

**Northwest Community EMSS  
Continuing Education Program**

# **PEDIATRIC RESPIRATORY EMERGENCIES**

Connie J. Mattera, MS, RN, EMT-P

## **KNOWLEDGE OBJECTIVES**

After completion of the assigned readings, class, and homework questions, each participant will do the following with at least an 80% degree of accuracy and no critical errors:

1. Describe how an integrated and patient-centered EMS system of care can affect pediatric outcomes.
2. Differentiate between upper and lower respiratory diseases/conditions.
3. Discuss the pathophysiology and assessment of each of the following pediatric respiratory emergencies: obstructed airway (FB aspiration), croup, epiglottitis, asthma and reactive airway diseases, bronchiolitis, RSV virus.
4. Sequence the treatment plan for children with respiratory distress.
5. Define a Brief Resolved Unexplained Event (BRUE) and describe the EMS assessments and management of this condition.

Children present a special challenge because seriously ill or injured pediatric patients are not as common as adults. Skilled EMS personnel, who competently manage adult crises, become nervous when faced with a critically ill or injured child.

## **By the numbers**

Peds patients are responsible for ~7–13% of EMS calls

Pediatric Emergency Care Applied Research Network most common chief complaints

- Traumatic injury (29%)
- Pain (combining abdominal and others) (10.5%)
- General illness (10%)
- Respiratory distress (9%)
- Behavioral disorder (8.6%)
- Seizure (7.45%)
- Asthma (3.9%)

**Plan ahead – peds education, proper equipment, and peds simulations**

## **Factors for successful outcomes**

- EMS agencies need to be prepared through education & having proper equipment.
- Properly trained personnel must be available with predesignated responsibilities.
- Care givers must appreciate a child's responses to injury - physiologic and psychologic.
- All personnel are familiar with the developmental stages/needs of children based on their physical, cognitive, and psychosocial growth and development must be understood.
- Caregivers must have knowledge of mechanisms and unique illness and injury patterns in children.
- **Know where your resources are!**

## **Essential pediatric knowledge/skills**

- Ability to establish therapeutic relationships and communicate effectively with children/caregivers
- Sequencing a pediatric assessment; correctly interpreting data; rapidly intervening with evidence-based care per peds SOPs

- Caring, supportive and patient-sensitive interactions
- Critical thinking/problem solving

**Children are not mini-adults (but some adults are big kids!)** There is no “average size” child. Assessments and interventions must be based on the individuality of each child in terms of age, size, psycho-social development and metabolic status. **Use PEDS SOPs for children 12 years and younger.**

#### Age definitions

Newborn	First mins to hrs following birth
Neonate	Birth to in first 28 days of life
Infant	1 to 12 months
Toddler	1 to 3 years
School age:	6 to 12 years
Adolescent:	Puberty to adult (18 years)

**Need child's size to treat:** Broselow Tape (2017) incorporates revised length weight zones based on most recent National Health and Nutrition Examination Survey data

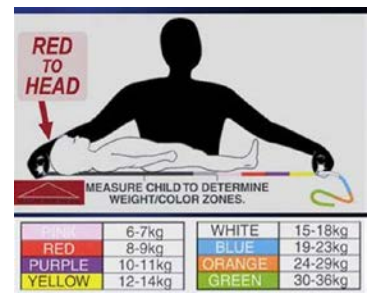
#### Alternatives to tape?

Use scale if available

Ask parents / caregiver

Use formula:  $2 \times \text{age in years} + 8 = \text{wt. in kg}$

Look up age/height/weight charts



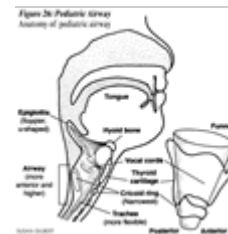
Age	Weight	Length	Age	Weight	Length
12 mth	20.4 lb (9.2 kg)	29.2" (74.1 cm)	12 mth	21.3 lb (9.6 kg)	29.8" (75.7 cm)
13 mth	21.0 lb (9.5 kg)	29.6" (75.1 cm)	13 mth	21.8 lb (9.9 kg)	30.3" (76.9 cm)
14 mth	21.5 lb (9.7 kg)	30.1" (76.4 cm)	14 mth	22.3 lb (10.1 kg)	30.7" (77.9 cm)
15 mth	22.0 lb (9.9 kg)	30.6" (77.7 cm)	15 mth	22.7 lb (10.3 kg)	31.2" (79.2 cm)
16 mth	22.5 lb (10.2 kg)	30.9" (78.4 cm)	16 mth	23.2 lb (10.5 kg)	31.6" (80.2 cm)
17 mth	23.0 lb (10.4 kg)	31.4" (79.7 cm)	17 mth	23.7 lb (10.7 kg)	32.0" (81.2 cm)
18 mth	23.4 lb (10.6 kg)	31.8" (80.7 cm)	18 mth	24.1 lb (10.9 kg)	32.4" (82.2 cm)
19 mth	23.9 lb (10.8 kg)	32.2" (81.7 cm)	19 mth	24.6 lb (11.2 kg)	32.8" (83.3 cm)
20 mth	24.4 lb (11 kg)	32.6" (82.8 cm)	20 mth	25.0 lb (11.3 kg)	33.1" (84 cm)
21 mth	24.9 lb (11.3 kg)	32.9" (83.5 cm)	21 mth	25.5 lb (11.5 kg)	33.5" (85 cm)
22 mth	25.4 lb (11.5 kg)	33.4" (84.8 cm)	22 mth	25.9 lb (11.7 kg)	33.9" (86.1 cm)
23 mth	25.9 lb (11.7 kg)	33.5" (85.1 cm)	23 mth	26.3 lb (11.9 kg)	34.2" (86.8 cm)
Female Children			Male Children		
Age	Weight	Height	Age	Weight	Height
2 yrs	26.5 lb (12.0 kg)	33.7" (85.5 cm)	2 yrs	27.5 lb (12.5 kg)	34.2" (86.8 cm)
3 yrs	31.5 lb (14.2 kg)	37.0" (94 cm)	3 yrs	31.0 lb (14.0 kg)	37.5" (95.2 cm)
4 yrs	34.0 lb (15.4 kg)	39.5" (100.3 cm)	4 yrs	36.0 lb (16.3 kg)	40.3" (102.3 cm)
5 yrs	39.5 lb (17.9 kg)	42.5" (107.9 cm)	5 yrs	40.5 lb (18.4 kg)	43.0" (109.2 cm)
6 yrs	44.0 lb (19.9 kg)	45.5" (115.5 cm)	6 yrs	45.5 lb (20.6 kg)	45.5" (115.5 cm)
7 yrs	49.5 lb (22.4 kg)	47.7" (121.1 cm)	7 yrs	50.5 lb (22.9 kg)	48.0" (121.9 cm)
8 yrs	57.0 lb (25.8 kg)	50.5" (128.2 cm)	8 yrs	56.5 lb (25.6 kg)	50.4" (128 cm)
9 yrs	62.0 lb (28.1 kg)	52.5" (133.3 cm)	9 yrs	63.0 lb (28.6 kg)	52.5" (133.3 cm)

## Metabolic and physiologic differences

### Airway

Anatomic differences leading to an increased susceptibility to airway obstruction in children:

- Infants (first 2-6 months) are **obligatory nose breathers**; Narrow nares are easily obstructed with edema or secretions like blood or mucous. Keep nasal passages clear to avoid airway obstruction.
- Tonsils and adenoids are large and have a plentiful blood supply.
- The oral cavity is smaller and the **tongue is large** in relationship to the mouth size.
- Because of the **large occiput** in infants and young children, a supine position flexes the cervical vertebrae and trachea. Large head + short neck + weak shoulder girdle = easily obstructed airway.
- The jaw is smaller in young infants:
- Larynx is higher (C2-C3) and more anterior that may make visualization more difficult. The small, immature larynx collapses on inspiration due to negative pressure breathing. This space must deal with food and liquids as well as air which can cause a feeding problem.
- The adult **epiglottis** is flat and flexible, while a child's is omega shaped. It extends at a 45° angle into the airway and is shorter and stiffer. This makes it more difficult to manipulate and is a common reason providers can't visualize an airway as easily with a curved blade in a pediatric patient.
- **Vocal cords** are short and concave and the trachea is shorter: 4-5 cm in newborn, 7-8 cm in 18 month old.
- Lack of cartilaginous supporting structures (immature tracheal rings) in the larynx and trachea and flaccidity of the esophagus allows swallowed foreign bodies in the cervical esophagus to balloon into the common wall between the esophagus and trachea and occlude the airway.
- **Narrowest part of the upper airway is at the cricoid ring**
- Speed of deterioration is mathematical. Diameter of a circle is  $\pi R^2$ . Since a child's airway is so small to begin with, even a mm or two of circumferential edema narrows it by a considerable percentage.
- Edema or infection more severe threat due to ↑ chance of obstruction
- The smaller the diameter, the more resistance there is to airflow and the more pressure needs to be exerted to ventilate. Decreasing airway diameter by ½ results in a 16 fold increase in resistance.
- Trachea and mainstem bronchi: Trachea cartilage softer, shorter in peds - increases likelihood of mainstem intubation. Division into the mainstem bronchi are more symmetrical at 55° angles; aspiration or intubation can occur on either side



### PULMONARY System

- There are ~10-70 million primitive fragile alveoli at birth, which increase to 200-600 million (ave 375 m) in an adult. Infants have an ↑ risk for pneumothorax following barotrauma and **atelectasis. Ask if infant was full-term or born prematurely. Their lungs have to catch up!**
- Alveolar surface ↑ from 2.8 m<sup>2</sup> (14% BSA) to 70 m<sup>2</sup> (25% BSA)
- Smaller lung capacity and ↓ pulmonary reserve means child becomes hypoxic more quickly
- Fewer pores of Kohn ↓ collateral ventilation ↑ risk for atelectasis
- Lung tissue more fragile; ↑ risk for pneumothorax
- High resistance ↑ respiratory effort
- Requires more time to fill & empty alveoli. If rapid RR does not allow adequate expiration, alveoli may overdistend and rupture.



- A newborn's chest has a cylindrical shape and a relatively horizontal orientation of softer ribs making the chest very pliant and the mediastinum is more mobile. The ribs are less likely to fracture, but pulmonary contusions are more common. Greater energy is transmitted to underlying organs following trauma, and significant internal injury can be present without external signs. Chest muscles are immature and fatigue easily. Tidal volumes ( $V_T$ ) in children are 6-8 mL/kg. Horizontal ribs + soft sternum + weak intercostal muscles = poor ability to create negative intrathoracic pressure so they cannot increase  $V_T$  when in distress.
- **"Belly breathers"** until the age of about three. Abdomen rises and falls with each breath.
- Heart: Proportionally takes up more room in chest
- Mediastinum more mobile; shift is greater with a tension pneumothorax.
- They have **poor pulmonary reserve** due to horizontal ribs, soft sternum, weak intercostal muscles, large heart, large abdomen and ↓ functional reserve capacity. They have poor ability to create negative intrathoracic pressure to inhale and cannot ↑  $V_T$  so ↑ RR when stressed
- Hypoxia will develop rapidly.
- Children tend to hold their breath when scared and swallow air when crying (aerophagia) which predisposes them to gastric distention.
- Small thorax, thin chest walls allows for **easily transmitted breath sounds** throughout the chest. It is easy to miss a pneumothorax or misplaced TT due to transmitted breath sounds.
- Children hyperventilate naturally. Resting RR decreases as body size increases
- Basal metabolic rate is higher in infants and small children than in later years, which makes **O<sub>2</sub> consumption approximately 50% higher**/unit of body weight in early childhood.

## Immune System

- Immature in first 3-6 mos
- More susceptible to severe infections
- Limited to passive immunity from mom

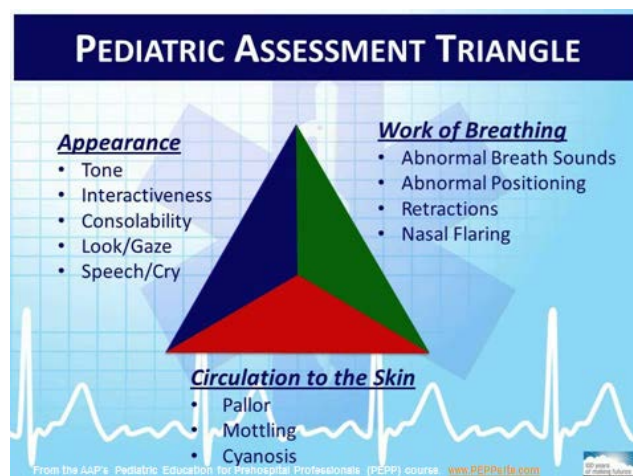
## PRIMARY assessment

**Purpose:** Detect and resuscitate all clinically evident, immediate life threats.

**Observe before touching, especially if conscious**

- Preferred position
- Unusual/significant odors
- Movement: spontaneous, purposeful, symmetrical

**General impression:** While walking up to the child, do a quick look to determine the severity and urgency of the situation using the **pediatric assessment triangle (PAT)**



The PAT focuses on three independent aspects of the physical assessment that are used to determine the physiologic stability of a child by just looking at them.

In other words, **“How sick?” “How quick?”**

- **Appearance:** The child's overall appearance reflects the adequacy of oxygenation, ventilation, and perfusion. There are very few false negatives (very few really sick or injured children have a normal appearance). However, a child can have a chronic illness with visible abnormalities, but not be physiologically sick. **A sick child will look sick.**
  - **Alertness, mental status and child's response to environment:** Observe for age-appropriate behavior, level of consciousness; affect, or restlessness. Is the child looking around, making eye contact; distractible, responding with curiosity or fear, playing, or quiet, eyes open but not moving much or uninterested in environment? Do they recognize parents/favorite toy? Are they uncooperative and clinging to parent vs. unconcerned and allowing invasive procedures? Are they irritable and unresponsive to comforting measures yet they stop crying and fall asleep when left alone? Paradoxical irritability is a sign of meningeal irritation.
  - Muscle tone: good or limp; sucking on a pacifier or bottle; hands of an infant should be in fists.
  - Cry or speech
- **Work of breathing**
  - General respiratory rate while child is quiet
  - Respiratory effort: Obvious respiratory distress or extreme pain; *retractions, nasal flaring*
  - *Abnormal audible breath sounds* – stridor, wheezing, grunting.

A normal appearance with increased work of breathing means **respiratory distress**.  
An abnormal appearance with increased or decreased work of breathing means **respiratory failure**.
- **Circulation to skin:** Inadequate perfusion of vital organs leads to compensatory vasoconstriction in non-essential areas, especially the skin. Circulation to the skin reflects overall adequacy of perfusion.
  - Skin signs: Obvious bleeding
  - Skin color: pink, pale, flushed, cyanotic, mottled
  - Skin temperature
  - Pulse strength
  - Capillary refill time (CRT)

**Normal appearance + poor circulation to skin = observe carefully**

**Abnormal appearance + poor circulation to skin= shock**

Other causes for vasoconstriction (mottling and/or prolonged capillary refill time (CRT): fever, hypothermia, medications, and normal vasomotor lability in infants.

The PAT can also help identify a child with CNS or systemic problems who has normal oxygenation, ventilation & perfusion.

**Abnormal appearance + normal WOB and normal circulation to skin may mean brain/CNS dysfunction.**

**After completing the PAT, begin a more complete Primary assessment.**

- **Determine level of consciousness:** Brief evaluation of responsiveness. Some parameters are not easily measured; Ex: assessing the level of consciousness in a baby at nap time.
  - **A:** Alert
  - **V:** Responds to verbal stimulus
  - **P:** Responds to painful stimulus
  - **U:** Unresponsive

Level of consciousness should dictate aggressiveness of field care. Allow conscious child with good ventilatory effort to remain in position of comfort. Do not force them to lie down for an exam or transport.

**Airway assessment – determine patency**

Airway obstruction may be acute, insidious, progressive or recurrent. Maintain high index of suspicion.



### Possible causes of airway impairment

- Tongue; improper positioning
- F/B aspiration, secretions, trauma
- Supra or subglottic allergic edema/anaphylactic shock
- Reactive airway disease
- Ingestion of caustic agent
- Unique airway infections: croup, epiglottitis, infectious mononucleosis, peri-tonsillar abscess, retropharyngeal abscess, bacterial tracheitis, diphtheria
- Pneumonia, pneumothorax, Reye's Syndrome, metabolic acidosis
- Congenital disorder: laryngomalacia, webs or polyps; Beckwith-Wiedemann syndrome (large tongue), Pierre Robin syndrome (relatively large tongue-to-chin ratio)

If a F/B passes the glottis, it can lodge in a lower-airway (suspect in child with recurrent pneumonia always in same place). Aspiration episodes are rarely witnessed. Ask about choking history or coughing spell that went away. Also look for unilateral wheezing, coughing, and decreased or absent breath sounds.

### Inspect: Look/listen for signs of airway obstruction

- If patient is responsive: are they crying or talking without difficulty?  
YES → assess breathing, quality of voice (hoarse or raspy?)  
NO → feel for air movement
- If unresponsive: look, listen, feel for air movement
- Position
- Face and neck: symmetry, wounds, edema, F/B, Secretions in mouth
- Symmetry of chest expansion and depth
- Listen for audible sounds

### S&S of partial airway obstruction

- Stridor •- Wheezing
- Choking • Grunting
- Drooling • Tachypnea
- Hoarseness • Retractions
- Tripod position
- Accessory muscle use: nasal flaring, head bobbing
- Diminished breath sounds
- Tachycardia/bradycardia
- Altered level of consciousness

### Airway access maneuvers

CHILDREN < 12 years of age shall have airways secured using BLS adjuncts & interventions. If unable to secure airway with BLS interventions: May make 1 attempt at advanced airway per OLMC only

ADOLESCENTS > 12 yrs: Manage airways per adult SOPs

### Position child appropriately

- If child is conscious, but struggling to breathe, allow children with medical conditions to assume a position that is most comfortable for them. Children will find the best position in which to keep the airway open.
- **Infants:** Place a towel under the shoulders to open airway. Avoid pillows in small infants and children.
- Children younger than 3 years with possible c-spine trauma must be supported under the torso in neutral, axial alignment with spine motion restriction, **not traction**. The spine must not be distracted or otherwise manipulated in any way that could worsen existing injury or convert a stable injury to unstable and result in permanent spinal cord injury

Reposition mandible. Use **chin lift** or **modified jaw thrust** on a less responsive child as a first step in securing an airway. Manually remove visible gross debris.

**Peds Foreign Body Airway Obstruction:** If a conscious child between the ages of 1-12 years cannot speak, cough, or cry, perform **abdominal thrusts** for witnessed or strongly suspected aspiration of F/B.

For a child < 1 yr, perform up to 5 back slaps and up to 5 chest thrusts. If the child is unconscious with an obstructed airway, begin CPR.

- ALS personnel are authorized to perform direct laryngoscopy w/ Magill forceps if BLS maneuvers are unsuccessful.
- If obstruction remains: intubate and attempt to push the PB into the right mainstem bronchus, pull ET back and ventilate left lung. If ≤ 12 years contact OLMC for authorization to intubate.
- Perform a **needle cric** as a last resort if complete upper airway obstruction is present and you cannot ventilate the child.

**Suction using a size-appropriate catheter** (usually no smaller than 8 Fr) to maintain patency. Children tend to have a profound vagal response to tracheal suctioning so monitor the ECG for bradycardia during the procedure. **Limit suction application time to 5 seconds**. Decrease suction negative pressure (≤ 100 mmHg) in infants.

#### **Airway adjuncts: size appropriate**

**Nasopharyngeal airways (NPA):** 26-34 Fr. for children older than 4 years. NPAs are generally contraindicated for younger children due to the small size of the nasal passageways and larger adenoids that make insertion difficult or impossible.

**Oropharyngeal airways (OPA):** Sized for children of all ages; particularly helpful w/ BVM ventilations. Measure from the front of the lips to the angle of the jaw. If too long, distal tip will irritate epiglottitis and cause it to swell. Insert along curvature of tongue to prevent oral trauma.

**See Peds Airway Adjuncts SOP - p. 70**

#### **Possible indications for peds intubation**

- Actual or potential airway impairment/aspiration risk
- Actual or impending ventilatory failure (apnea, RR < 10 or > 40; shallow/labored effort; or SpO<sub>2</sub> ≤ 92)
- Excessive work of breathing (retractions, nasal flaring, grunting) → fatigue
- **DAI:** GCS 8 or less due to an acute condition w/ retained airway reflexes unlikely to be self-limited (Ex. seizures, hypoglycemia, postictal state, certain ODs)
- Inability to ventilate/oxygenate adequately after insertion of OP/NP airway and/or via BVM
- Need for ↑ inspiratory or positive end expiratory pressures to maintain gas exchange
- Need for sedation to control ventilations

**Contraindications/restrictions for DAI:** Coma with absent airway reflexes or known hypersensitivity/allergy to drugs. Agitation (hypoxemia) may precipitate worsening respiratory distress in the conscious child. Impending respiratory failure should be suspected in a child with decreasing level of consciousness

**Preoxygenate** with 12-15 L O<sub>2</sub>/appropriate sized peds NRM or ventilate with a peds BVM every 3 to 5 seconds for 3 minutes just to see the chest rise and hear midaxillary breath sounds. Children have a profound vagal response to hypoxia.

#### **Prepare equipment per usual procedure**

Assess child for difficult intubation, i.e., mobility of the mandible, loose teeth or F/B.

#### **Monitor ECG for bradycardia & dysrhythmias during procedure**

**DAI premedications** prior to intubating a responsive child

- Gag reflex present: **BENZOCAINE** 1-2 second spray, 30 seconds apart X 2 to posterior pharynx
- **2015 (Updated AHA guidelines):** There is no evidence to support the *routine* use of atropine as a premedication to prevent bradycardia in emergency pediatric intubations. It may be considered in situations where there is an increased risk of bradycardia. There is no evidence to support a minimum dose of atropine when used as a premedication for emergency intubation.
- **Pain: FENTANYL:** 1 mcg/kg (round to closest 5 mcg -max 100 mcg) IVP/IN/IM/IO. May repeat X1 at 0.5 mcg/kg (max 50 mcg) in 5 min to a max of 1.5 mcg/kg/SOP

**Sedation: KETAMINE 2 mg/kg slow IVP (over 1 min) or 4 mg/kg IN/IM.** Allow for clinical response before DAI (if possible); **See notes on peds sedation in PEDs IMC p. 67 and after pain mgt. in this outline.**

Monitor VS, ECG, level of consciousness, skin color and SpO<sub>2</sub> q. 5 min. during procedure. Interrupt DAI if HR drops < 60 or SpO<sub>2</sub> < 94%. Ventilate w/ O<sub>2</sub> 15 L/Peds BVM at 12 BPM until condition improves.

### Special considerations when intubating children

- Vocal cords may be difficult to visualize
- Glottis is higher, more anterior, and more flexible
- May have difficulty passing the tube below the cords through a narrow cricoid ring.

### Pass the tube

- **Introduce laryngoscope** (straight blade may work better) and gently elevate the epiglottis. Do not pull back along glottic tissues if the cords are not immediately visualized - will harm delicate tissue. **Apply anterior laryngeal pressure to drop cords into view.**
- **Visualize cords**; may only see pink-rimmed hole
- **Insert tube.** Do not advance more than 2 cm below the cords. **Align distal tube markings** with the vocal cords and note the markings on the proximal end of the tube that correspond to the gums/teeth or lips.
- **Depth of insertion:**
  - Internal tube diameter (in mm) X 3
  - If > 2 years: (Age in years ÷ 2) + 12
- **Confirm tracheal placement**
  - Visualize ET tube going through cords
  - Attach peds capnography monitor plus exam.
  - Auscultate breath sounds over epigastrium (should be no sounds), bilateral midaxillary lines and anterior chest for symmetric sounds. If in stomach, withdraw tube, start again. Do not allow a tube to remain in the right or left mainstem bronchus. Pull back slightly until breath sounds are equal bilaterally.
  - Monitor EtCO<sub>2</sub> to determine ongoing tracheal placement. If EtCO<sub>2</sub> not detected, confirm placement with direct laryngoscopy. Reconfirm tube placement every time the child is moved.
- **Inflate cuff** (if one is present)
- **If correctly placed**, ventilate every 3 to 5 sec just to see the chest rise. **Secure the tube** with tape or commercial tube stabilizer if size-appropriate device for a peds tube is available. An ET tube is easily displaced with head and neck movement. Immobilize the head, neck, and shoulders.
- If intubated: Max suction force of -80 to -120 mmHg; higher suction pressures OK for mouth/pharynx
- **Post-intubation sedation** If SBP > 70 + 2X age or ≥ 90 if 10-12 years: **MIDAZOLAM 0.1 mg/kg slow IVP (0.2 mg/kg IN/IM)** (max single dose 5 mg). May repeat to total of 10 mg based on size and BP.

**If unsuccessful and good air exchange** w/ peds BVM: Continue ventilations/BVM

If unable to intubate or adequately ventilate, consider need for a **cricothyrotomy**. This can be done by needle jet-insufflation on children of any age or using a surgical method in children 12 or older. Surgical crics are contraindicated in younger children due to their small cricothyroid membrane, risk of tracheal stenosis and procedural complications.

**Never leave an intubated child unattended. You may need to restrain the child's hands if they begin to regain consciousness. Use post-intubation sedation guidelines.**

Carefully monitor for rhythm and SpO<sub>2</sub> changes during and after procedure. If condition of an intubated patient deteriorates, consider the following causes:

- Displacement of the tube from the trachea,
- Obstruction of the tube,
- Pneumothorax, and
- Equipment failure.

## Breathing/ventilatory status/gas exchange

### Inspection

**Ventilatory attempts:** Spontaneous? Generally fast or slow?

**Tachypnea** may be due to metabolic acidosis secondary to ↓ perfusion with ↑ lactic acid production.

**Bradypnea** may indicate impending respiratory arrest.



**Mechanics:** Symmetry of chest expansion; retractions, tracheal tugging, accessory muscle use(head bobbing, expiratory grunting), work of breathing (repeated from PAT)

**Abdominal contour:** Distended?

**Adequacy of gas exchange**

- **Skin color:** Mottling of extremities?
- **SpO<sub>2</sub>:** Children should easily maintain an SpO<sub>2</sub> well over 96% on room air (higher than normal adult values). SpO<sub>2</sub> of  $\leq 94$  is a clue that pulmonary function is impaired. If nonperfusing rhythm, monitor SpO<sub>2</sub> as clinical recognition of hypoxia is not reliable. (SpO<sub>2</sub> unreliable in pts w/ poor peripheral perfusion, CO poisoning or methemoglobinemia.)  
Use a pediatric sensor.

**Palpation**

- Amount of air movement
- Tracheal position in neck
- Chest wall expansion
- Skin temperature/moisture

**Auscultation** immediately if patient appears to be in ventilatory distress. Assess if breath sounds are present, diminished, or absent; compare equality; note adventitious sounds.

**Signs of inadequate ventilations/gas exchange**

- ↑ work of breathing
- Increased use of accessory muscles: **Head bobbing** in infants 6-12 months. Head bobs with each breath to ↑ the effectiveness of the accessory muscles
- Presence of **retractions**
- RR: Increase then decrease
- Depth: decreased
- **Nasal flaring**
- Expiratory grunting
- I/E Ratio: Prolonged expiration
- Frequent coughing
- Mottling/cyanosis of extremities
- Anxiety, irritability,
- AMS; lethargy
- Tachycardia → bradycardia; ↓ BP
- Irregular respiratory pattern
- Breath sounds: wheezes, crackles, stridor or absent
- Central cyanosis: **late** sign of hypoxia

**Anticipate deterioration or imminent respiratory arrest** if: ↑ RR esp. if accompanied by S&S of distress & ↑ effort; inadequate RR, effort, or chest excursion; diminished peripheral breath sounds; gasping or grunting respirations; decreased LOC or response to pain; poor skeletal muscle tone; or cyanosis.

Apply peds SpO<sub>2</sub> , capnography monitors if ventilation/gas exchange deficits

Offer supplemental oxygen as tolerated. Infants and young children may not tolerate mask or nasal prongs.  
Allow parent to administer blow-by O<sub>2</sub>

**Oxygen/ventilatory therapy**

**Oxygen 1-6 L/NC:** Adequate rate/depth; minimal distress and SpO<sub>2</sub> 92- 94%

**Oxygen 12-15 L/peds NRM:** Adequate rate/depth; mod/ severe distress; S&S hypoxia (SpO<sub>2</sub> <92%) or as specified in protocol

**Oxygen 15 L/ BVM:** Inadequate rate/depth: mod/ severe distress; unstable. If spontaneous respiratory effort present, attempt to coordinate assisted ventilations with child's own breaths. If apneic, ventilate at 1 breath every 3 to 5 sec.

Avoid hyperventilation; volume should just cause the chest to rise. BVMs require a high degree of skill to operate effectively, particularly in the peds patient. Insert BLS airways first.

Child who does not respond to BVM ventilations with improved responsiveness, color, and pulse is not being adequately oxygenated and ventilated.

### BVM Sizes

0 - 1 Month	Neonatal bag
>1 month - 8 Yrs	Peds bag
Over 8 Years	Adult bag

### Key points

- Over-ventilation can fill the stomach with air, prevent adequate ventilations, and cause a pneumothorax.
- A child may be difficult to ventilate if they are struggling, have a laryngeal injury, if the upper airway is filled with vomitus, in the presence of a pneumothorax with ↑ airway resistance, or there is massive airway obstruction. Anticipate tension pneumothorax and prepare for needle decompression whenever BVM ventilations are given.

### **Circulation:** CO/ECG/fluid status/perfusion

Rapidly recognize hypovolemia with inadequate perfusion and/or shock. **Hypotension is a late sign of shock in children.** Assess for other signs of perfusion deficit. Often, seemingly subtle clues such as sustained tachycardia, listlessness, or mottled skin signify impending cardiovascular collapse.

- **Palpate** presence, location, **general rate**, volume/ strength, and rhythmicity **of pulses** in all extremities. Compare to central pulses (brachial, femoral, carotid).
- **Pulse assessment sites**
  - Umbilical cord/brachial artery in newborn
  - Brachial artery in infants, young children
  - Radial/carotid arteries in older children
  - Femoral artery in undressed child of any age

Interpret the significance of your findings by taking into consideration age-appropriate norms and whether the child is crying, is fearful and in need of family presence, has a fever or is in pain.

**Sustained tachycardia:** In the quiet or unconscious, non-febrile child, HR ↑ long before the BP falls, and is an indicator of ↓ CO.

Even more alarming is **bradycardia**, which often signals severe hypoxia and extreme distress.

If no central pulse & unresponsive: Start CPR at 100-120 compressions/min. (No ResQPod use in children)

- **Skin**
    - **Color:** Pink, pale, flushed, mottled. Decreased peripheral perfusion triggers ↑ peripheral vasoconstriction resulting in cold, mottled extremities - **look at the knee caps!**
    - **Temperature:** Hot, warm, cool, cold
    - **Moisture:** Dry, moist, diaphoretic
- Delayed **capillary refill** (normal < 2 sec in warm ambient environment in child < 6 years)
- **Altered LOC** with agitation, restlessness, confusion, listlessness, or stupor.
  - **Decreased muscle tone** = poor central perfusion

### **Cardiac rhythm/ECG monitoring**

- Apply ECG monitor (defib/pacing pads) if actual or potential cardiorespiratory compromise.
- Use standard size pads in children > 10 kg (use largest size that fits on the chest wall without touching with 3 cm between them). Prepare peds defib paddles if no pads.
- ALS patients do not necessarily require ongoing ECG monitoring or transmission of a strip to OLMC. If ECG is run, attach/append to PCR/EHR left at, faxed to, or downloaded to, the receiving facility.
- **Consider need for peds 12 L ECG;** based on chief complaint or PMH: same criteria as adults.

**Peds ECG changes:** PR & QRS intervals are shorter Be alert for conduction abnormalities in what looks like “normal” intervals or complex durations in young children. T waves normally inverted V1-V3 up to 8 yrs.

Treat dysrhythmias per appropriate SOP: **Most peds arrhythmias caused by hypoxemia, acidosis, or hypotension. At risk children for cardiac arrest:**

- Respiratory compromise/hypoxia
- Hypotension/shock due to trauma/acute blood loss/ cardiac tamponade
- Dehydrated
- Sepsis
- Congenital heart disease
- Altered mental status/lethargy
- **The most common cause of pediatric cardiac arrest is respiratory compromise/arrest.** Asystole and brady-arrhythmias are responsible for 90% of the rhythms seen in peds arrests. Ventricular dysrhythmias are responsible for the remaining 10%.

**Hydration status:** Anterior fontanel in infants, mucous membranes, skin turgor, presence or absence of tears when crying, urine output.

Carefully assess signs of fluid imbalances to recognize subtle as well as obvious signs and appropriately intervene before the child is in trouble.

### Vascular access

IV access should not be attempted unless clearly indicated. Consider patient's condition and hemodynamic stability. Vascular access is indicated for fluid and electrolyte replacement or as a route for drug administration. IVs are most urgently needed in hypovolemia, hemorrhage, or prolonged cardiac dysfunction with acidosis. **Limit time spent establishing peripheral venous access in critically ill or injured child.**

### Prepare the patient/significant others

Use age-appropriate techniques to prepare the child. Inform them about what you are going to do and explain in terms they can understand what they will experience and feel. Children are often very fearful of needles (pain) and may be afraid that they are about to be poisoned or that the needle will never be removed.

### Select the site

The equipment and site selected will depend in part on the purpose and duration of the infusion plus the patient's clinical status, age, and health history.

Peripheral veins are generally selected based on their location, condition, relation to other anatomical structures, physical path along the extremity, and size. The best choice is a vein that is pliable, appears long enough to accommodate the catheter length without traversing a joint, and large enough to allow blood flow around the catheter.

**Commonly selected vessels** include the metacarpal veins on the dorsum of the hand, accessory cephalic, cephalic, and antecubital veins. In non-emergent situations, attempt distal sites first.

The antecubitals are often visible or palpable in children when other veins won't dilate, as in shock or severe dehydration, and can be best accessed by placing a small roll of gauze behind the elbow to aid in hyperextension. During CPR, the preferred site is the largest, most accessible vein that does not require interruption of resuscitation (IO often used). If able, select a site in the non-dominant hand or arm.

Avoid veins in the inner wrist or arm as they are small and uncomfortable for the patient. Equally, avoid sites where there is a circumferential burn, infection, or marked edema in an extremity from a suspected fracture.

### Sites of venous access in priority are:

- Percutaneous peripheral (two attempts max)
- Intraosseous: During insertion, **prior to activating trigger, insert needle through skin/fat/muscle and rest tip needle on bone; at least the 5 mm mark on needle should be visible.** This tells you the needle is long enough. If no markings are visible, remove the needle and use a longer needle or alternate site.
- Peripheral access may be attempted enroute; IO should be attained while stationary

### IV catheters

The type of venipuncture device will depend on the child's age, activity level, type of therapy, available veins, and site selected. Generally, the largest gauge needle (catheter) with the shortest length is preferred to allow rapid fluid infusion when volume resuscitation is necessary.

Fluid flow rate is directly proportional to the diameter of the catheter and inversely proportional to the length of the catheter.

**Gauge selection** for peripheral catheters: 24-26 for neonates, 22-24 for infants, 20-22 for children, and 16-18 for adolescents who need large amounts of fluids.

#### Administration sets

If child needs IVF volume challenges, use regular drip tubing, a large volume syringe and 3-way stop-cock to bolus in the fluid.

If IO infusion: put a pressure infuser around IV bag and inflate to 300mmHg.

#### Volume of fluid to be infused

Rapidly infuse a **precalculated** amount of fluid based on child's weight delivered in a fluid bolus or challenge.

Give **20 mL/kg** as the initial bolus **even if BP is normal** if **other S&S of hypoperfusion are present**. Draw fluid into a 50-60 mL syringe using a 3-way stopcock and push it as rapidly as possible (over 5 minutes) while preserving the integrity of the IV. If IVF is given too fast or too slowly, the child may experience phlebitis, infiltration, circulatory overload, or insufficient resuscitation.

**Response to initial fluid bolus** should be an improvement in capillary refill, mental status, skin color and temperature of the extremities, ↓ HR, and elevation of an initially low BP.

If reassessment reveals **on-going hemodynamic instability** additional boluses of 20 mL/kg should be repeated X 2.

Avoid excess volume replacement in children with possible ↑ ICP, such as meningitis, prolonged seizures, or severe

### Let's put this information into practice - Scenario

A 5 y/o male presents with a history of fever, noisy breathing, and drooling. Mom states that the fever began this morning and has spiked this afternoon. The noisy breathing was alarming to the child's parents and as a result, 911 was called. Mom states that the child has not taken anything by mouth since he became ill.

VS: BP 100/66; P 144, RR 32 & shallow; SpO<sub>2</sub> 90% on RA; T 103° F

Alert, awake, in acute respiratory distress, and prefers an upright or forward leaning position

Skin: hot and moist without a rash

Oropharynx: clear; mucosa is moist

Lung sounds: clear bilaterally; inspiratory stridor with retractions

What is your impression? \_\_\_\_\_

Main Differentials to Consider	

Other Infectious Differentials to Consider	
Mononucleosis	Tonsillitis
Diphtheria	Ludwig's angina with retropharyngeal abscess
Pertussis	Subglottic laryngitis

Other Non-Infectious Differentials to Consider	
Allergic reaction	Laryngeal tumor
Angioneurotic edema	Hydrocarbon aspiration
Foreign body aspiration	Systemic lupus erythematosus
Reflex laryngospasm	Inhalation of toxic fumes or super-heated steam

## Background information

### I. Upper respiratory emergencies

- A. Respiratory infections are more serious in children than in adults because serious obstruction can occur due to the small size of the eustachian tubes, larynx and bronchi. Children have a poor cough reflex and minimal pulmonary reserves.
- B. Localizing site of illness to upper or lower airway may assist field treatment decisions

#### 1. History

- a. Has the child had a fever? For how long?
  - (1) Acute onset of respiratory distress in the absence of a fever suggests F/B aspiration.
  - (2) Pneumonia, croup, and epiglottitis all have associated fever.
    - (a) Croup: history of several days of low-grade fever.
    - (b) Epiglottitis: onset of respiratory distress occurs within 12 hours of the onset of fever.
    - (c) Temp in epiglottitis often exceeds 40° C.
- b. Has the child had an acute episode of coughing or choking suggestive of F/B aspiration?
- c. Will the child drink? Has he/she been drooling?
  - (1) Difficulty swallowing suggests upper airway obstruction
  - (2) Fever and drooling suggests epiglottitis
- d. Has the voice changed?
  - (1) Hoarse or raspy cry suggests croup
  - (2) Muffled voice or refusal to talk suggests epiglottitis
- e. Has the child had a similar problem in the past?
- f. Is the child a known asthmatic? On what medications? Last dose?

#### 2. Physical exam

- a. Abnormal lung sounds may be difficult to appreciate under noisy conditions in the field. If adequate auscultation is possible, the following sounds may help localize the site of illness:
  - (1) **Snoring:** Due to very proximal upper airway obstruction (tongue falling back against the posterior pharynx)
  - (2) **Wheezing:** Heard most commonly on expiration. Indicates lower airway obstruction to airflow as in asthma or bronchiolitis.
  - (3) **Crackles:** Heard on inspiration with parenchymal lung disease like pneumonia or bronchiolitis.
  - (4) **Stridor** is produced by rapid, turbulent flow of air through a narrowed segment of the respiratory tract. It is often the **most prominent symptom of airway obstruction** in the peds patient.
    - (a) Stridor may be high or low pitched, loud or soft, inspiratory or expiratory. Inspiratory stridor usually results from an obstruction at or above the larynx. Expiratory stridor usually results from an obstruction below the carina.
    - (b) Acute stridor usually results from infection. Croup accounts for about 90% of infectious stridor. Epiglottitis accounts for most of the rest.
    - (c) Conditions causing stridor are common, and erroneous presumptive diagnoses and delay of proper treatment are



possible. The most common misdiagnoses are asthma, croup, bronchiolitis, laryngomalacia and bronchitis.

(d) Differential diagnoses of stridor

- (i) Stuffy nose
- (ii) Nasopharyngeal mass
- (iii) Base of tongue mass
- (iv) Neurologic lesions (Cranial nerves IX, X, XI)
- (v) Enlarged tonsils and adenoids
- (vi) Retropharyngeal mass (abscess or tumor)
- (vii) Peritonsillar or parapharyngeal space abscess
- (viii) Croup (laryngotracheobronchitis)
- (ix) Acute supraglottitis (epiglottitis)
- (x) Diphtheria
- (xi) FB in the larynx of tracheobronchial tree
- (xii) Asthma (expiratory)
- (xiii) Bronchiolitis (expiratory)
- (xiv) Pneumonia



C. **Croup (Laryngotracheobronchitis)**

1. **Pathophysiology:** Generic term used to describe a syndrome causing inflammation & edema of larynx, trachea and bronchi. The term croup is now used to describe subglottic airway disease. Croup accounts for 90% of upper airway infections in children. While the most common cause for stridor, it is fortunately not the most serious. LTB and spasmodic croup are similar illnesses except that LTB takes longer to develop and is usually preceded by a URI and/or fever.
2. **Etiology:** Adenovirus, bacteria in rare cases
3. **Incidence:** Seen more often in temperate zones in urban areas with smog during the winter months. Most common 6 months - 4 years of age; rarely seen in older children.
4. **Onset:** Generally preceded by an URI and/or slight fever for several days. Notorious for getting worse at night and improving during the day. The course is subacute and respiratory failure is rare.
5. **Signs & symptoms**
  - a. Respiratory distress, dyspnea; ↑ respiratory rate
  - b. Marked stridor, retractions: Patient may be fairly calm until you begin the exam = ↑ anxiety and ↑ stridor
  - c. Hoarseness
  - d. Barking (seal bark) cough
  - e. Mild cyanosis when breathing room air
  - f. Sits up and holds head back to open airway
  - g. Tachycardia
  - h. May have a low grade fever 101-102 degrees F maximum
  - i. X-ray findings at hospital: Lateral neck shows a normal epiglottis, distended hypopharynx and a narrowed subglottic airway ("Steeple sign")
  - j. Acuity: There are essentially three ways a child may present to you
  - k. Mild respiratory distress amenable to treatment with nebulized saline. Usually discharged from ED for symptomatic therapy at home.

- l. Moderate to severe respiratory distress not amenable to nebulized saline. Usually admitted to the hospital.
- m. Severe respiratory distress with poor air exchange, cyanosis, and possibly altered mental status. This child must be carefully observed and may require invasive airways.

6. **Treatment: See SOP**

D. **Epiglottitis:** True emergency; may be life-threatening

- 1. **Etiology:** Viral and bacterial causes are known, but **tends to be a bacterial infection** caused by the *Haemophilus influenzae* Type B bacteria. Other bacterial causes include pneumococci, streptococci and staphylococci.
- 2. **Incidence:** Uncommon. Formerly seen 2-7 year olds, but is now more a disease of adults than children. Incidence is decreasing as most children have been vaccinated against the H-flu bacteria. Seen more often in winter.
- 3. **Pathophysiology:** The size and function of the epiglottis are altered resulting in a completely occluded upper airway due to an edematous, less mobile, fiery red epiglottis without involvement of the vocal cords.-
- 4. **Onset:** Slow and rapid onset forms; we are more concerned about the **rapid onset** type with progression to severe airway obstruction over hours. Respiratory arrest can occur very rapidly.
- 5. **General assessment**
  - a. Interactions with the parent
  - b. Verbal ability
  - c. Movement of the body and extremities
  - d. Awareness of surroundings



- 6. **Clinical picture**
  - a. Looks sick! Anxious with minimal movement; irritability, lethargy
  - b. **4 Ds**
    - (1)  **Drooling:** Too much pain, swelling, and inflammation to swallow (dysphagia); ↑ salivation, secretions pool in the hypopharynx and supraglottic **larynx**
    - (2) **Dysphonia** (difficulty speaking): Whispering or muffled voice with little air exchange but not hoarse
    - (3) **Dysphagia** (difficulty swallowing): Complains of sore throat, **pain on swallowing**
    - (4) **Distressed inspiratory efforts**/Respiratory distress
      - (a) Nasal flaring
      - (b) Ashen, gray color
      - (c) Substernal, intercostal, or suprasternal retractions
      - (d) inspiratory stridor or wheezes: not as loud as in croup
  - c. Protective of airway; sitting up with neck thrust forward and still (sniffing position - own jaw thrust) with open mouth
  - d. Tripod placement of the supporting upper extremities.
  - e. **Fever above 102° F**; appears toxic
  - f. ↑ P; ↑ RR
  - g. X-rays (at hospital): Portable lateral neck shows a positive "Thumb sign"

7. **History**

- a. Time of onset of symptoms
- b. Prior illness; upper respiratory tract infection

- c. Time of most recent oral intake, or medication administration
  - d. Evidence of prior events consistent with airway obstruction: choking at home, playing with small objects, eating items such as peanuts, hot dogs, or popcorn
8. **Cardinal rule:** Avoid any stimulation of the child until the personnel and equipment necessary to protect and stabilize the airway are available
9. **DO:** Provide clear, calm and concise explanation of what you are doing to parent and child
10. **DO NOT:**
- a. undress the child,
  - b. separate the child from the parents,
  - c. examine the child's throat,
  - d. put anything into the child's mouth,
  - e. take an oral temperature,
  - f. lay the child flat, or
  - g. leave the child unattended at any time.
11. **Treatment per SOPs**
12. **Ongoing assessment**
- a. Assess frequently for sudden respiratory obstruction
  - b. Changes in skin color, level of consciousness, rashes; be alert for possible concurrent meningitis
  - c. Any ↑ in retractions
  - d. Cyanosis of lips or nailbeds
  - e. Any ↑ in stridor, nasal flaring, or respiratory rate
  - f. Any ↓ in respiratory effort may be an ominous sign in a tiring child

**E. Foreign body aspiration**

- 1. Ages at risk: 6 mos - 5 years. 90% of peds deaths due to F/B aspiration occur in children < 5 years of age; 65% in infants
- 2. Diagnosis should be suspected in any previously well, afebrile child with a sudden onset of respiratory distress and associated coughing, choking, stridor, or wheezing. Fewer than 50% of the children will have a history of witnessed or suspected F/B aspiration.
- 3. Severity and nature of symptoms varies with location of F/B in the respiratory tract. Assess for new onset, unilateral wheezing.
- 4. See SOP: **PEDIATRIC FOREIGN BODY AIRWAY OBSTRUCTION**

**II. Allergic reactions/ Anaphylaxis**



An 8-year-old male is brought to the school nurse after developing increased work of breathing while in the cafeteria. On arrival at the office, the patient has red blotchy hives on his face and neck. The nurse learns he has a peanut allergy and may have ingested a cookie with peanuts. She notes that the patient's voice is becoming slightly hoarse and the hives are becoming more pronounced, including on the hands.



Realizing the patient's condition is worsening and having no diphenhydramine or epinephrine, the RN calls 9-1-1.

EMS arrives on scene four minutes later and finds the patient anxious and pale with difficulty breathing, beginning retractions and complaining of intense itching on his face, lips, throat and hands. VS: BP 85/40; HR 140, RR 30, SpO<sub>2</sub> 92% on room air; ETCO<sub>2</sub> 30. The urticaria is now widespread, his lips are swollen, and his capillary refill is 4 seconds.

***What are the EMS priorities of management right now?***

How can EMS determine the patient's size?

**SIMULTANEOUSLY**

- Apply O<sub>2</sub> while preparing drugs

***How should O<sub>2</sub> be given?*** \_\_\_\_\_

- **First drug dose and route?**

**This patient** by weight-based dosing: \_\_\_\_\_

- Also prepare a long-acting antihistamine: Drug, dose and route?

**This patient:** \_\_\_\_\_

- Set up for IV attempt  
Size of catheter?  
If successful, fluid volume to infuse?

**This patient's volume?** \_\_\_\_\_

- Apply ECG electrodes to chest ST

***The child's level of consciousness and respiratory effort rapidly deteriorate, what intervention is needed now?***

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

***Once inside the ambulance, the patient becomes completely unresponsive and apneic. Pulseless ventricular fibrillation is apparent. What interventions are indicated now?***

**Begin quality CPR;** Prolonged CPR indicated while S&S of anaphylaxis resolve.

Start 2<sup>nd</sup> vascular access line (IO); give IVF as rapidly as possible (up to 20 mL/kg) (use pressure infusers if available)

**EPINEPHRINE** (1mg/10mL) **0.01 mg/kg** (0.1 mL/kg) up to 1 mg **IVP/IO q. 2 min**; treat dysrhythmias per appropriate SOP. Repeat q. 3-5 min as long as CPR continues.

***What is the dose for THIS patient?*** \_\_\_\_\_

**AMIODARONE** 5 mg/kg IVP/IO. Max single dose 300 mg.

***What is the dose for THIS patient?*** \_\_\_\_\_

After 5 min: **AMIODARONE** 2.5 mg/kg (max 150 mg) IVP/IO

***What is the dose for THIS patient?*** \_\_\_\_\_

Due to poor BVM compliance, the patient is intubated using a 5.5 cuffed endotracheal tube, noting obvious laryngeal swelling and difficult insertion. Continuous waveform capnography confirms tube placement with a

CO<sub>2</sub> of 80. After advanced airway: child was ventilated at 1 breath every 3-5 sec with no compression pause for breaths.

After next two minutes of CPR, patient is found to have a strong central pulse and some ventilatory effort. Upon arrival in the ED, a physician immediately confirms tube placement and orders 2 mg/kg of methylprednisolone via IV. Good save, EMS!

### III. Lower airway obstructive diseases

- A. **Asthma:** Of the 6-8 million people who suffer from asthma, an estimated 1.5 million are school aged children.
1. The airway has increased sensitivity and reactivity to external stimuli i.e., URI, aspirin, exercise, odors and smoke, weather changes, cold air, and stress. Usually has a history of asthma or allergies.
  2. Manifested by a set of symptoms caused by various processes that result in bronchospasm, edema of the bronchi, and increased mucus production (occurs in that order). Some airways are occluded, others are distended with old, stale air (CO<sub>2</sub>) = ineffective oxygen exchange.
  3. **Clinical presentation**
    - a. **S&S**
      - (1) Due to small airway diameters, even incremental edema/ bronchoconstriction may cause severe air exchange problems and distress.
      - (2) The inability of pediatric patients to increase their tidal volumes often results in markedly increased respiratory rates that rapidly dehydrate the airways and accelerates the development of mucous plugs.
      - (3) Prolonged expiration; nasal flaring, use of accessory muscles (↑ work of breathing), retractions
      - (4) Audible wheezing; sub-q emphysema between neck and navel
      - (5) Itchy, tingly skin (especially younger kids)
      - (6) Sudden, sharp chest pain (pneumothorax).
      - (7) Hypoxemia and hypercarbia lead to acidosis and bradycardia. Kids die from acidosis, not hypoxia
    - b. **Children may present differently than adults.** It is usually known as **cough variant asthma**. The children may not wheeze but may continuously cough for 20 – 30 minutes after excitement or exercise. The also may abruptly vomit without nausea.
    - c. **How can you differentiate mild/moderate from severe asthma?**
      - (1) Appearance: Severe – exhausted
      - (2) Work of breathing: Severe SOB
      - (3) SpO<sub>2</sub>: Severe = 94% or less
      - (4) Capnography: Severe – EtCO<sub>2</sub> elevated over 55 with shark fin waveform
      - (5) Breath sounds: Severe – decreased or absent
      - (6) HR: Severe - bradycardia
      - (7) **O'Brien's Triad:** Cyanosis, severe retractions and minimal or absent wheezing indicates impending respiratory failure. Silent chest is a worrisome sign.
  4. **Report to hospital:** Degree of respiratory distress (WOB); vital signs; presence and/or degree of retractions; adequacy of gas exchange (SpO<sub>2</sub>, cyanosis), breath sounds, capnography findings; hydration status..
  5. **Treatment per SOP p. 74**
    - a. **How can you tell the difference between an asthma attack and an**



**allergic reaction?**

- b. History and physical exam
  - (1) Allergic reaction has a history of an exposure to an allergen. It often begins with GI (N/V) or skin (hives, itching, flushed) signs and progresses to respiratory (SOB, wheezes) and cardiovascular (hypotension) S&S.
  - (2) A child with asthma has a history of asthma without other S&S.
- c. Drugs: Albuterol, epinephrine 1mg/1mL, magnesium sulfate

**B. Respiratory Syncytial Virus (RSV)**

- 1. **Definition:** RSV is the most important cause of lower respiratory tract disease in infants and children. It can present like asthma.
- 2. **Incidence:** Peak incidence occurs in the first year with the most serious illnesses occurring within the first 6 months. RSV produces yearly epidemics lasting 4-6 months during late fall, winter or early spring in the northern hemisphere. Timing and severity of outbreaks vary from year to year.
- 3. **Pathology**
  - a. RSV is spread from respiratory secretions via contact with infected persons or contaminated surfaces.
  - b. Infection occurs when infectious material contacts mucous membranes of the eyes/mouth/nose, and possibly inhalation of droplets generated by a sneeze or cough.
  - c. The first infection tends to be severe; 25-40% have S&S of **bronchiolitis** or pneumonia and 0.5-2% require hospitalization.
  - d. The bronchioles become occluded by mucus, fibrin, and cellular debris. The patient develops air trapping with alveolar enlargement.
  - e. Most recover in 8-15 days. Most children have serologic evidence of RSV exposure by 2 years of age. Reinfection is common, but clinically milder.
  - f. About 40% of infants with proven RSV bronchiolitis are reported to develop repeated wheezing attacks later in life. RSV may become a potent stimulant of wheezing the in the asthma-prone individual.
- 4. **Clinical presentation**
  - a. Early S&S are no different than those of the common cold: runny nose, cough, and mild fever.
  - b. Within 1-2 days the breathing becomes more labored and temperature elevation is present.
  - c. Patient may have sternal and intercostal retractions during inspiration.
  - d. Apnea may occur in young infants
  - e. Expiratory phase is prolonged with air trapping and wheezing
  - f. RR rapid and shallow
  - g. With increasingly severe exhaustion, the infant may arrest
- 5. **Treatment:** See Peds SOP p. 75
  - a. Ask about family history of asthma, history of repeated attacks, sudden onset without preceding infection, and markedly prolonged expiration.
  - b. If severe viral syndrome may need ventilator support and IV fluids for dehydration.
  - c. Drug: epinephrine per nebulizer

**IV. Brief Resolved Unexplained Events [BRUE] (formerly known as ALTE - apparent life-threatening event)**

- A. The AAP defines the term BRUE as “an event occurring in an infant younger than 1 year when the observer reports a sudden, brief, and now resolved episode of  $\geq 1$  of the following:

(1) cyanosis or pallor; (2) absent, decreased, or irregular breathing; (3) marked change in tone (hyper- or hypotonia); and (4) altered level of responsiveness. A BRUE is diagnosed only when there is no explanation for a qualifying event after conducting an appropriate history and physical examination.”

- B. The term ALTE was coined in the late 1980s to distinguish it more clearly from SIDS as it became evident that no definite link could be established between apnea & SIDS. (NIH Consensus Development Conf on Inf Apnea & Home Monitoring)
- C. **Epidemiology:** The population that is most affected are infants less than 12 months old, but should be suspected in any child less than 2 years of age who display symptoms. Because of variability in clinical presentations, it makes the true frequency in unknown. However, it is estimated that the frequency among healthy term infants widely varies from 0.5-6% of all newborns. (<http://emedicine.medscape.com/article/1418765-overview>)
- D. Infants who present with a BRUE can either be classified as lower- or higher-risk, based on history and physical examination. The AAP's guidelines only apply to lower-risk patients who have the following characteristics:
1. Older than 60 days
  2. Gestational age of  $\geq 32$  weeks and postconceptional age of  $\geq 45$  weeks
  3. Occurrence of only 1 BRUE
  4. Duration of the BRUE is less than 1 minute
  5. No CPR required by trained medical provider
  6. No concerning history feature
  7. No concerning physical examination findings
- E. **Physical Examination:** Pre-hospital evaluation will be limited to a primary & secondary physical examination & should focus specifically on any neurologic, respiratory, or cardiac abnormalities. Be sure to include the infant's general tone & appearance. **Most pts will appear stable & may have a normal physical exam by the time EMS arrives.**

**Caution:** Despite their appearance, some of these pts WILL be later diagnosed with a condition(s) that may require further medical care.

- F. **Treatment per SOP.** Provide pediatric IMC. **ASSUME** history given is accurate & obtain a description of the severity, nature & duration of the event.
- G. **Documentation**
1. Description of the event including any intervention given & the infant's response, estimated time of recovery & duration of the event is important to record. Additional questions can include:
    - a. *Any known chronic illnesses?*
    - b. *Evidence of seizure activity?*
    - c. *Current or recent infections?*
    - d. *History of gastroesophageal reflux?*
    - e. *History or evidence of recent trauma?*
    - f. *Current medication list?*
    - g. *Associated events (eating, crying, etc)?*
  2. Evaluation begins with a thorough history & physical examination. Try to determine the severity of the event. Direct questions about the event to the person who witnessed it. Ask about the duration of the episode; intervention required for the episode to cease; color changes in the infant (& lighting in the room to clarify the ability to observe the infant's color); respiratory effort; muscle tone; activity of the infant immediately prior to the event; relationship to time of feeding; & the presence of choking, gasping, emesis, rhythmic movements, eye movement, nasal congestion, or fever. Clarify if the infant appeared normal after the event & the length of time for him / her to reach that stage. In addition to the history of the event, the hospital will ask about the medical history including pregnancy, birth, neonatal period, subsequent medical problems, and a complete review of systems. Details of the family history should be obtained with particular attention to genetic or

neurologic disorders, cardiac disease, infants dying suddenly & unexpectedly, & prior BRUEs in other family members.)

### 3. **Diagnosis**

- a. While it is difficult to diagnose BRUE, the hospital will conduct an extensive workup including infection (particularly pertussis, respiratory syncytial virus, sepsis, or meningitis), gastroesophageal reflux (GERD), seizures or other neurologic disorders, airway anomalies, aspiration, asthma, cardiac dysrhythmias such as prolonged QT syndrome, metabolic abnormalities, apnea of infancy, & nonaccidental trauma or Munchausen by proxy. The etiology in as many as 50% of BRUEs remains idiopathic. *In some instances*, the event is the result of benign perfusion changes in the infant that lead to overreaction by the caregiver. Details of the history & physical examination are critical in guiding subsequent evaluation of the events.
- b. Most common diagnoses include:
  - (1) 50% Gastrointestinal (GERD, swallowing dysfunction)
  - (2) 30% Neurologic (seizure, CNS hemorrhage)
  - (3) 20% Respiratory (upper airway obstruction, infection)
  - (4) 5% Cardiovascular (prolonged QT, arrhythmia)
  - (5) 5% metabolic/endocrine (electrolyte imbalance)
  - (6) 3-5% non-accidental trauma (abuse, shaken baby, Munchausen by proxy)

### **Outcome of original scenario**

EMS providers believed this child was in acute respiratory distress and attempted to ventilate w/ a BVM.

Upon putting the mask on the child, he became agitated and the paramedic thought he needed to be intubated immediately for the hypoxia.

After lying the child flat, he went into respiratory arrest. When attempting intubation, the paramedic stated that he was unable to visualize the airway structures.

While attempting to intubate, the child went into cardiac arrest while enroute to the ED.

The patient remained apneic and was pronounced dead 30 minutes after arrival in the ED...and a mother cries.

We don't always have a happy outcome. Thank you for being a learning community that is ever striving to improve our care!

Differential diagnoses				Differential diagnosis cont.			
	Croup	Epiglottitis	FBAO		Pneumonia	Asthma	Bronchiolitis
Age	6 mos – 3 yrs	1 – 7 yrs	6 mos – 5 yrs	Age	Birth- 10 yrs	1 & up	6 mos – 2 yrs
Onset	1 – 5 days	Rapid; hrs	Immed.	Onset	Gradual/weeks	Rapid	3 – 5 days
Position	None	Prefer erect	None	Position	None	Prefer erect	Prefer erect
Stridor	I & E	I	Variable	Stridor	None	None	None
Lung sounds	Normal/wheeze	Normal	Absent/wheeze	Lung sounds	Crackles	Wheeze/absent	Wheeze/absent
Cough	Seal-like bark	No	Possible	Cough	Yes	Yes or no	Yes
Voice change	Hoarse	Muffled	Variable	Voice change	No	Possible	No
Drool	No	Yes	No	Drool	No	No	No
Dysphagia	No	Yes	No	Dysphagia	No	No	No
Temperature	Low grade	Yes	None	Temperature	Yes	None	Yes