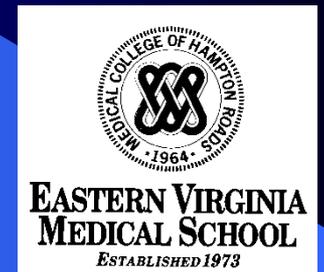


# Pediatric Respiratory Distress

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# Objectives

- Assessment
- Croup
- Bronchiolitis
- Asthma
- Foreign Bodies
- Pertussis

# Respiratory Distress

- Frequent reason for call to EMS/ED visit
- Due to higher metabolic demands, less reserve, anatomic and physiologic differences, children decompensate more quickly.

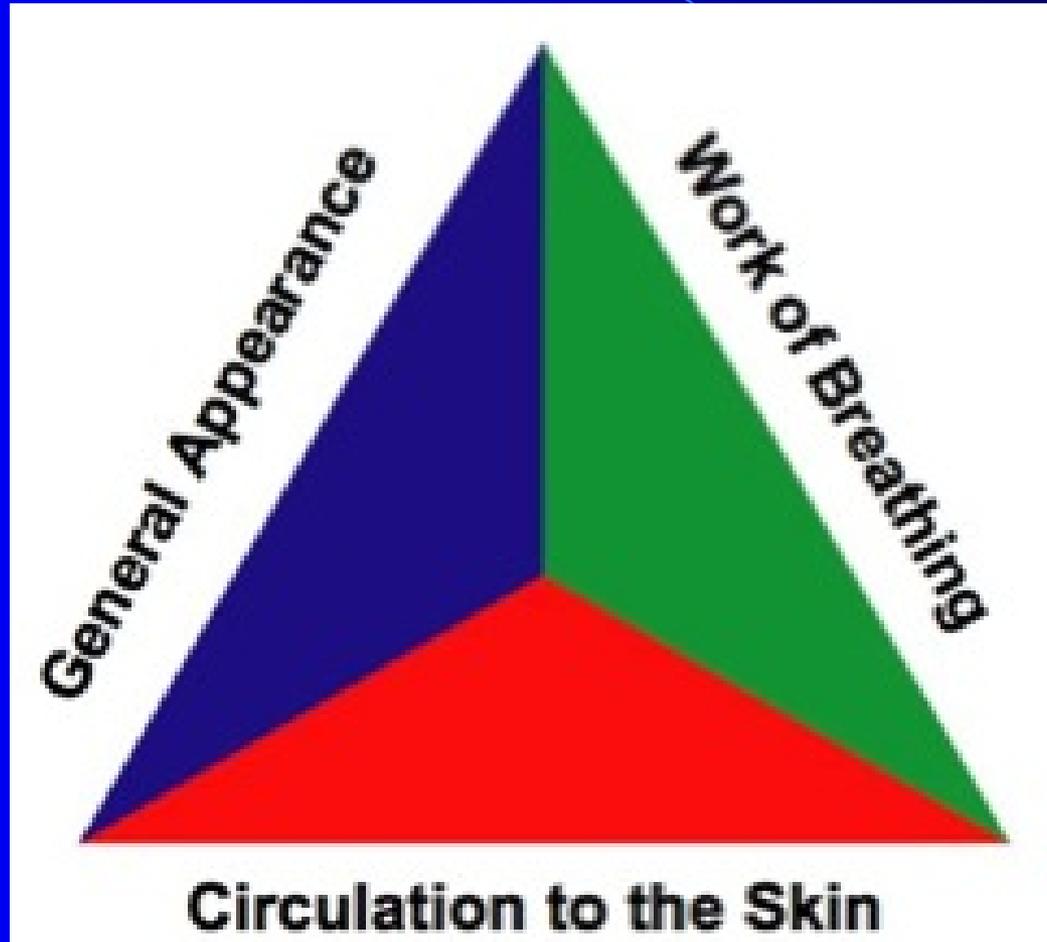
# How is Pediatric Airway Management Different?

- Anatomy/Physiology
- Etiology of airway problems
- Equipment
- Frequency with which many practitioners encounter true pediatric airway problems means less experience available

# Why be aggressive in Pediatric Airway Management?

- Children have limited ability to compensate for respiratory compromise.
- Early recognition of any dysfunction and anticipation of respiratory failure is essential.

# Pediatric Assessment Triangle



# Appearance

- **T**one
- **I**nteractiveness
- **C**onsolability
- **L**ook/Gaze
- **S**peech/Cry



# Work of Breathing

- Abnormal airway sounds
- Abnormal positioning
- Retractions
- Nasal flaring
- Head bobbing



# Normal Respiratory Rates

- Infant 30-60
- Toddler 24-40
- Preschool 20-30
- School-age 12-25
- Adolescent 12-16

# Circulation to Skin

- Pallor
- Mottling
- Cyanosis



# Assessment

- Now officially CAB per AHA guidelines!  
However, A is still extremely important in a peds patient. Do them simultaneously!
- A: Assess patency and ability to maintain the airway, intervene if necessary. Level of consciousness is very important to note.

# Assessment

- B: Breathing
  - Count respiratory rate, know normal ranges
  - Assess for increased work of breathing, retracting, flaring, grunting, head bobbing.
  - Listen to evaluate aeration and breath sounds
- C. Circulation
  - Assess color ( lips, mucous membranes, nail beds)
  - Central and peripheral pulses
  - Capillary refill and peripheral perfusion

# Physical Exam—Observation

- Respiratory rate
  - Periodic breathing in infants
  - Inaccurate while crying
- Respiratory pattern
  - Inspiratory to expiratory ratio
  - Normal is less than 1 to 1
- Retractions
  - Subcostal or “belly breathing”
  - Intercostal
  - Suprasternal

# Physical Exam—Auscultation

- Wheezing
- Stridor
- Crackles
- Rhonchi
- Snot

# Wheezing

- Whistling noise thru constricted bronchioles
- KEY: More time spent in expiration
- Noise typically is heard more in expiration
- Varying degrees of respiratory distress
- Frequently confused for transmitted upper airway noises
  
- Examples: Asthma, Bronchiolitis

# Stridor

- High-pitched noise
  - Usually heard in inspiration
  - Typically with suprasternal retractions
  - Often anxious appearing
- 
- Examples: Croup, Bacterial Tracheitis, Epiglottitis

# Crackles

- Sounds like velcro
- Difficult to hear in noisy environment
- Characterize as focal or diffuse
- Varying degrees of respiratory distress
  
- Examples: Pneumonia, Congestive Heart Failure

# Rhonchi

- Coarser than crackles
- Finer than transmitted upper airway noise
- If pathologic should not change with:
  - Coughing
  - Time
- Example: Pneumonia, Bronchiolitis

# Transmitted Upper Airway Noise

- Sources include:
  - Snot
  - Relaxed hypo pharyngeal tissues
- Changes with respiration
- May require prolonged listening to distinguish from other sounds
- Frequently mistaken for wheezing
- Examples: URI, neurologically impaired persons

# Tricks to Improving Your Exam

- Changing position of patient
- Distract the patient
- Have patient cough
- Have patient breathe through mouth
- Have patient blow nose
- Decrease ambient noise
- Listen for a little longer



Respiratory Distress



Respiratory Failure



Respiratory Arrest



Cardiac Arrest

# Respiratory Distress

- Child is alert or agitated, normal tone
- Pink or pallid skin color
- Increased work of breathing
- Chest rise is normal or shallow
- Tachypnea is present
- Breath sounds may include wheezing

# Respiratory Failure

- Child will appear ill
- Agitation or somnolence with hypotonia
- Greatly increased work of breathing
- Tachypnea (+/- periods of bradypnea)
- Skin is pallid, mottled or cyanotic

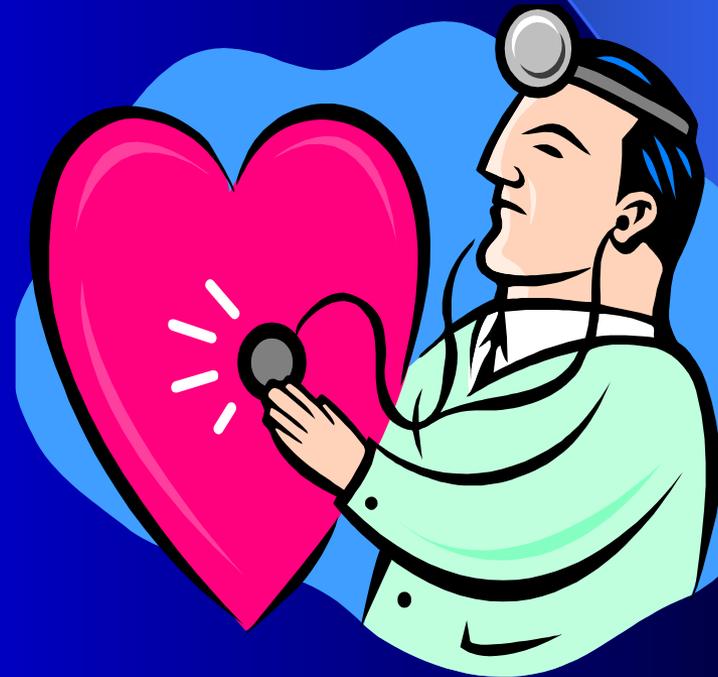
# Respiratory Failure

- Inability of the respiratory system to meet demands for oxygenation and CO<sub>2</sub> elimination or both.
- May occur with or without respiratory distress.
- Objectively defined by the ABG.

# Respiratory Arrest

- Unresponsive, no muscle tone
  - No visible chest rise
  - Absent work of breathing
  - Cyanosis
- 
- Cardiac arrest will follow quickly!!

# What Can We Do?

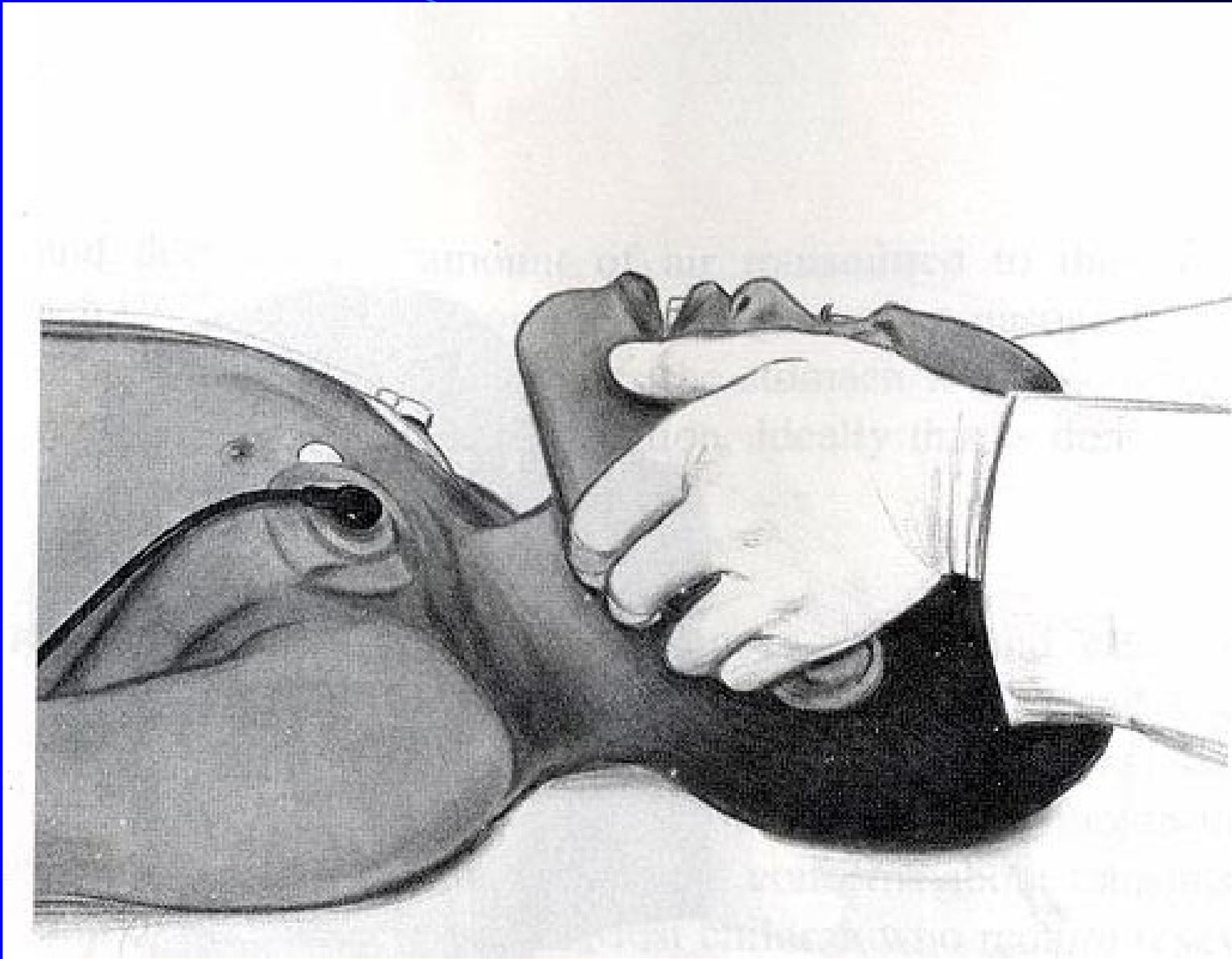


# Goals of Airway Therapy

- Recognize respiratory distress and failure before they progress to arrest.
- Anticipate respiratory problems.
- Support those functions that are lost or compromised.
- Start with least invasive methods.

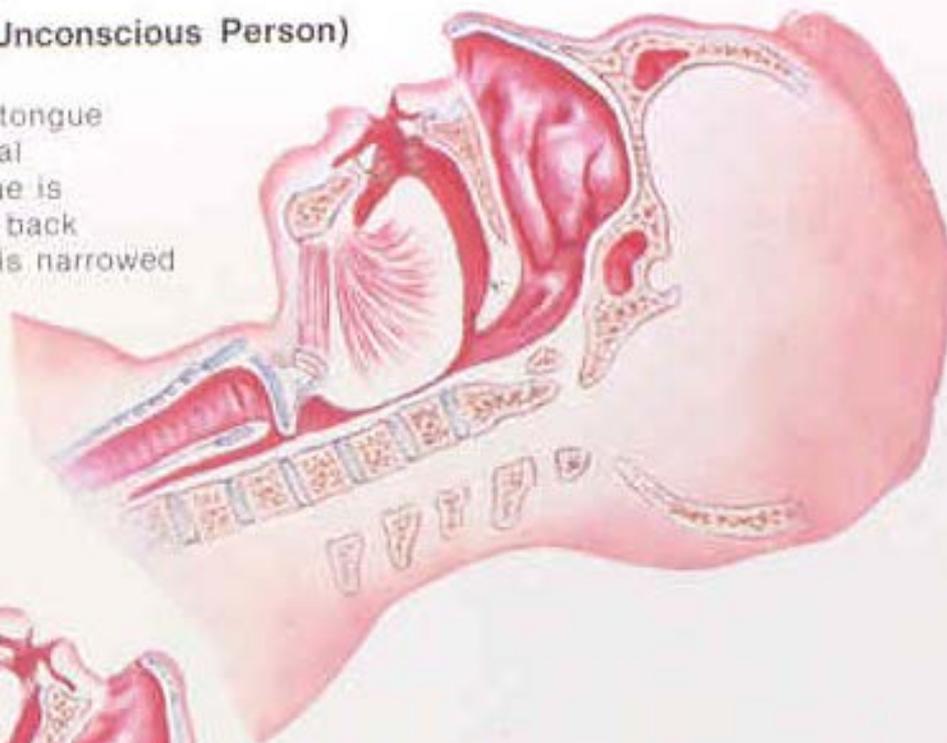
# Interventions

- Open and Position the Airway
- Oxygen
- Nasopharyngeal Airway
- Oropharyngeal Airway
- Bag-Valve-Mask Ventilation



## Airway Obstruction and Patency (Unconscious Person)

**Obstruction.** With head flexed, flaccid tongue drops back against posterior pharyngeal wall because mandible (to which tongue is attached) recedes. Epiglottis also falls back because hyoid bone recedes. Pharynx is narrowed by flexion of cervical vertebrae



**Patency.** With head extended (head-tilt maneuver), mandible usually moves forward (or is actively pushed forward with jaw-thrust maneuver); tongue is thus drawn forward. Epiglottis is also pulled anteriorly by movement of hyoid bone. Pharynx is widened by extension of cervical vertebrae

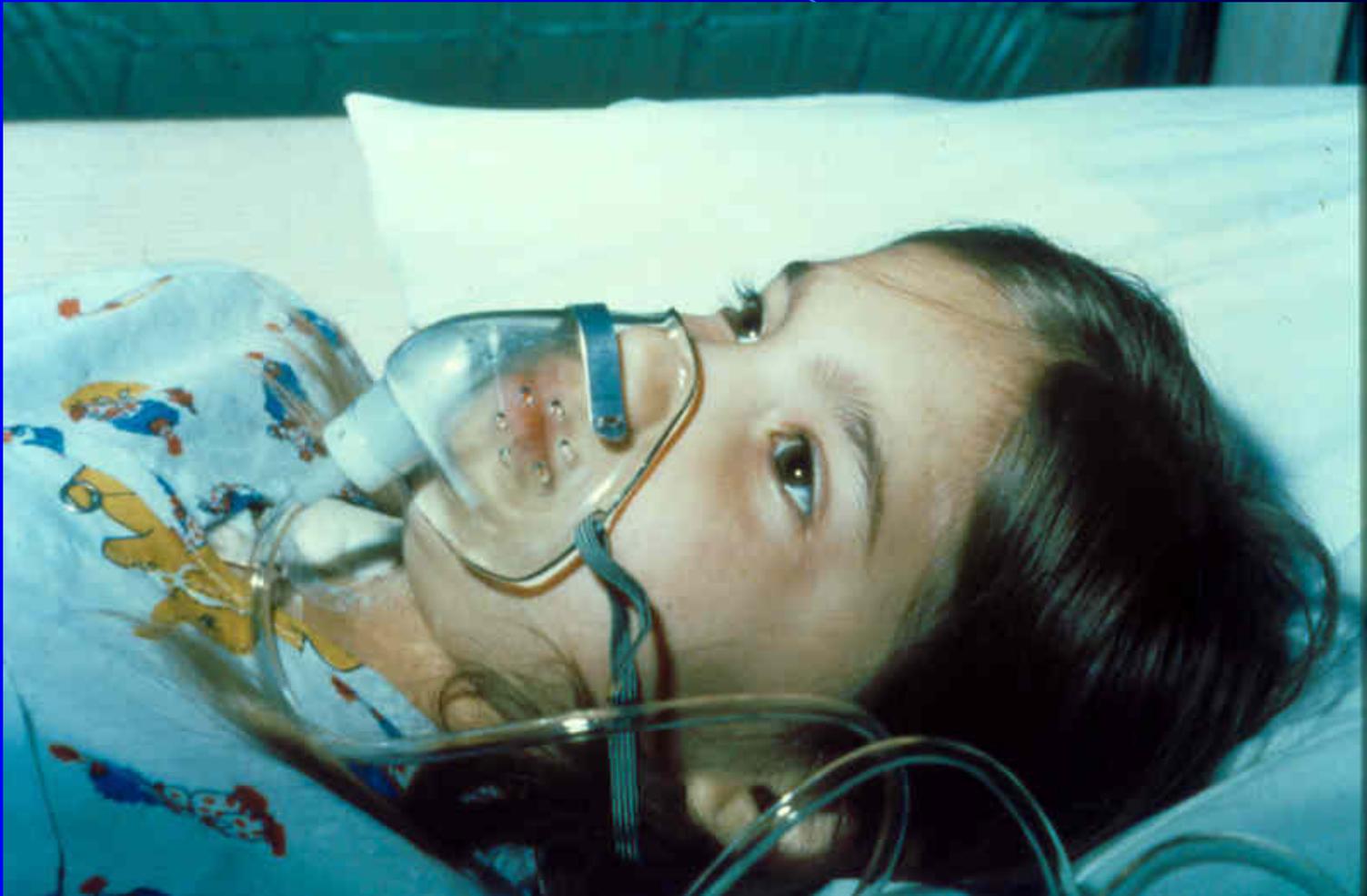
# Interventions

- Administer Oxygen
  - Nasal cannula
  - Simple face mask
  - Non-rebreather mask

# Nasal Cannula



# Simple Face Mask



# Non-Rebreather Mask



# Nasopharyngeal Airway

- Soft rubber or plastic tube in many sizes
- Used to bypass upper airway obstruction
- Well tolerated in semiconscious or conscious patients
- Easily obstructed with secretions in small children

# Nasopharyngeal Airway

- The nasal airway is lubricated with a water soluble lubricant
- The beveled tip is inserted directed towards the septum, with the airway directed perpendicular to the face





- Flange at tip of nose
- End at tragus of ear

# Oropharyngeal Airway

- Holds tongue away from the posterior pharyngeal wall.
- Only in unconscious patients.
- Measure from the corner of the mouth to the angle of the jaw.





Anyone who provides critical care to children needs to be expert in managing the unprotected airway with a bag-valve-mask.

“When bag-valve-mask is done appropriately, it can be every bit as effective as endotracheal intubation.”

Jim Seidel, MD

# Airway Management Maxim

Airway Management DOES NOT Mean  
Intubation!

Airway management means just that!

**Patients will not die because you do not or cannot intubate them. They will die if you do not ventilate and/or oxygenate them.**

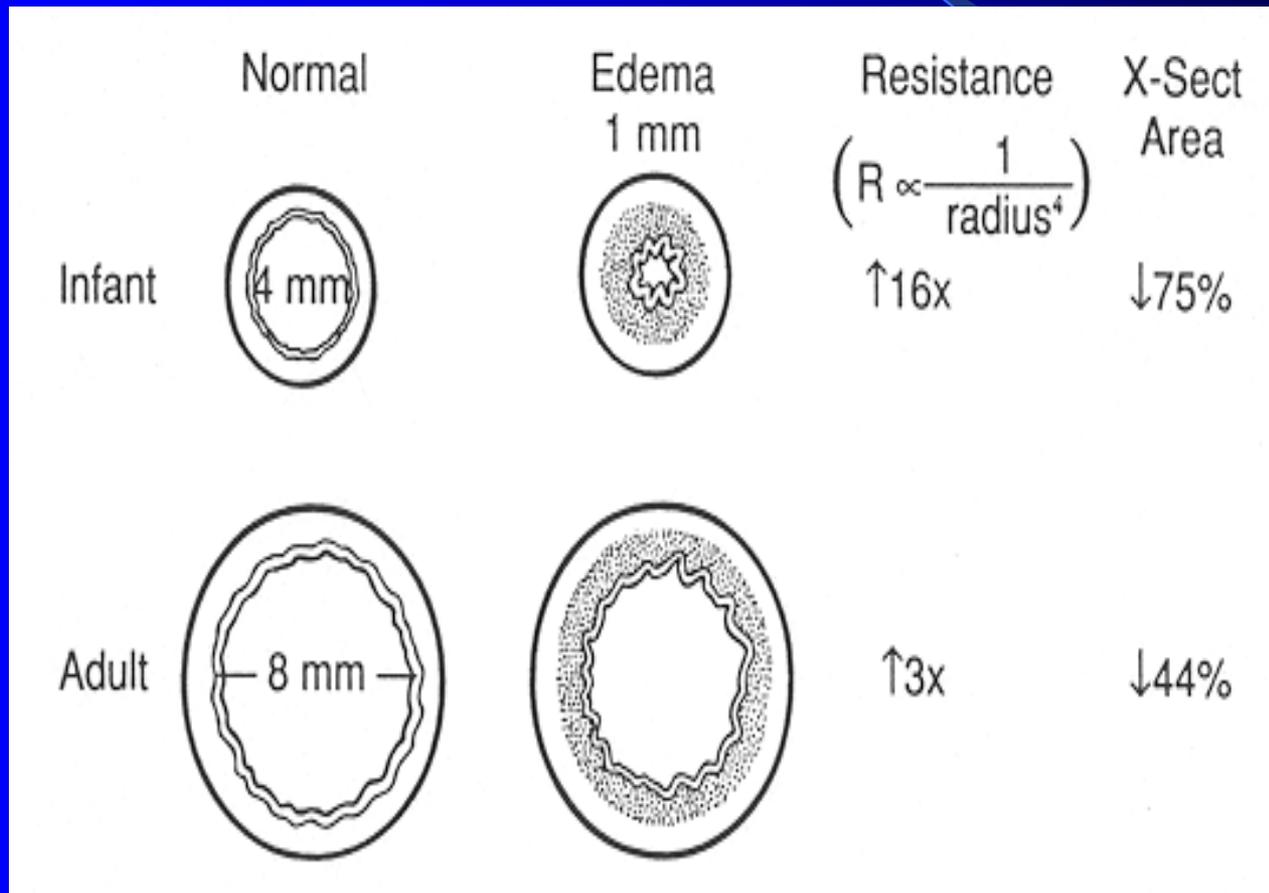


Eric Petersen / The Livingston Enterprise

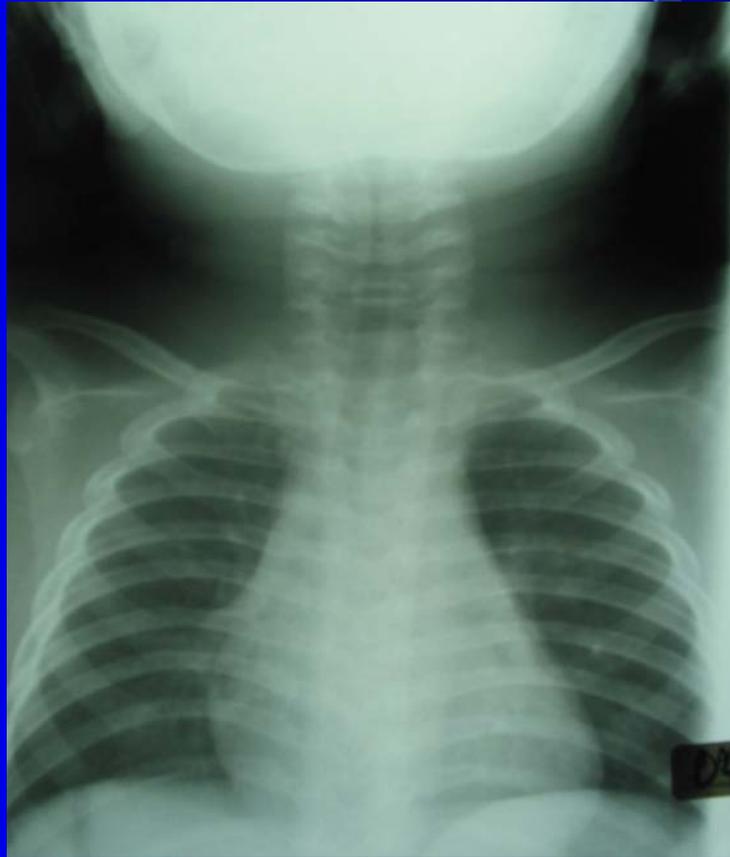
# Croup

- Also known as laryngotracheobronchitis.
- Infection causes inflammation of the larynx and subglottic airway
- Typical age is 6 months to 3 years.
  - Rare beyond age 6 years.

# Airway Resistance



# Steeple Sign



# Croup

- Cause is primarily viral
  - Parainfluenza virus type 1 and 2
  - RSV, Influenza and Adenovirus less often
- Outbreaks most common in fall/winter
- Most EMS calls/ED visits 10pm-4am.

# Clinical Presentation

- Many have 12 to 48 hours of URI symptoms prior to onset of upper airway obstruction.
- Spasmodic croup- abrupt onset of stridor and barking cough, typically while asleep.
- Fever is common, ranges from 38 to 40.5.

# Clinical Presentation

- Mild cases: Hoarse with a barky cough
- More severe:
  - Stridor
  - Retractions
  - Diminished breath sounds
  - Agitation

# Croup

- Hypoxia and cyanosis can develop, but rare.
- Prolonged respiratory distress can lead to fatigue and respiratory failure.
- Need for intubation or death from croup are also rare occurrences.

# History

- Factors in the history that may suggest significant worsening:
  - Rapidly progressing symptoms
  - History of prior episodes of croup
  - Underlying airway abnormalities

# Differential Diagnosis

- Bacterial Tracheitis
- Acute Epiglottitis
- Peritonsillar or Retropharyngeal Abscess
- Airway Foreign Body
- Congenital Airway Anomalies



# Evaluation

- CAB's – Assess the child for signs of obstruction or impending failure/arrest.
- Keep the child as comfortable as possible.
  - agitation and fear may make the airway narrowing worse.

# Evaluation

- Before even touching the child, assess:
  - Overall appearance
  - Work of breathing
  - Chest expansion
  - Quality of the cry/voice
  - Abnormal sounds, stridor vs. wheezing?

**NOT SICK !!**



**SICK !!!**



# Physical Findings

- Increased work of breathing
  - Tachypnea, retractions, nasal flaring
- Inspiratory stridor
  - At rest, or only heard when agitated/crying?
- Breath sounds are usually clear!!
  - Wheezing is a sign of lower airway obstruction

# Treatment of Croup

- Mist
- Oxygen
- Steroids
- Nebulized epinephrine

# Treatment

- Mist/Humidified air – no proven benefit
  - May help prevent inspissation of secretions
- Oxygen: If the child is in moderate to severe distress or hypoxic.
  - Use judgment in the non-hypoxic child that is more agitated by the therapy.

# Treatment

- Corticosteroids – mainstay of therapy
  - Decreases the edema in the airway
  - Requires several hours for onset of effect
  - Not recommended in the pre-hospital setting
  - Dexamethasone is the steroid of choice.

# Treatment

- Nebulized Epinephrine
  - Rapid improvement due to decrease in the airway edema.
  - Racemic vs. L-epinephrine: Equally effective with the same incidence of side effects.  
(most common is tachycardia)

# Nebulized Epi

- Indications:
  - Children with croup who are in severe respiratory distress
  - Stridor at rest
- Dose: 0.5 mL/kg per dose of the 1:1000 preparation. Max dose: 5 mL.

# Treatment

- Intubation: VERY rarely necessary!
- Less than 1% of patients seen in the ED for croup require intubation.
- If deemed necessary, use an ETT that is  $\frac{1}{2}$  to 1 size smaller to account for the edema in the airway.

# Disposition

- Most children who present to the ED for croup are discharged to home.
- If a nebulized epi treatment was given, the child is observed for 2 to 3 hours for recurrence of stridor.
  - Return of stridor requiring further nebulized epi treatment meets criteria for admission.

# Bronchiolitis



# Characteristics

- Inflammatory obstruction of small airways
- Children < 2 years
- Usually secondary to a viral infection
- URI → Wheezing → Respiratory distress

# Etiology

- RSV: 50 - 90%
- Parainfluenza
- Adenovirus, Rhinovirus, Influenza
- Mycoplasma / Chlamydia

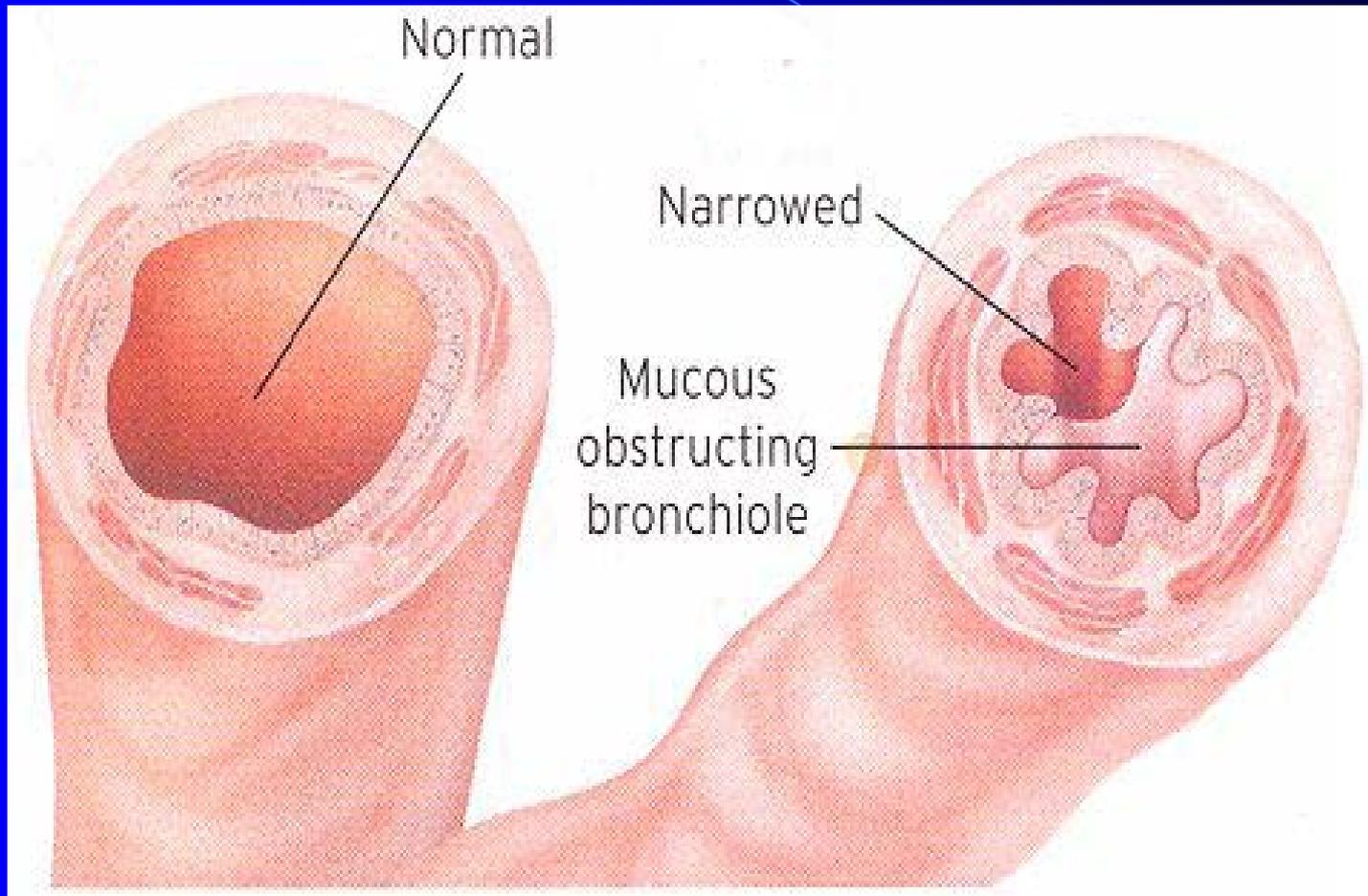
# Epidemiology (RSV)

- Winter / Spring (Nov - Mar)
- 60,000 - 90,000 hospitalized per year
  - 80% < 6 months old
  - 2 - 5% develop respiratory failure
- 500 deaths / year

# Pathophysiology

- Bronchiolar obstruction/inflammation
  - Cellular debris / Mucus / Mucosal edema
- Bronchoconstriction - variable
  - ◆ Airway obstruction → Hyperinflation / atelectasis
    - V / Q abnormalities → Hypoxia →
    - ↑ WOB → Fatigue → CO<sub>2</sub> retention

# Pathology



# Pathophysiology

- Infants affected more severely
  - Small airway diameter
  - High airway resistance
  - More mucous glands
  - Poor airway recoil
  - High ribcage compliance

# Clinical Course

- Day 1 - 3: Rhinorrhea / mild cough
- Day 4 - 5: Cough worsens, wheezing, decreased intake, irritability, fever
  - Tachypnea, tachycardia, retractions, grunting, exp / insp wheeze, fine crackles
- Day 11 - 14: Recovery

# High Risk Infants

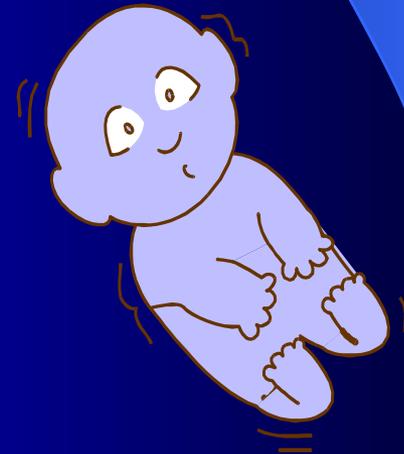
- Prematurity (< 34 weeks)
- Chronic lung disease (BPD, CF)
- Congenital heart disease
- Immune suppression
- Age < 6 weeks
  - Risk of hospitalization: 10 - 60%
  - Disease more severe

# Complications

- Severe respiratory distress
- Respiratory failure
- Apnea (15 - 20% of hospitalized infants)
- Dehydration
- Bacterial superinfection (1%)
- Pneumothorax / pneumomediastinum (rare)

# Predictors Of Severe Disease

- General appearance - “Looks sick”
- High risk infant
- $O_2$  sats  $\leq 93\%$
- RR  $> 70$



# Differential Diagnosis

- Asthma
- Congestive heart failure
- Foreign body aspiration
- Pertussis
- Cystic Fibrosis
- Bacterial pneumonia / sepsis

What To Do ?



# EMS Priorities

- Depends on severity of presentation:
  - None/Minimal distress, not hypoxic: transport
  - Moderate/Severe distress: provide oxygen and consider Albuterol, 2.5 mg HHN.
  - Apnea or Poor respiratory effort: BVM
  - Frequently reassess these children as their condition can change very rapidly.

# Beta<sub>2</sub> Agonists

- Subgroup of patients may respond to  $\beta_2$  agonists (Albuterol)
- Non-responders more likely to be admitted
- Adverse affects:
  - Tachycardia, irritability, hypoxemia, exacerbation of airway obstruction

# Epinephrine

- Epinephrine is more effective than albuterol or placebo
- The preferred bronchodilator in the treatment of bronchiolitis
- Has not been evaluated and is currently not recommended in the pre-hospital setting.

# Steroids

- For previously healthy infants with bronchiolitis, corticosteroids are not effective
- May consider if previous episodes of wheezing / underlying cardiopulmonary disease / ? severe illness

# Antibiotics

- 65 - 70% of hospitalized infants with bronchiolitis are febrile
- Incidence of SBI : 0 - 1.9 %
- Antibiotics are not routinely indicated

# ED Management

## LOOKS “WELL”

- RR < 70, sats  $\geq$  93%, adequate PO
- Home with supportive care:
  - Suction nasal secretions
  - Small frequent feedings / watch UO
  - No smoking
  - Room temp 70° - 72°

# ED Management

## IN “DISTRESS”

- O<sub>2</sub> to keep sats  $\geq$  93% (mask or cannula)
- IV fluids if dehydrated or not feeding well
- Bronchodilators - evidence for efficacy controversial

# Conclusions

- Albuterol may improve clinical scores. Does not reduce admission rates or length of hospitalization
- Epinephrine improves clinical scores and acute symptoms. May decrease rate of hospitalization and length of time in ED. Future use in EMS?
- Steroids - no evidence to support efficacy

# Asthma



# Definition

## Asthma

- Chronic disease of the airways
  - Inflammation
  - Obstruction
  - Hyperresponsiveness
- Clinically: Recurrent episodes of wheezing, breathlessness, chest tightness and cough

# Definition

- Status Asthmaticus

Persistent airflow obstruction that fails to improve or worsens despite appropriate therapy

# Assessment

## Physical Examination

- General appearance / level of consciousness  
- most useful
- Wheezing correlates poorly with severity
- Tachypnea / use of accessory muscles /  
ability to speak

# Management

## Oxygen

- Mechanisms of action
  - Improves tissue oxygenation
  - Facilitates bronchodilation
  - Reduces pulmonary vasoconstriction
- Tight fitting or non-rebreather face mask / high flow oxygen
- Keep  $O_2$  sats  $\geq 95\%$

# EMS Treatment Options

- Quick relief medications
  - Beta-adrenergic agonists (Albuterol)
  - Anticholinergics (Atrovent)
- Medications to reverse inflammation
  - Corticosteroids (Solumedrol)

# $\beta$ -Adrenergic Agonists

- Albuterol is the treatment of choice
  - 2.5 mg for <20 kg, and 5 mg for >20 kg.
- Nebulizer or MDI
  - Depends on child's coordination, technique, cooperation, degree of airflow obstruction
  - 6-10 puffs from MDI = 2.5 mg nebulized

# $\beta$ -Adrenergic Agonists

- Quick relief drugs of choice
- Mechanisms of action
  - Smooth muscle relaxation
  - Decrease airway edema
  - Enhance mucociliary clearance
  - Inhibit inflammatory mediator release

# $\beta$ -Adrenergic Agonists

## Adverse effects

- Dose and route related
- Tachycardia, tremors, agitation, vomiting, arrhythmias
- $\downarrow$  in  $O_2$  sats due to worsening V/Q ratio  
BUT if patient looks better and is moving air better  
PATIENCE – Treat the patient and not the oximeter

# $\beta$ -Adrenergic Agonists

## Levalbuterol

- No conclusive evidence that levalb safer or more effective than racemic albuterol
- In acute asthma standard dose of levalb (0.625 or 1.25 mg) may be too low
- More expensive

# $\beta$ -Adrenergic Agonists

## Intramuscular Epinephrine

- Indications
  - Severe bronchospasm
  - Patient unable to cooperate with or not responding to inhaled therapy

# Anticholinergics

Mechanisms of action: Atrovent

- Inhibit parasympathetic mediated bronchoconstriction
- Decrease mucosal edema and secretions
- Weak bronchodilators when used alone
- Augment bronchodilating effects of Albuterol

# Anticholinergics

## Indications

- Moderate / severe asthma exacerbations
- Patient not responding appropriately to initial Albuterol treatment.
  - Dose: 0.5 mg, may use up to 3 doses in ED.
  - Combine with albuterol

# Other Options ?



# Corticosteroids (Solumedrol)

## Mechanisms of action

- Suppress mediators of inflammation → decrease airway edema and secretions
- Reverse down regulation of  $\beta$ -agonist receptors thus potentiating their effectiveness → increase bronchodilation

# Corticosteroids

- Not recommended in areas with rapid transport times: takes hours to work.
- Discretion of medical control in more remote areas.
- Requires placement of IV, which very few pediatric asthma patients require
- Varicella issue: be very careful!!!

# Magnesium Sulfate

## Mechanisms of action

- Blocks calcium mediated smooth muscle contraction → bronchodilation
- Potentiates effect of  $\beta$ -adrenergic agonists
- Decreases inflammatory response

# Magnesium Sulfate

- Indications

- Severe bronchospasm unresponsive to initial  $\beta$ -agonist treatment
- Currently not recommended for pre-hospital use in pediatric patients.
  - Must carefully monitor HR / BP
  - High levels cause CNS depression, muscle weakness, nausea, flushing

# Summary

- Rapid assessment
- $\beta$ -agonists - frequently and appropriate dose
- Ipratropium - enhances bronchodilation
- Corticosteroids – consider
- Maintain oxygenation - children die from hypoxia, not hypercarbia

# Foreign Body Aspiration

- Food items are the most commonly aspirated FB.
- Balloons are the most common FB to result in death.



# Airway Foreign Bodies

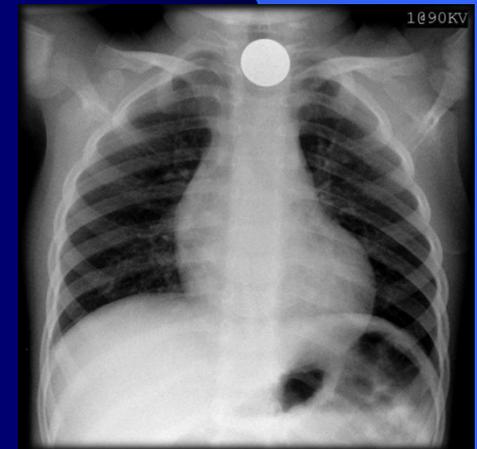
- 80% of episodes occur in children < 3yo, peak age between 1-2 yo
- Food most commonly aspirated by infants and toddlers (peanuts)
- Toy balloons most common object involved in fatal childhood foreign body aspiration

# Your First Clue: Foreign Body Aspiration

- A history of choking is the most reliable predictor of FB aspiration.
- Other signs and symptoms include:
  - Upper airway: Stridor, respiratory or cardiopulmonary arrest.
  - Lower airway: Coughing, wheezing, retractions, decreased breath sounds, cyanosis.

# Esophageal Foreign Bodies

- Peak age 6 mos-6 years
- Coins most commonly ingested object (66%)
  - Button batteries, must be removed emergently!
- Approximately 10% of ingested foreign body will require intervention



# Esophageal Foreign Bodies

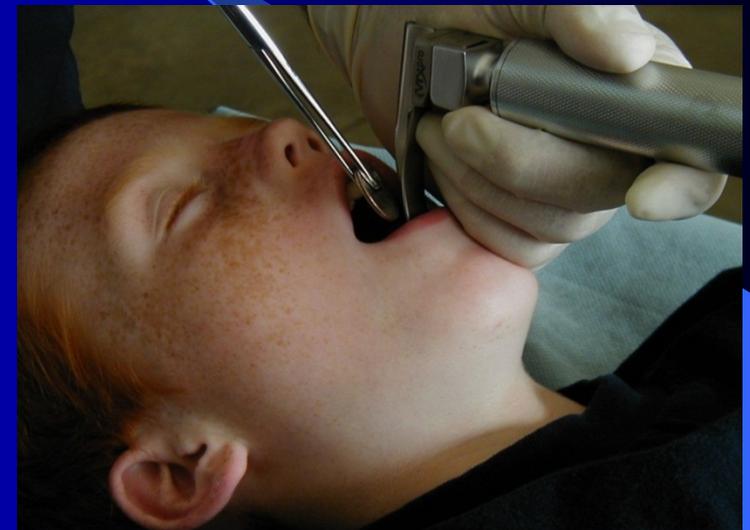
- Clinical presentation
  - 6-49% will be asymptomatic
- Common symptoms include
  - Drooling
  - Dysphagia
  - Cough
  - Gagging/vomiting

# EMS Management

- Upper airway FB:
  - If patient is able to cough or speak:
    - Leave in a position of comfort.
    - Provide supplemental oxygen.
    - Priority transport to ED for removal.
- Lower airway/esophageal FB:
  - Position of comfort, transport

# Definitive Management

- Laryngoscopy and removal with pediatric Magill forceps
- If unable to grasp FB at or near the vocal cords, OK to push it in to secure the airway!





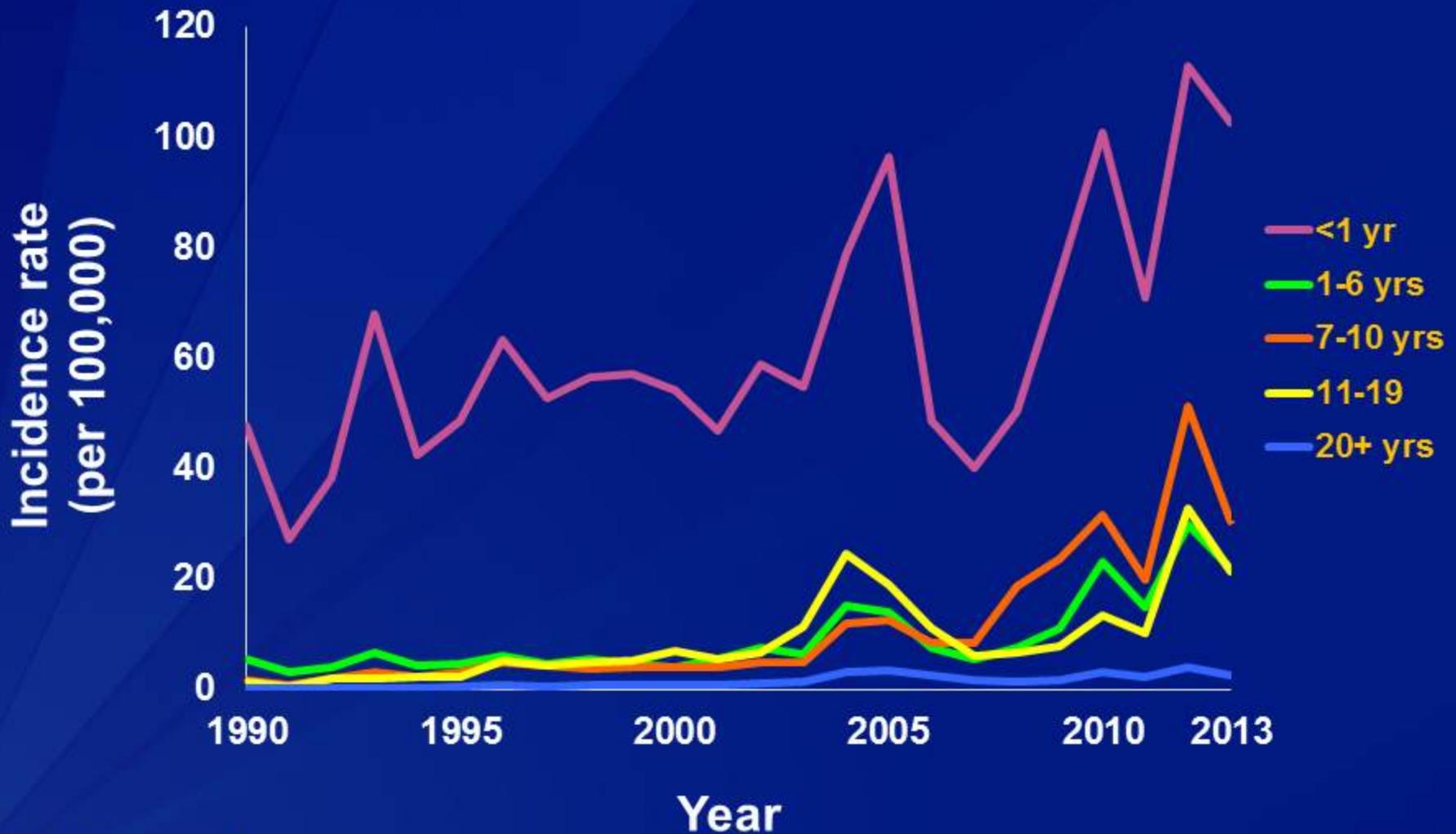
# Pertussis

- Pertussis is a highly communicable, potentially lethal, vaccine-preventable disease.
- It lasts for many weeks and typically afflicts infants and children with severe coughing, whooping, and posttussive vomiting.

# Facts

- Pertussis is caused by a bacterium named *Bordetella pertussis*.
- Transmission: by close contact with cases via aerosolized droplets.
- Neither infection nor immunization provides lifelong immunity
- In 2013, 28,000 cases of pertussis were reported in the U.S.

## Reported pertussis incidence by age group: 1990-2013



\*2012 data are provisional.

SOURCE: CDC, National Notifiable Diseases Surveillance System and Supplemental Pertussis Surveillance System

# Epidemiology

- Lack of natural booster events and waning immunity since childhood immunization were responsible for the increase in cases of pertussis in people older than 10 years of age noted before use of the adolescent booster immunization.
- The incubation period is 7 to 10 days, with a range of 5 to 21 days

# Clinical Manifestations

- Pertussis begins with mild upper respiratory tract symptoms similar to the common cold (catarrhal stage).
- It then progresses to cough and then usually to paroxysms of cough (paroxysmal stage) characterized by inspiratory whoop and commonly followed by vomiting.
- Fever is absent or minimal.

# Clinical Manifestations

- Symptoms wane gradually over weeks to months (convalescent stage).
- Sudden unexpected death can be caused by pertussis, especially in the young infants.
- The duration of classic pertussis is 6 to 10 weeks.

# Treatment

- Antimicrobial agents administered during the catarrhal stage may ameliorate the disease.
- After the cough is established, antimicrobial agents have no discernible effect on the course of illness but are recommended to limit the spread of organisms to others.
- Azithromycin, erythromycin, or clarithromycin are appropriate first-line agents for treatment and prophylaxis

# EMS Priorities

- Pediatric Assessment Triangle
- Provide Oxygen if sats <95%
- Supportive care, no IV needed
- No medications have any effect
- Proper isolation measures

# Complications

Bilateral subconjunctival hemorrhages and facial bruising in children with pertussis.



# Control Measures

- All health care professionals should observe standard precautions and wear a respiratory mask when examining a patient with a cough illness suspected or confirmed to be pertussis.
- Exposed, unprotected people should be given prophylaxis promptly.

# Control Measures

- Preexposure immunization of health care personnel with tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tda.p) vaccine is recommended





Questions?

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