Pediatric Cardiac Emergencies

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Mercyhealth Prehospital & Emergency Services Center

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Lesson Overview

- Forming a general impression
- Effective airway management
- Assessment of breathing status
- Shock assessment & management
- Quality chest compressions
- Primary cardiac emergencies
- AHA 2020 cardiac arrest updates
- Safe medication administration practices
- Hands-on clinical skills practice
- Completion of quiz & survey

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General Principles of Pediatric Patient Assessment

THE ESSENTIALS:

- Rely on good communication and psychological support.
- Be honest and calm to gain their trust.
- Form a quick general impression
- **Identify and intervene early**

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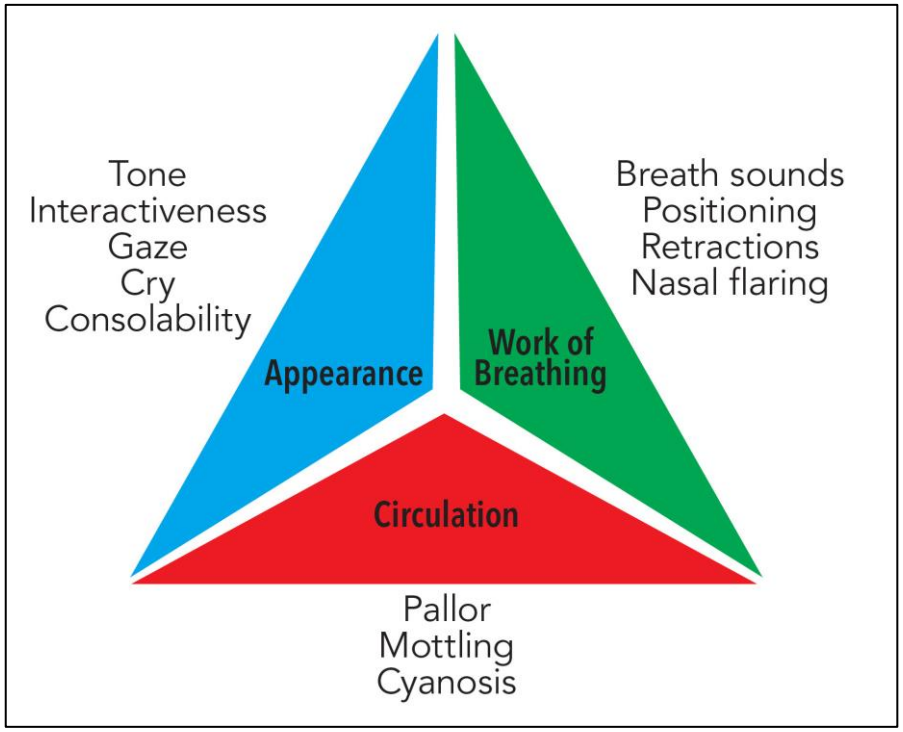
Pediatric ABCs

- General impression…
  - Altered LOC
  - Irregular respirations
  - Signs of poor perfusion



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Appearance: The "Tickles" (TICLS) Mnemonic	
Characteristic	**Normal features**
T one	Move spontaneously, resists examination, sits or stands (age appropriate)
I nteractiveness	Appears alert/engaged with clinician or caregiver, interacts well with people/environment, reaches for objects
C onsolability	Stops crying with holding/comforting by caregiver, has differential response to caregiver vs. examiner
L ook/gaze	Makes eye contact with clinician, tracks visually
S peech/cry	Uses age-appropriate speech

Work of breathing	
Characteristic	**Abnormal features**
Abnormal airway sounds	Snoring, muffled/hoarse speech, stridor, grunting, wheezing
Abnormal positioning	Sniffing position, tripoding, prefers seated posture
Retractions	Supraclavicular, intercostal, or substernal, head bobbing (infants)
Flaring	Flaring of the nares on inspiration

Circulation to skin	
Characteristic	**Abnormal features**
Pallor	White/pale skin or mucous membranes
Mottling	Patchy skin discoloration due to variable vasoconstriction
Cyanosis	Bluish discoloration of skin/mucous membranes

Dieckmann R et al. *Ped Emerg Care* 2010.

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Pediatric Anatomical Differences

- Large head – airway, head injury, difficult immobilization
- Large & floppy tongue/epiglottis
- Large secretions
- Flat face
- Narrow & elastic cricoid/trachea
- Fontanelles – Posterior (4mo), Anterior (9-18mo)

Care measures:

- Do not allow the next to overextend or flex
- Place padding under the shoulders (< 2yo) or head (> 2yo)
- Be gentle inside the mouth and nose, try to keep the nares clear
- Look for stridor
- Be prepared for difficult airway

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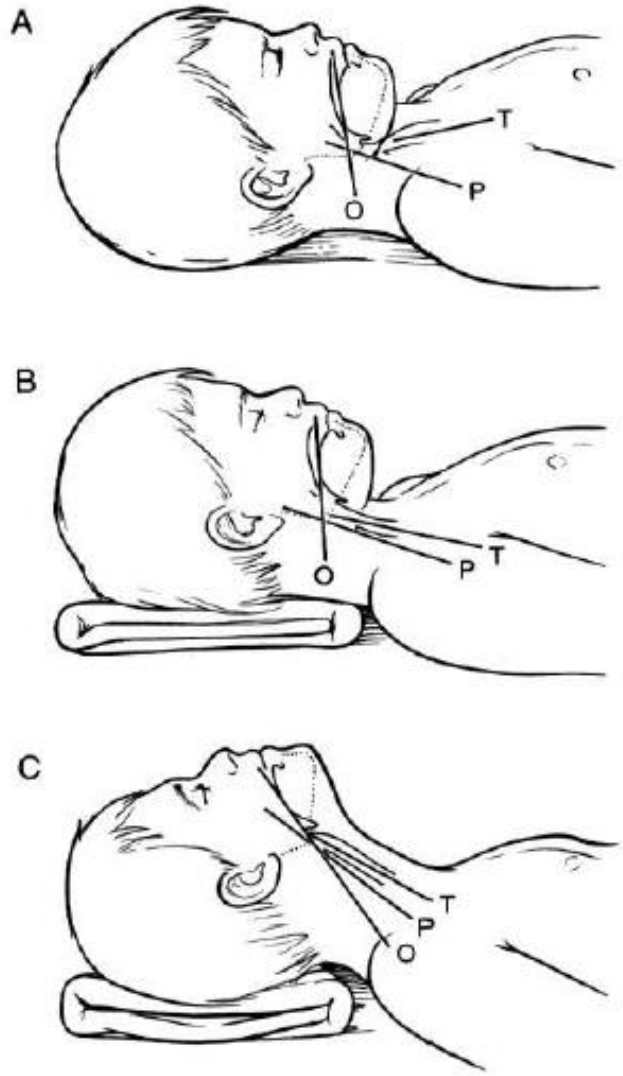

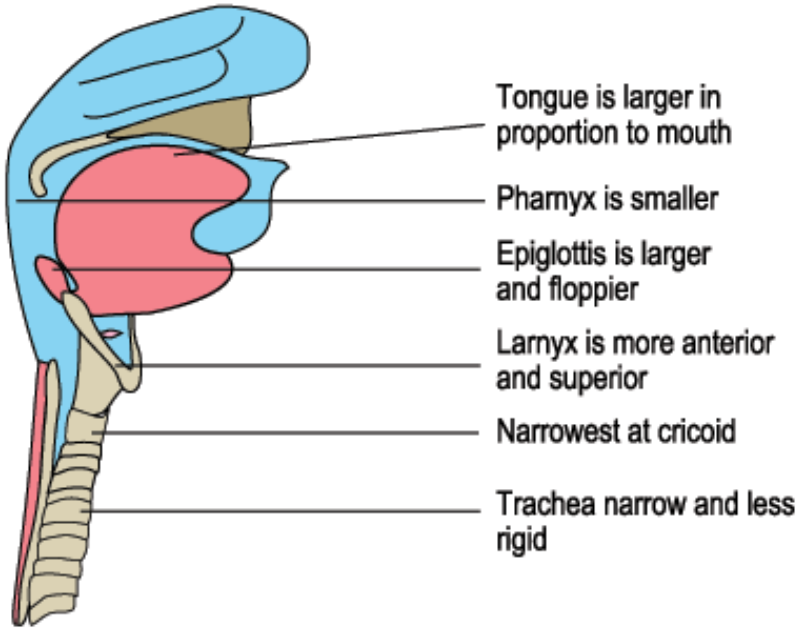

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Basic Airway Maneuvers – **Basic Devices & Positioning**

R.E.B.E.L.EM

HMS F0404

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15mm connector
Reliable connection to any standard catheter mount or connection

Proximal end of gastric channel

Colour coded hook ring
To secure the i-gel O_2 in position with the airway support strap

Clearly displayed product information
For quick easy reference. Includes confirmation of size and weight guidance

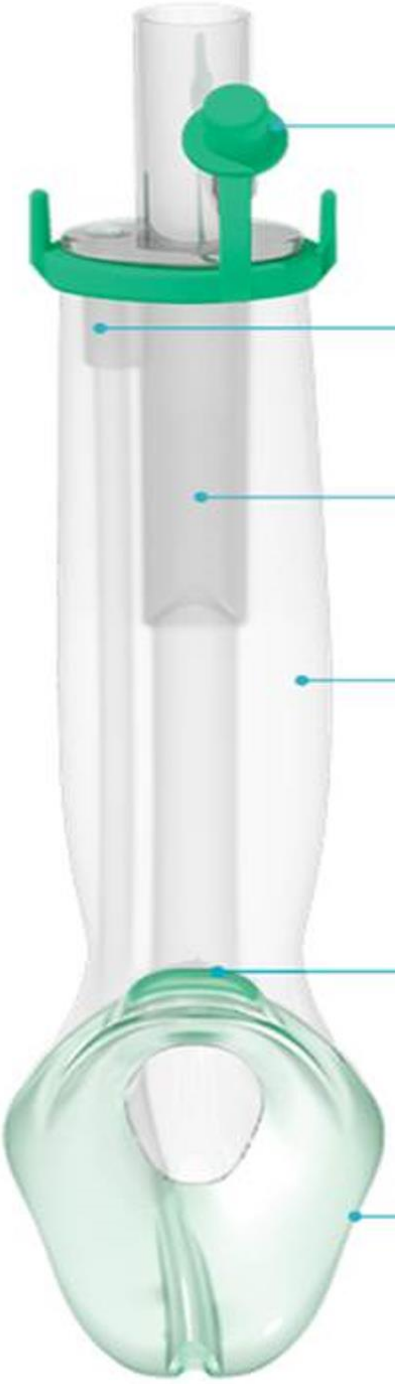
Position guide
(adult sizes only)

Supplementary oxygen port
For the administration of passive oxygenation as a component of cardiocerebral resuscitation (CCR)

Gastric channel
Enhances patient safety by providing a mechanism for the management of regurgitant fluid

Integral bite block
Reduces the possibility of airway channel occlusion

Buccal cavity stabiliser
Aids insertion and eliminates the potential for rotation



Epiglottic rest
Reduces the possibility of epiglottis 'down folding' and airway obstruction

Non-inflatable cuff
Eliminates the need for cuff inflation after insertion, allowing easy and rapid insertion

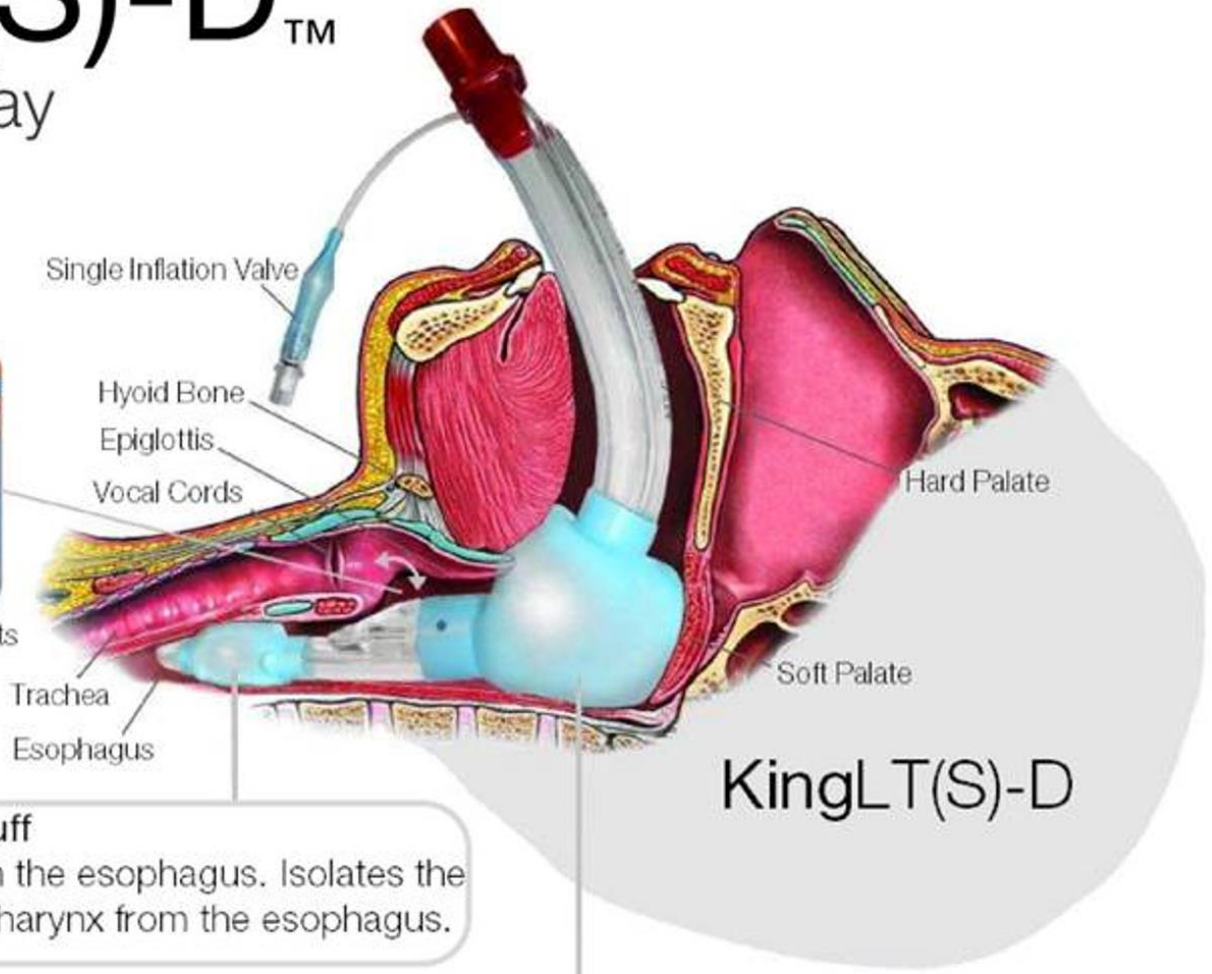
Distal end of gastric channel

The i-gel O_2 Resus Pack is available in 3 adult sizes and includes:

- i-gel O_2 supraglottic airway
- Sachet of lubricant – for quick and easy lubrication of the i-gel O_2 prior to insertion
- Airway support strap – to secure the i-gel O_2 in position
- 12 FG suction tube – for insertion through the gastric channel to empty fluid from the stomach.

KingLT(S)-D™
supraglottic airway

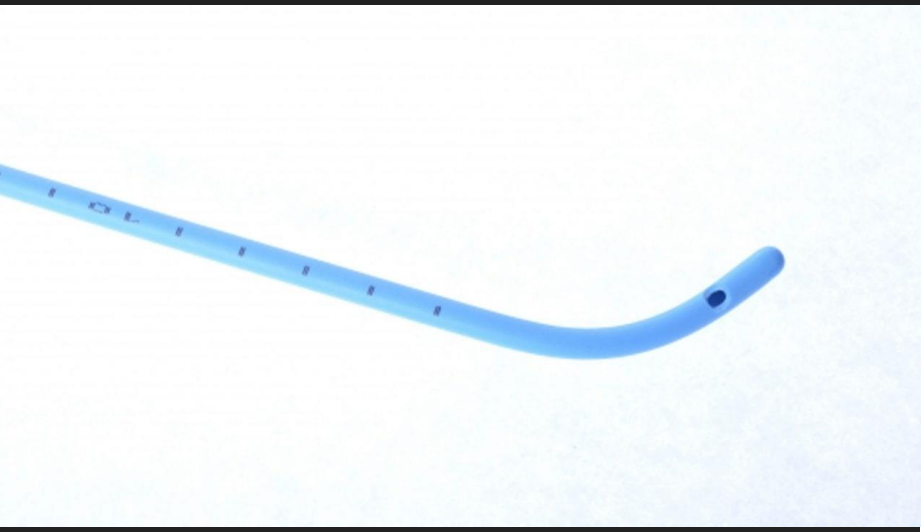
Kingsystems



Distal Cuff
Inflates in the esophagus. Isolates the laryngopharynx from the esophagus.

Proximal Cuff
Inflates the base of the tongue. Isolates the laryngopharynx from the oropharynx and nasopharynx.


SunMed
Greenline D




H&H
Emergency Cricothyrotomy Kit
NSN 6515-01-573-0692
(1) Disposable Scalpel #10 Blade
(1) Endotracheal Tube, 6fr, Cuffed
(1) 10cc Syringe
(1) Curved Kelly Hemostat
(1) NEWS Tracheal Hook
H and H Associates, Inc.
CAGE 1NNH6 (800) 326-5708 P/N HHECT

Pediatric ETT Considerations

- Size (uncuffed) = (age + 16)/4
  - Subtract 1 for cuffed

  ex: 8 yo requires a (24/4) size 6 uncuffed tube

- Depth = size x 3
  - 2cm past vocal cords

- How difficult is the pediatric airway?

PEDIATRICS/ORIGINAL RESEARCH

Rapid Sequence Intubation for Pediatric Emergency Patients: Higher Frequency of Failed Attempts and Adverse Effects Found by Video Review

Benjamin T. Kerrey, MD, MS, Andrea S. Rinderknecht, MD, Gary L. Geis, MD, Lise E. Nigrovic, MD, MPH, Matthew R. Mittiga, MD

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Deadly Respiratory Emergencies

- ✓ FBAO
- ✓ Croup
- ✓ Epiglottitis
- ✓ Bacterial tracheitis
- ✓ Bronchiolitis
- ✓ Asthma

IM 1:1,000 epinephrine (0.01mg/kg) up to 0.3mg
IV/IO Methylprednisolone (2mg/kg) up to 125mg
IV/IO Magnesium (50mg/kg) up to 2grams over 10-20 min
Ketamine (0.25-0.5mg/kg) IV/IO or (0.5-1mg/kg) IM
IV/IO 1:10,000 epinephrine (0.01mg/kg) up to 0.1mg dose q5min for impending arrest, max total 0.5mg

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Pediatric Respiratory Tidbits

- Obligate nose (< 6mo) & abdominal breathers
- Early muscle fatigue
- Thin chest wall, increased lung compliance

Care measures:

- Assess respiratory effort on bare chest
- Don’t wait until it’s too late to control airway or assist breathing
- Manual decompression of chest in severe asthmatics

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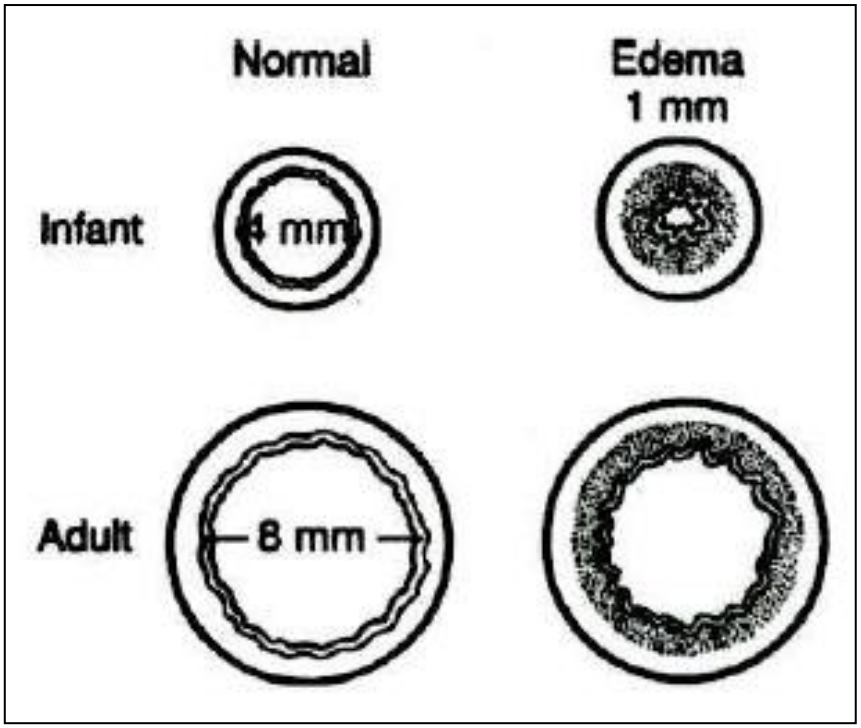
Small diameter airways

- If the radius is reduced by ½ (as little as 1mm in infants), then the resistance is 16x worse!



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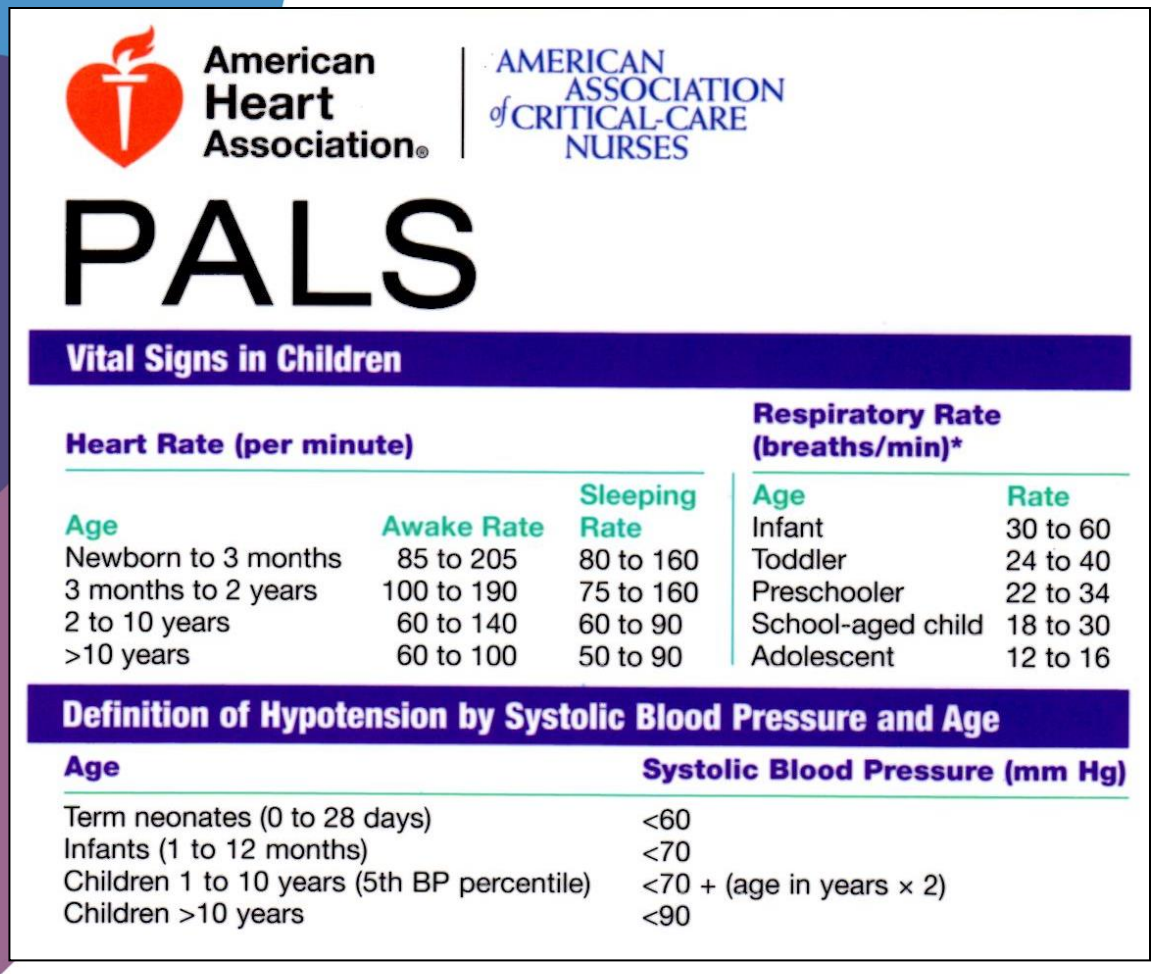
Normal Vital Sign Ranges



American Heart Association | AMERICAN ASSOCIATION of CRITICAL-CARE NURSES

PALS

Vital Signs in Children

Heart Rate (per minute)

Age	Awake Rate	Sleeping Rate
Newborn to 3 months	85 to 205	80 to 160
3 months to 2 years	100 to 190	75 to 160
2 to 10 years	60 to 140	60 to 90
>10 years	60 to 100	50 to 90

Respiratory Rate (breaths/min)*

Age	Rate
Infant	30 to 60
Toddler	24 to 40
Preschooler	22 to 34
School-aged child	18 to 30
Adolescent	12 to 16

Definition of Hypotension by Systolic Blood Pressure and Age

Age	Systolic Blood Pressure (mm Hg)
Term neonates (0 to 28 days)	<60
Infants (1 to 12 months)	<70
Children 1 to 10 years (5th BP percentile)	<70 + (age in years × 2)
Children >10 years	<90

Resp:

- **Infants 40's**
- **Toddlers 30's**
- **Adolescents 20's**

HR:

- **Newborn/infant > 100**
- **Young kids up to 140**
- **< 100 after age 10**

Low BP:

- **70 + 2(yrs)**
- **90 after age 10**

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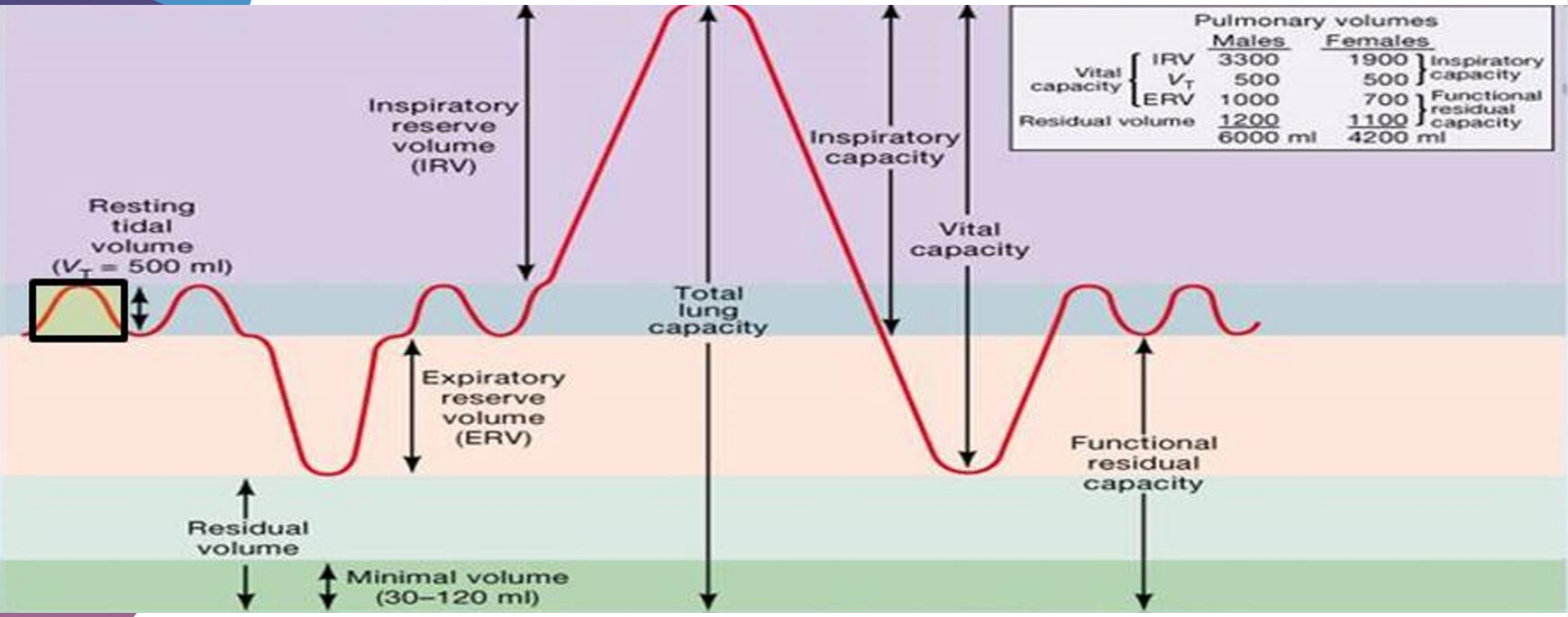
PEDS Respiratory Physiology



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Don’t overventilate the BVM!

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GASP!

Riviello RJ, Rozzi HV. GASP. *ACEP NOW*. Jan 2018.

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Signs of shock in infant

AMS (crying or lethargy)

Poor oral intake/ vomiting

Mottling

Hyper- or hypothermia

Abnormal VS

- Hypoxia
- RR >60
- SBP <60
- HR >160 (or bradycardia)

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What type of shock?

3 general problems arise:

- **Not enough fluid (blood)**
  - hypovolemic, hemorrhagic
- **Vessels not constricting**
  - anaphylactic, septic, distributive
- **Heart not pumping properly**
  - cardiogenic, obstructive

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Cause of shock?

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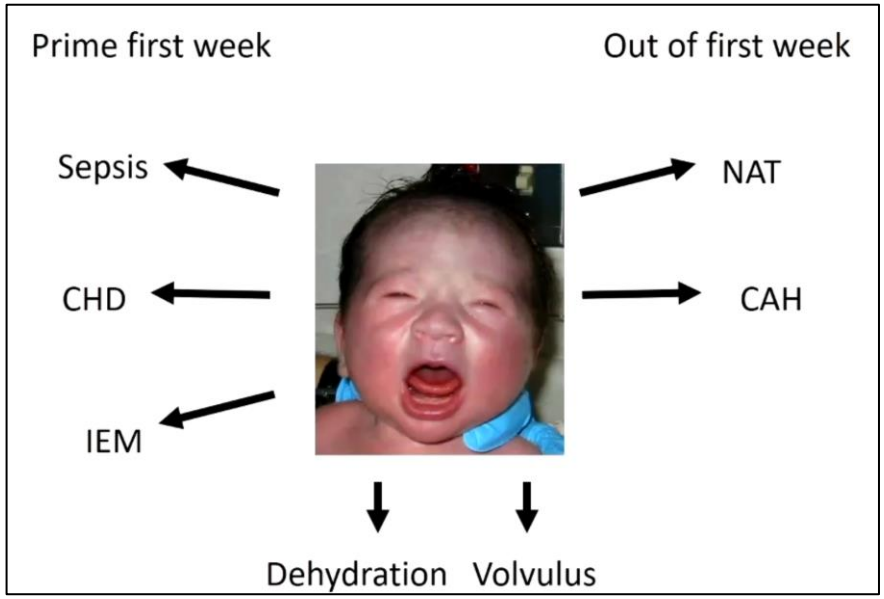
Shock in the infant

- Under 2 weeks old is most likely
  - Volume depletion
  - Sepsis
  - Ductal dependent lesion
- Bilious vomiting
  - Intussusception or volvulus
- Other causes…



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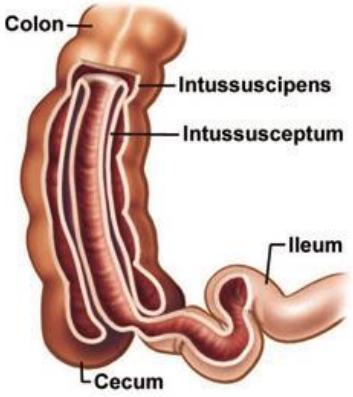
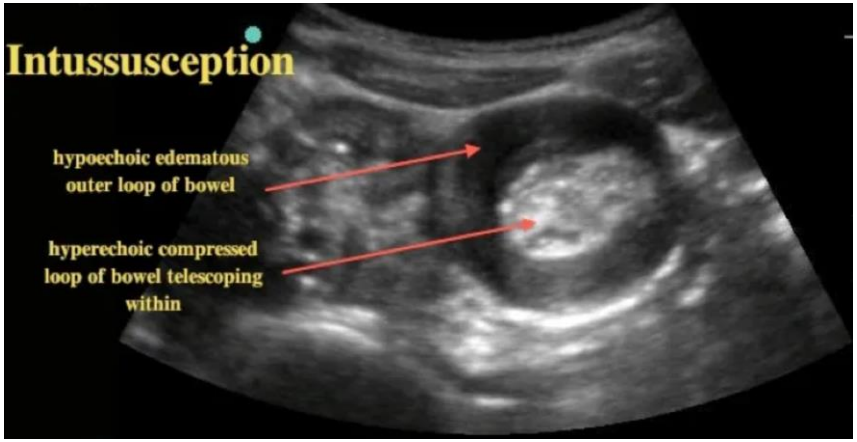
Examples of Bowel Emergency

Midgut Volvulus

Intussusception





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Intraosseous Access in Pediatrics

Indications:

- 2 failed IV attempts
- IV access cannot be quickly and reliably established

Contraindications:

- Fracture, burn, or infection at site
- Structural bone disease
- Previous attempt at the same site, unable to locate landmarks

Needle sizing:

- 15mm (3-39Kg), 25mm (thin > 40Kg), 45mm (thick > 40Kg)

Sites:

- Proximal tibia (AEMT), distal tibia or proximal humerus (medic)

Additional considerations:

- Direct needle away from growth plates
- Careful not to use excessive force

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Hemorrhagic Shock in Pediatrics

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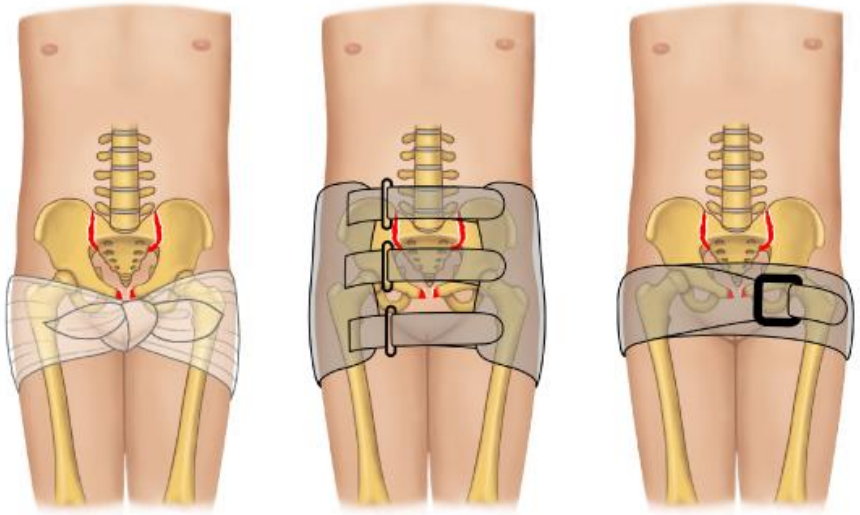
Treatment of Hemorrhagic Shock

- **Fluid boluses**
- **TXA**
- **Epi push/drip**
- **TQ, pelvic binder considerations**
- **Check glucose, keep warm!**



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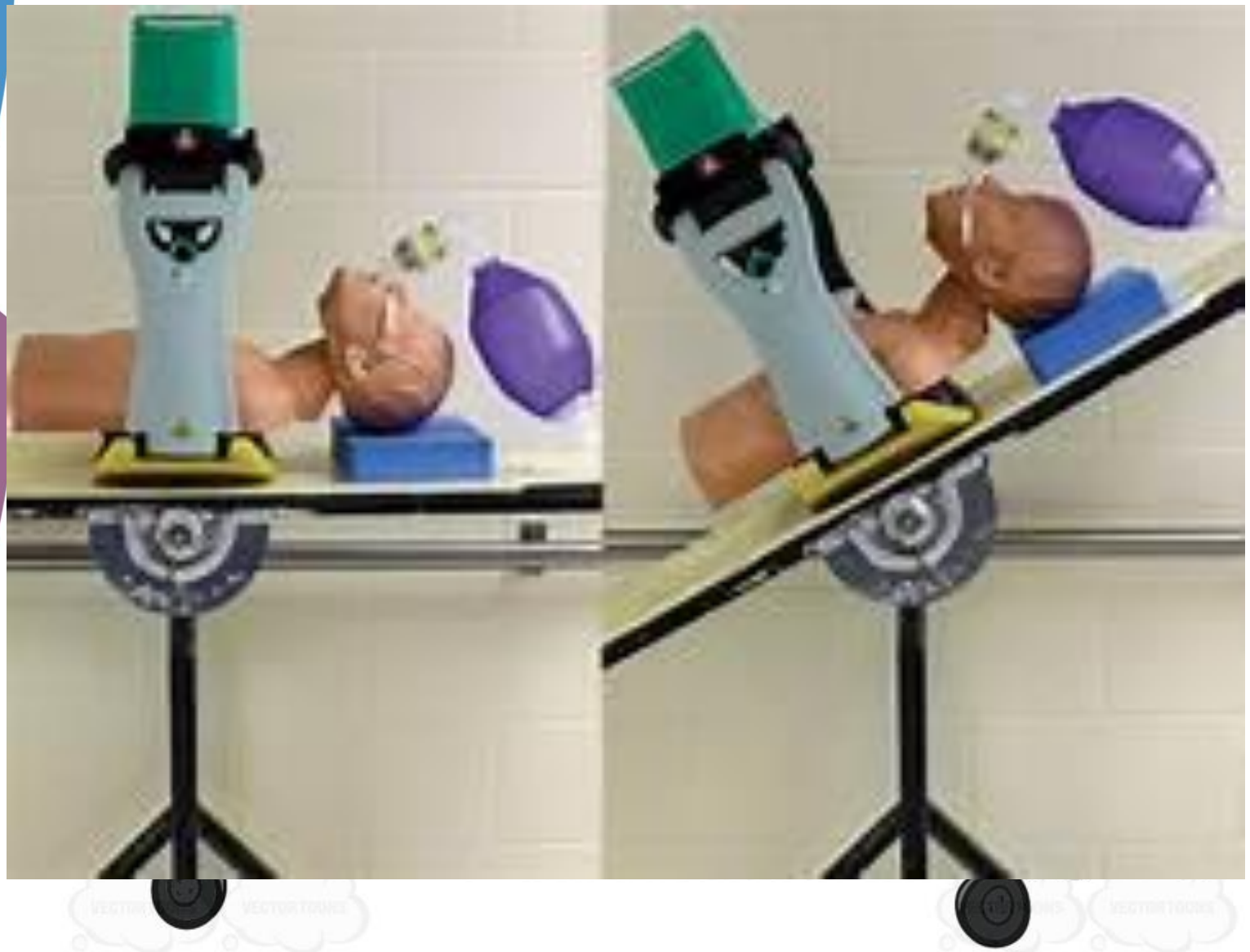

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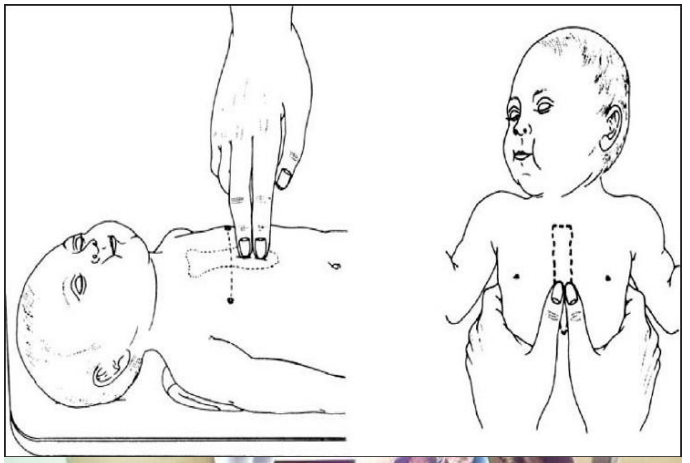
Quality Pediatric CPR

CPR Quality

- Push hard (≥⅓ 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



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Arrhythmias in Pediatric Patient

- Still support ABCs
  - Support AB
  - ALWAYS provide oxygen
  - Establish IV (IO) access
- Still categorized as brady vs tachy
- Still determine stability of patient
- Important to gain history (potential causes)

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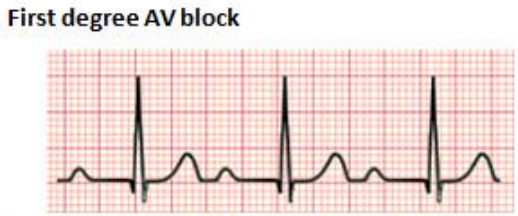
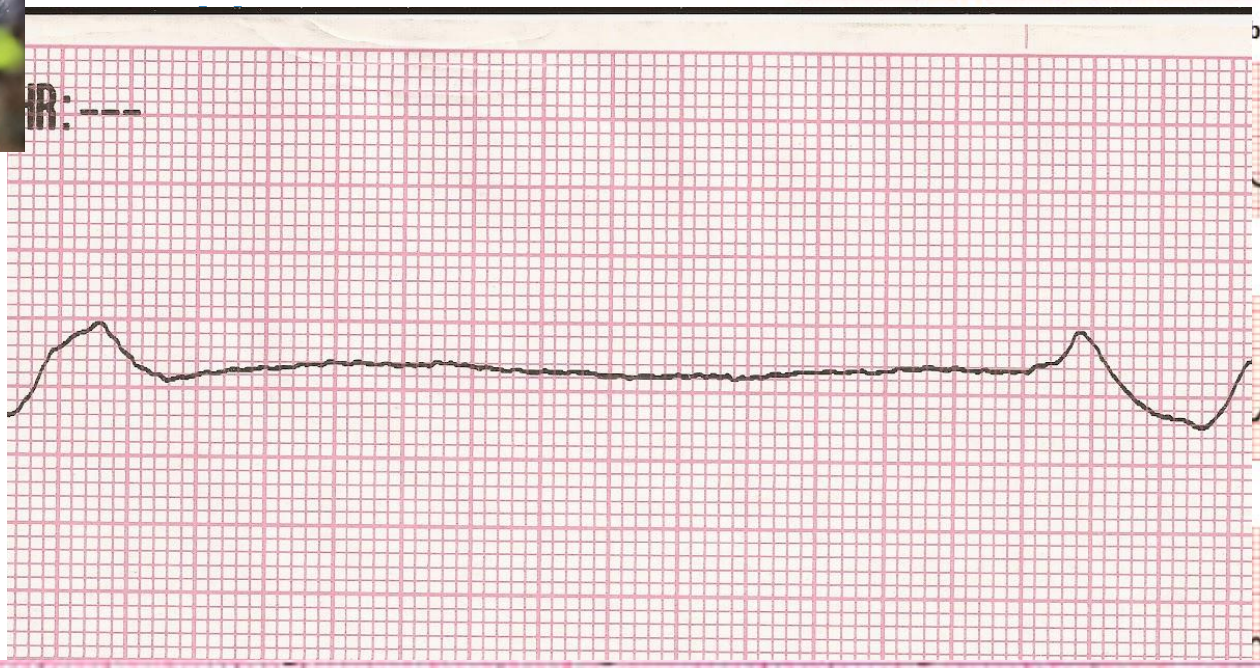
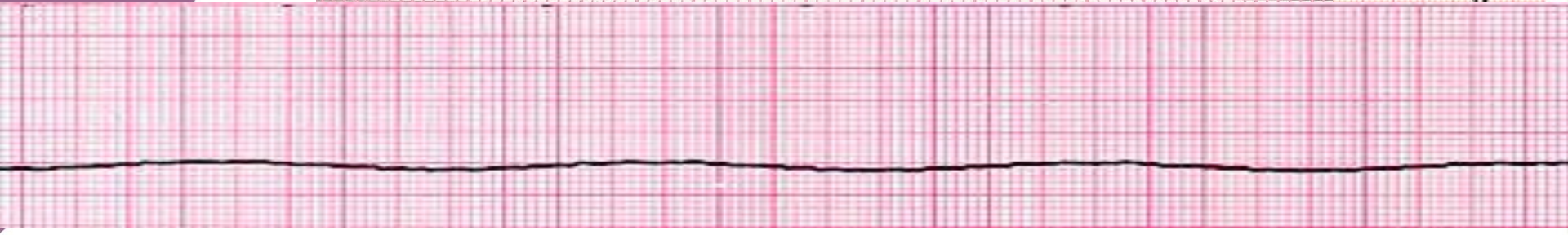
Brady PEDS







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Tachy PEDS

- BLS – support ABCs, O2/IV/Monitor
- ALS – Identify & treat specific rhythm
- Stable or Unstable?
- Narrow or wide?
- Are they on prescriptions?
- Any potential illicit drug use?
  - Recall your toxidromes
- **Sync**honized cardioversion – 1 J/kg, 2 J/kg
- Defibrillation -

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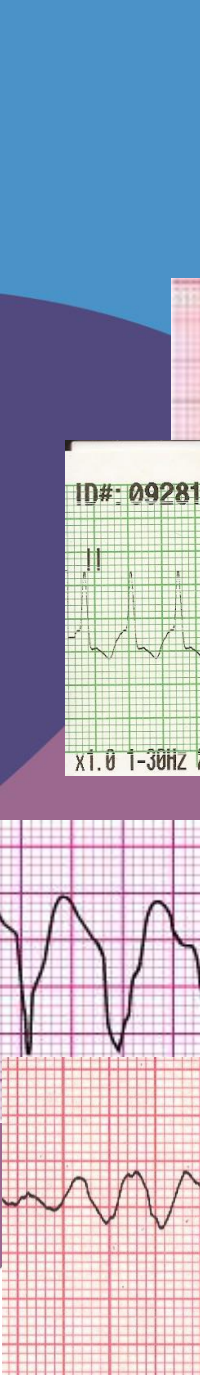

Initial assessment and support
- Maintain patent airway; assist breathing as necessary
- Administer oxygen
- Cardiac monitor to identify rhythm; monitor pulse, blood pressure, and oximetry
- IV/IO access
- 12-Lead ECG if available

Evaluate rhythm with 12-lead ECG or monitor.

Probable sinus tachycardia *if*
- P waves present/normal
- Variable RR interval
- Infant rate usually <220/min
- Child rate usually <180/min

Search for and treat cause.

Cardiopulmonary compromise?
- Acutely altered mental status
- Signs of shock
- Hypotension

Yes

Narrow (≤0.09 sec)

Evaluate QRS duration.

Wide (>0.09 sec)

Probable supraventricular tachycardia
- P waves absent/abnormal
- RR interval not variable
- Infant rate usually ≥220/min
- Child rate usually ≥180/min
- History of abrupt rate change

- If IV/IO access is present, give **adenosine**
or
- If IV/IO access is not available, or if adenosine is ineffective, perform synchronized cardioversion

Possible ventricular tachycardia

Synchronized cardioversion
Expert consultation is advised before additional drug therapies.

No

Narrow (≤0.09 sec)

Evaluate QRS duration.

Wide (>0.09 sec)

Probable supraventricular tachycardia
- P waves absent/abnormal
- RR interval not variable
- Infant rate usually ≥220/min
- Child rate usually ≥180/min
- History of abrupt rate change

Consider vagal maneuvers.

If IV/IO access is present, give **adenosine.**

Possible ventricular tachycardia

If rhythm is **regular** and QRS **monomorphic**, consider **adenosine.**

Expert consultation is recommended.

Doses/Details

Synchronized cardioversion
Begin with 0.5-1 J/kg; if not effective, increase to 2 J/kg. Sedate if needed, but don't delay cardioversion.

Drug Therapy

Adenosine IV/IO dose
- First dose: 0.1 mg/kg rapid bolus (maximum: 6 mg)
- Second dose: 0.2 mg/kg rapid bolus (maximum second dose: 12 mg)

Hypertrophic Cardiomyopathy

- Heart becomes thickened especially at interventricular septum and ventricles.
- Presentations:
  - Asymptomatic → sudden arrest
  - Fatigue, CP, CHF, syncope
- Definitive Dx:
  - ECG, cardiac cath, echo, MRI, genetics
- Treatment:
  - HTN control, septal myectomy, AICD
  - Can yield fairly good lifespan

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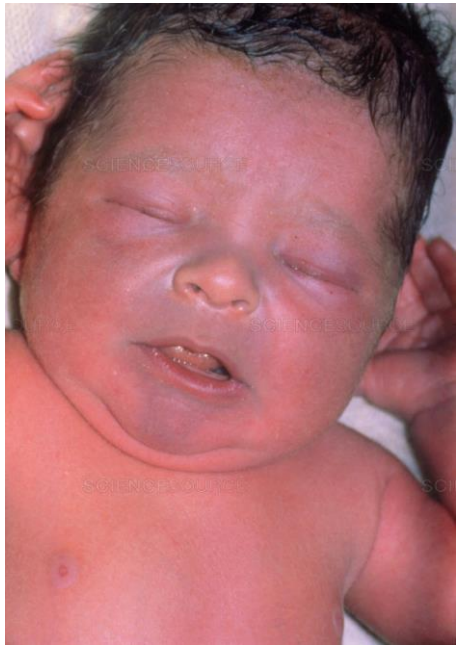
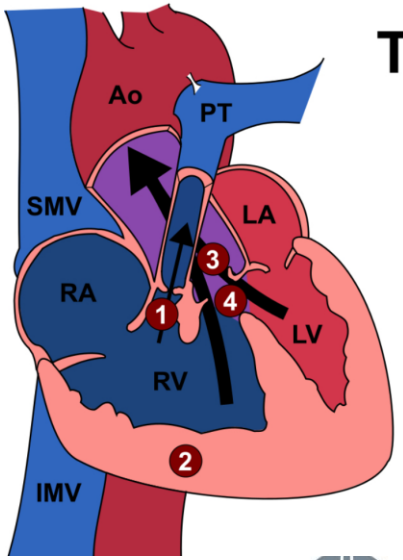
Cyanotic Congenital Heart Conditions

- Tetrology of fallot
- Transposition of great vessels
- Truncus arteriosus
- Tricuspid atresia





Tetralogy of Fallot

Major Defects

1. Pulmonary Stenosis
2. Right Ventricular Hypertrophy
3. Overriding Aorta
4. Ventricular Septal Defect

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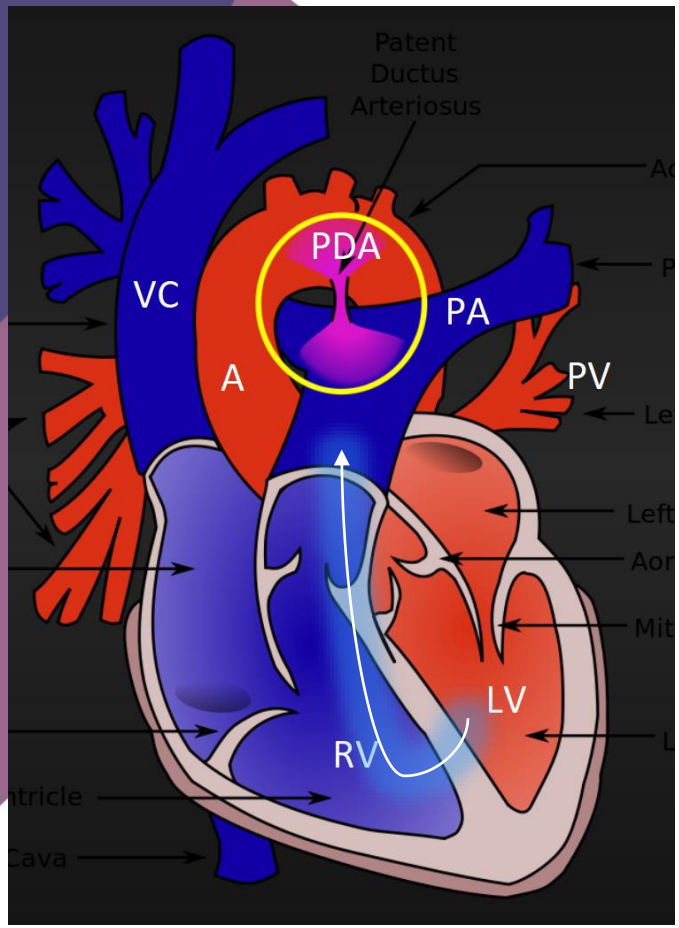
Pediatric CHD & Acute Heart Failure



The "Blocks"	The "Holes"
Aortic Stenosis	ASD
Coarctation	VSD
Interrupted Aortic Arch	PDA
	AV Canal

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2020 AHA CPR & ECC Guidelines

Visit **ECCGuidelines.Heart.org** today for your official Guidelines resources:

- *2020 American Heart Association Guidelines for CPR and ECC* (Print and Digital)
- *Highlights of the 2020 American Heart Association Guidelines for CPR and ECC*—in 17 languages!
- 2020 American Heart Association Guidelines Science In-Service eLearning Course for Healthcare Professionals
- *2020 Handbook of ECC for Healthcare Providers* (Print and Digital)

American Heart Association.
2020
CPR & ECC
GUIDELINES

"The fact that only 6 of these 491 recommendations (1.2%) are based on Level A evidence (at least 1 high-quality randomized clinical trial [RCT], corroborated by a second high-quality trial or registry study) testifies to the ongoing challenges in performing high-quality resuscitation research."

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OHCA

Activation of Emergency Response | High-Quality CPR | Defibrillation | Advanced Resuscitation | Post-Cardiac Arrest Care | Recovery

eccguidelines.heart.org

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AHA 2020 Updates to CPR & ECC

BLS/ACLS (reached puberty):

- Agonal respirations (if opioid OD suspected): start BVM/CPR, then give Narcan, then apply monitor.
- Defib vs epi ASAP based on rhythm
- Choice of amiodarone or lidocaine
- Focus on achieving intubation
- Post-ROSC SpO2 goal of 92-98%, start at 10 BPM

BLS/PALS (Infant - puberty):

- 20-30 BPM for all PEDS (1 breath every 2-3 sec)
- Cuffed ETT preferred
- Eval & treat for seizure activity
- Consider steroids for refractory shock

Pregnancy/NALS (Newborn):

- Left lateral uterine displacement, call MD1, prioritize effective airway and oxygenation
- Keep warm & tachy!

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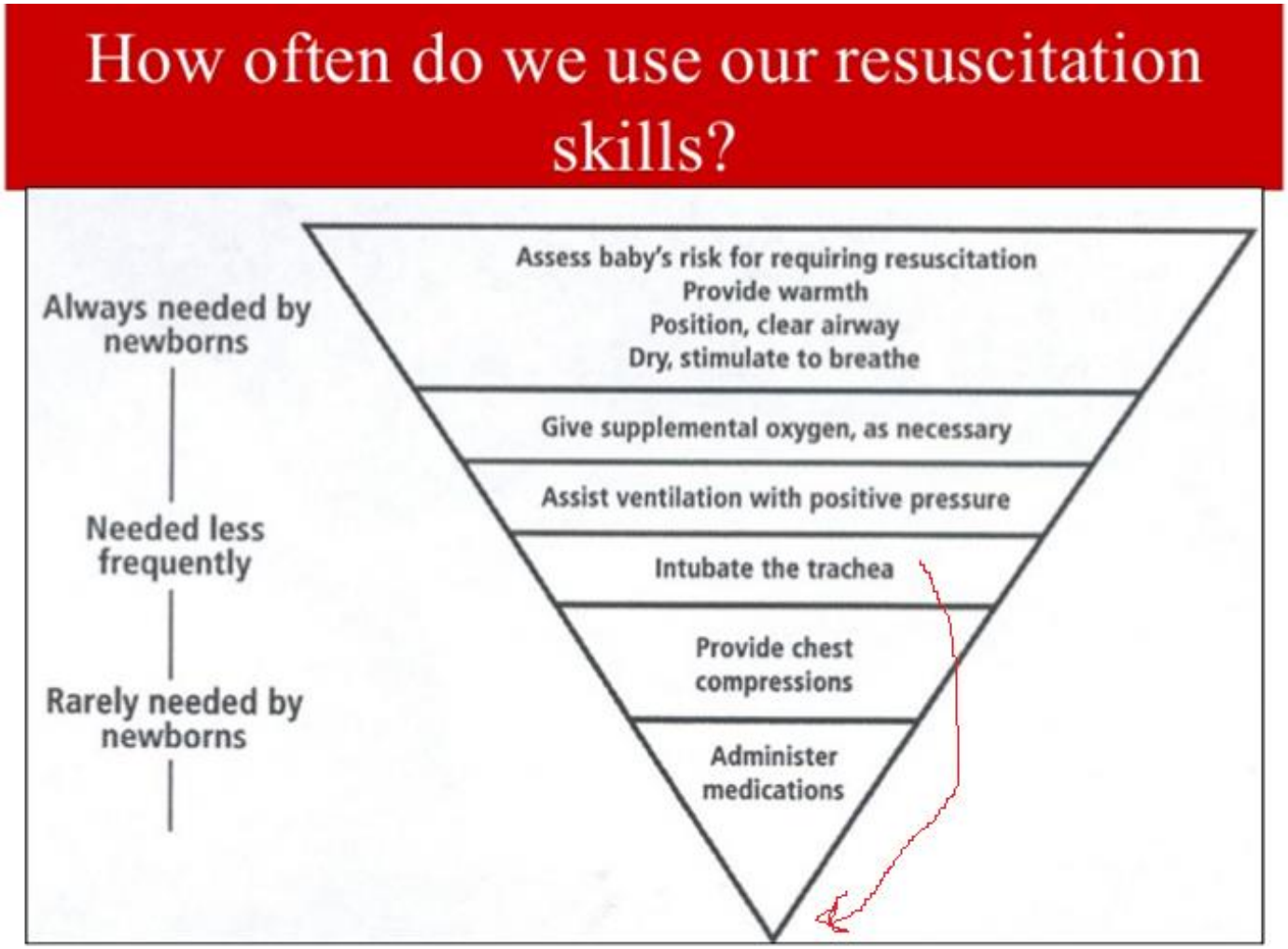
Neonatal Care & Resuscitation



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PEDS Cardiac Pharmacology 1

- Epinephrine
  - α/b agonist – increases HR, SV, CO, vasoconstriction
  - 1mg (.01mg/kg) q3-5min, titrate infusion, push dose
- Amiodarone
  - Class 3 (K+ channel blocker) antiarrhythmic
  - Adult: 300mg IVP, 150mg IVP (or 300mg over 20min)
  - PEDS: 5mg/kg, may repeat up to 3 total doses
- Lidocaine
  - Class 1b (Na+ channel blocker) antiarrhythmic
  - All: 1mg/kg, 0.5mg/kg
- Adenosine
  - Affects cell metabolism & ion channels, brief AV block
  - 0.1mg/kg (max 6mg), 0.2mg/kg (max 12mg)

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PEDS Cardiac Pharmacology 2

Beta Blockers	
Brand Name	**Other Name**
Bystolic	Nebivolol
	Timolol
Coreg	Carvedilol
Corgard	Nadolol
Inderal	Propranolol
Inderal LA	Propranolol
	Betaxolol
Levatol	Penbutolol
Lopressor	Metoprolol
Sectral	Acebutolol
Tenormin	Atenolol
Toprol XL	Metoprolol
Trandate	Labetalol
	Pindolol
Zebeta	Bisoprolol

g (up to 2mg) per dose, repeat prn

- Amlodipine (Norvasc)
- Diltiazem (Cardizem, Tiazac, others)
- Felodipine.
- Isradipine.
- Nicardipine.
- Nifedipine (Adalat CC, Procardia)
- Nisoldipine (Sular)
- Verapamil (Calan, Verelan)

rams) IV, repeat prn

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Broselow Still Valid?

18.5%

Objective: The aim of this study was to evaluate the accuracy of the color-coded BT in weight estimation and the influence of obesity on its accuracy.

Methods: This is a retrospective study conducted in a pediatric clinic of urban hospital. This study reviewed the medical records of children up to 96 months of age, who presented during 2008-2010. We recorded the child's age (in months), actual (measured) weight (in kilograms), and height (in centimeters). Based on the height, weight estimation was obtained using the color-coded BT. The actual weight was compared with the predicted weight obtained by the height-based BT. Patients presenting with any medical condition that would substantially affect growth of the child were excluded. A univariate logistic regression model was utilized to predict any underestimation based on age, sex, and body mass index (BMI) percentile.

Results: The medical records of 538 children were reviewed. There was a discrepancy in 226 children (42%). Broselow Pediatric Emergency Tape underestimated weight (measured weight was higher than predicted weight) in 158 children (29.4%) and overestimated (measured weight was lower than predicted weight) in 68 children (12.6%). Of the 158 underestimated children, 138 were off by 1 color zone, 16 by 2 color zones, and 4 by more than 2 color zones. When characterized by BMI, 46 children (13.6%) had normal BMI, 27 (45.8%) were overweight, and 84 (80.8%) were obese, whereas one child (2.8%) was underweight.

Conclusions: In our population, BT was inaccurate in predicting weight in 42% of children (underestimation in 158 children [29.4%] and overestimation weight in 68 children [12.6%]). However, the majority of discrepancies involved only 1 BT color zone. Emergency physicians should be aware of this discrepancy until more accurate methods become available.

Pediatr Emerg Care. 2019 Feb;35(2):112-116.

www.cdc.gov/obesity/data/childhood.html

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Broselow Chart (2007)

Equipment	GRAY* 3-5 kg	PINK Small Infant 6-7 kg	RED Infant 8-9 kg	PURPLE Toddler 10-11 kg	YELLOW Small Child 12-14 kg	WHITE Child 15-18 kg	BLUE Child 19-23 kg	ORANGE Large Child 24-29 kg	GREEN Adult 30-36 kg
Resuscitation bag		Infant/child	Infant/child	Child	Child	Child	Child	Child	Adult
Oxygen mask (NRB)		Pediatric	Pediatric	Pediatric	Pediatric	Pediatric	Pediatric	Pediatric	Pediatric/ adult
Oral airway (mm)		50	50	60	60	60	70	80	80
Laryngoscope blade (size)		1 Straight	1 Straight	1 Straight	2 Straight	2 Straight	2 Straight or curved	2 Straight or curved	3 Straight or curved
ET tube (mm)†		3.5 Uncuffed 3.0 Cuffed	3.5 Uncuffed 3.0 Cuffed	4.0 Uncuffed 3.5 Cuffed	4.5 Uncuffed 4.0 Cuffed	5.0 Uncuffed 4.5 Cuffed	5.5 Uncuffed 5.0 Cuffed	6.0 Cuffed	6.5 Cuffed
ET tube insertion length (cm)	3 kg 9-9.5 4 kg 9.5-10 5 kg 10-10.5	10.5-11	10.5-11	11-12	13.5	14-15	16.5	17-18	18.5-19.5
Suction catheter (F)		8	8	10	10	10	10	10	10-12
BP cuff	Neonatal #5/infant	Infant/child	Infant/child	Child	Child	Child	Child	Child	Small adult
IV catheter (ga)		22-24	22-24	20-24	18-22	18-22	18-20	18-20	16-20
IO (ga)		18/15	18/15	15	15	15	15	15	15
NG tube (F)		5-8	5-8	8-10	10	10	12-14	14-18	16-18
Urinary catheter (F)	5	8	8	8-10	10	10-12	10-12	12	12
Chest tube (F)		10-12	10-12	16-20	20-24	20-24	24-32	28-32	32-38

Abbreviations: BP, blood pressure; ET, endotracheal; F, French; IO, intraosseous; IV, intravenous; NG, nasogastric; NRB, nonrebreathing.

*For Gray column, use Pink or Red equipment sizes if no size is listed.

†Per *2010 AHA Guidelines*, in the hospital cuffed or uncuffed tubes may be used (see below for sizing of cuffed tubes).

Adapted from *Broselow™ Pediatric Emergency Tape.* Distributed by Armstrong Medical Industries, Lincolnshire, IL.

Pediatric Color-Coded Length-Based Resuscitation Tape

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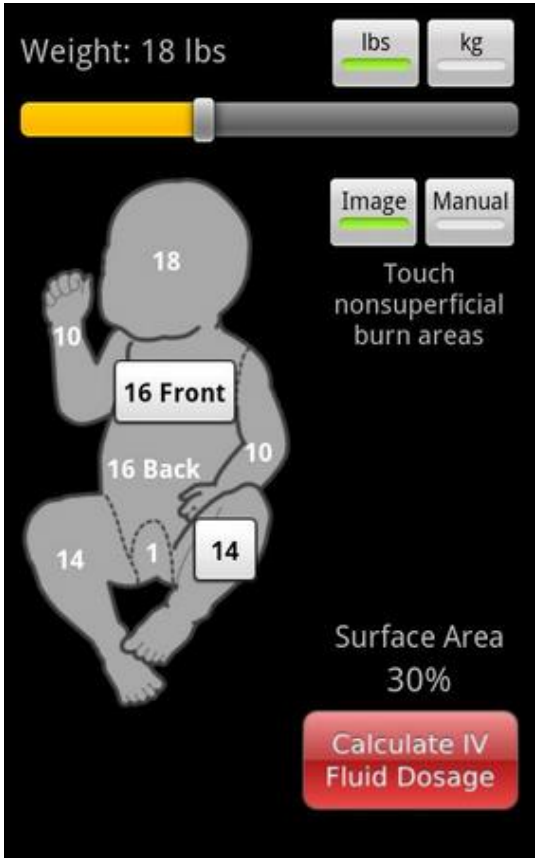
Examples of Smart Phone Apps

Pedi STAT
Developed by QxMD

Pediatric EMS



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Pediatric Arrest: TOR & DNR

- TOR can be considered after 20min (AHA, 2020)
  - witnessed, bystander CPR, shockable rhythm, ROSC

- DNR Rules:
  - Wis. Stat. § 154.17 (4) – Must be at least 18y/o to be “qualified patient”.
  - 755 ILCS 35/2 – Allows DNR, POLST for persons of all ages with terminal condition.

https://www.ilga.gov/legislation/ilcs/ilcs3.asp?ActID=2110&ChapAct=755

https://dph.illinois.gov/sites/default/files/forms/polstform.pdf

https://www.dhs.wisconsin.gov/ems/dnr.htm

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Pediatric Pain Scales

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Hands-on Clinical Skills Practice

- Airway management station – adjuncts insertion
- Medication administration station – IO, IV, epi IM, drug calculation
- MCMAID station – BVM, CPR, manual defib
- PALS scenario – unstable SVT

Can be done during this classroom training, scheduled time with service leadership or Mercyhealth education team, or in MWH sim lab

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