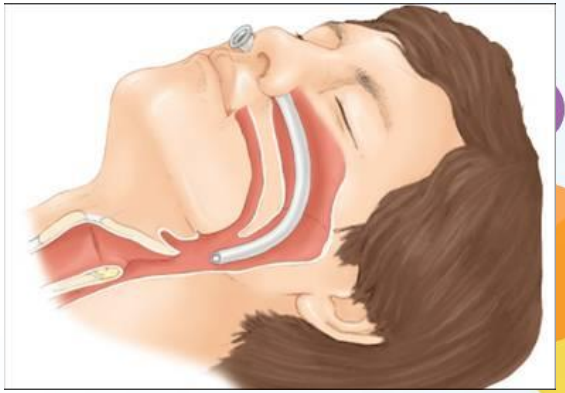
Oral Airway

- Keeps tongue out of the way
- Only in unconscious patients



Nasal Airway

- Great for children with copious secretions but breathing on their own.



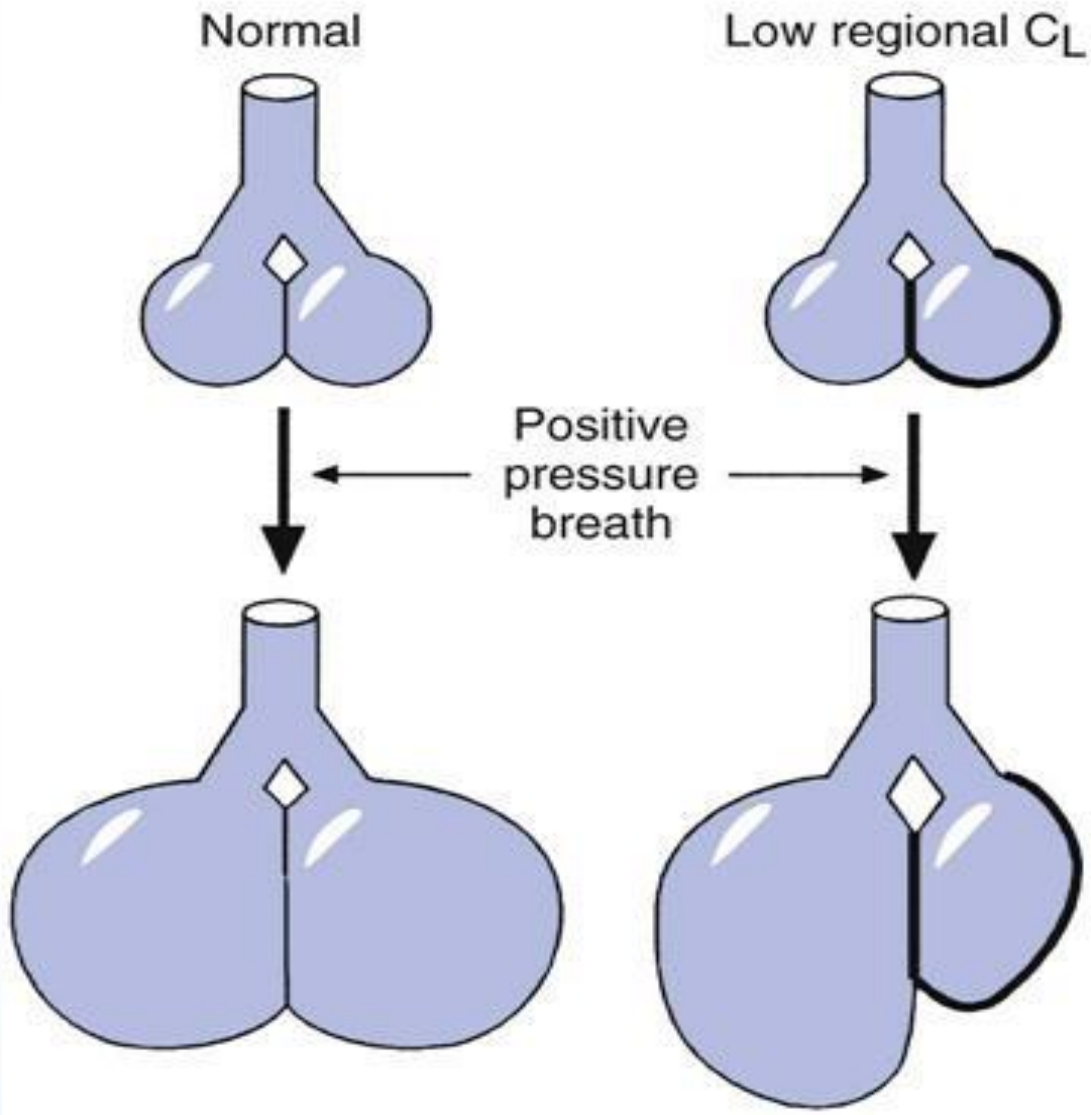
Positive Pressure Options

BMV

Heated Hi-Flow

BiPAP

CPAP


Normal
Low regional C_L
Positive pressure breath

Bag-Mask Ventilation

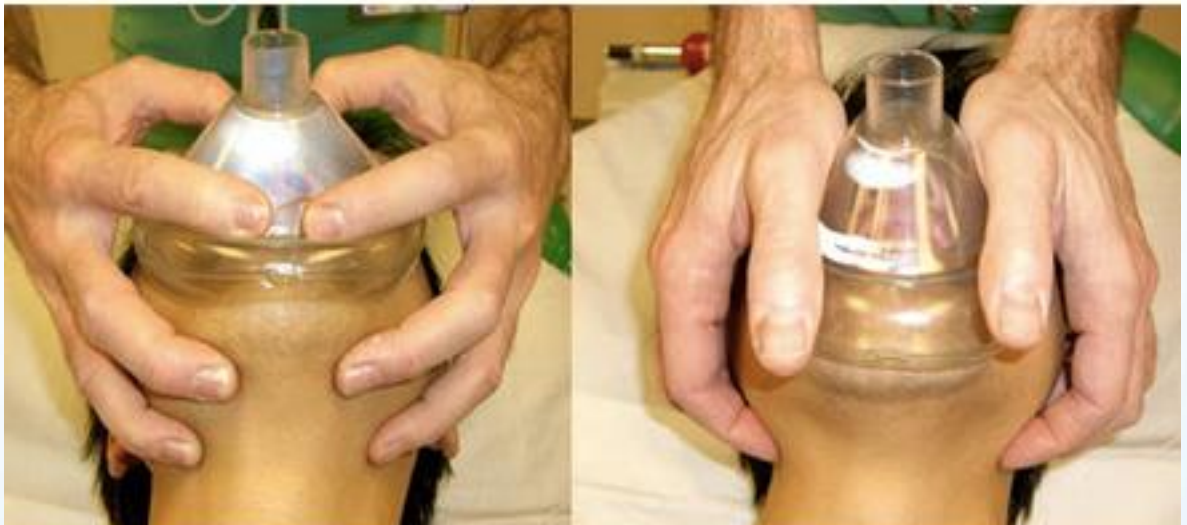
<u>THE</u> single most important life-saving skill

C-E technique/2 hand Thenar technique/v-clamp

Jaw thrust

Not as easy as it looks- PRACTICE!

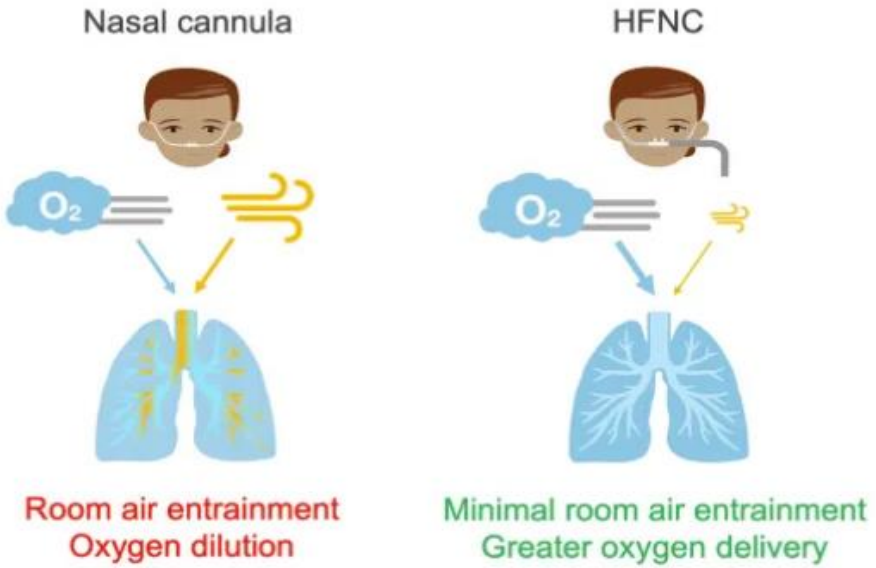
Always observe for chest rise

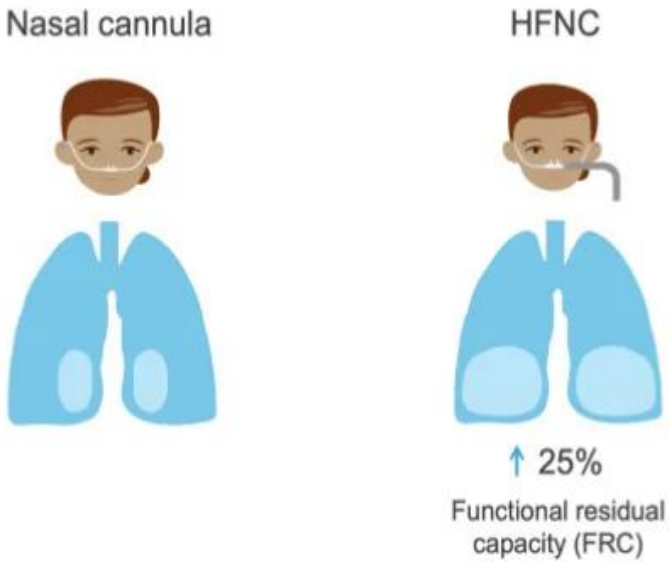


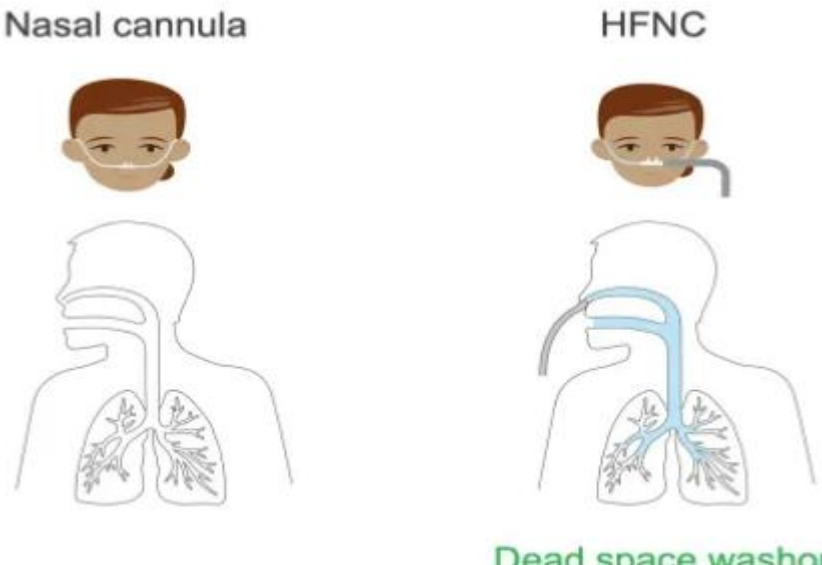
How does Vapotherm (HHF) work

There are three main proposed benefits of HFNC:

1. Precise oxygen delivery
2. Functional residual capacity enhancement
3. Dead space washout







How does Vapotherm (HHF) work

Summary of Actions:

Dead space washout	Reduce dead space making minute ventilation more efficient
Reduce inspiratory work of breathing	Exceed inspiratory flow thus eliminating nasal resistance
Improved lung Mechanics	Warmed, humidified gas has been shown to improve conductance, lung compliance and lung elasticity
Eliminates metabolic work associated with gas conditiong	Attenuates the energy and water loss associated with conditiong inspiratory gas
Provision of mild distending pressure	Provides positive distending pressure for lung recruitment. It prevents alveolar collapse
Improve secretion mobilisation	Ideal humidification of the inspired gas has been shown to restore muco-cilliary function and reduce symptoms of airway exacerbations

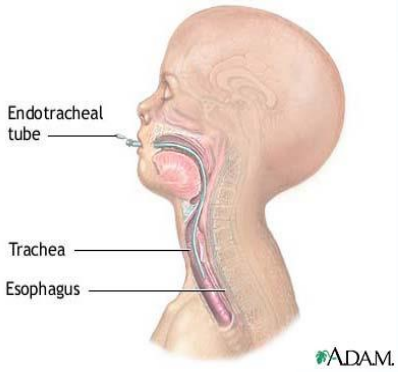
Table adapted from: High Flow Nasal Cannula Therapy in Neonatology (TL Miller 2013).

A

B

Advanced Airways

Endotracheal Tube -ETT

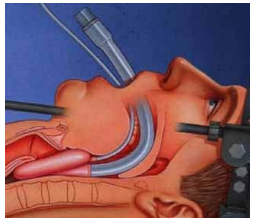


- Pediatric sizes based on **age**
- Only way to provide high pressure ventilation
- Takes time and direct visualization
- Prevents aspiration

Advanced Airways

I-Gel

LMAs



Pediatric sizes based on **weight**.

Easy, blind insertion

Easier to maintain than BMV

Faster than ETI and better success rate

Does not definitively protect airway

Signs of Respiratory Distress

Early Signs

- ↑ RR
- Nasal flaring
- Intercostal, supraclavicular, and subcostal retractions
- Neck muscle use
- Audible noises: stridor, wheezing
- "see-saw" respirations

Late Signs

- RR >60
- Cyanosis
- Decreased muscle tone
- Severe accessory muscle use (sternal retractions)
- Poor peripheral perfusion
- Altered mental status
- Grunting
- Head bobbing

Children's Hospital Colorado

Late Signs

of Respiratory Distress

Respiratory Distress & Failure

Distress:

State of increased **respiratory rate** and increased **respiratory effort**:

- Tachypnea
- Nasal flaring
- Retractions

Respiratory Distress & Failure

Failure:

Inadequate gas exchange by the respiratory system

*Usually follows period of distress

Most common pathway to cardiopulmonary arrest!!!

Pediatric Respiratory Emergencies

Upper Airway

- Distress occurs when structures of upper airway are occluded
  - Edema
  - Secretions
  - Foreign bodies
  - Anatomical defects
- Examples
  - Croup
  - Epiglottitis
  - Bacterial tracheitis
  - FB obstruction
  - Anaphylaxis

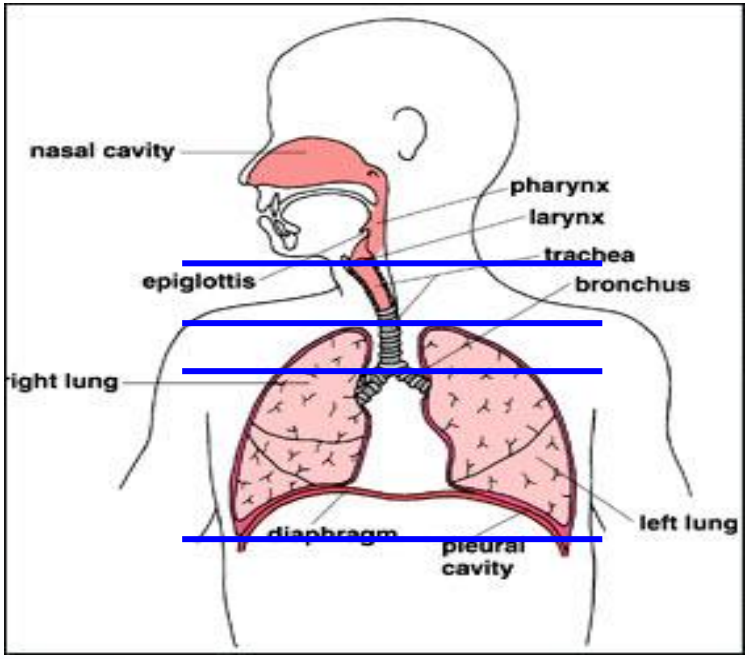
Lower Airway

- Distress occurs when lower airway structures are occluded
  - Edema
  - Bronchoconstriction
- Examples
  - Asthma
  - Bronchiolitis
  - Pertussis
  - Pneumonia
  - Anaphylaxis

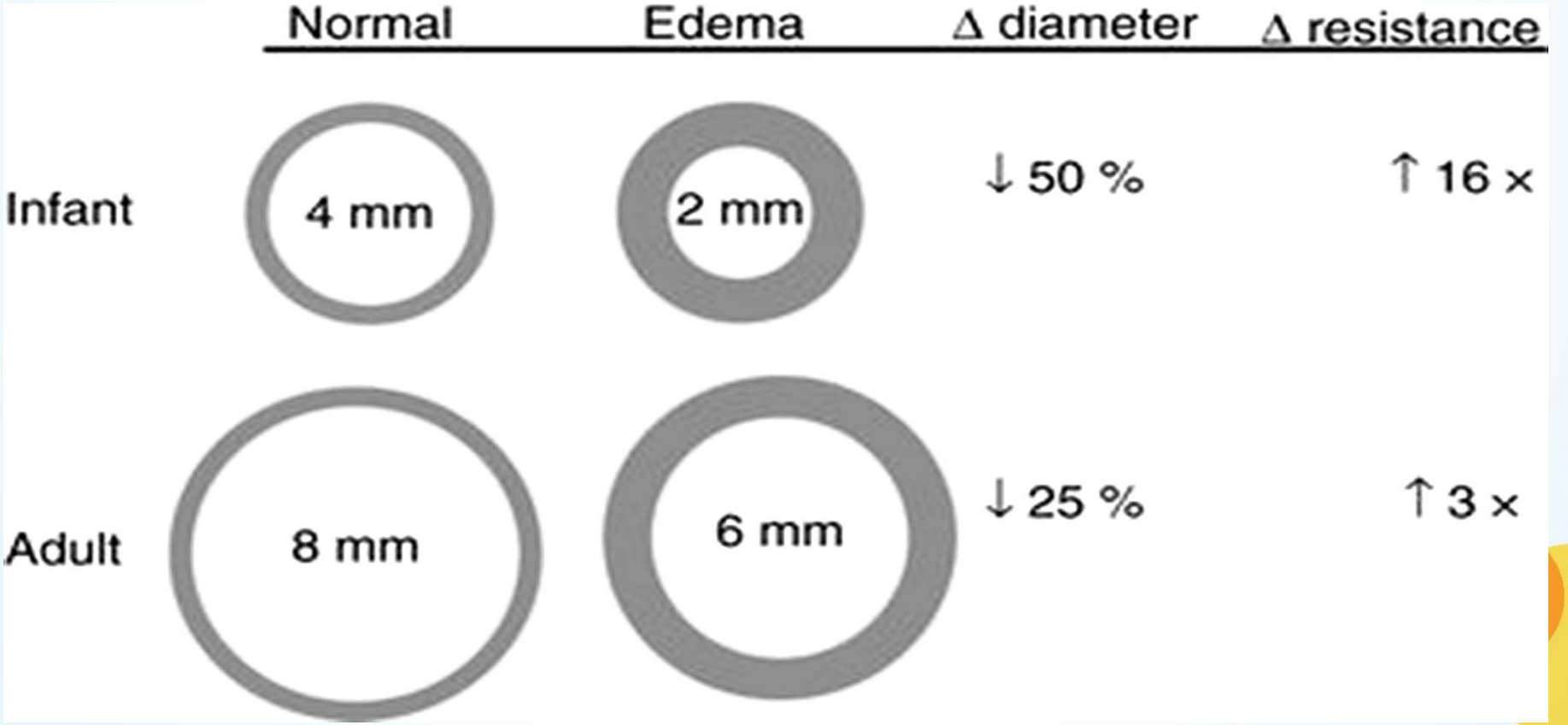
Define the Problem

Is this a primary respiratory problem?

Which part of the respiratory tree is involved?



Airway Resistance



3 y/o trouble breathing

6 year old child presented to PCP office with respiratory distress

Sx: 1 day of barky cough, audible wheezing, retractions, drooling

Pt received Albuterol neb x1 with minimal improvement

EMS transferred child from PCP office to CHCO

EMS reports child was in respiratory distress

- Gave Duoneb and Racemic Epi x1 en route

3 year old trouble breathing

- Upon arrival in ED:
- T 98.4, RR: 32, HR 153, BP 123/88 and 95% RA
- Awake, alert, no drooling, + barky cough with stridor at rest
- HEENT: + congestion , MMM, slightly red throat
- CV: Tachycardic, RR, no m/r/g, pulses 2+
- Lungs: Suprasternal retractions, good aeration, symmetric, no crackles, wheezing, rales, rhonchi

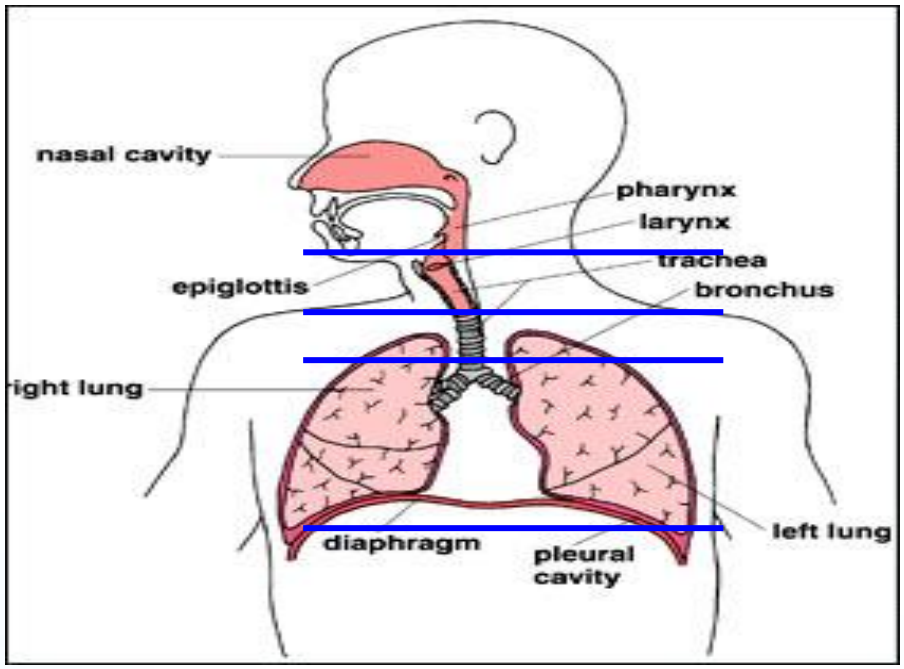
Thoughts?

Differential?

What to you want to do?

Define the Problem

Which part of the respiratory tree is involved?



Stridor

- Harsh, high pitched airway sound
- Characteristic of significant upper airway obstruction from swelling

Differential of Stridor

Infection

- Croup
- Bacterial tracheitis
- Retropharyngeal abscess

Foreign Body-(especially starting in middle of the day)

Laryngomalacia/Tracheomalacia

Less common causes:

- vocal cord paresis,
- subglottic hemangioma,
  - causes rapidly progressing stridor, sometimes associated with a facial hemangioma
- vascular ring, vascular sling, fixed mediastinal mass

Croup

Accounts for over 90% of stridor with fever

Common illness: ages 6 months- 5 years

More common in spring to summer and summer to fall

Subglottic stenosis secondary to edematous, inflamed mucosa

NOT SMOOTH MUSCLE ISSUE

Most commonly caused by parainfluenza>>>RSV, adenovirus, and influenza

With different waves of Covid, we saw large number of Covid+ croup with more recent variants

Croup-Symptoms

- Signs/symptoms: barky cough, hoarse voice, fever, inspiratory/exp stridor, tachypnea, tachycardia, retractions
- **Sick vs not sick**= inspiratory/exp stridor and increased WOB
- Stridor at rest

Croup- Interventions

#1 Rule…

Don’t piss them off!!

Croup- Interventions

Treatment:

Mild-Barky cough, no stridor at rest

- Decadron: standard dose 0.6mg/kg (max 8mg)
  - Studies have shown as doses as low as 0.2 mg/kg are just as affective
  - No studies have shown benefit from 2nd dose
- Cool mist-no study to show this is beneficial

Croup- Interventions

- Position of comfort
- Monitor O2 sats- cover up the probe!!
- Encourage cold fluids

Croup- Interventions

#1 Rule…

Don’t piss them off!!

Unless you have to…

Croup- Interventions

Treatment:

Mild-Barky cough, no stridor at rest

- Decadron: standard dose 0.6mg/kg (max 16 mg)*
  - Studies have shown as doses as low as 0.2 mg/kg are just as affective
  - No studies have shown benefit from 2nd dose
- Cool mist-no study to show this is beneficial

Severe-Stridor at rest and/or severe distress

- **Racemic epinephrine(0.5 ml of 0.25% solution dissolved in 2.5ml of NS)**
  - **Watch for 2-3 hours after treatment**
- **Heliox-Use limited by hypoxia**

Pt with significant hypoxia with croup are worrisome for severe disease/critical airways

Albuterol does not help bc not a smooth muscle issue

Case #1- ED Interventions

- Racemic Epi neb over 15 minutes
- Dexamethasone
- Cardiac monitor and pulse ox
- Observation x 3 hours- watch for rebound
- Popsicle and juice, then discharged home

Questions?

7 y/o male trouble breathing

1405 – 911 call ;

- “My son is having trouble breathing”
- “We are in the car going to the hospital”

14:07 - EMS finds car on road, car does not stop

14:11 - EMS follows car to ED ambulance bay

- Find male in backseat apneic, pale, poor tone
- MOC reports “He had a ball in his mouth and then started having trouble breathing”
- EMS provider performs abdominal thrusts as he carries patient in to the hospital

.

7 y/o male trouble breathing

14:13 – Arrives in CHCO ED being held around the abdomen by EMS provider

awake, insp/exp stridor, hoarse voice: RR 28,

Thoughts?

Differential?

What to you want to do?

7 y/o male trouble breathing

14:13 – Arrives in CHCO ED being held around the abdomen by EMS provider

awake, insp/exp stridor, hoarse voice: RR 28,

Pt is placed in a sitting up positioning and placed on oxygen

14:15 - ENT consulted, imaging ordered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mAs: 1
Kvp: 72

Page: 1 of 1
cm
S: 167
Z: 0.39
C: 511
W: 1023
IM:1002

7 y/o male trouble breathing

14:13 – Arrives in CHCO ED being held around the abdomen by EMS provider

awake, insp/exp stridor, hoarse voice: RR 28, sat up and placed on oxygen

14:15 - ENT consulted, imaging ordered

14:25 - ENT asks for 2nd image


CHCO MAIN PORT DR01
X-RAY NECK 1 VIEW LATERAL SOFT TISSUE
3/21/2015 12:22:39 AM
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mAs: 1
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cm
S: 100
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7 y/o male with trouble breathing

14:13 – Arrives in CHCO ED being held around the abdomen by EMS provider

awake, insp/exp stridor, hoarse voice: RR 28, sat up and placed on oxygen

14:15 - ENT consulted, imaging ordered

14:25 - ENT asks for 2nd image

14:42 - Pt transferred to OR for removal

7 y/o trouble breathing

After removal in OR, patient admitted to PICU

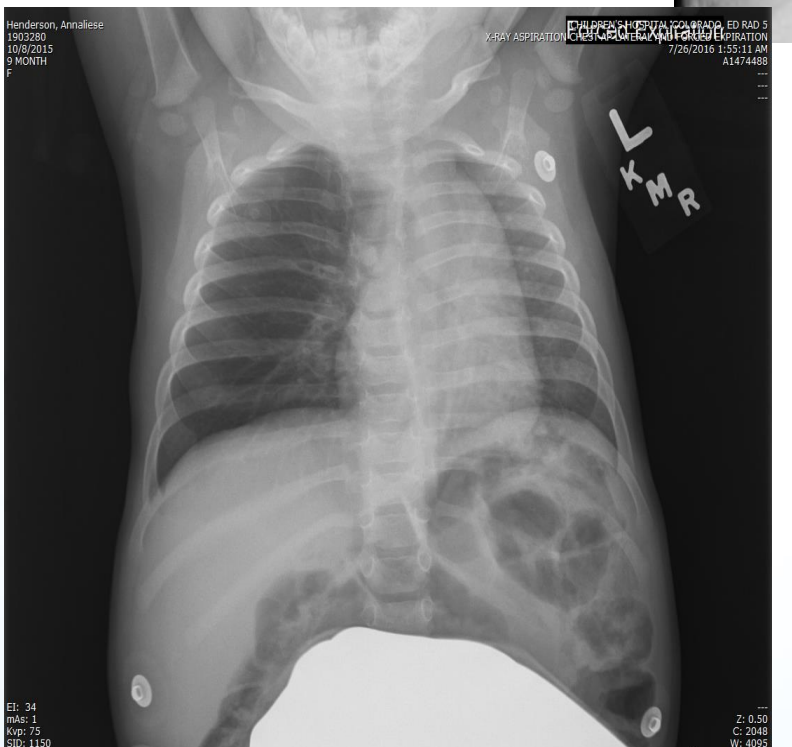
He went home the next day and is doing fine

Upper Airway-Foreign Body Obstruction

- True medical emergency
- Usually in children <3 years old
- Size of object determines severity
- Most often caused by food
  - Hot dogs
  - Round candy
  - Peanuts
  - Plastic/glass beads
  - Buttons
  - Coins
  - Disc batteries

Foreign body obstruction-symptoms

- Drooling
- Stridor
- Wheezing
- Unequal breath sounds
- Chest pain



Airway FB - Aspiration Management/Interventions

CAB/ABCs

- Intervention if needed
- Blind finger sweep not indicated
- If visible, can be removed with Magill Forceps

Airway FB interventions

If coughing, gagging let child clear without interventions – **POSITION**

NO noise, no sound - **INTERVENE**

<1 y/o old, 5 back blows, 5 chest blows

Head down

>1 y/o, abdominal thrusts indicated

If unconscious, start CPR

After 30 chest compressions, open AW, check for FB, remove if able

NO BLIND FINGER SWEEPS


CHCO MAIN PORT DR01
X-RAY NECK 1 VIEW LATERAL SOFT TISSUE
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Questions?

Upper airway-Anaphylaxis

- Severe life-threatening allergic rx
- Symptoms can develop rapidly-seconds/minutes
- Can lead to anaphylactic shock (distributive shock)-massive vasodilation

Anaphylaxis-Symptoms

- Flushed/red skin
- Hives
- Intense itching
- Angioedema
- Noisy breathing (stridor, wheezing)
- Tachycardia
- Hypotension
- Anxiety
- N/V

Anaphylaxis- Interventions

- Maintain open airway
- Keep calm
- Oxygen
- IV access for fluid bolus if suspect severe rx
- Bronchospasm- albuterol
- Racemic epi
- Antihistamines*
- Corticosteroids*

- Auto-injector epi
- Epinephrine (1:1000)
  - 0.01 mg/kg (0.01 mL/kg)
    IM- lateral thigh

15 mos old with difficulty breathing

CC: My child is having a hard time breathing and has a fever

15 mos old with 2 days of cough, congestion and tactile fever.

Decreased drinking and post-tussive emesis

8 yo sibling with cold;

Triage vital signs:

HR 173 RR: 54 Pulse Ox: 91% Temp: 38.8

15 month with difficulty breathing

PMHx: None.

Allergies: Amoxicillin

Family Hx: MOC: thyroid issues FOC: ulcerative colitis

Immunizations: UTD

What else do you need to ask?

15 month with difficulty breathing

Physical Exam:

HR 173 RR: 54 Pulse Ox: 91% Temp: 38.8

Gen: Tired appearing in MOC's arms. cough

HEENT: + nasal discharge; TM: erythematous bilat

Lungs: + retractions; coarse BS with intermittent crackles and wheezing.

Heart: S1S2 no mur. Tachycardiac

Abd: soft, NT/ND. No HSM

Ex: Cap refill 2-3 sec.

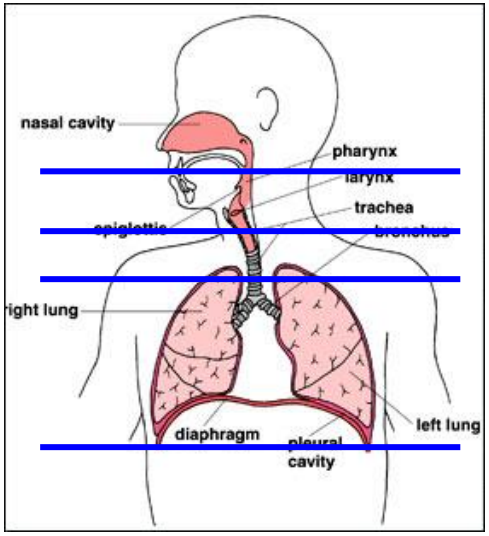
Thoughts?

Differential?

What to you want to do?

Define the Problem

Which part of the respiratory tree is involved?



Bronchiolitis

- Acute viral infection- most commonly RSV
- Age ≤ 2 years of age
- Infant's sx are worsen for the first 3-5 days
- Infectious process → **destruction in lining of bronchioles**
  - Bronchoconstriction
  - Mucous plugging
- Most common in winter and early spring
- Apnea= most concerning complication in infants

Bronchiolitis

Signs/Symptoms

runny nose, coughing, sneezing, tachypnea, retractions, wheezing/crackles, volume depletion due to decreased oral intake, apnea, fever

Bronchiolitis-Interventions

- Contact isolation- mask up
- Supportive care!!
  - SUCTION, SUCTION, SUCTION
  - Oxygen-heated high flow
  - Treat fever
  - ORT with Pedialyte
  - Positive pressure
  - SUCTION again

Bronchiolitis

What is the problem?

Viral infection makes the bronchioles swell and become inflamed. Mucus collects in these airways, which can make it difficult for air to flow freely into and out from the lungs.

How do we make diagnosis?

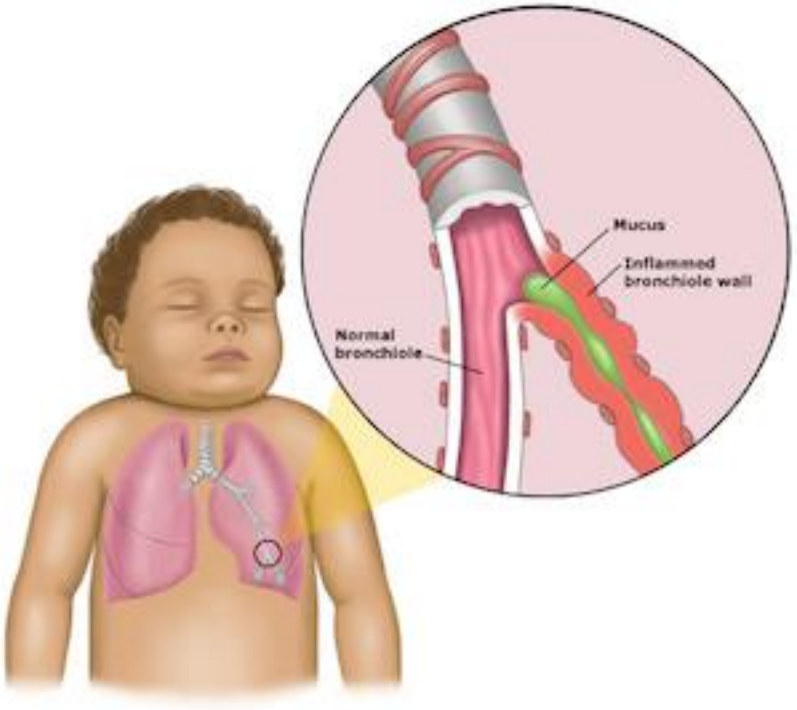
Clinical diagnosis—NO TEST NEEDED

CXR-

- Unlikely to be helpful
- Charge: ~$450

Viral DFA

- Who cares which virus?
- We never use to care



Bronchiolitis

What do we do?

Suctioning—helps clear secretions in upper airway but not lower airway, but has proven beneficial

Supplemental O2 when hypoxic

Things thought to possibly help, but evidence lacking:

- Steroids—Decrease airway swelling??—no proven benefit
- Hypertonic saline nebs: thin secretions/mucus plugging—Studies yet to show significant benefit
- Albuterol—rarely helps more likely hurts

Bronchiolitis

Interventions

American Academy of Pediatrics on Bronchiolitis:2014 Clinical Practice Guideline Stated:

"Clinicians should not administer albuterol or racemic epinephrine to infants and children with a diagnosis of bronchiolitis. Evidence Quality: B Strong Recommendation"

Albuterol in bronchiolitis

1. How does albuterol work?

2. Where does it have its effect?

Remember the Basics!!

Albuterol ain’t the answer!

15 month with difficulty breathing

Pt suctioned with nasal saline flush for large amount of thick secretions.

Pt able to drink 8 ounces.

Motrin given

30 min later:

HR: 145 RR: 55 Pulse Ox: 84% Temp: 37.5

Now what?

15 month with difficulty breathing

Pt placed on O2 via low flow nasal cannula, but pulls it out immediately

How do we delivery needed O2?

- Blow by?
- Facemask?
- Keep trying nasal cannula?

Why Not Blow-by?

A manikin of a child with a facemask of appropriate size was transported along a 60 m corridor from OR to the PACU. O2 delivery to the face of the manikin was measured during transport.

Six blow-by methods were tested with oxygen flows of 3, 6, and 10 L/min and with the facemask at 0 cm from the face and at 5 cm from the face.

The outcome parameter was: blow-by method reaching and maintaining an FiO2 >50% during transport from OR to the PACU.

Why Not Blow-by?

At 0 cm from the face, blow-by methods maintained a FiO2 >50%

At 5 cm only at 10 L/min flow blow-by methods were able to maintain an FiO2~50%

At distance greater than 5cm from face or at flow rates less than 10 L/min, FiO2 decreased to ~21%.

The decrease in FiO2 typically started within 6-12 meters from the start of the transport

15 month with difficulty breathing

Nasal cannula put back on with Tender Grips

Have parent hold child wrapped in blanket.

Distraction:

- Provide toys/movie

30 minutes later:

- HR: 145 RR: 52 (with retractions and head bobbing)
- Pox: 92% on 2Liters

Now what?

15 month with difficulty breathing

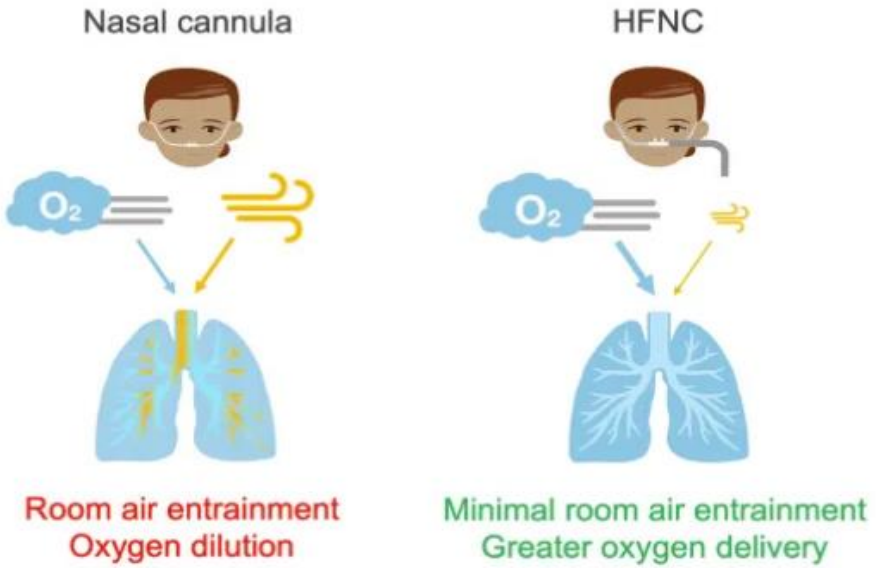
Pt suctioned and O2 turned up to 4 liters w/out improvement.

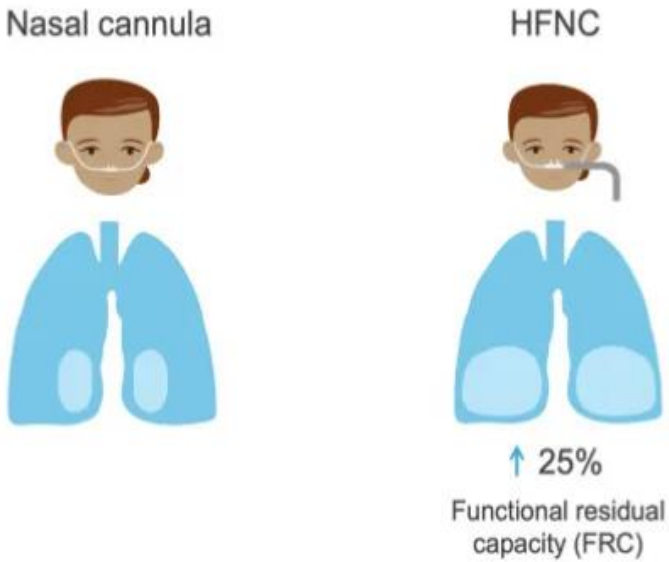
Decision made to increase respiratory support by starting patient on HHFNC/Vapotherm

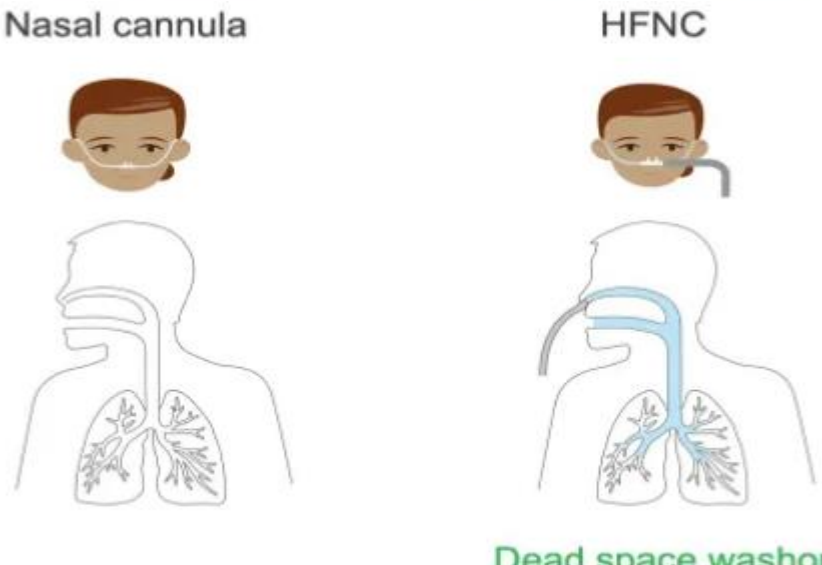
How does Vapotherm (HHF) work

There are three main proposed benefits of HFNC:

1. Precise oxygen delivery
2. Functional residual capacity enhancement
3. Dead space washout







Oxygen flow settings for high-flow nasal cannula use in infants and children

Patient weight (kg)	Starting flow (L/minute)	Maximum flow (L/minute)
<5	6	8
5 to 10	8	15
10 to 20	15 to 20	20
20 to 40	25 to 30	40
>40	25 to 30	40 to 60

HFNC: high-flow nasal cannula.

UpToDate®

15 month old difficulty breathing

30 minutes later:

HR: 150 RR: 55 (continues with retractions and head bobbing)

Pox: 92% on HHFNC/Vapotherm

Now what?

15 month old with difficulty breathing

Decision made to increase respiratory support and place patient on BiPAP

Scuba mask

IVF (Pt needs to be NPO)

Sedation:

Dexmedetomidine (Precedex)

Admitted to PICU

BiPAP

Per CHCO RT recommendations:

Start at pressures you would start an adult

IPAP: inspiratory pressure

EPAP: expiratory pressure

NO PRESSURE SETTINGS

PEEP: start at 5 – in infants start at 6

IPAP: inspiratory pressure

EPAP: expiratory pressure

Questions?

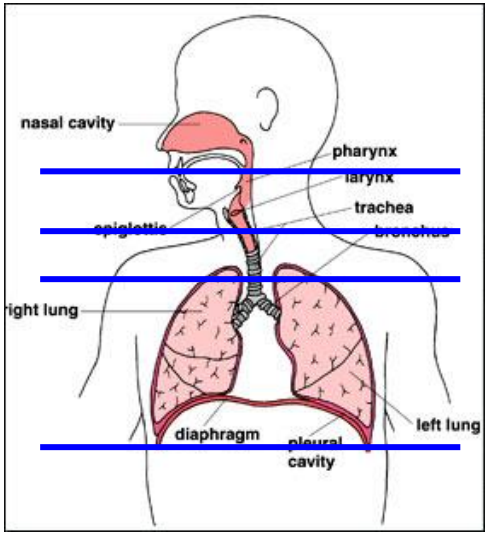
Lower Airway- Asthma

- Most common chronic illness in children
- Affects 9.3% of children in US
- CHRONIC inflammatory disorder of the airways
- Characterized by:
  - Hyperreactiveness of airway
  - Widespread inflammatory changes
  - Bronchospasm
  - Mucous plugging
- Dx is delayed until child has repeated episodes and is

>2 years old

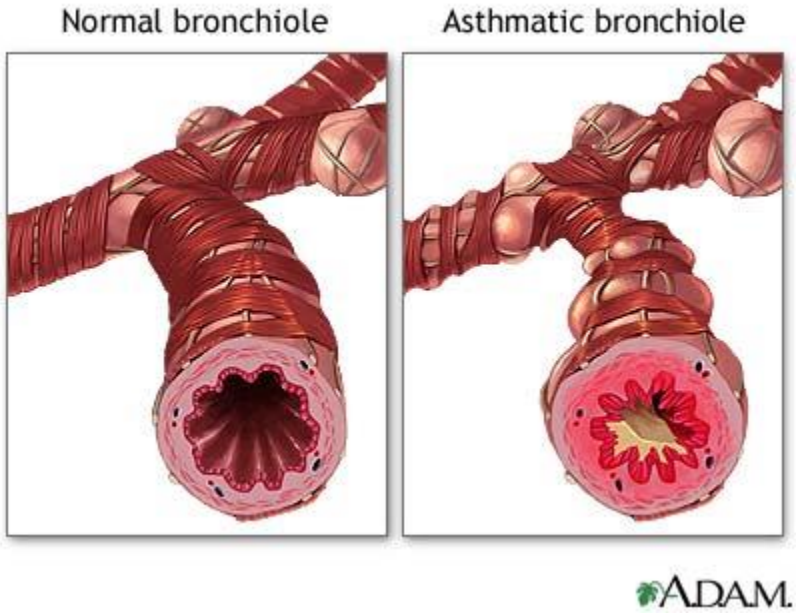
Define the Problem

Which part of the respiratory tree is involved?



Asthma-Symptoms

- Wheezing
- Prolonged expiratory phase
- Decreased or unequal breath sounds
- Tachypnea
- Retractions
- Coughing
- Nasal flaring



Asthma: Interventions

- Oxygen
- Monitor pox and HR
- Medications
  - Albuterol
    - <20 kg: 2.5 mg
    - >20 kg: 5 mg
  - Atrovent
    - 0.5 mg bullet
  - Steroids- Dexamethasone

In Summary…

- Be good at the basics- basic treatments can save lives!
- Keep Calm; take a big breath!
- Distinguish Upper vs Lower
- Remember your options for interventions
  - Suction
  - Oxygen
- Aggressively treat respiratory distress and intervene
- Decide where your treatment needs to occur

Thank You! Final Questions?


YOU!
KEEP BEING
AWESOME!