

Pediatric Assessment: Sick or not Sick?

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Financial Disclosures

I have NO relevant financial relationships with any commercial interests



Objectives

- Discuss the differences of pediatric and adult physiology
- Identify a deteriorating pediatric patient's signs and symptoms using assessment tools
- Review initial interventions for a resuscitation and stabilization of a pediatric patient
- Discuss escalation of care of pediatric emergencies including changing levels of support and triggers for transferring a patient





Why do we care?

Hospitalizations

Over 5 million stays annually

Total cost 46 billion dollars

17% admitted via ED

Causes:

Respiratory

Mental Health

(Weiss, Liang, & Martin, 2022)





Why do we care?

Pediatric Cardiac Arrest

7-10% of EMS calls

Most common ages

0-1 years & 15-17 years

(Shekhar et al., 2022)

Greater complexity of care

(Hansen et al., 2023)

OHCA has ~90% mortality

(Mick & Williams, 2020)

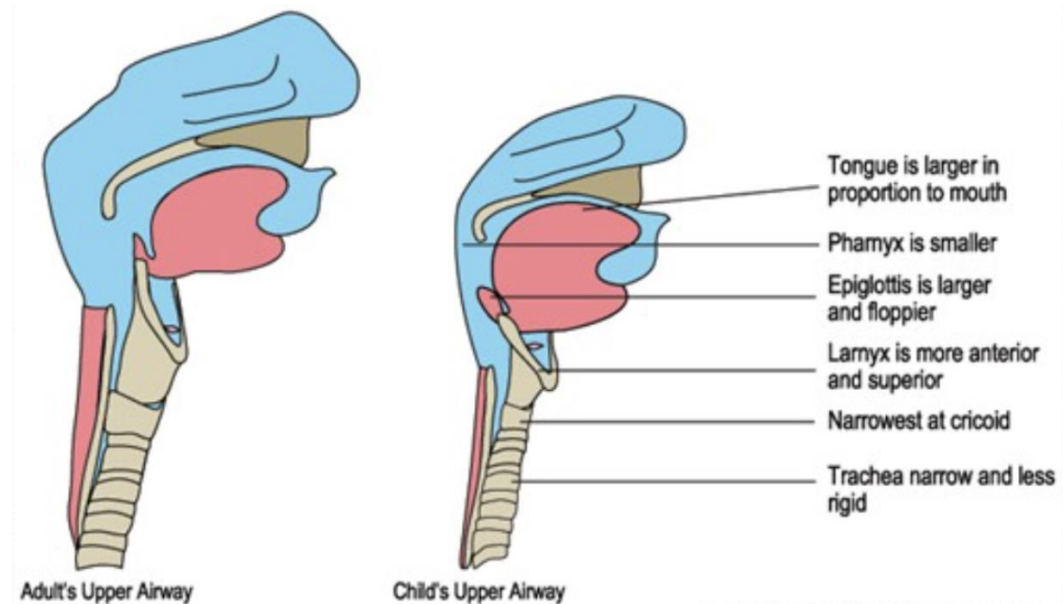
Quick physiology review...

Respiratory

Pediatric vs Adult airway

- Larger head compared to body size
- Larger tongue compared to mouth size
- Smaller nose, mouth, airways
- Musculature not fully developed
- More flexible rib cage
- Rely more on abdominal musculature

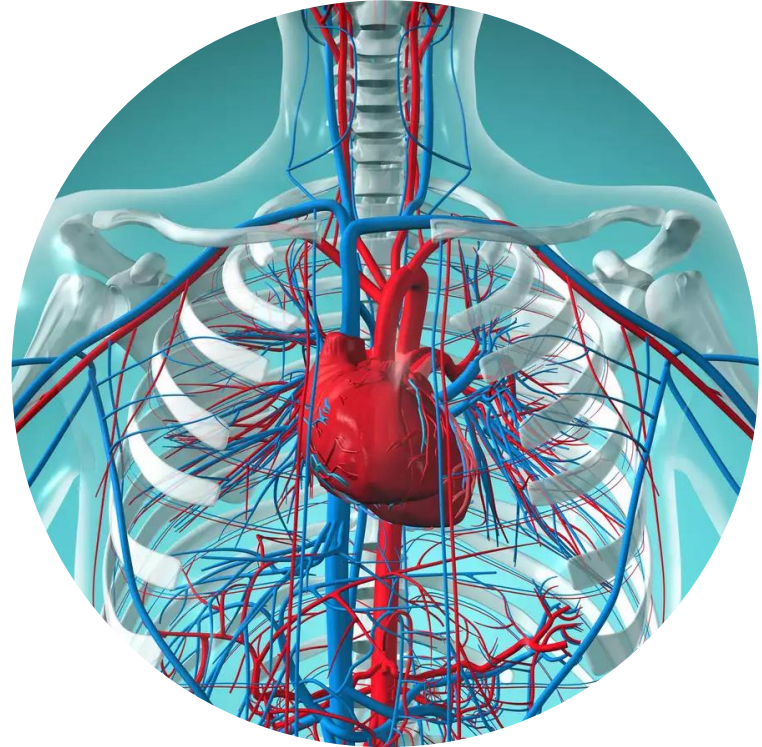
(DiCicco et al., 2021)



Cardiovascular

Pediatric vs Adult cardiovascular system

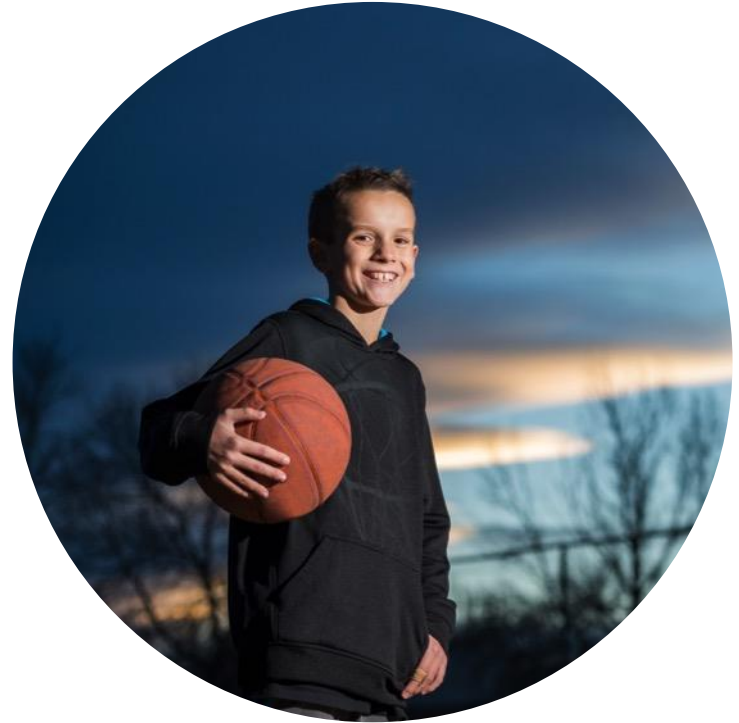
- Increased physiologic reserve
- Smaller circulating volume
- Decreased contractility
- Increased oxygen delivery and oxygen consumption



Neurologic

- Fontanelles provide increased tolerance of increased pressures and expansion
- Increased cerebral metabolism

(Figaji, 2017)

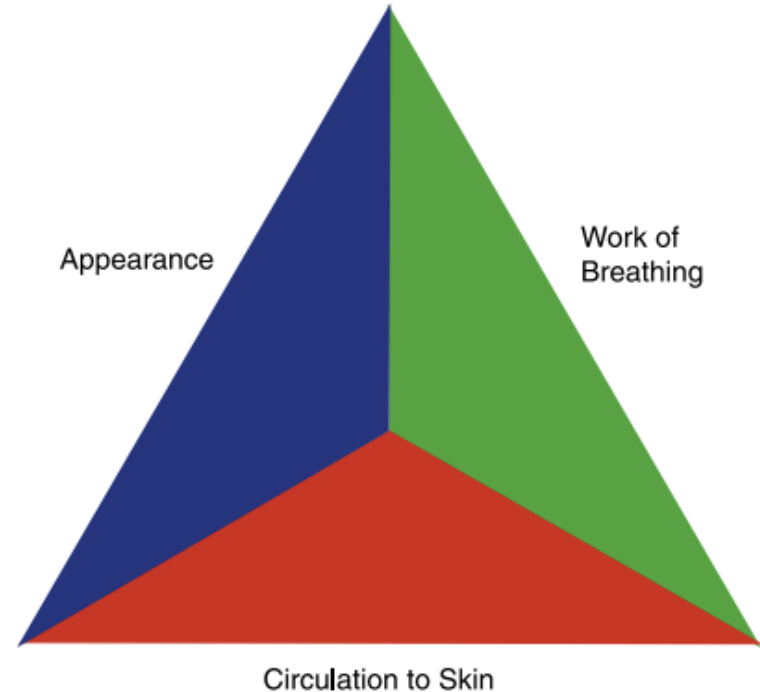


Physical Assessment

Approaching the Pediatric Patient

Pediatric Assessment Triangle

- Observational
 - No equipment needed
- Helps to prioritize interventions
(Dieckmann, Fuchs, & Gausche-Hill, 2023)
- Indicate urgency and severity of illness





AMERICAN ASSOCIATION
of CRITICAL-CARE
NURSES

PALS

Vital Signs in Children

These 3 tables are reproduced or modified from Hazinski MF. Children are different. In: *Nursing Care of the Critically Ill Child*. 3rd ed. Mosby; 2013:1-18, copyright Elsevier.

Normal Heart Rates*

Age	Awake rate	Sleeping rate (beats/min)
Neonate	100-205	90-160
Infant	100-180	90-160
Toddler	98-140	80-120
Preschooler	80-120	65-100
School-age child	75-118	58-90
Adolescent	60-100	50-90

*Always consider the patient's normal range and clinical condition. Heart rate will normally increase with fever or stress.

Normal Respiratory Rates*

Age	Rate (breaths/min)
Infant	30-53
Toddler	22-37
Preschooler	20-28
School-age child	18-25
Adolescent	12-20

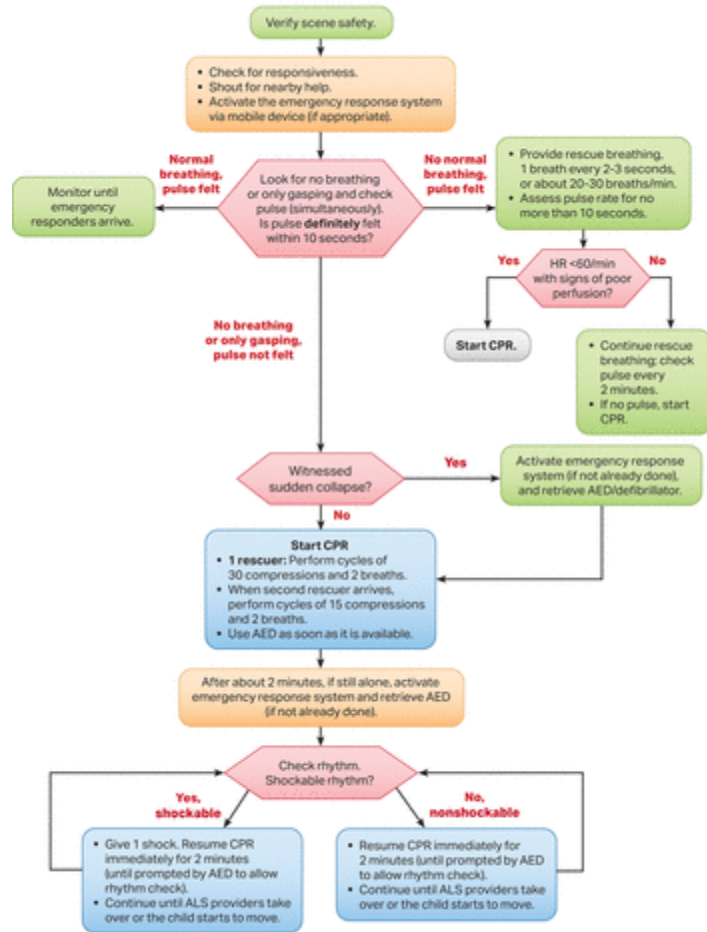
*Consider the patient's normal range. The child's respiratory rate is expected to increase in the presence of fever or stress.

Data from Fleming S et al. *Lancet*. 2011;377(9770):1011-1018.

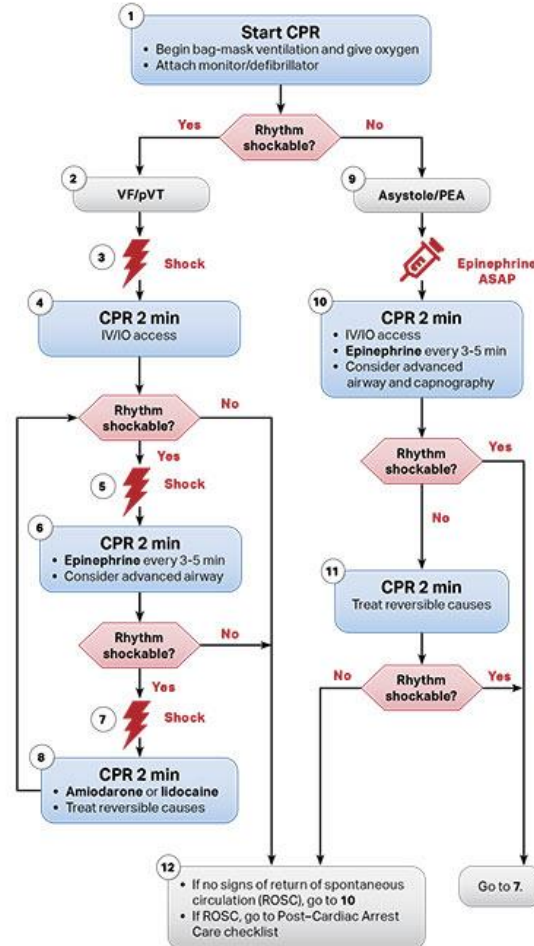


American Heart Association: <https://shopcpr.heart.org/pals-digital-reference-card>

Pediatric Basic Life Support Algorithm for Healthcare Providers—Single Rescuer



Pediatric Cardiac Arrest Algorithm



CPR Quality

- Push hard (2/3 of anteroposterior diameter of chest) and fast (100-120/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Change compressor every 2 minutes, or sooner if fatigued
- If no advanced airway, 15:2 compression-ventilation ratio
- If advanced airway, provide continuous compressions and give a breath every 2-3 seconds

Shock Energy for Defibrillation

- First shock 2 J/kg
- Second shock 4 J/kg
- Subsequent shocks ≥ 4 J/kg, maximum 10 J/kg or adult dose

Drug Therapy

- Epinephrine IV/IO dose:** 0.01 mg/kg (0.1 mL/kg of the 0.1 mg/mL concentration). Max dose 1 mg. Repeat every 3-5 minutes. If no IV/IO access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of the 1 mg/mL concentration).
- Amiodarone IV/IO dose:** 5 mg/kg bolus during cardiac arrest. May repeat up to 3 total doses for refractory VF/pulseless VT or
- Lidocaine IV/IO dose:** Initial: 1 mg/kg loading dose

Advanced Airway

- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor ET tube placement

Reversible Causes

- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypoglycemia
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary

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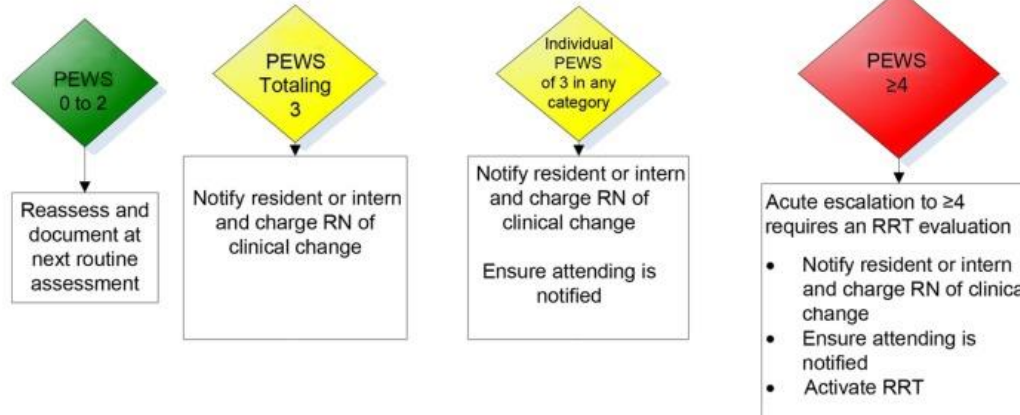


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Pediatric Early Warning Score

PEWS

	0	1	2	3	Score
Behavior	<ul style="list-style-type: none"> Active and alert Appropriate at baseline Sleeping and/or easily arousable 	<ul style="list-style-type: none"> Sleepy Fussy but consolable 	<ul style="list-style-type: none"> Irritable Inconsolable Agitated, anxious 	<ul style="list-style-type: none"> Lethargic Confused Reduced response to pain 	
Cardiovascular	<ul style="list-style-type: none"> Pink Capillary refill 1 to 2 seconds HR normal for age 	<ul style="list-style-type: none"> Pale Capillary refill 3 seconds 	<ul style="list-style-type: none"> Gray Capillary refill 4 seconds Tachycardia of 20 above normal rate 	<ul style="list-style-type: none"> Mottled Capillary refill ≥ 5 seconds or above Tachycardia of 30 above normal rate or bradycardia. 	
Respiratory	<ul style="list-style-type: none"> RR normal for age No retractions or stridor 	<ul style="list-style-type: none"> RR >10 above normal parameters Use of accessory muscles 30%+ F_{IO_2} 3+ L per minute 	<ul style="list-style-type: none"> RR greater than 20 above normal parameters Retractions 40%+ F_{IO_2} 6+ L per minute Ventilator dependent 	<ul style="list-style-type: none"> RR below normal parameters with retractions Grunting 50% F_{IO_2} 8+ L per minute Continuous nebulization 	



Lockwood, J., Reese, J., Wathen, B., Thomas, J., Brittan, M., Iwanowski, M., & McLeod, L. (2019). The Association Between Fever and Subsequent Deterioration Among Hospitalized Children With Elevated PEWS. *Hospital pediatrics*, 9(3), 170–178. <https://doi.org/10.1542/hpeds.2018-0187>



Distress or Failure?

Early Signs/Symptoms

Distress

Tachypnea

↑ Respiratory Effort

Abnormal Airway Sounds

Retractions

Accessory muscle use

Abdominal breathing



Failure

Marked Tachypnea (early)

Apnea (late)

↑/↓ respiratory effort

Poor/absent distal air

Movement

See saw breathing

Tracheal tug

Grunting

Nasal Flaring

Position of comfort



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What do you observe that causes concern?



What do you observe that causes concern?



Early Signs/Symptoms

Tachycardia

Pale

Cool extremities

Normal Blood Pressure

Decreased UOP



Late Signs/Symptoms

Cyanosis

Mottled skin

Hypotension



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Initial Impression



What do you observe that causes concern?



**Early
Signs/Symptoms**

Irritability
Restlessness
Lethargy
Tachycardic



Late Signs/Symptoms

Decreased responsiveness
Unresponsive
Cushing's Triad
Flaccid



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Stabilization and Treatment



Evaluation

Identify Primary Underlying Problem/Cause

- Respiratory
 - Upper
 - Lower
- Circulation
 - Shock
 - Hypovolemic, Distributive, Cardiogenic, or Obstructive
- Neuro
 - Stroke
 - Seizure
 - Ingestion



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Early Intervention Considerations

- Ask for help!
- Use your resources
 - Call Provider, Charge Nurse, RT or additional EMS staff
 - IV/IO placement,
 - Pharmacy
 - Broselow tape or cart
 - Code Blue



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Broselow-Luten Tape



RED	6-7kg	WHITE	15-18kg
PURPLE	8-9kg	BLUE	19-23kg
YELLOW	10-11kg	ORANGE	24-29kg
	12-14kg	GREEN	30-36kg

<https://crystalsokolovrn.com/wp-content/uploads/2019/05/Broselow-Pediatric-Emergency-Tape-2.pdf>

BLUE

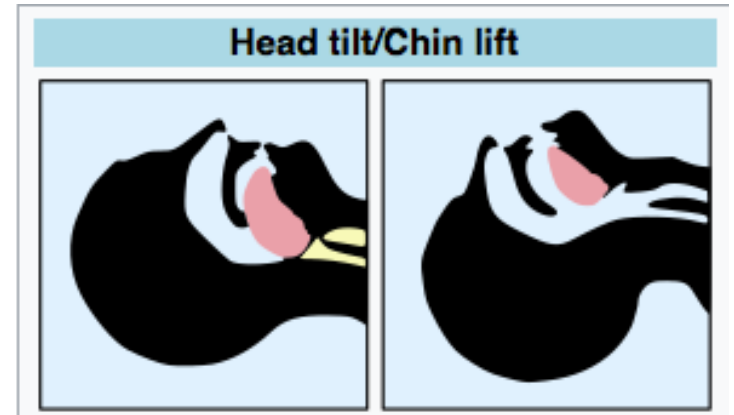
SEIZURE		ICP	
Lorazepam (2 mg/mL)	2 mg (1 mL)	3% Saline	42-105 mL
(4 mg/mL)	2 mg (0.5 mL)	Mannitol 20% (0.2 g/mL)	21 g (105 mL)
Diazepam IV (5 mg/mL)	4.2 mg (0.84 mL)	25% (0.25 g/mL)	21 g (84 mL)
Phenobarbital (65 mg/mL)	420 mg (6.5 mL)	Furosemide (10 mg/mL)	21 mg (2.1 mL)
(130 mg/mL)	420 mg (3.2 mL)		
Phenytoin (50 mg/mL)	420 mg (8.4 mL)	FLUIDS	
Fosphenytoin (50 mg PE/mL)	420 mg PE (8.4 mL)	Fluid Bolus	
Levetiracetam (100 mg/mL)	1050 mg (10.5 mL)	Crystalloid (NS or LR)	420 mL
		Colloid/blood	210 mL
OVERDOSE/HYPOGLYCEMIA		Maintenance	
D ₂₅ W (0.25 g/mL)	10.5 g (42 mL)	D5 1/2 NS + 20 mEq KCL/L	63 mL/hr
D ₅₀ W* (0.5 g/mL)	10.5 g (21 mL)	PAIN	
Naloxone (1 mg/mL)	2 mg (2 mL)	Fentanyl (50 mcg/mL)	21 mcg (0.42 mL)
(0.4 mg/mL)	2 mg (5 mL)	Morphine (2 mg/mL)	2.1 mg (1.1 mL)
Flumazenil (0.1 mg/mL)	0.2 mg (2 mL)	(4 mg/mL)	2.1 mg (0.53 mL)
Charcoal (25 g/120 mL)	21 g (100mL)		
Glucagon (1 mg/mL)	1 mg (1 mL)		
		* Dilute D ₅₀ W 1:1 with preservative free sterile water	
EQUIPMENT		EQUIPMENT	
*E.T. Tube	5.5 Uncuffed/*5.0 Cuffed	Oxygen Mask	Pediatric NRB
E.T. Insertion Length	15.5-16.5 cm	*ETCO ₂	Adult
Stylet	10 French	*Urinary Catheter	10-12 French
Suction Catheter	10 French	*Chest Tube	20-28 French
Laryngoscope	2 Straight or Curved	NG Tube	10-14 French
BVM	Child	Vascular Access	18-20 Ga
Oral Airway	70 mm	Intraosseous (IO)	15 Ga
*Nasopharyngeal Airway	24 French	BP Cuff	Child
*LMA	2-2.5	*May not be included in Organizer System(s).	

<https://www.hmpgloballearningnetwork.com/site/emsworld/article/1224785/times-tapes-are-changin-latest-broselow-luten-tape-ems>



Airway Interventions

- Positioning
 - Allow patient to assume position of comfort
 - Head tilt-chin lift maneuver (shoulder roll)
- Suction
- Positive pressure with BVM
- Nasopharyngeal (NP) airway
- Medications
 - Racemic Epinephrine
 - Albuterol



Breathing Interventions

- Determine upper vs lower airway disease
- Apply oxygen – Blowby, NC, HFNC, NIPPV, Intubation
- Suction
 - Hydration status?
- Medications
 - Albuterol
 - Racemic epi nebs



Upper Airway Obstruction



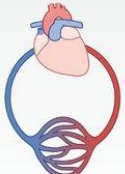
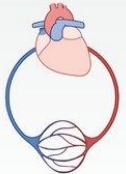
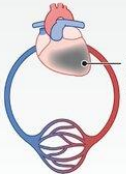
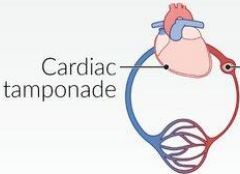


Lower Airway Obstruction



Circulation Interventions

Shock

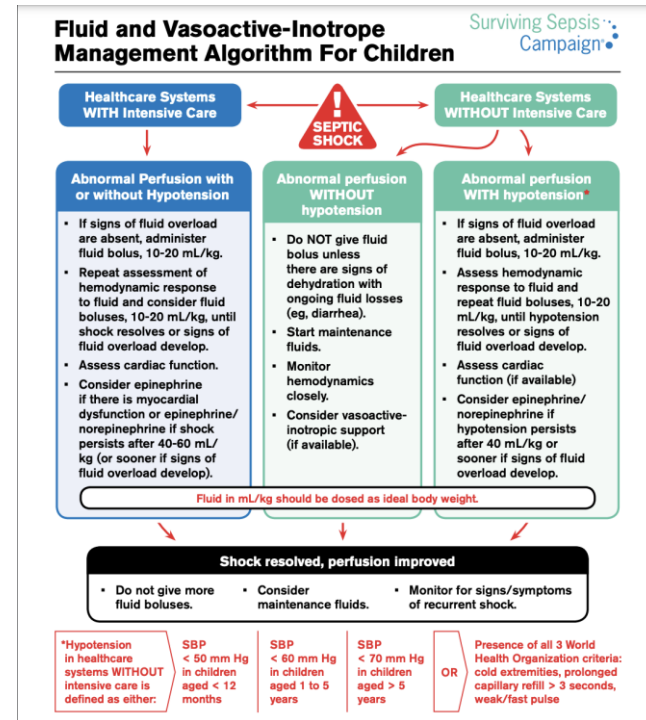
Classification of Shock							
Volume				Output			
Shift Distributive shock		Loss Hypovolemic shock		Cardiac Cardiogenic shock		Extracardiac Obstructive shock	
Septic	Capillary leakage	Hemorrhagic (traumatic or nontraumatic)	Blood (whole)	Myocardial causes	Myocardium	Impaired diastolic filling	E.g., cardiac tamponade
Anaphylactic	Vascular tone dysregulation	Nonhemorrhagic (nontraumatic)	Body fluids (e.g., GI loss)	Arrhythmias	Conduction system	↑ Ventricular afterload	E.g., massive PE
Anaphylactoid		Nonhemorrhagic (traumatic)	Plasma (e.g., from burns)	Valvular heart disease		Obstruction of venous return	E.g., tension pneumothorax
 <p>Vasodilation</p>		 <p>Hypovolemia</p>		 <p>Pump failure</p>		 <p>Cardiac tamponade</p> <p>Obstruction</p>	



Circulation Interventions

Shock

- PALS Algorithms
 - Stop source of fluid losses if applicable
- Fluid Bolus
 - 20 mL/kg
 - Isotonic fluids
- Medications
 - Anaphylaxis
 - Sepsis Activation
- Expert consultation



Initial Impression



Septic shock

Delayed cap refill


Cold extremities



Disability Interventions

Mental Status

- GCS
- AVPU
- Neuro Exam
- Seizure
- Stroke
- Ingestion



GLASGOW COMA SCALE					
<2 Years Old		EYES		Age 2 - Adult	
4	Spontaneous		Spontaneous	4	
3	To speech		To speech	3	
2	To pain		To pain	2	
1	None		None	1	
VERBAL					
5	Coos, babbles		Oriented	5	
4	Irritable, cries		Confused	4	
3	Cries to pain		Inappropriate words	3	
2	Moans to pain		Incomprehensible	2	
1	None		None	1	
MOTOR					
6	Normal spontaneous movements		Obeys commands	6	
5	Withdraws from touch		Localizes to pain	5	
4	Withdraws from pain		Withdrawal to pain	4	
3	Abnormal flexion		Flexion to pain	3	
2	Abnormal extension		Extension to pain	2	
1	None		None	1	
Total PGCS Score			Total GCS Score		
TriageTags.com			DMS-05743 · Rev. 12-9-21		



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Exposure Interventions

Thermoregulation

- Remove wet or damaged clothing
- Warming
 - Blankets
 - Warmed IV fluids
 - Bair Hugger, heat packs
- Cooling
 - Remove layers
 - Ice packs, wet washcloths
 - Cooling blankets
 - Antipyretics

Escalation

Monitor

Serial assessments
Disease specific severity scores
Utilize Pediatric Early Warning Score (PEWS)

Escalate

Escalate support using Clinical Pathways as a guide

- Keep in mind your facilities resources

Call

Call In house ED provider or code team
Call an RRT or call CHCO OneCall to speak with PICU, ED or Inpatient teams
Activate transfer to higher level of care





Progressive Case Study



Case Study – EMS call to home

14 month old child with no prior medical history with increased work of breathing. Caregiver called 911 due to child's distress

Caregiver endorses three days of URI symptoms including cough and rhinorrhea with fevers up to 103.

Hx: Born full term. Imm UTD. Attends daycare. No known allergies.

VS: T: 102.6°F HR: 156 RR: 46 O₂ Sat: 89% BP: 92/48

PE: **General:** WNWD, non-toxic appearing, alert

Neuro: Held by caregiver, tracking examiner, crying upon approach but soothed easily, normal tone throughout

HEENT: NC/AT, PERRL, no eye discharge or injection, mild rhinorrhea

Resp: Tachypneic, mild subcostal retractions with belly breathing, no wheezing, rhonchi, or rales. Aerating to bases. Equal chest rise.

Cardiac: Tachycardic rate, no m/r/g, distal pulses 2+, cap refill 2s, warm extremities

Abdomen: Soft, ND/NT, no HSM or masses. Normoactive BS.

MSK: MAES, FROM, no edema or tenderness

Skin: No rash, lacerations or ecchymosis.



Case Study

PAT – Respiratory only

PEWS score: Behavior 0 CV 0 Resp 1

Initial management:

Supplemental oxygen

What level of support?

Suction

Nasal aspirator (non-invasive)

<https://vimeo.com/508853687/684e8a81cd>

Hydration status

Making urine? Drinking?

Antipyretics



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Case Study – Emergency Department

Assessment upon arrival:

VS: T: 99.1°F (37.3°C) HR: 166 RR: 62 O₂ Sat: 90% on 3L LFNC BP: 88/50

PE: **General:** WNWD, tired appearing

Neuro: irritable with intermittent crying

HEENT: NC/AT, PERRL, no eye discharge or injection, rhinorrhea with congestion noted

Resp: Tachypneic, moderate subcostal and intercostal retractions with belly breathing, intermittent grunting noted, expiratory wheeze, no rhonchi, or rales. Prolonged expiratory phase. Aerating to bases bilaterally and nonfocal. Equal chest rise.

Cardiac: Tachycardic, no m/r/g, distal pulses 2+, cap refill 3s, cool fingers with warm hands

Abdomen: Soft, ND/NT, no HSM or masses. Normoactive BS.

MSK: MAES, FROM, no edema or tenderness

Skin: Mild diaper rash, no lacerations or ecchymosis.

No UOP for 6 hours



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Case Study – Emergency Department

PEWS score: Behavior 2 CV 1 Resp 3

PAT: Resp and circulation

Initial management:

- Supplemental oxygen

 - What level of support?

 - High Flow Nasal Cannula (HFNC)

- Suction

 - NP suction with catheter and saline

- Hydration status

 - Place IV and administer 20 mL/kg fluid bolus

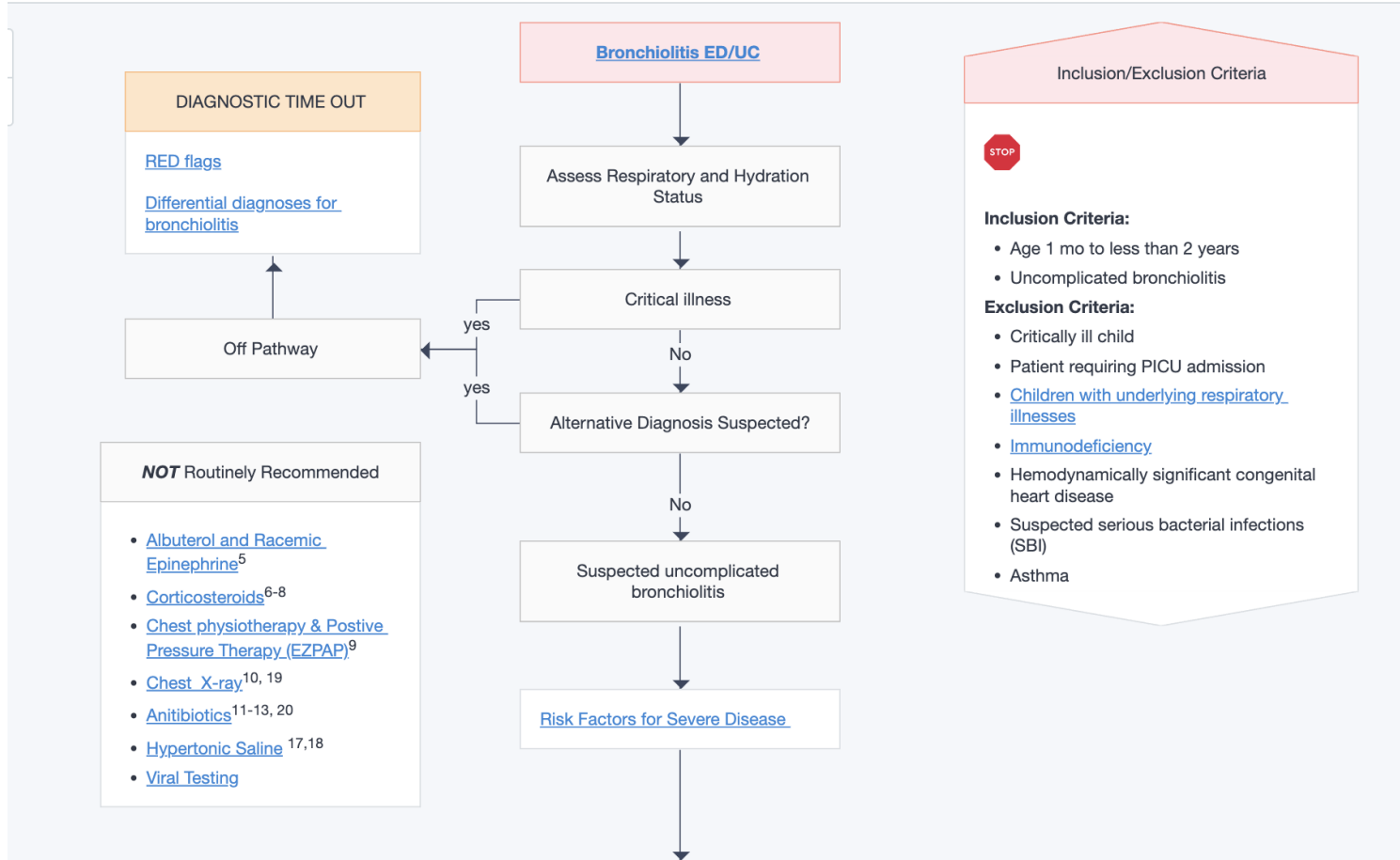
 - Start mIVF

- Antipyretics

- Other interventions?



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HFNC Initiation Pearls

GUIDELINE

1. Prior to initiation of HFNC therapy, the following are encouraged:
 - A. Multi-disciplinary huddle to evaluate the patient's overall condition and additional supportive measures for the patient that may be needed, such as fever, dehydration, agitation, and pain.
 - B. Suction the patient to ensure that upper airway is cleared from residual secretions
 - C. Position patient in upright position to augment work of breathing
 - D. Adjust oxygen flow rates to maximum on current device to achieve goal saturations
 - 1) See [Oxygen Delivery Devices](#)
 - 2) Reassess patient within 15 minutes following interventions outlined above.
2. If no improvement of patient's saturations and/or work of breathing after interventions, contact the Provider and collaborate with healthcare team to initiate HFNC.
3. Patients who do not respond with improved clinical status within one (1) hour, should be reassessed by the medical team and/or Rapid Response Team (RRT) for consideration of an ICU placement or transfer.

Acute Care Flow Guidelines

Age	Acute Care Flow Rate Limit L/min
30 days up to 12 months	8
13 months up to 24 months	10
25 months up to five (5) years	12
Greater than five (5) years	16



Case Study – ED to Inpatient

Admitted to Inpatient unit. Assessment on arrival to medical floor:

VS: T: 99.1°F (37.3°C) HR: 162 RR: 52 O₂ Sat: 92% on 8L HFNC, 40% BP: 94/54

PE: **General:** WNWD, tired appearing

Neuro: Sleeping but easily arousable, crying but able to be soothed by caregiver

HEENT: NC/AT, PERRL, no eye discharge or injection, rhinorrhea with congestion noted

Resp: Tachypneic, mild subcostal and intercostal retractions with belly breathing, no wheeze, rhonchi, or rales.
Aerating to bases bilaterally and nonfocal. Equal chest rise.

Cardiac: Tachycardic, no m/r/g, distal pulses 2+, cap refill 2s

Abdomen: Soft, ND/NT, no HSM or masses. Normoactive BS.

MSK: MAES, FROM, no edema or tenderness

Skin: Mild diaper rash, no lacerations or ecchymosis.

Floor orders: mIVF and PO ALD. Strict I/Os. Continued antipyretics. Suctioning PRN.

PEWS: Behavior 2 CV 1 Resp 1



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Case Study – Inpatient

Next morning, RN reports patient is worsening.

PEWS: Behavior 3 CV 2 Resp 3

VS: T: 100.2°F (37.9°C) HR: 174 RR: 70 O₂ Sat: 93% on 10L HFNC, 60% BP: 86/45

PE: **General:** WNWD, somnolent

Neuro: Primarily sleeping, more difficult to arouse and maintain wakefulness, crying intermittent

HEENT: NC/AT, PERRL, no eye discharge or injection, congestion noted

Resp: Tachypneic, moderate subcostal, intercostal retractions with belly breathing, tracheal tug, no wheeze, rhonchi, or rales. Prolonged expiratory phase with diminished breath sounds bilaterally. Equal chest rise.

Cardiac: Tachycardic, no m/r/g, distal pulses 2+, cap refill 4s

Abdomen: Soft, ND/NT, no HSM or masses. Normoactive BS.

MSK: MAES, FROM, no edema or tenderness

Skin: Pale, mild diaper rash, no lacerations or ecchymosis.

Next steps?



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Take Away Points

- Use assessment tools to help guide your clinical decision making
- Know where to access resources for pediatric care
- Be familiar with current recommendations and guidelines
- Community Resources: CHCO Pathways
 - <https://www.childrenscolorado.org/health-professionals/clinical-resources/clinical-pathways/>
- If clinically worsening, discuss with other experienced providers or initiate transfer to higher level of care



Thank you Questions?



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