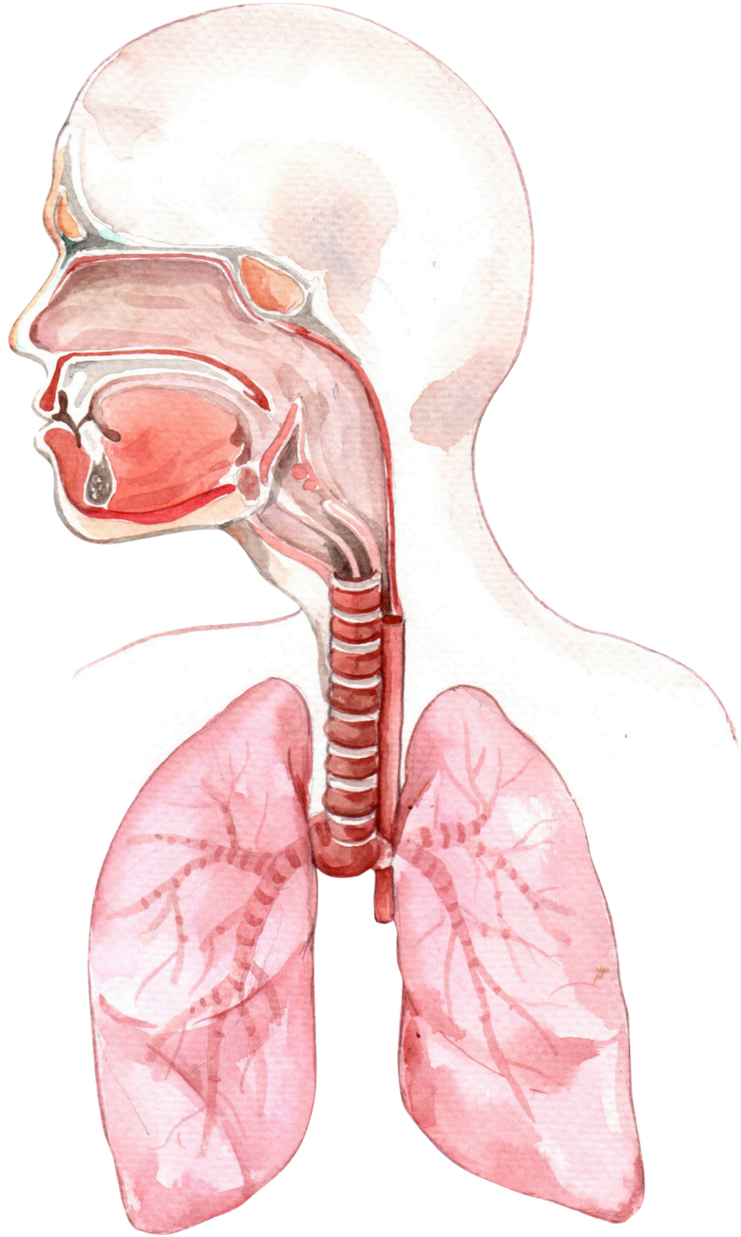
Respiratory Distress

Madi Lewis - Clinical Practice Leader, Pediatrics
Maritime Child Health

Dr. Barb Blackie - Physician Lead TREKK Maritimes

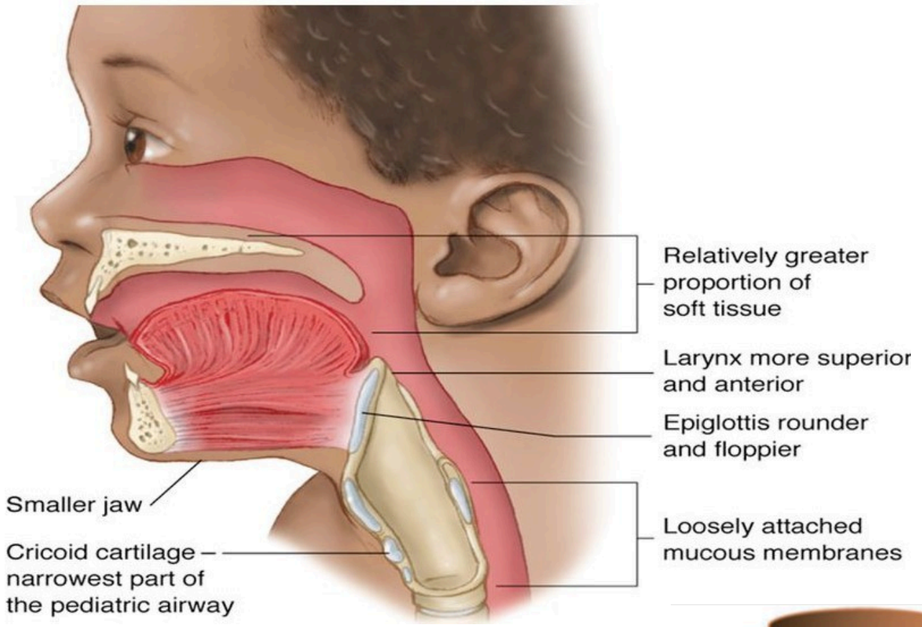


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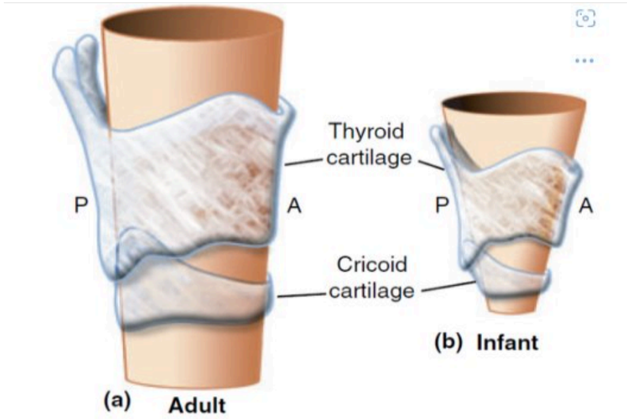
Objectives:

- Compare adult and pediatric airway anatomy and physiology
- Describe the key components of a pediatric respiratory assessment
- Recognize early and late signs of respiratory deterioration in pediatric patients
- Demonstrate appropriate pediatric airway support interventions
- Differentiate between pediatric oxygen delivery methods and their clinical indications
- Apply clinical reasoning during a pediatric respiratory case study
- Identify available pediatric respiratory resources and supports for clinical practice

Pediatric Airway



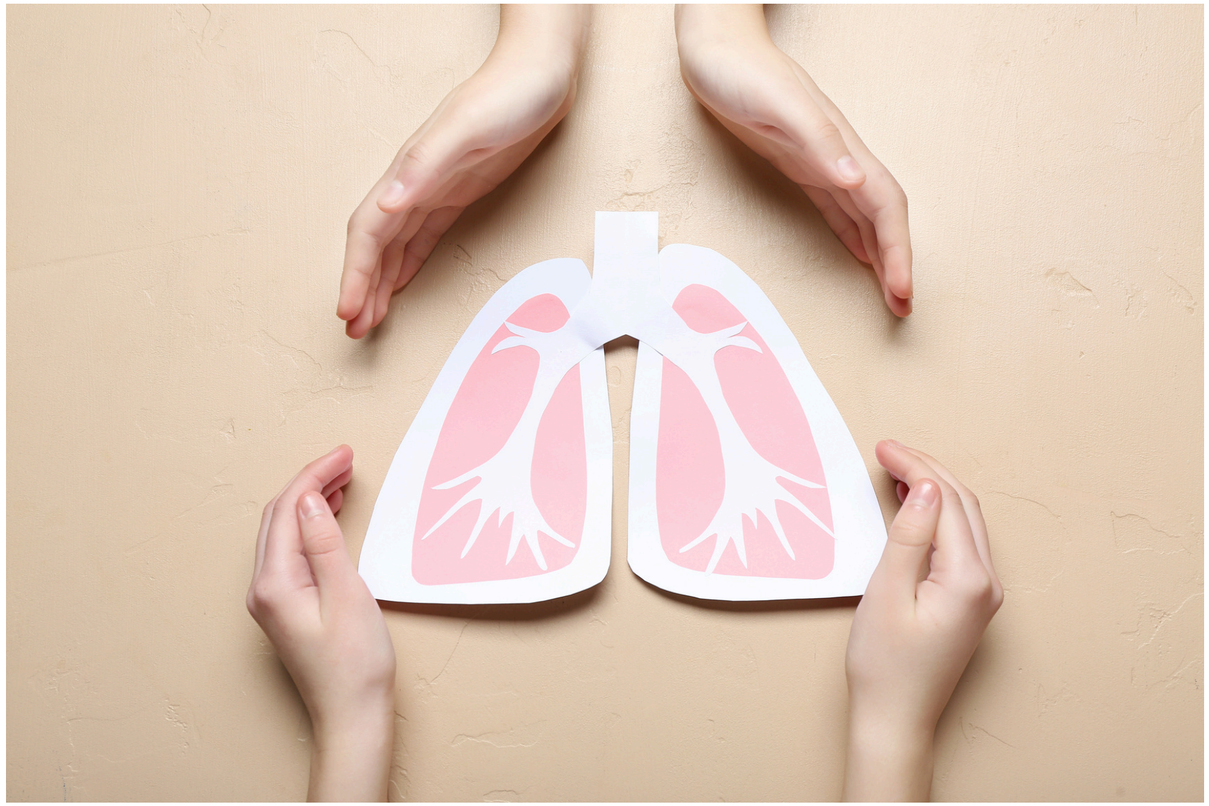
- Much smaller in diameter and shorter in length compared to adults
- Proportionally larger head & occiput
- Large tongue
- Funnel-shaped airway as opposed to cylindrical
- “Floppy” epiglottis
- Trachea cartiledge is soft/pliable



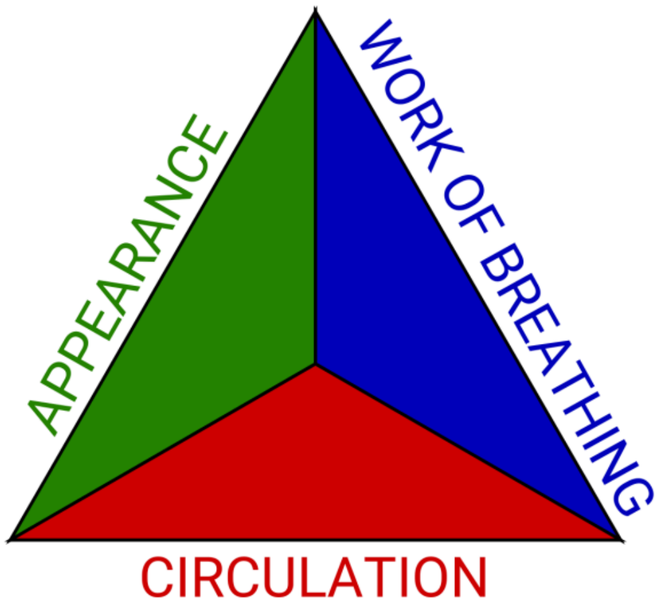
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Pediatric Physiology

- Higher metabolic rates and respiratory rates therefore higher oxygen consumption
- Smaller tidal volumes & lower functional residual capacity
- Premature and inefficient respiratory muscles in infants and very young children - fatigue quickly!
- Flexible ribs - more prominent indrawing
- Smaller & fewer alveoli, limiting surface area for gas exchange
- Infants are obligatory nose breathers (until 6 months)
- Early tachycardia



Pediatric Assessment Triangle (PAT)



Nurse obtains a quick (10-15 second) general impression of the patient's physiologic status. Performed before engaging in direct physical contact with the patient.

It's your "across the room look"

Respiratory Assessment





Airway

Looking and listening for any signs of airway obstruction and compromise:

- Gurgling - secretions pooling
- Snoring respirations
- Lack of effort/lots of effort
- Stridor
- Visible foreign body

Respiratory Assessment



Breathing

Looking & listening for signs of obstruction/compromise:

- Tachypnea (rapid breathing)
- Accessory muscle use
- Head bobbing/nasal flaring
- Persistent coughing
- Cyanosis
- Decreased level of consciousness
- Lack of respiratory effort
- Adventitious breath sounds



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Breath Sounds



Stridor

- Abnormal, high-pitched sound caused by turbulent airflow through a partially obstructed airway
- At the level of the supraglottis, glottis, subglottis, or trachea
- Typically on inspiration
- Potential differentials:
  - Croup
  - Anaphylaxis
  - Foreign body
  - Epiglottitis
  - Retropharyngeal/peritonsillar abscess
  - Bacterial tracheitis
  - Congenital malformation
  - Laryngomalacia
  - Tracheomalacia
  - Tumor
  - Subglottic stenosis
  - Vocal cord paralysis

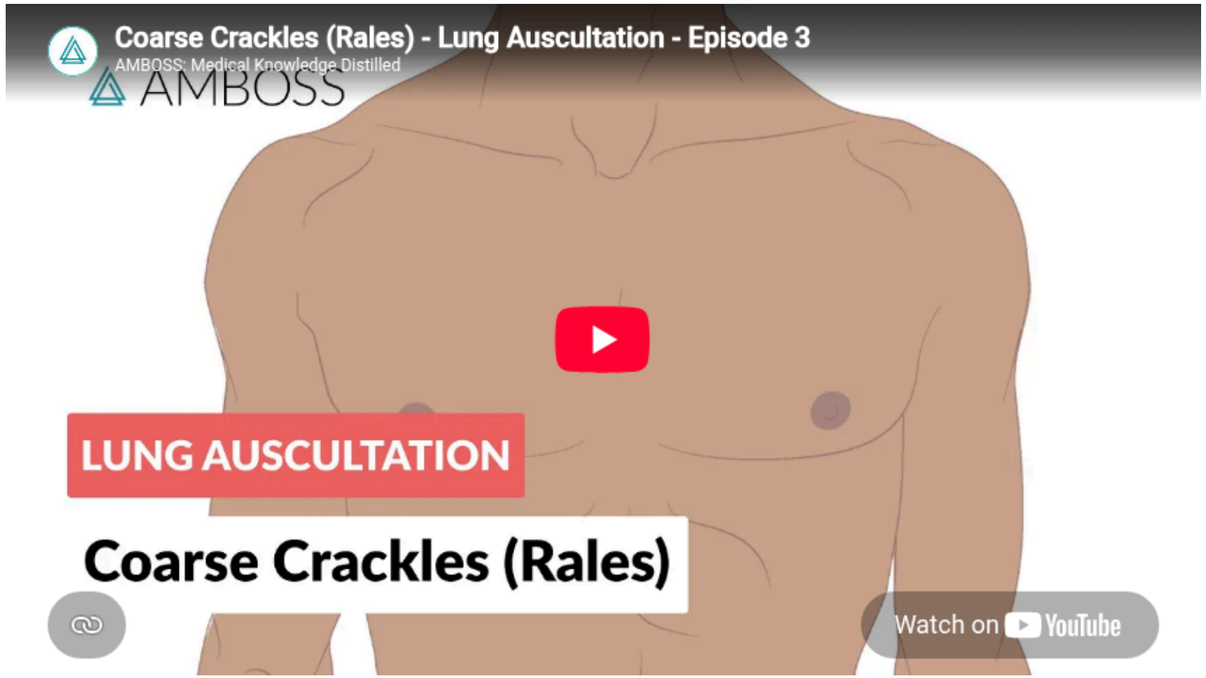
Breath Sounds



Wheeze

- A musical, high-pitched whistling sound produced by turbulent airflow in the lower airways
- Mild: only at the end of expiration
- As severity increases, wheezing lasts throughout all of expiration
- When severe, wheezing can be both inspiratory & expiratory
- Potential differentials:
  - Asthma
  - Bronchiolitis
  - Foreign body
  - Anaphylaxis
  - Viral respiratory tract infection
  - Reflux

Breath Sounds



Crackles:

- Short, non-musical sound
- Fine crackles - higher frequency, shorter duration. Caused by the sudden opening of a closed airway
- Coarse crackles are lower frequency, wet sounding. Caused by secretions
- Potential differentials:
  - Pneumonia
  - Bronchiolitis
  - Congestive heart failure
  - Viral respiratory tract infection
  - Reflux

The Deteriorating Child



- Can be difficult to assess - can’t verbally communicate well or at all
- Rely on parent report & detailed assessment
- Deterioration can be subtle and quiet
- .. until it’s rapid and catastrophic
- Adults roll down the hill, pediatric patients fall off the cliff

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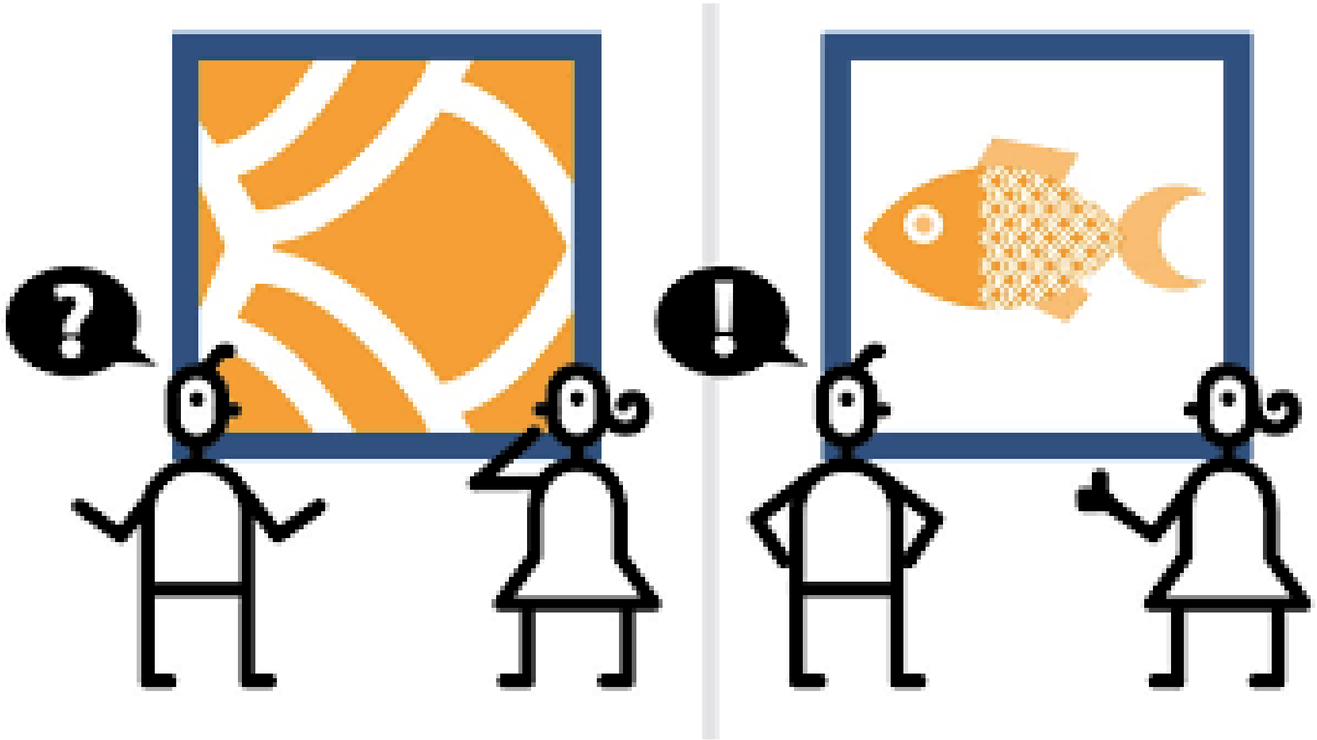
Pediatric Vital Signs

Pediatric Normal Vital Signs				
Age	**RR**	**HR**	**Systolic**	**Diastolic**
Premature	40-70	110-170	55-75	35-45
0–3 months	35-55	*(90)* 110-160	65-85	45-55
3-6 months	30-45	*(90)* 100-160	70-90	50-65
6-12 months	22-38	*(80)* 90-160	80-100	55-65
1-3 years	22-30	*(65)* 80-150	90-105	55-70
3-6 years	20-24	*(58)* 70-120	95-110	60-75
6-12 years	16-22	*(58)* 60-110	100-120	60-75
12+ years	12-20	*(50)* 60-100	110-135	65-85
(HR) represents possible lower limit in a healthy sleeping patient.				
***Always consider the patient's normal range and clinical condition!**				

ENA triage guidelines

The Deteriorating Child

- Vital signs are important but not everything
- Need to take a step back and look at the whole picture



Distress, Failure, Arrest



Respiratory Distress - the body is working really hard to breath leading to inadequate gas exchange.

Respiratory Failure - the body is no longer able to maintain adequate gas exchange (ventilation) or adequately deliver oxygen to the body's tissues (oxygenation). In children, often the precipitating factor to respiratory failure is fatigue.

Respiratory Arrest - The cessation of breathing altogether. Progressive respiratory failure is the most common cause of cardiopulmonary arrests in children.

Early vs. Late Signs

Early:

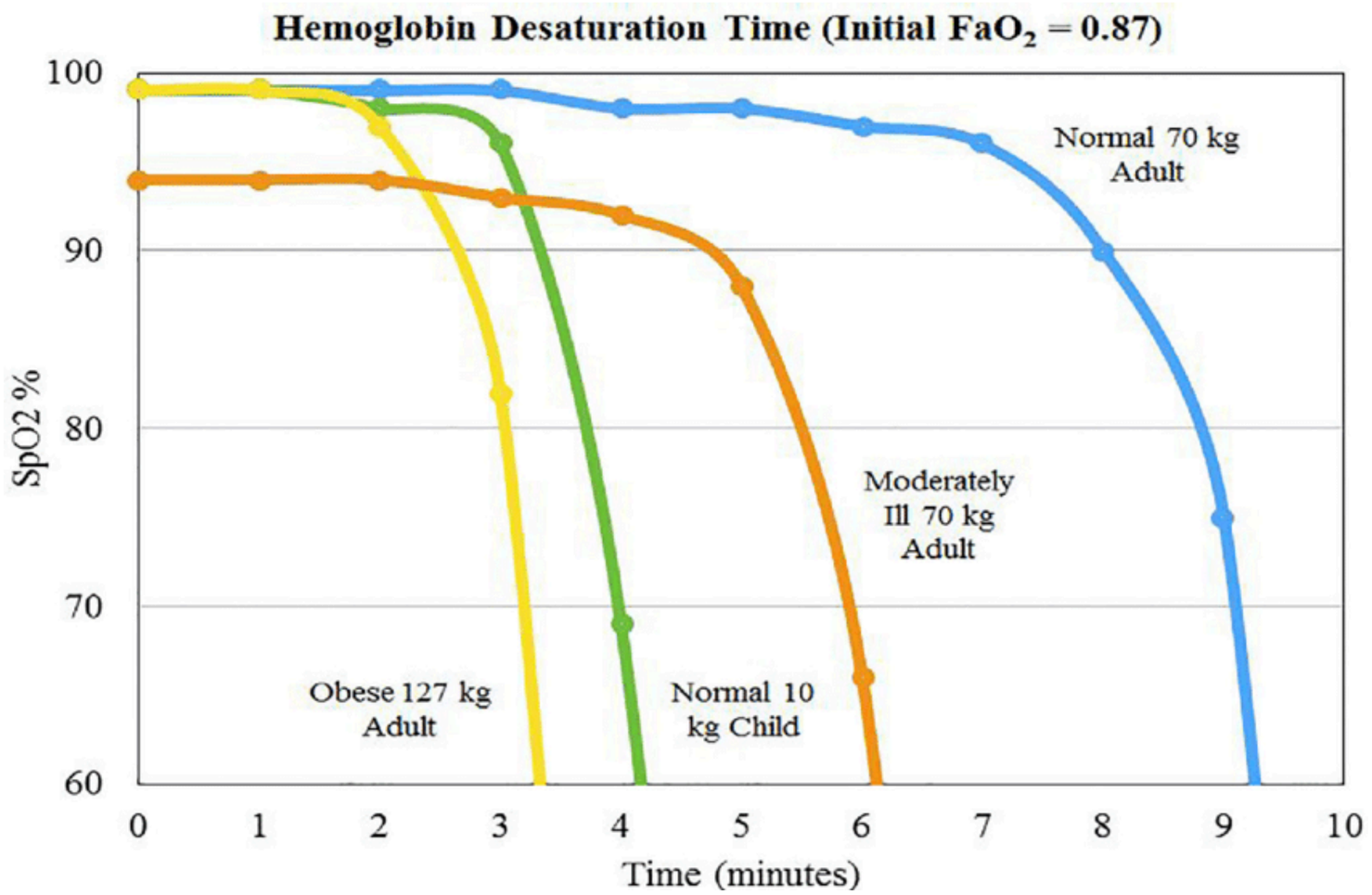
- Tachypnea
- Increased effort with accessory muscle use & retractions (subcostal, intercostal, suprasternal)
- Crying

Late:

- Tachypnea with increased effort. Head bobbing, grunting, nasal flaring, tripoding. Will lead to bradypnea when really fatigued
- Diminished breath sounds



Time to Desaturation



Circulation - Recognizing Trouble



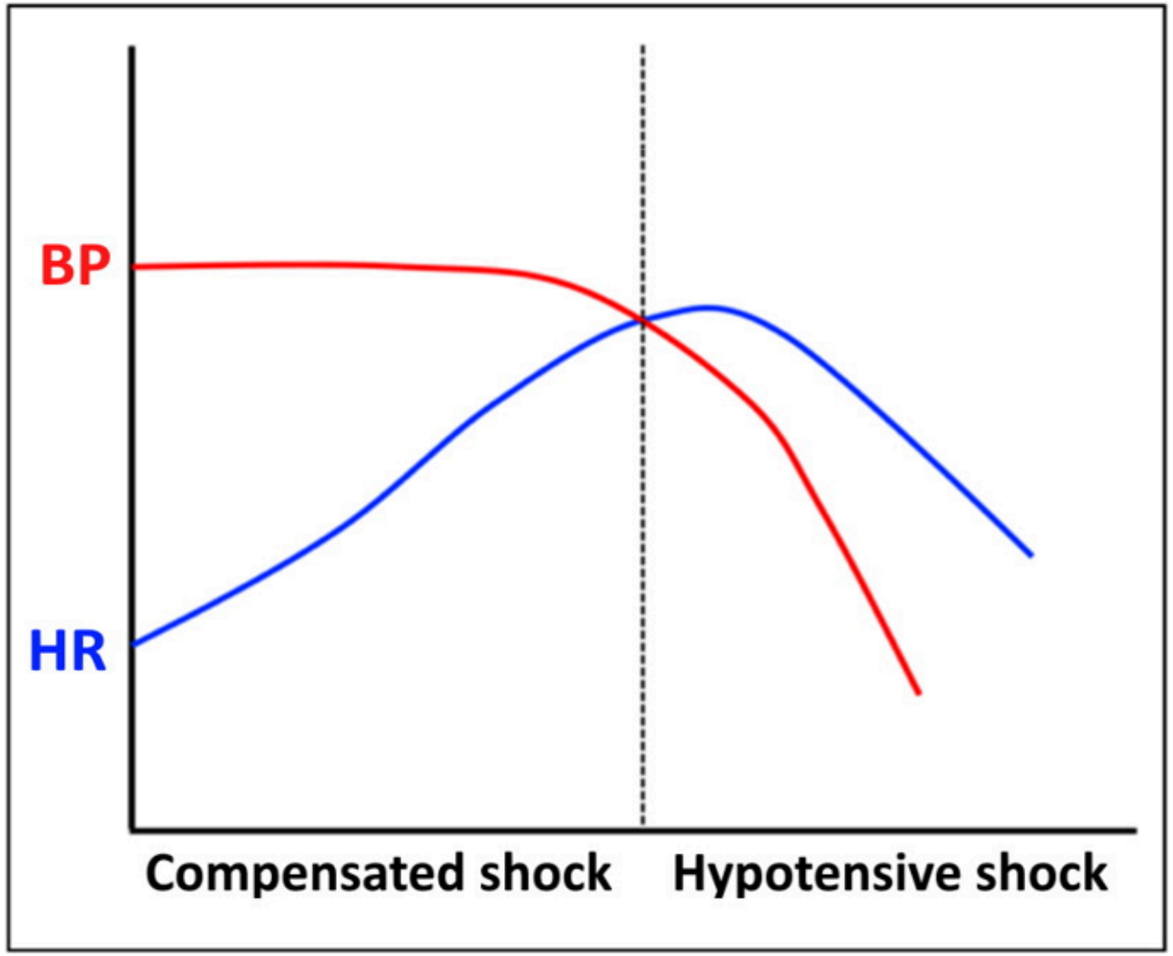
Early:

- Tachycardia
- Pale. cool extremities
- Normal blood pressure
- Oliguria - urine output < 1ml/kg/hr

Late:

- Cyanosis (peripheral/central)
- Mottled and/or poorly perfused skin
- Hypotensive - 20-25% of blood loss may occur before patient becomes hypotensive

Hypotension



CNS - Recognizing Trouble



Early:

- Lethargy
- Irritability
- Restlessness

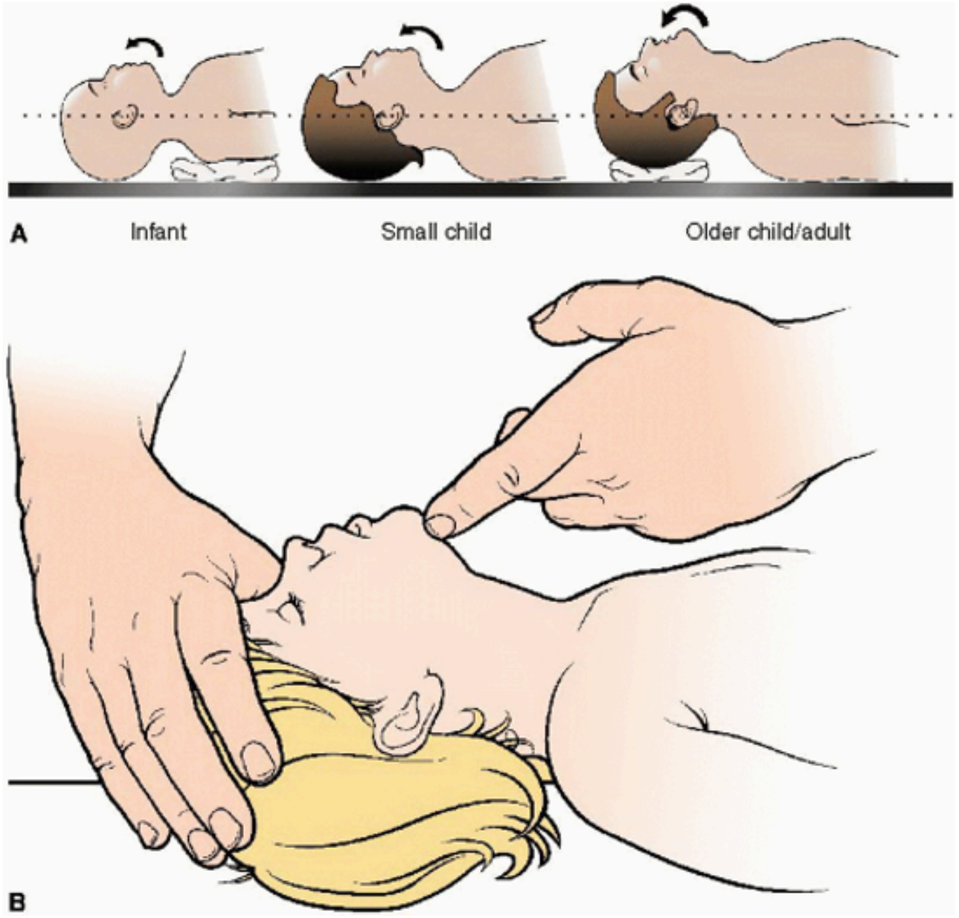
Late:

- Stupor: due to decreased brain perfusion

Airway Support

Positioning:

- Sniffing position, chin lift
- Roll under shoulders for infant due to large head
- Forehead & chin plane should be horizontally aligned
- Anterior neck space should be open & wide
- External auditory meatus & suprasternal notch plane should be horizontally aligned
- Jaw thrust to open airway if need to protect c-spine



https://doctorlib.info/medical/airway/21.html

Airway Support

Suctioning:

- Yankeur rigid catheter
- Y suction catheter
- Nasal aspirator
- 1cc syringe

Not deep and long, max. 10 sec



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Airway Support



Oropharyngeal Airway:

- Don’t use on conscious patients with a gag reflex
- Measure from the lips to the corner of the mandible
- Might help if patient in a deep sleep, sedated or intoxicated and oxygenation/end tidal CO2 are ok
- Helps keep the airway open by preventing the tongue from falling back to the posterior pharynx
- Open mouth, tongue depressor to hold tongue down, insert OPA directly in its natural concave-down position

Airway Support



Nasopharyngeal Airway:

- Can be used in anyone, except if patient has facial trauma/basal skull fracture
- Measure from nostril to tragus of ear
- Lubricate well, insert with the beveled tip facing the nasal septum. Insertion should follow the nasopharyngeal floor. Flange sits flush against the nare
- Good for patients with an intact gag reflex

Oxygen Therapy

Necessary if oxygen saturations are persistently below 90-92% on room air. Low-flow oxygen options like nasal cannula & simple face mask can only deliver FiO2 slightly above that of room air.



Flow Rates:

Nasal Cannula:

FiO2: 25 - 40%

- Newborn - max 1L/min
- Infant (< 5kg) - max 2L/min
- Peds (< 20kg) - max 4L/min
- Peds/Teens (> 20kg) - max 6L/min

Simple Face Mask:

FiO2: 35 - 50%

- 6 - 10L/min to prevent re-breathing of CO2
- Do NOT wean

Oxygen Therapy

Non-Rebreather:

- 10-15L
- Ensure bag remains inflated
- An appropriately sized, well-fitting non-rebreather will provide closer to (but not quite) 100% O2



High Flow Nasal Cannula



- Heated and humidified oxygen is easier on the nasal mucosa; patients can tolerate much higher flow rates
- Can deliver higher Fi02 than low flow therapy
- Minimizes or eliminates the inspiration of room air (and the subsequent dilution of supplemental high Fi02 gas)
- Washes out anatomic dead space
- Helps with CO2 clearance
- Typical starting flow rate of 2L/kg/min. Max 50L/min

Non-Invasive Ventilation

CPAP and BiPAP are forms of NIV

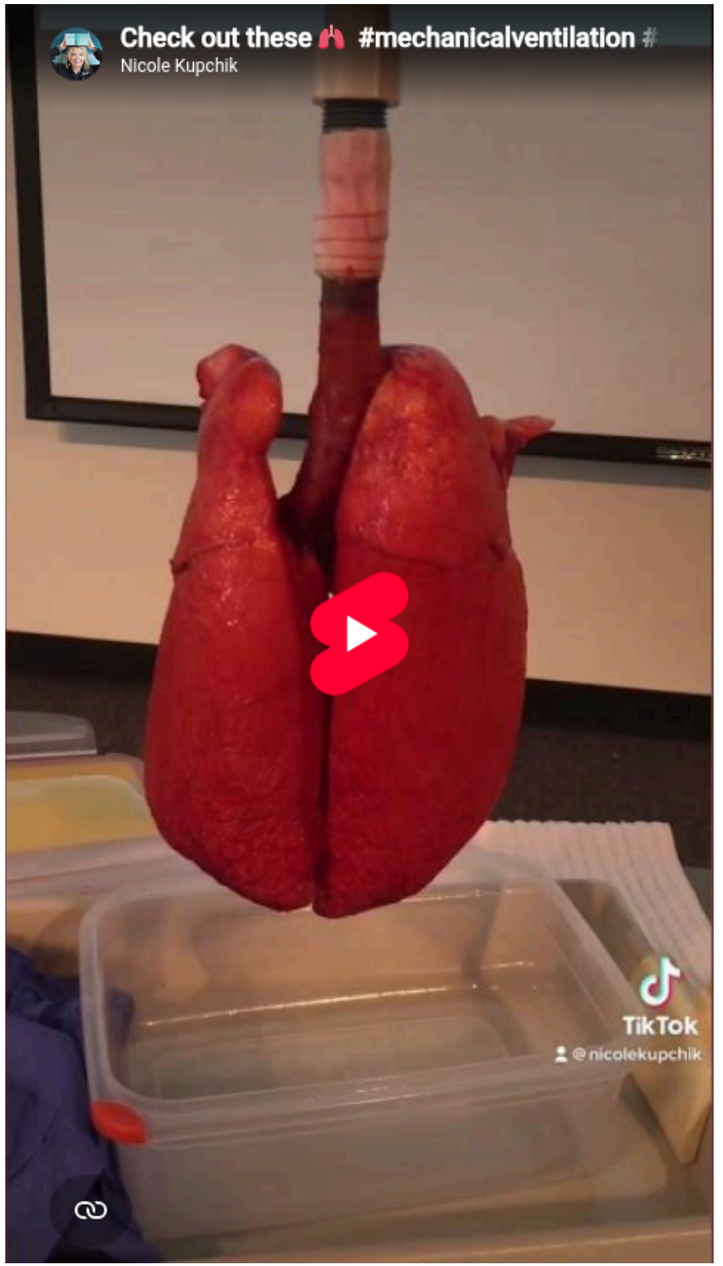
- Higher level of respiratory support than HFNC
- Reduces WOB, improves gas exchange
- CPAP provides a constant level of supportive airway pressure throughout all phases of respiration
- BiPAP uses two different pressure settings, one for inspiration and one for expiration, considered a higher level of support than CPAP



PEEP & Alveoli Recruitment

PEEP (positive end expiratory pressure) recruits alveoli by maintaining positive airway pressure at the end of expiration, acting as a “splint” to prevent collapsed or unstable alveoli from closing

Can also reopen already collapsed alveoli



Non-Invasive Ventilation



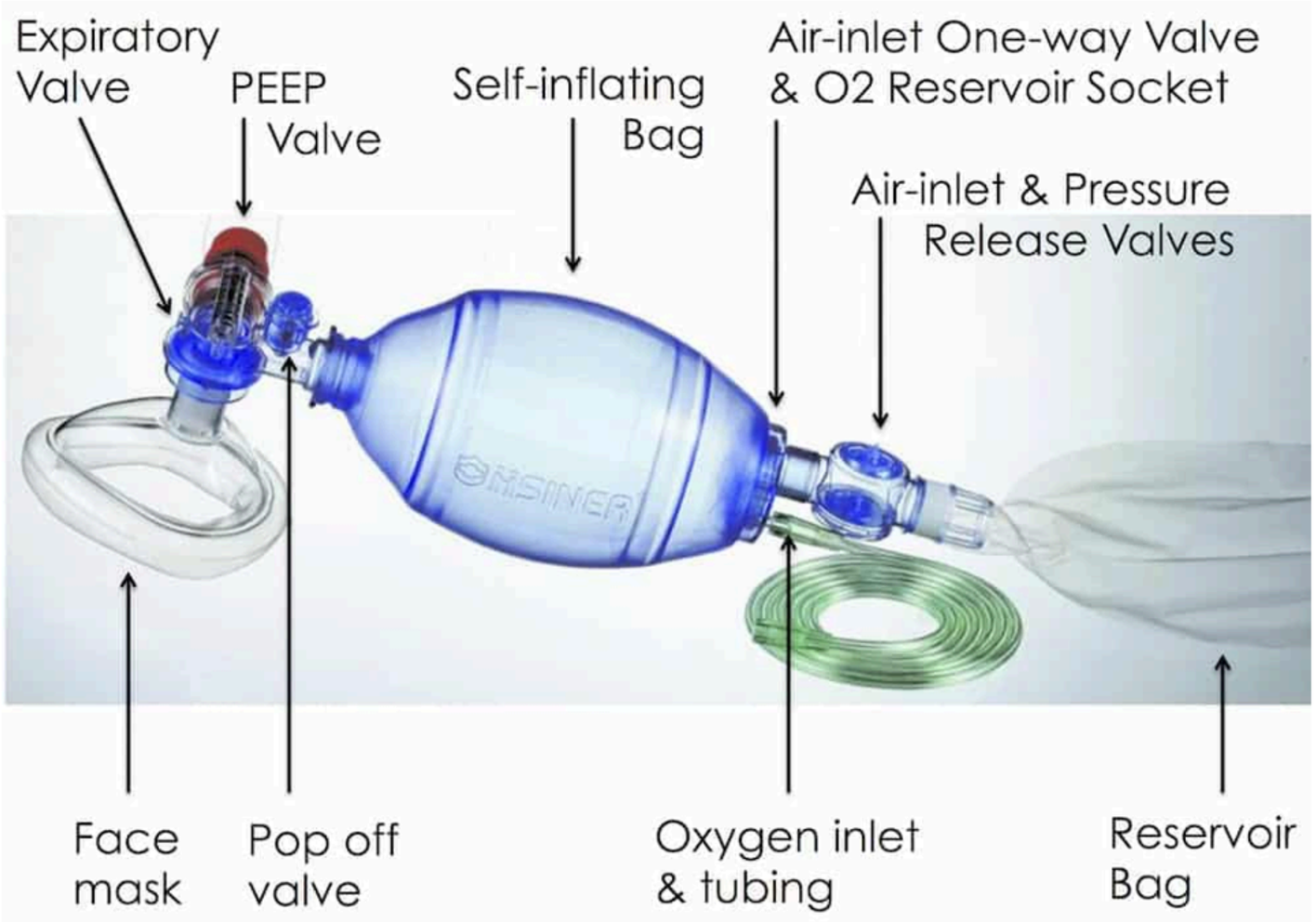
Indications:

- Acute Respiratory Distress Syndrome (ARDS)
- Asthma
- Bronchiolitis
- Pneumonia
- Neuromuscular weakness
- Obstructive sleep apnea
- Congenital central hypoventilation syndrome

Contraindications:

- Pt. MUST be spontaneously breathing
- Unstable cardiorespiratory status
- Inability to protect airway
- Inability to get adequate seal of interface
- Uncooperative patient (may need some sedation)

Bag Valve Mask



Bag Valve Mask



Indications:

- Respiratory distress and failure
- Cardiac arrest

Effective BVM requires a properly fitting mask

- Smallest mask that completely covers the patient's mouth and nose without covering the eyes or overlapping the chin
- An airtight seal is required to deliver adequate inflation volume for effective oxygenation and ventilation

Supraglottic Airway



Indications:

- Cardiac arrest: Used as a primary or rescue airway device when ventilation via bag-valve-mask (BVM) is ineffective or endotracheal intubation is delayed or unsuccessful
- Decreased LOC & unable to maintain airway
- Difficult or failed intubation

Endotracheal Intubation



- Broselow tape for equipment sizes
- RSI medication calculator - IWK Drug Information
- Prepare post intubation sedation prior to intubating
- Pre-intubation timeout - right equipment, right personel
- Discuss plan A,B,C
- Push sedative THEN paralytic
- As calm and controlled as possible. Preparation is key

Table Top Case



8m old baby, cough & congestion past 5 days. Today wheezing & having trouble breathing at home as per mom. Was crying and seemed to stop breathing for about 30 seconds. Lips turned blue. Started breathing on his own again. Mom brought him into the ED to be checked.

History:

- Fever x2 days
- Vomiting x1 with coughing at home
- + Sick contacts - older brother sick with a URTI
- NKA
- No past medical history, born term
- Mom tried older brother's puffers at home. Ventolin 2puffs 6 times at home throughout the morning but didn't seem to help

Table Top Case



Vitals on arrival:

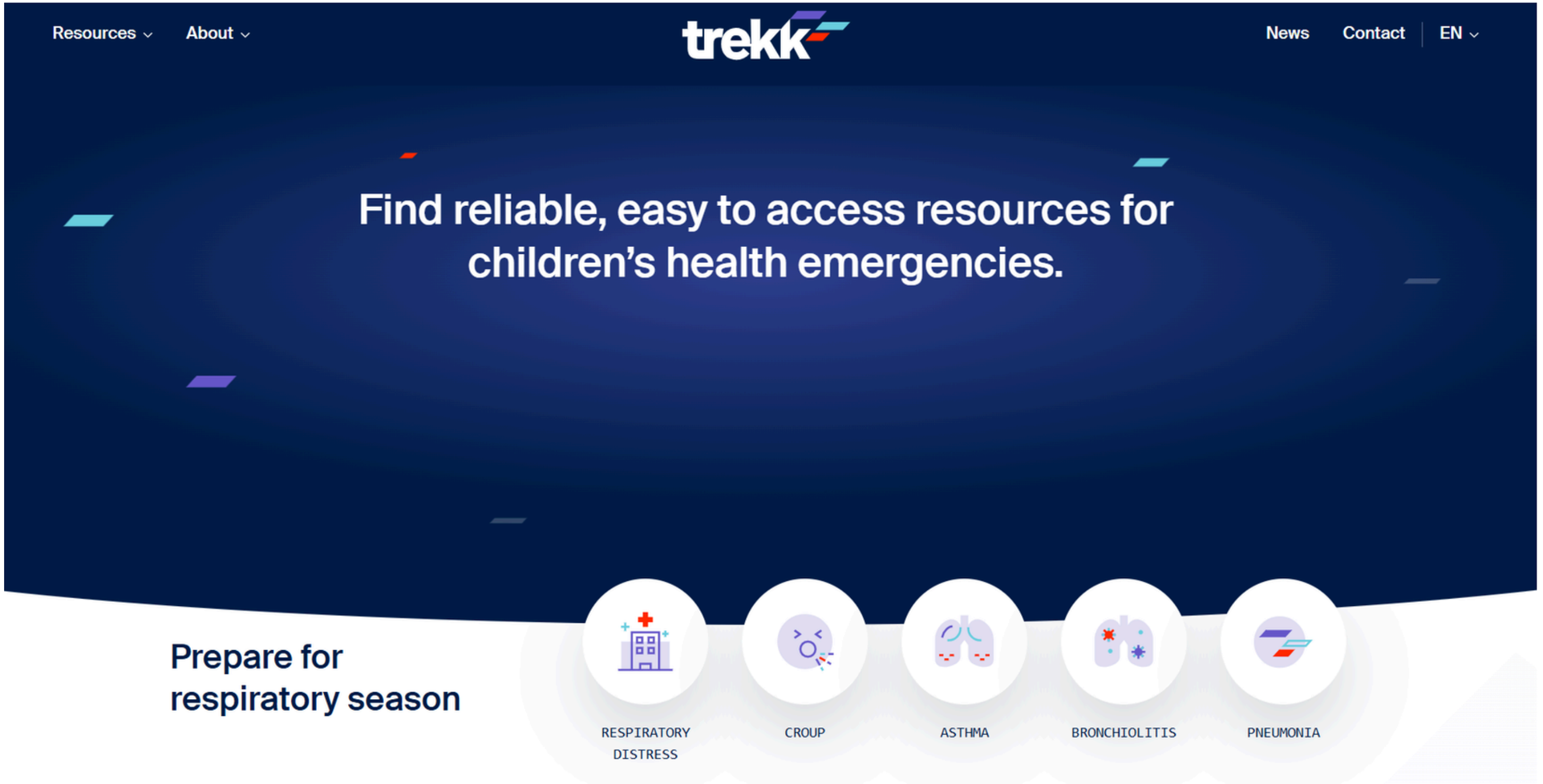
T - 38.2
HR - 175
RR - 75
BP - 95/60
O2 - 83% room air

CNS: Awake but looks tired

CVS: Pulses strong, cap refill < 2 sec

Resp: Scattered, diffuse wheezes bilaterally. Grunting and nasal flaring

Resources



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Resources

Approach to the Assessment and Management of Pediatric Respiratory Distress

Recognition of Respiratory Distress

	Mild/moderate	Severe
Respiratory rate	Tachypnea	Severe tachypnea or impending failure (decreased rate/effort)
Air entry	Decreased	Quiet chest
Work of breathing	Increased (retractions, nasal flaring)	Severely increased (head bobbing, paradoxical breathing, grunting) OR decreased effort OR apnea
Circulation	Usually normal	Pallor, mottling, cyanosis, bradycardia
Level of consciousness	Anxiety, agitation	Lethargy, unresponsiveness

Vital Signs Reference Chart

CAUTION!

Respiratory failure is the most frequent cause of pediatric cardiac arrest.

Assume that a pediatric airway is a difficult airway.

Effective BVM saves lives. Resuscitate before intubation.

Monitor HR, BP and perfusion closely.

Initial Assessment & Management

1. **Airway: Assess that airway is patent and protected.**
   - Minimal swelling can cause significant obstruction in small airways.
   - Elevate head of bed. Use head tilt or chin lift to reduce risk of upper airway obstruction; add oropharyngeal or nasopharyngeal airway PRN.
   - Use shoulder roll to reduce neck flexion and upper airway obstruction in infants/toddlers.
   - Perform nasal suction in infants to improve airway patency in obligate nose breathers.
2. **Breathing: Assess age-specific respiratory rate. Assess breath sounds and work of breathing, refer to Recognition of Respiratory Distress Table.**
   - Apply supplemental O_2 PRN.
3. **Circulation: Assess age-specific heart rate, BP, perfusion (pallor, mottling, cyanosis, skin temperature, capillary refill, pulses).**
   - Recognize tachycardia as an early sign of shock. Both bradycardia and hypotension are late signs of shock and pre-arrest.
   - Initiate IV access and 10-20 mL/kg NS/RL bolus if decreased perfusion or concern for shock.
4. **Disability: Assess level of consciousness and pupils. Measure POCT glucose.**
   - Use AVPU (alert, responsive to voice, responsive to pain, unresponsive) to assess level of consciousness.
   - Treat hypoglycemia. If blood sugar < 3.3 mmol/L treat with D10W 5 mL/kg IV and recheck in 5 minutes.
5. **Exposure: Measure core temperature and protect from heat loss.**

Resources

Further Assessment and Management		
Consideration	**Features**	**Immediate Management**
Is it the upper airway?		**Limit disturbances, assume position of comfort**
Anaphylaxis	Multi-system involvement, hypotension, urticaria, vomiting, stridor	IM Epinephrine. Refer to TREKK's Anaphylaxis Algorithm.
Croup	Barky cough, hoarse voice, stridor	Dexamethasone and nebulized epinephrine. Refer to TREKK's Croup Recommendations.
Foreign Body	History of ingestion, choking, aspiration +/- stridor	Consider early imaging if stable. Remove foreign body if visualized or proceed to bronchoscopy.
Infection (e.g., bacterial tracheitis, epiglottitis, retropharyngeal abscess)	Unwell child, fever, drooling, dysphonia, decreased neck ROM	Consider early imaging if stable. Call for help. Prepare for difficult airway. Broad-spectrum antibiotics.
Is it the lower airway?		**Limit disturbances, assume position of comfort**
Anaphylaxis	Multi-system involvement, hypotension, urticaria, vomiting, wheezing	IM Epinephrine. Refer to TREKK's Anaphylaxis Algorithm.
Asthma	Wheeze, prolonged expiratory phase, atopic history, responsive to Salbutamol	Bronchodilators and corticosteroid. Refer to TREKK's Asthma Algorithm.
Bronchiolitis	Infant/toddler with URTI prodrome, generalized wheeze/crackles	Supportive care. Refer to TREKK's Bronchiolitis Recommendations.
Pneumonia/viral lower respiratory tract infection	Hypoxia, tachypnea, fever, focal chest findings on exam	CXR, POCUS. Supplemental O_2 PRN. IV/PO hydration. IV/PO antibiotics (pneumonia only). Refer to TREKK's Pneumonia Recommendations.
Foreign Body	History of ingestion, choking, aspiration +/- stridor, unilateral wheeze	Consider early imaging if stable. Proceed to bronchoscopy.
Pneumothorax	Unilateral decreased/absent breath sounds, tracheal deviation/hypotension (if tension pneumothorax)	POCUS, CXR. Needle decompression (tension pneumothorax), chest tube insertion.
Is it the heart?		
Congestive Heart Failure	Murmur, crackles, hepatomegaly, tachypnea, faltering growth, signs of cardiogenic shock (if secondary to myocarditis)	CXR, ECG, POCUS. Consult Pediatrics/Pediatric Cardiology/PICU/ Pediatric Referral Centre. May need diuresis. May need pressors. Minimize use of IV fluids.
Congenital Heart Disease	Cyanosis, shock, murmur, hepatomegaly, absent femoral pulses, abnormal pre/post ductal sats, abnormal four-limb BP, no improvement with supplemental oxygen (failed hyperoxic test)	Consult PICU/Pediatric Referral Centre/Transport Team.
Is it another cause?		
Disordered control of breathing	Raised ICP with irregular breathing/apnea; DKA with ketotic/Kussmaul respiration; toxic ingestion with altered LOC, vomiting	Initiate workup and consult Pediatrics/Pediatric Referral Centre. Treat underlying cause.
Polytrauma	Dangerous mechanism of injury, thoracic injuries	Follow ATLS protocol.

Pediatric Referral Centre Discussion

- Severity of work of breathing and level of consciousness
- Key management steps to be initiated prior to transfer
- Need for respiratory support, including HFNC or non-invasive ventilation or intubation
- Initiate transport if respiratory support needs cannot be met
- Review transport checklist (trekk.ca)

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BOTTOM LINE RECOMMENDATIONS

Bronchiolitis

trekk Translating Emergency Knowledge for Kids

Bronchiolitis is a common viral illness. It is usually caused by Respiratory Syncytial Virus (RSV) and typically occurs during the late fall and winter months. Children less than 2 years of age are most affected, with the largest burden of illness being in infants less than 12 months of age.

The illness is characterized by acute inflammation in the airways, edema & necrosis of epithelial cells lining the small airways, bronchospasm, and increased mucus production.

Clinical signs and symptoms include runny nose, cough, wheezing, crackles, increased respiratory effort, and fever.

Patient-level risk factors for severe bronchiolitis include less than 2 months of age, history of prematurity, and presence of underlying cardio-respiratory disease or immunodeficiency.[1]

Diagnosis

- Bronchiolitis is a clinical diagnosis based on the patient's history and physical exam.
- Typically made for a first episode of wheezing in children less than 24 months of age in winter months.
- Routine laboratory tests and chest x-rays are **NOT** helpful in diagnosing or managing bronchiolitis; use of chest x-rays is associated with inappropriate use of antibiotics.[2]
- Viral testing by PCR should **only** be performed for cohorting infants admitted to hospital. Consider rapid influenza testing for high-risk patients who may benefit from antiviral treatment.[3] COVID-19 viral testing should follow local public health policies.
- Refer to TREKK's Fever in Young Infants Recommendations, for infants 0-60 days with febrile bronchiolitis.

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Treatment

- **Supportive care is the cornerstone of treatment.**
- The main management goals are to ensure adequate oxygenation and hydration.



OXYGENATION

- Supplemental oxygen is only necessary if oxygen saturations are persistently less than 90% while awake. Transient mild desaturations during sleep are frequent, and do not warrant supplemental oxygen.[4]
- Oxygen saturations should be checked **intermittently**, not continuously, unless the patient is receiving respiratory support.[5]
- Limited suctioning to clear the nares may decrease respiratory distress in younger infants and should be considered prior to feeds.
- **High-flow nasal cannula (HFNC)** can improve work of breathing and oxygenation in infants/children with moderate-severe respiratory distress. However, trials suggest that it does not reduce the risk of subsequent ICU admission, or positive pressure ventilation (non-invasive or invasive) when compared to low-flow oxygen. Use HFNC as a rescue treatment for those who fail standard oxygen therapy and start at a dose of 2L/kg/minute.[6]
- Infants/children with signs of respiratory failure (respiratory acidosis, altered mental status, and/or apnea) or persistent severe respiratory distress will need advanced respiratory support with **non-invasive ventilation** (CPAP, BiPAP) or **invasive ventilation, and admission to a PICU.**

HYDRATION

- Poor feeding and dehydration can complicate a bronchiolitis episode.
- Use smaller more frequent oral feeds, if tolerated.
- Nasogastric (NG) or intravenous (IV) rehydration may be necessary for infants/children who cannot maintain oral hydration or are on positive-pressure ventilation. NG tube is the hydration method of choice since it is easier to insert and associated with fewer adverse events.[7]

Thank you!

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