# Pediatric Medication Overview- Case Review

Teddy Bear Transport Outreach Education

TEDDY BEAR TRANSPORT

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# Objectives

1. Discuss the importance of thorough pediatric respiratory assessments and treatment
2. Identify what makes children more susceptible to respiratory complications
3. Discuss treatment options for pediatric respiratory patients
4. Discuss rapid sequence intubation procedure
5. Review medications used for pediatric intubations and ongoing sedation

# Statistics

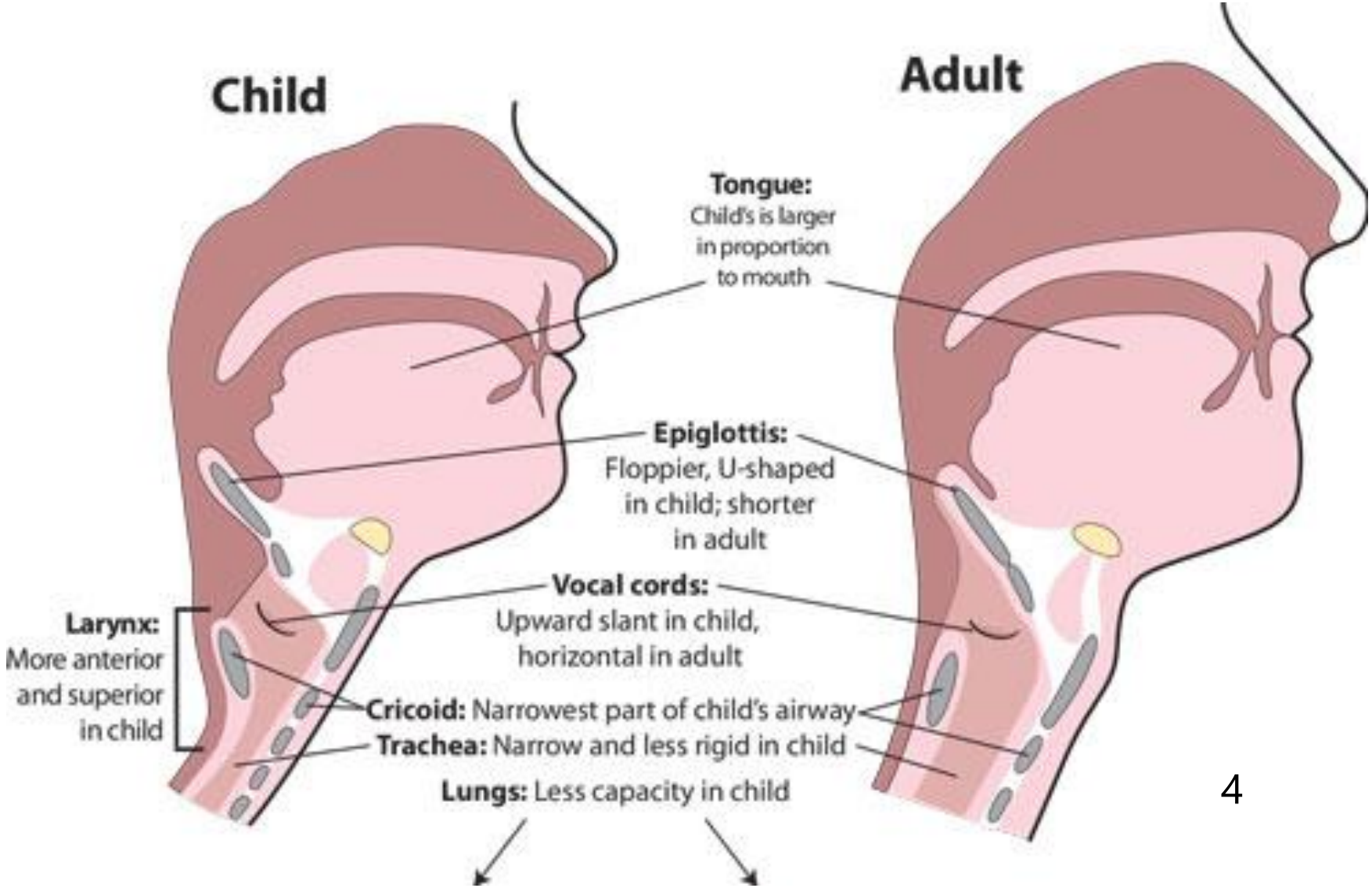
**Respiratory arrest is the most common cause of cardiac arrest in children**

**Survival to discharge for pediatric non-traumatic cardiac arrest patients is less than 10%, with the many of those patients having a degree of neurological dysfunction**

**…this makes recognizing and treating respiratory complications in pediatric patients absolutely essential!**

# The Pediatric Respiratory System

# Pediatric Respiratory System

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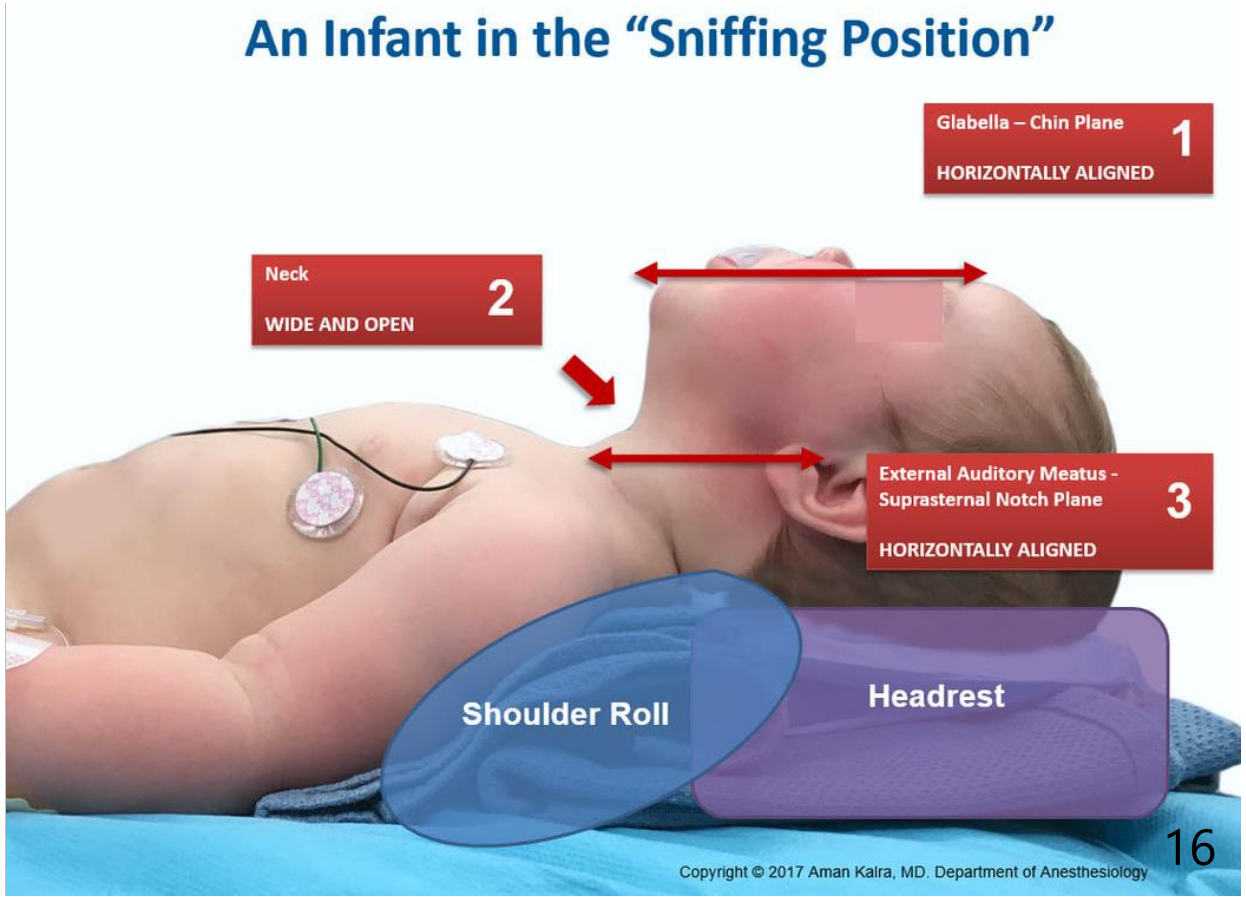
# Pediatric Respiratory System

**Infants and younger children have considerably large heads for their body size as well, making positioning for optimal breathing key!**



# Assessment

# Assessment

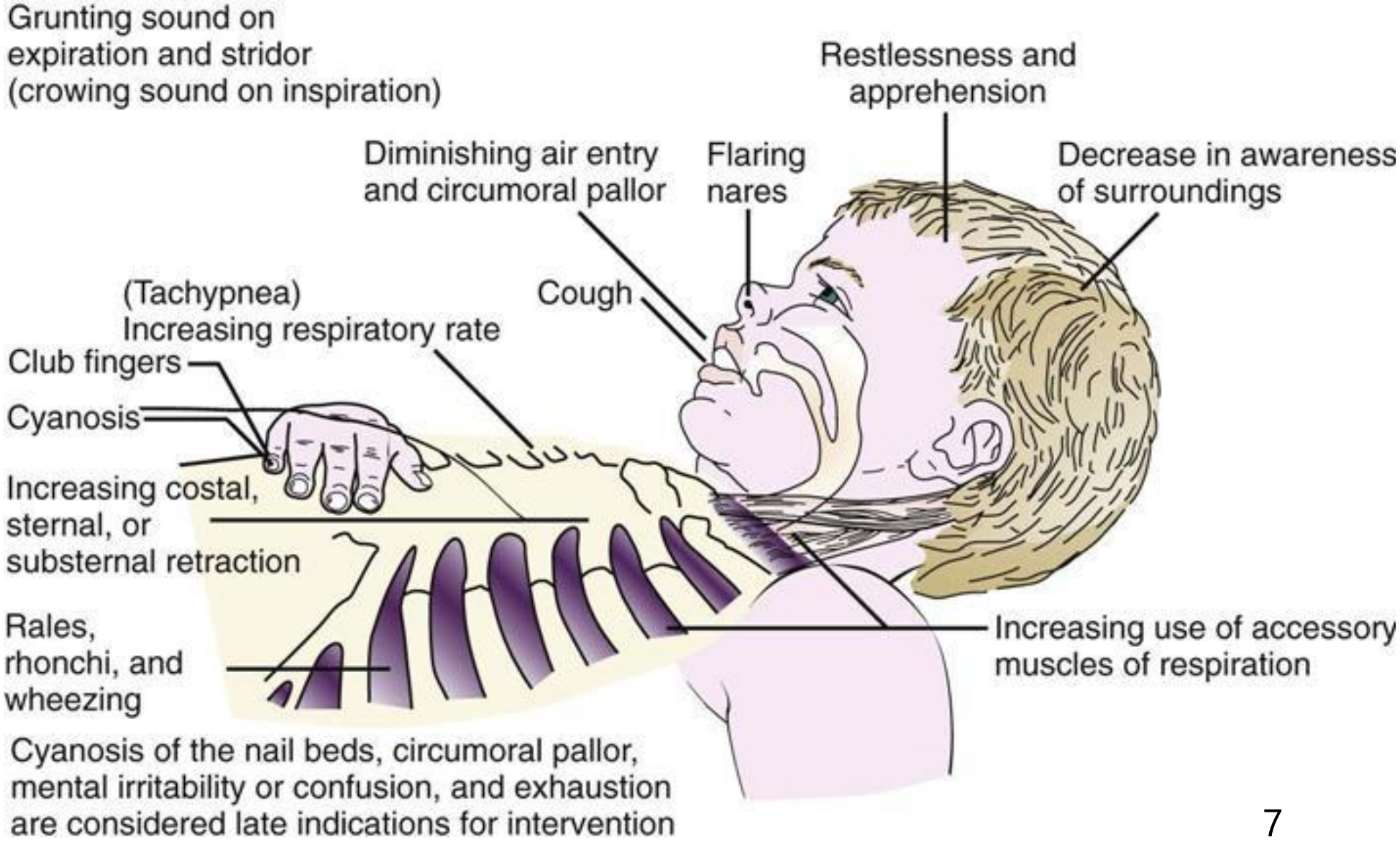
## Infants and children have:

- Higher metabolic rates
- Increased oxygen demand
- Fewer alveoli
- Weaker chest walls
- Lower residual capacity

## Which changes what “normal” looks like.

- The younger the child, the higher the respiratory rate (40-60 is normal for an infant)
- Thinner chest walls means louder breath sounds
- Smaller airways mean obstructions and restricted air flow happen more often
- Children “tire out” faster than adults

# Pediatric Respiratory Distress



# Pediatric Respiratory Definitions

## Respiratory Distress

- Occurs on a spectrum of severity: mild to moderate to severe
- Considered more severe with presence of cyanosis, inability to speak in sentences, increasing retractions and work of breathing

## Respiratory Failure

- Gas exchange is not effective enough to meet the body's demands
- Hypoxemia: not enough O2
- Hypercapnia: too much CO2
- Characterized by agonal breathing, worsening blood gases, irregular breathing, decreasing LOC, hemodynamic changes

# Types of Respiratory Illnesses

# What exactly are we talking about?

## Upper Airway Illnesses

- Croup
- Epiglottitis
- Foreign Body Obstruction

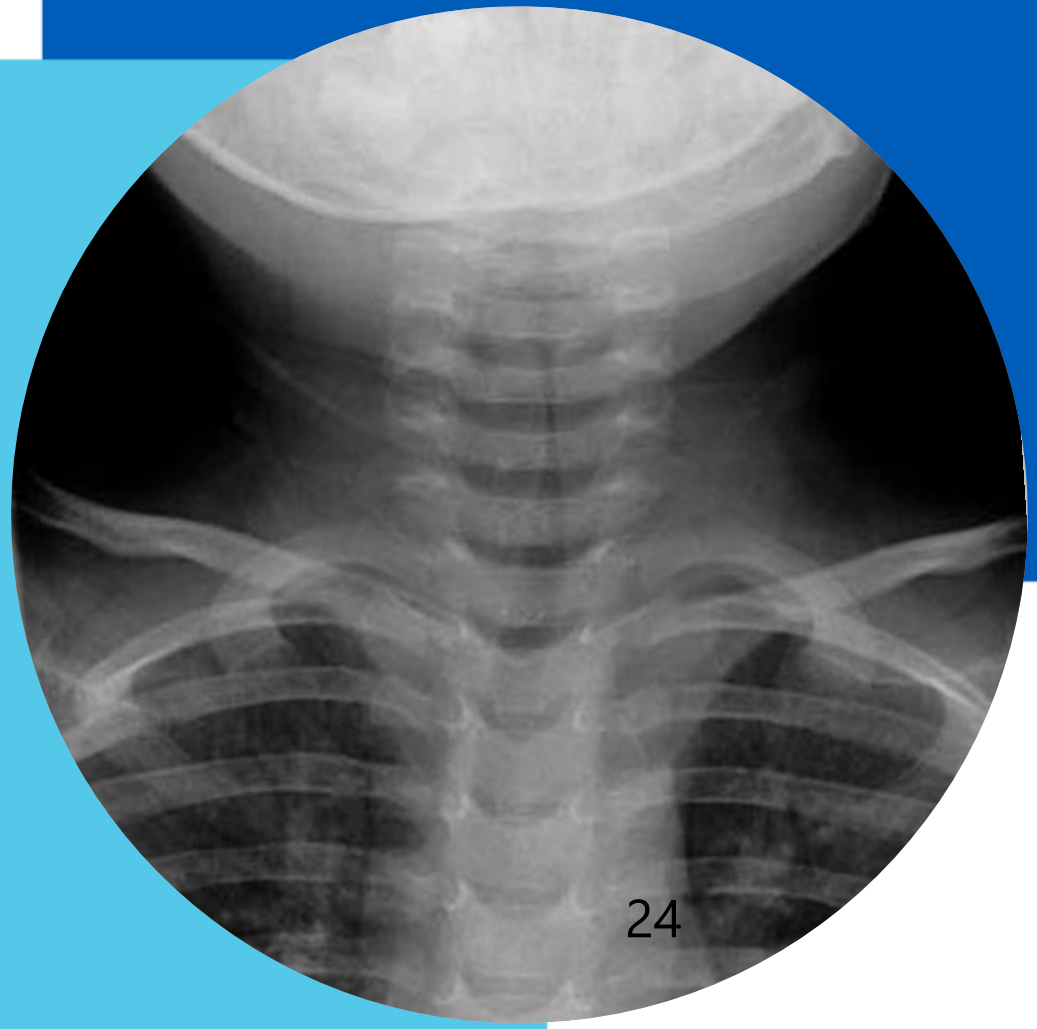
## Lower Airway Illnesses

- Asthma
- Reactive Airway Disease
- Bronchiolitis
- Pneumonia

## Viruses

- RSV
- Coronavirus
- Flu
- Rhinovirus

# Croup

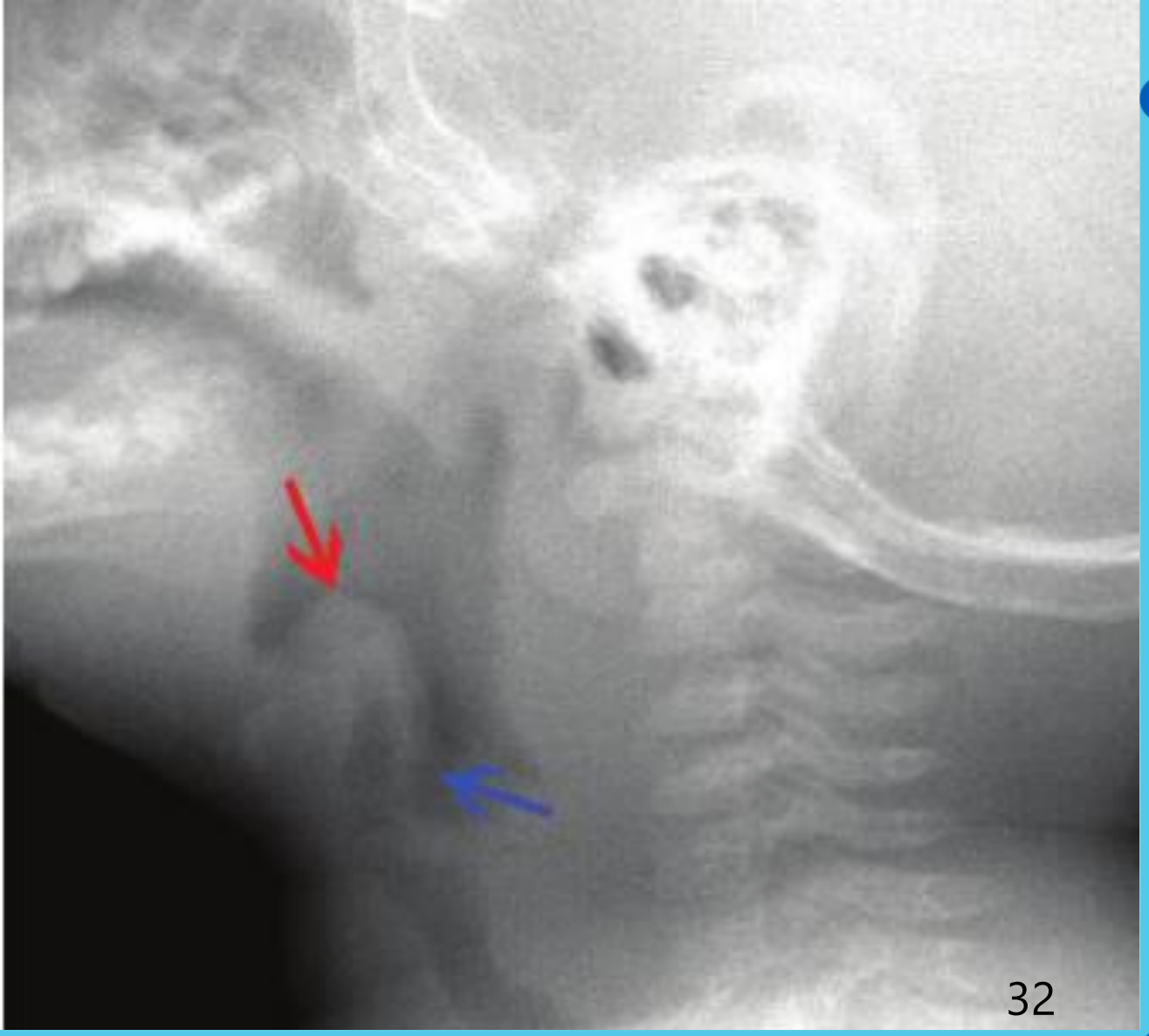



**Airway inflammation often caused by a parainfluenza virus**

**Most commonly seen in the 6 month–5 year age group due to smaller airways**

**Key findings: inspiratory stridor, barking cough, worsening symptoms at night, Steeple sign on CXR**

**Treatment: racemic epinephrine, corticosteroids, warmed and humidified medical air/oxygen**




# Epiglottitis

**Inflammation of the epiglottis due to infection, typically *Haemophilus influenzae* type B (HIB)**

**This is a medical emergency!!**

**Key findings: high fever, salivation, throat pain, difficulty breathing with rapid progression of symptoms, thumb outline on CXR**

**Treatment: ensure a patent and effective airway, antibiotics, corticosteroids**

# Foreign Body Aspiration

**..Okay, not really an illness, but we see these quite a bit!**

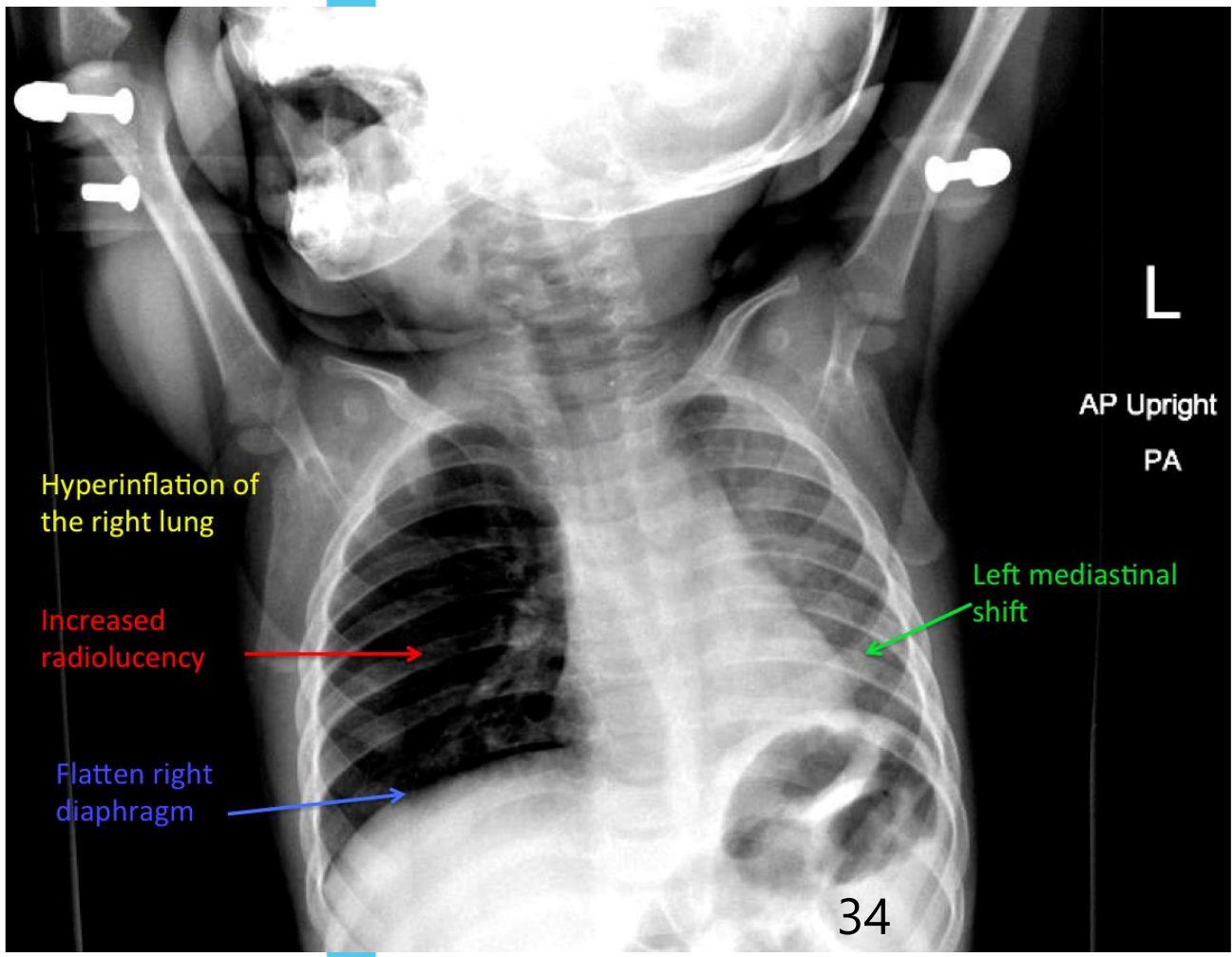
**98% of cases are patients less than five years old**

**96% of foreign bodies aspirated were found in the proximal airway**

**35% of CXRs were normal despite present foreign body; most common abnormal finding on films is air trapping**

**Key findings: sudden onset of cough, choking, dyspnea, wheezing, decreased and/or asymmetrical breath sounds**

**Treatment: supportive care until bronchoscopy for removal**

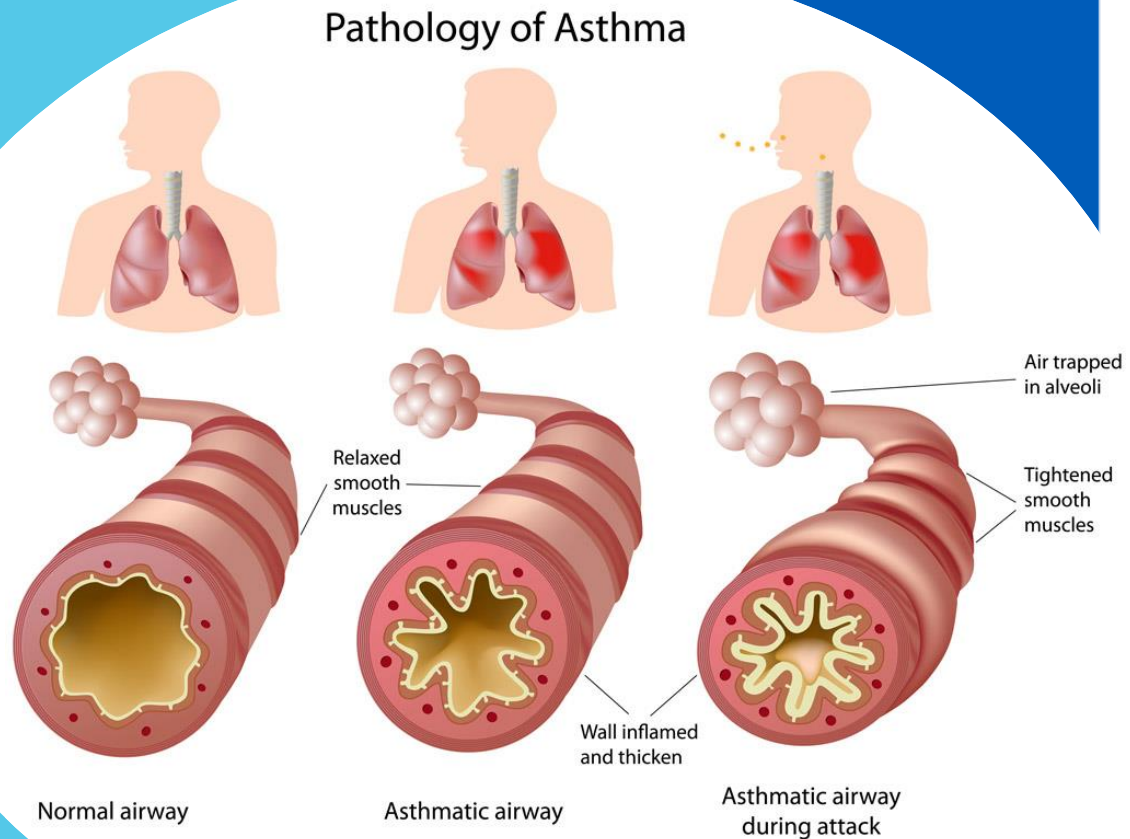


# Asthma

**Asthma is an inflammatory response of the airways and bronchial tubes in response to a trigger**

**Bronchial spasms and bronchial narrowing from inflammation results in more swelling, mucus production, and constriction, creating a vicious cycle**

**Key findings: wheezing, dry cough, increasing respiratory distress, complaints of “tight chest”, and air-trapping on CXR**

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# Asthma

## How we treat asthma ranges based on severity of illness:

- High Flow Oxygen
- Nebulized Albuterol and Ipratropium Bromide
- IV Solumedrol or PO dexamethasone
- Magnesium Sulfate
- Subcutaneous Terbutaline/Epinephrine
- BiPAP or Intubation*

*Intubation may cause bronchospasm as well as hemodynamic changes related to decreased cardiac output.

# Asthma: Clinical Respiratory Score

| Assess | Score 0 | Score 1 | Score 2 |
|---|---|---|---|
| **Respiratory Rate** | <2 months <50<br>2-12 months <40<br>1-5 years <30<br>>5 years <20 | <2 months 50-60<br>2-12 months 40-50<br>1-5 years 30-40<br>>5 years 20-30 | <2 months >60<br>2-12 months >50<br>1-5 years >40<br>>5 years >30 |
| **Auscultation** | Good air movement, expiratory scattered wheezing or loose rales/crackles | Depressed air movement, inspiratory and expiratory wheezes or rales/crackles | Diminished or absent breath sounds, severe wheezing, or rales/ crackles or marked prolonged expiration |
| **Use of Accessory Muscles** | Mild to no use of accessory muscles, mild to no retractions **OR** nasal flaring on inspiration | Moderate intercostals retractions, mild to moderate use of accessory muscles, nasal flaring | Severe intercostals and substernal retractions, nasal flaring |
| **Mental Status** | Normal to mildly irritable | Irritable, agitated, restless | Lethargic |
| **Room Air SpO2** | > 95% | 90-95% | <90% |
| **Color** | Normal | Pale to normal | Cyanotic, dusky |

# Asthma: Medications

Dosing Reference

**Dexamethasone:** PO 0.6mg/kg (max 16mg)

**Methylprednisolone:** IV 2mg/kg (max 80mg)

**Albuterol:** Continous 20mg/hr

MDI w/ spacer: 8-20kg = 4 puffs

>20kg = 8 puffs

**Magnesium Sulfate:** IV 50mg/kg (max 2grams) over 20 mins

**Terbutaline:** SubQ: Children 0.01mg/kg/dose every 20 mins x 3doses

Adol 0.25mg/dose every 20 mins x 3 doses

**Aminophylline:** IV Load dose 5.7mg/kg

# Bronchiolitis

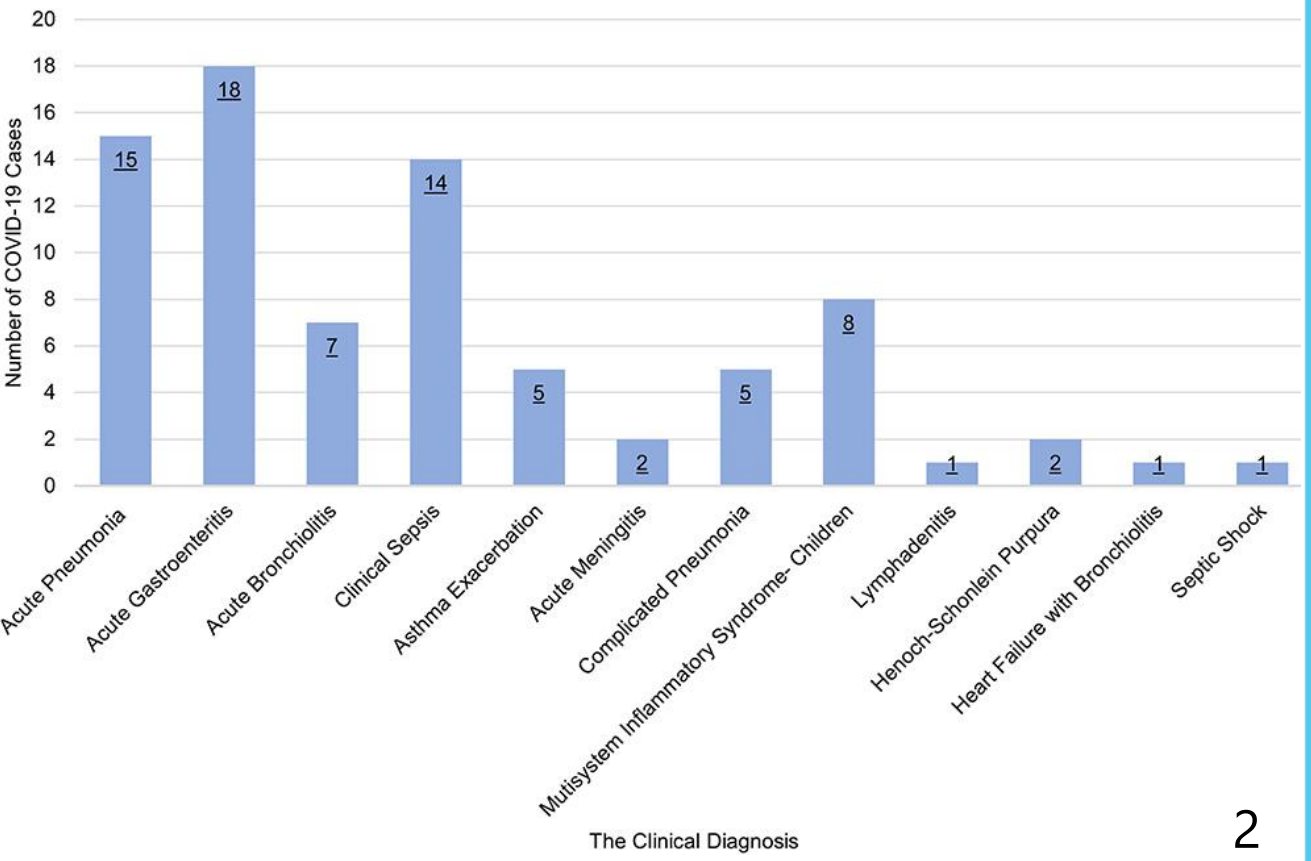
**Swelling of small airways in the lungs seen commonly in children <2 with RSV as the most frequent cause**

**Key Findings: secretions!!**

**Treatment: suctioning, hydration, supplemental oxygen if needed**

**Treatments that are NOT recommended: CXR, antibiotics, nebulized hypertonic saline, albuterol, racemic epi, blood cultures**

**Only 3 blood cultures drawn from all patients with this diagnosis at Cook from 2018-2022 were positive.**

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# Coronavirus

**Similar symptoms in children and adults- those most affected have other risk factors**

**Significantly less hospitalizations and mortality when compared to adults**

**MISC several weeks after initial infection can lead to severe organ dysfunction**

**Treatment: dexamethasone, Remdesivir for severe cases**

# Pneumonia

**2.8 million ambulatory visits and 124,000 hospitalizations in US children annually**

**Typically viral in nature in preschool aged children**

**Key findings: fever, respiratory distress**

**Treatment: RVP (if this is positive, they likely don't need antibiotics), procalcitonin to determine if source is bacterial, amoxicillin if mild case, ceftriaxone and clindamycin or vancomycin if severe**

# Flu

**Children often have higher fevers and more digestive symptoms than adults from the same virus**

**Key Findings: symptoms last 5-7 days, muscle aches, fever, cough, runny nose, fatigue**

**Treatment: rest and fluids**

**Treatments that are NOT recommended: antibiotics**

# Rhinovirus

**Responsible for over 50% of respiratory tract infections worldwide; typically the cause of the “common cold”**

**Circulation typically occurs year round**

**Key findings: runny nose, cough, mild fever**

**Treatment: supportive care**

**Symptoms can arise in as little as 10 hours from exposure and can last three weeks.**

# Respiratory Failure

**Acute respiratory failure is a leading cause for admission to a pediatric intensive care unit**

**Most respiratory failure can be grouped under the umbrella of lung parenchymal disease, airway obstruction, or neuromuscular dysfunction**

**Many patients are managed successfully with noninvasive respiratory support but in severe cases intubation and mechanical ventilation are needed**

# Continuum of respiratory support

# We have lots of options for respiratory support!

**Nasopharyngeal airway**
**Oropharyngeal airway**
**Face Mask**
**Non-rebreather Mask**
**Nasal Cannula**
**High flow Nasal Cannula**
**CPAP**
**BiPAP**
**Intubation**
**LMA**

**..to name a few..**

# So how do we know which one to use?

## We start asking questions..

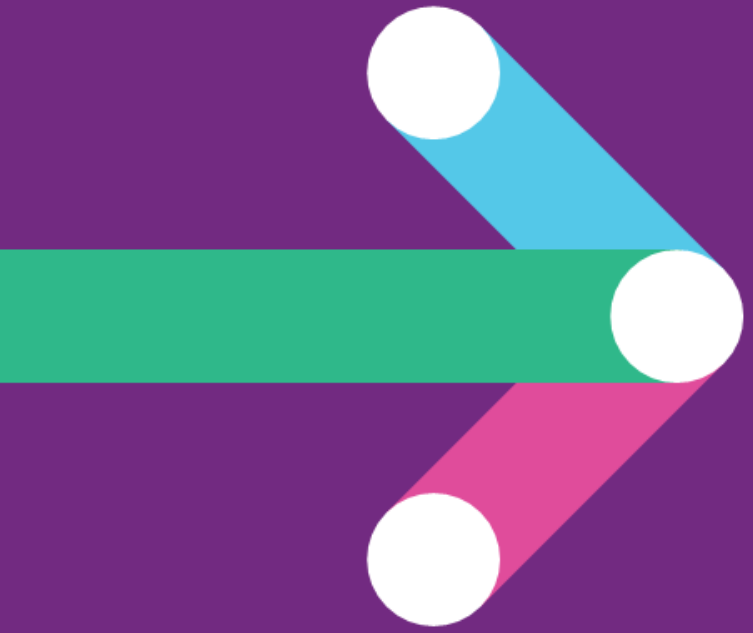
**Is the airway open?**

**Can the patient protect their airway?**

**Is oxygenation adequate?**

**Is ventilation adequate?**

**Intrinsic respiratory drive of patient?**



# Intubation

## “By failing to prepare, you are preparing to fail.”

**– Benjamin Franklin**

- Prepare the patient and family
- Prepare the equipment
- Prepare the team
- Prepare the room/space

# General Intubation Size Guidelines

Utilize the Broselow tape!

## PEDIATRIC INTUBATION PEARLS

- RED TO HEAD
- Cuffed ETT = (Age/4) + 3.5 **or (age+16) / 4**
- Uncuffed ETT= (Age/4) + 4
- Oral Airway/Nasopharyngeal Airway
  - Oral airway sizing: Measure from angle of mouth to angle of mandible.
    - Do not use in awake patients!
  - NPA sizing: Measure from tip of nose to ear lobe.
- Intubate to a depth of 3x ETT size [1]

# What extra steps should I think of when intubating a child?

## Consider:

- your medications; both drugs and dose
- using a stylet
- using a Miller blade
- the size of your patient; take a breath, be gentle
- consider the stomach to be full unless hx. confirms NPO status

# Drug List for Intubation

| | MEDICATION | CONCENTRATION | STANDARD DOSE | DOSE RANGE | MAXIMUM DOSE | CONSIDERATIONS |
|---|---|---|---|---|---|---|
| **PAIN CONTROL** | Fentanyl | 50 mcg/mL | 2 mcg/kg IV | 1-3 mcg/kg | 100 mcg | Slow push to avoid chest wall rigidity. Caution in shock and hypotensive patients. |
| **PRE-MEDICATION** | Atropine | 0.1 mg/mL | 0.01 mcg/kg IV | 0.01-0.02 mcg/kg | Child: 0.5 mg<br>Adolescent: 1 mg | May use in non-emergent intubation to prevent vagal bradycardia. Rapid push. Do not give if HR >180. |
| | Lidocaine | 20 mg/mL | 1 mg/kg IV | 1 mg/kg | 100 mg | For ↑ ICP, consider to suppress cough reflex. Slow push, Max: 50 mg/min. Monitor for bradycardia and hypotension. |
| **INDUCTION/ SEDATION** | Ketamine | 100 mg/mL | 1 mg/kg IV<br>(Dilute to 50 mg/mL with NS.) | 1-2 mg/kg | 100 mg | Consider for use in asthmatics d/t bronchodilatory properties, as well as in septic and shock patients as it maximizes sympathetic response, preserves airway reflexes, and maintains hemodynamics. Contraindications: Age < 3 months, uncontrolled hypertension, known hydrocephalus. Onset: 30 seconds |
| | Midazolam (Versed) | 5 mg/mL | 0.1 mg/kg IV | 0.1-0.3 mg/kg | 5 mg | Monitor for hypotension, respiratory depression. Avoid use in neonates. |
| | Etomidate | 2 mg/mL | 0.3 mg/kg IV | 0.2-0.6 mg/kg | 20 mg | Ultrashort-acting, non-barbiturate anesthetic without analgesic activity. May cause adrenal suppression, avoid use in septic shock and renal insufficiency. Onset: 10-15 seconds. |
| | Precedex<br>(Dexmedetomidine) | 4 mcg/mL | Initial Dose:<br>0.2-0.5 mcg/kg/hr | Titrate by:<br>0.1-0.3 mcg/kg/hr | 1.5 mcg/kg/hr | For maintenance sedation of intubated patients during transport. BP and HR should be considered before titration. Bradycardia tends to be dose-limiting factor. |
| **PARALYTIC AGENTS** | Rocuronium | 10 mg/mL | 1 mg/kg IV | 0.6-1.2 mg/kg | 50 mg | Paralytic of choice for RSI.<br>Onset: 60-90 sec, Duration: 20-75 min |
| | Vecuronium | 1 mg/mL<br>(After dilution of 10 mg vial with 10 mL NS/SW.) | 0.1 mg/kg IV | 0.1-0.2 mg/kg | 10 mg | Not preferred for RSI d/t delayed onset. Consider after initial paralysis with Rocuronium for prolonged transports.<br>Onset: 3 min, Duration 30 min |

# Rapid Sequence Intubation

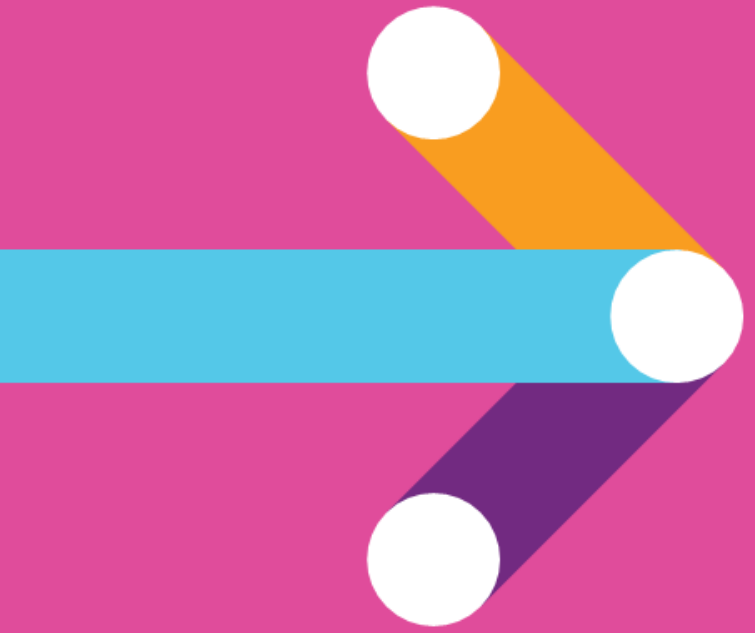
- Assess airway for any abnormalities or special circumstances
- Pre-oxygenate patient
- Establish IV access and select medications (sedatives, paralytics, etc.) taking any special considerations into play (i.e. TBI, hypotensive, sepsis, asthma)
- Intubation attempt should not exceed 30 seconds
- Monitor HR, SpO2, B/P continuously
- Confirm ETT placement with CO2 detector, auscultation, x-ray

# Assisting w/ Intubation

- Notify staff of plan to intubate
- Airway cart/supplies at bedside
- Correct size blade, ETT, and ETCO2 cap
- O2 on wall turned on and ambu bag connected
- Suction turned on to 100-120mmHg
- Intubation medications drawn up and labeled
- Atropine available, fluids for bolus available
- Clear HOB or prepare to turn child
- Positioning device at HOB
- Have benzoin and tape or tube securement device ready to go
- Be prepared to provide cricoid pressure or suction with catheter

# Following Intubation

Immediate primary check of ETT?
Secure ETT, (note the level)
Secondary confirmation of ETT?
Chest x-ray
Anticipate ABG w/in 30 min
Adjust ventilator settings



# Continuous Sedation for Ventilated Patients

# Precedex

- Maintenance of sedation of intubated patients
- Monitor HR, BP closely
- Bradycardia may be dose-limiting factor
- Initial dose: 0.2-0.5 mcg/kg/hr.
- Titrate by 0.1-0.3 mcg/kg/hr.
- Max dose: 1.5 mcg/kg/hr.
- Standard concentration= 4 mcg/ml Premix bag
- Short-term use, typically less than 24 hours

# Fentanyl

- Consider drip for maintenance of intubated patient
- Use with caution in shock and hypotensive patients
- Dose range: 0.5-5 mcg/kg/hr. Usual dose for peds is 1-3 mcg/kg/hr.
- Max dose 5 mcg/kg/hr.
- Standard concentration 1 kg-40 kg is 10 mcg/ml; greater than 40 kg conc. is 50 mcg/ml

# Midazolam

- May use in combination with Fentanyl for sedation
- Monitor for hypotension, respiratory depression
- Caution using in patients less than 3 years old
- Dose range: 0.02-0.2 mg/kg/hr.
- Standard concentration 1kg-5kg is 0.5 mg/ml; for 5kg- over 40 kg conc. is 1mg/ml

# Ketamine

- Consider using for asthmatics d/t bronchodilatory effects
- Consider using in sepsis and shock; maximizes sympathetic response, preserves airway reflexes, and maintains hemodynamics
- Avoid using under 3 months of age
- Avoid using on hypertensive patients or with known hydrocephalus
- Dose range: 0.2-2 mg/kg/hr.
- Standard concentration for drip is: 2 mg/ml

# Propofol

- Used for induction or maintenance of anesthesia; does not have analgesic effects
- Used for continuous sedation or procedural sedation
- Onset is 30 secs. after bolus infusion
- Side effects: Hypotension, bradycardia, myocardial depression, flushing, fever, headache, n/v, abdominal cramping, respiratory depression, apnea
- Dose: Initial dose 5-15 mcg/kg/min and increase q5-10 min
- Maintenance dose 5-50 mcg/kg/min
- Protect from light
- Discard unused portion and tubing after 12 hours
- Do not administer with any blood products in same line

# Safety Steps with Continuous Infusions

Safety steps for all medication infusions, as the person setting up the infusion should always trace the IV tubing from the source, through the pump, and to the patient. Some general safety tips while administering infusions are to:

1. Establish an expectation that all infusions, regardless of their risk level, be administered using a smart infusion pump (exception: fluid resuscitation)
2. Employ Dose Error-Reduction System (DERS) when administering all infusions
3. Label lines at the points of connection (above the pump and above the access point to the patient)
4. Trace infusion lines
5. Confirm before opening the roller clamp
6. Manage distractions and time constraints (encourage staff to speak up if they feel it is an unsafe environment)

# Case Review

# Patient History

- 10 y.o. female brought in by parents for significant respiratory distress
- PMH includes asthma, diagnosed at age 5, NKDA, no family hx., IUTD
- Patient is compliant on asthma regimen and used rescue inhaler x3 already today
- Vital signs in triage: HR =126, RR =31, SPO2= 94% T=100.6
- Assessment:
- Neuro: alert & anxious, irritable
- Airway/Breathing: BS wheezes throughout, no upper airway noise, decreased in bases, working hard, moderate retractions throughout, no cyanosis
- Cardiac: Pulses easily palpable, CR brisk, diaphoretic, warm and pale pink
- GI: WNL
- GU: WNL
- Obtain a score using the pulmonary scoring tool on slide 19

# Interventions

Pulmonary Score= 7-8 (Moderate Exacerbation)

What are your top priorities for this patient?

# 4 Hours later

Patient has been on continuous nebs Albuterol 20 mg/hr

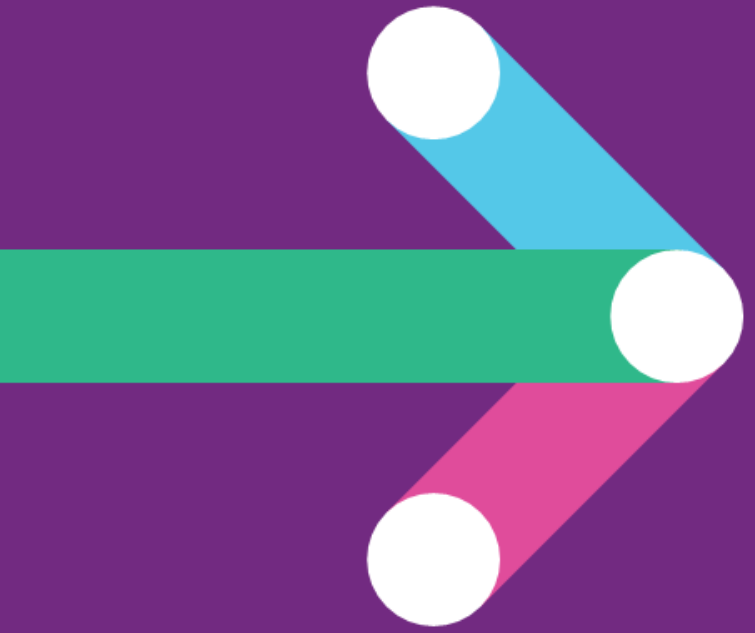
Received Solumedrol IV 3.5 hours ago

Received NS bolus of 20 mls/kg

Positive for Mycoplasm Pneumonia, all other labs negative

Vital Signs:  HR =137, RR =36, SPO2= 91% T=100.6

- Assessment:
- Neuro: Sleeping but not willing to lie down flat
- Airway/Breathing: BS wheezes throughout, no upper airway noise, decreased in bases, working hard, moderate-severe retractions throughout, no cyanosis
- Cardiac: Pulses easily palpable, CR 3-4 seconds, diaphoretic, warm and pale pink
- GI: WNL
- GU: WNL



# What is next?

# Interventions

- Consider BiPAP and sedation
- Prepare for intubation just in case ☺
- Administer Mag Sulfate 50 mg/kg over 20 min.
- Administer SQ Terbutaline 0.25 mg/dose every 20 mins. X 3 doses
- Aminophylline 5.7 mg/kg IV over 30 min.

# Preparing for intubation

Patient weight is 38 kg

ETT size=

OGT size=

Depth of tube=

Medications selected for intubation?

Other considerations?

# Summary

- Pediatric airway anatomy is considerably different from adults.
- Positioning is key!
- Identify signs of respiratory distress early and intervene
- Effective communication is critical before, during, and after the intubation procedure.
- Consider sedation drips according to patient diagnosis, medical hx., length of use, etc.

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# Thank You

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