

Pediatric Advanced Life Support Preparatory Materials

National Certification Services 1/17 Review

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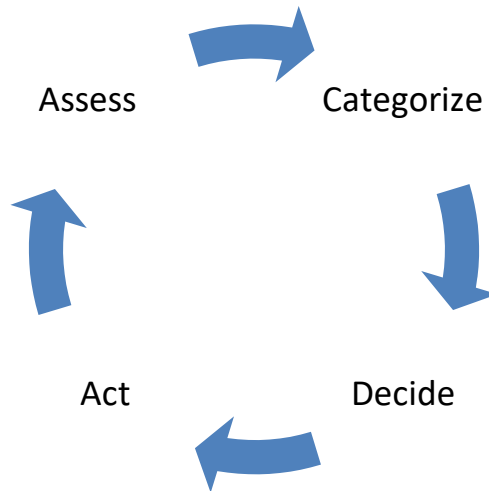


PEDIATRIC ADVANCED LIFE SUPPORT (PALS) RECERTIFICATION

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I. Cyclic Approach



This is the cyclic approach used to assess and manage an ill or injured child. It is repeated frequently during evaluation and management.

Assess: Evaluation starts with the general assessment and continues with the primary assessment, the secondary assessment, and the tertiary assessment. If you recognize a life-threatening condition at any time in any assessment, begin interventions.

Categorize: Attempt to categorize the child’s condition by type and severity.

	Type	Severity
Respiratory	<ul style="list-style-type: none"> • Upper airway obstruction • Lower airway obstruction • Lung tissue disease • Disordered control of breathing 	<ul style="list-style-type: none"> • Respiratory distress • Respiratory failure
Circulatory	<ul style="list-style-type: none"> • Hypovolemic Shock • Obstructive Shock • Distributive/Septic Shock • Cardiogenic Shock 	<ul style="list-style-type: none"> • Compensated Shock • Hypotensive Shock

The child’s condition may also be a combination of the two. As their condition deteriorates, one category may lead to others.

Decide: Now you need to decide on appropriate management based on your assessment and categorization of the child’s condition. This is done based on your scope of practice.

Act: Start treatment appropriate for the clinical condition.

II. Pediatric Assessment Flowchart

General Assessment:	A – appearance B – work of breathing C – circulation
Primary Assessment:	A – airway B – breathing C – circulation D – disability E - exposure
Secondary Assessment:	S – signs and symptoms A – allergies M – medications P – past medical history L – last meal / liquids consumed E – events leading up to incident Also: Focused physical examination
Tertiary Assessment:	Labs X-Rays Other tests as needed

Categorize Illness by Type and Severity

	Type	Severity
Respiratory	<ul style="list-style-type: none"> • Upper airway obstruction • Lower airway obstruction • Lung tissue disease • Disordered control of breathing 	<ul style="list-style-type: none"> • Respiratory distress • Respiratory failure
Circulatory	<ul style="list-style-type: none"> • Hypovolemic Shock • Obstructive Shock • Distributive/Septic Shock • Cardiogenic Shock 	<ul style="list-style-type: none"> • Compensated Shock • Hypotensive Shock

Respiratory + Circulatory = Cardiopulmonary failure

III. Management of Respiratory Emergencies Flowchart

- Airway positioning
- Oxygen Pulse oximetry
- ECG monitoring as needed
- BLS as needed

Upper Airway Obstruction Specific Management for Selected Conditions		
Croup	Anaphylaxis	Aspiration Foreign Body
<ul style="list-style-type: none"> • Racemic epinephrine • Corticosteroids 	<ul style="list-style-type: none"> • IM epinephrine • Albuterol • Antihistamines • Corticosteroids 	<ul style="list-style-type: none"> • Allow position of comfort • Specialty consultation

Lower Airway Obstruction Specific Management for Selected Conditions	
Bronchiolitis	Asthma
<ul style="list-style-type: none"> • Nasal suctioning • Bronchodilator trial 	<ul style="list-style-type: none"> • Albuterol and/or ipratropium • Corticosteroids • SQ epinephrine • Magnesium sulfate • Terbutaline

Lung Tissue (Parenchymal) Disease Specific Management for Selected Conditions	
Pneumonia / Pneumonitis Infectious Chemical Aspiration	Pulmonary Edema Cardiogenic or ARDS
<ul style="list-style-type: none"> • Albuterol • Antibiotics as needed 	<ul style="list-style-type: none"> • Consider noninvasive or invasive ventilator support with PEEP • Consider vasoactive support • Consider diuretic

Disordered Control of Breathing Specific Management for Selected Conditions		
Increased ICP	Poisoning / Overdose	Neuromuscular Disease
<ul style="list-style-type: none"> • Avoid hypoxemia • Avoid hypercarbia • Avoid hyperthermia 	<ul style="list-style-type: none"> • Antidote (if available) • Contact Poison Control 	<ul style="list-style-type: none"> • Consider noninvasive or invasive ventilator support

This chart does not include all respiratory emergencies.

IV. Management of Shock Emergencies Flowchart

- Oxygen
- Pulse oximetry
- ECG monitor
- IV/IO access
- BLS as needed
- Bedside glucose

Hypovolemic Shock Specific Management for Selected Conditions	
Non-hemorrhagic	Hemorrhagic
<ul style="list-style-type: none"> • 20 mL/kg NS/LR bolus, repeat as needed • Consider colloid after 3rd NS/RL bolus 	<ul style="list-style-type: none"> • Control external bleeding • 20 mL/kg NS/RL bolus repeat 2 or 3x as needed • Transfuse PRBC's as indicated

Distributive Shock Specific Management for Selected Conditions		
Septic	Anaphylactic	Neurogenic
Management Algorithm <ul style="list-style-type: none"> • Septic Shock 	<ul style="list-style-type: none"> • IM epinephrine • Antihistamines • Corticosteroids • Epinephrine infusion • Albuterol 	<ul style="list-style-type: none"> • 20 mL/kg NS/LR bolus, repeat PRN • Vasopressor

Cardiogenic Shock Specific Management for Selected Conditions			
Brady / Tachyarrhythmia		CHD, Myocarditis, Cardiomyopathy, Poisoning	
Management Algorithms: <ul style="list-style-type: none"> • Bradycardia • Tachycardia with poor perfusion 		<ul style="list-style-type: none"> • 5-10 mL/kg NS/RL bolus, repeat PRN • Vasoactive infusion • Consider expert consultation 	

Obstructive Shock Specific Management for Selected Conditions			
Ductal-Dependent	Tension Pneumothorax	Cardiac Tamponade	Pulmonary Embolism
<ul style="list-style-type: none"> • Prostaglandin • Expert Consultation 	<ul style="list-style-type: none"> • Needle decompression • Tube thoracotomy 	<ul style="list-style-type: none"> • Pericardiocentesis • 20 mL/kg NS/RL bolus 	<ul style="list-style-type: none"> • 20 mL/kg NS/RL bolus, repeat PRN • Consider thrombolytics, anticoagulants • Expert consultation

V. Recognition of Shock Flowchart

- **Clinical Signs:**
 - Hypovolemic Shock**
 - A** - Airway-open and maintainable/not maintainable
 - B** - Respiratory rate-increased
Effort-normal to increased
Breath sounds-normal, maybe crackles
 - C - Systolic blood pressure-Compensated to Hypotensive**
Pulse pressure-narrow
Heart rate-increased
Pulse quality-weak
Skin-pale, cool
Cap refill-delayed
Urine output-decreased
 - D** - Level of consciousness-irritable early, lethargic late
 - E** - Variable

- **Clinical Signs: Distributive Shock**
 - A** - Airway-open and maintainable/not maintainable
 - B** - Respiratory rate-increased
Effort-normal to increased
Breath sounds-normal, maybe crackles
 - C - Systolic blood pressure-Compensated to Hypotensive**
Pulse pressure-wide
Heart rate-increased
Pulse quality-bounding or weak
Skin-warm or cool
Cap refill-variable
Urine output-decreased
 - D** - Level of consciousness-irritable early, lethargic late
 - E** - Variable

- **Clinical Signs: Cardiogenic Shock**
 - A** - Airway-open and maintainable/not maintainable
 - B** - Respiratory rate-increased
Effort-labored
Breath sounds-crackles, grunting
 - C - Systolic blood pressure-Compensated to Hypotensive**
Pulse pressure-narrow
Heart rate-increased
Pulse quality-weak
Skin-pale, cool
Cap refill-delayed
Urine output-decreased
 - D** - Level of consciousness-irritable early, lethargic late
 - E** - Variable

- **Clinical Signs: Obstructive Shock**
 - A** - *Airway-open and* maintainable/not maintainable
 - B** - Respiratory rate-increased
Effort-labored
Breath sounds-crackles, grunting
 - C - Systolic blood pressure-Compensated to Hypotensive**
Pulse pressure-narrow
Heart rate-increased
Pulse quality-weak
Skin-pale, cool
Cap refill-delayed
Urine output-decreased
 - D** - Level of consciousness-irritable early, lethargic late

E - Variable

VI. Recognition of Respiratory Problems Flowchart

- **Clinical Signs: Upper Airway Obstruction**
 - A** - Airway-open and maintainable/not maintainable
 - B** - Respiratory rate/effort-increased
Breath sounds-stridor (typically inspiratory)-seal like cough- hoarseness
Air movement-decreased
 - C** - Heart rate-increased
Skin-pallor, cool skin (early) cyanosis (late)
 - D** - Level of consciousness-anxiety, agitation (early) lethargy, unresponsiveness (late)
 - E - Variable

- **Clinical Signs: Lower Airway Obstruction**
 - A** - Airway-open and maintainable/not maintainable
 - B** - Respiratory rate/effort-increased
Breath sounds-wheezing (typically expiratory) prolonged expiratory phase
Air movement-decreased
 - C** - Heart rate-increased Skin-pallor, cool skin (early) cyanosis (late)
 - D** - Level of consciousness-anxiety, agitation (early) lethargy, unresponsiveness (late)
 - E - Variable

- **Clinical Signs: Lung Tissue (Parenchymal) Disease**
 - A** - Airway-open and maintainable/not maintainable
 - B** - Respiratory rate/effort-increased
Breath sounds-grunting, crackles, decreased breath sounds
Air movement-decreased
 - C** - Heart rate-increased
Skin-pallor, cool skin (early) cyanosis (late)
 - D** - Level of consciousness-anxiety, agitation (early) lethargy, unresponsiveness (late)
 - E - Variable

- **Clinical Signs: Disordered Control of Breathing**
 - A** - Airway-open and maintainable/not maintainable
 - B** - Respiratory rate/effort-variable
Breath sounds-normal
Air movement-variable
 - C** - Heart rate-increased
Skin-pallor, cool skin (early) cyanosis (late)
 - D** - Level of consciousness-anxiety, agitation (early) lethargy, unresponsiveness (late)
 - E - Variable

VII. Normal Vital Signs for Pediatric Patients

- **Normal Respiratory Rates**

Age	Breaths / Minute
Infant (<1 year)	30 - 60
Toddler (1 – 3 years)	24 - 40
Preschooler (4 – 5 years)	22 - 34
School Age (6 – 12 years)	18 - 30
Adolescent (13 – 18 years)	12 - 18

* A respiratory rate more than 60 per minutes at any age is abnormal and should serve as a “red Flag.”

- **Normal Heart Rates**

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

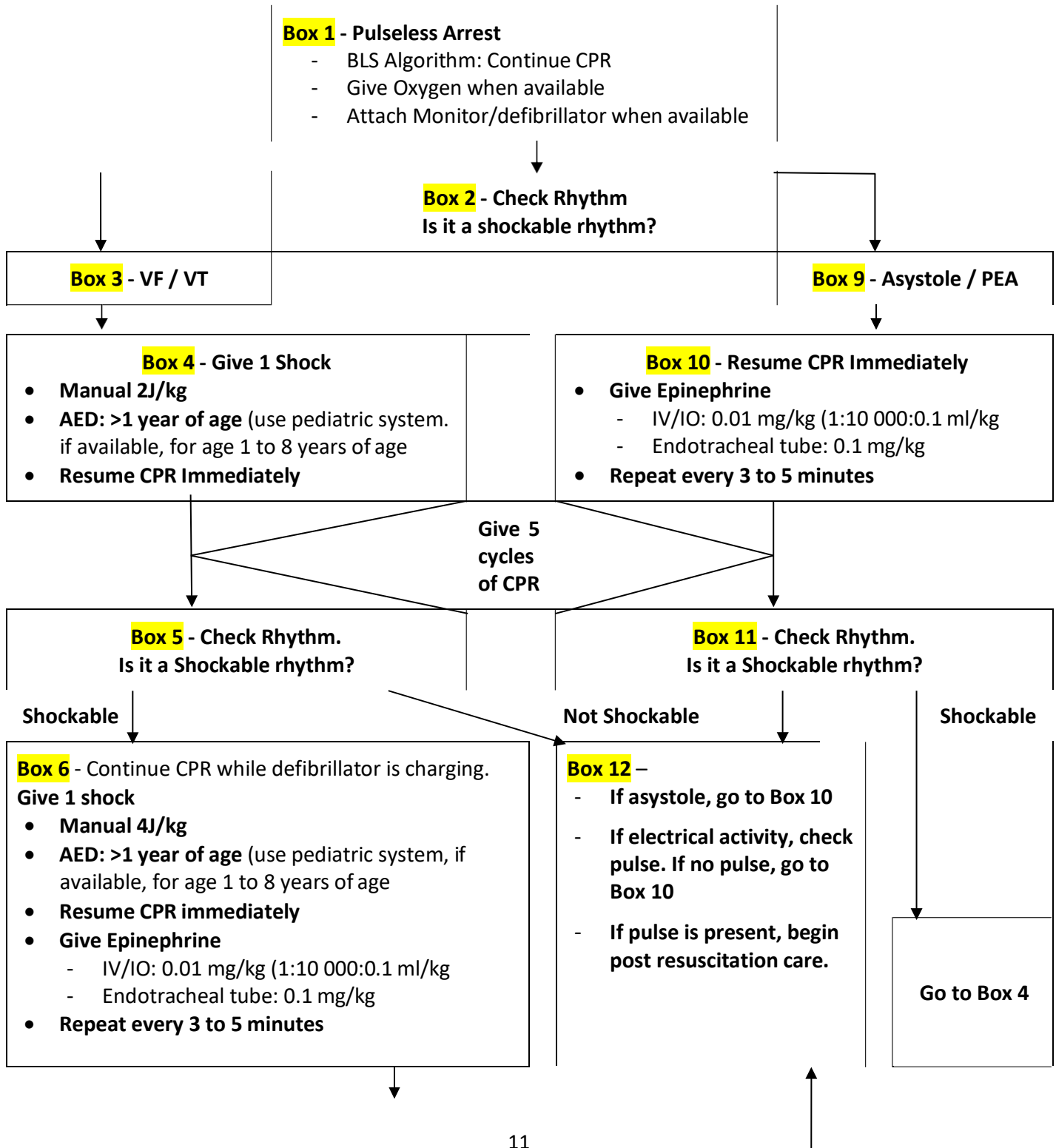
* Heart rate should be appropriate for the child’s age, activity level and clinical condition. Heart rates vary in a sleeping or athletic child. “red Flag.”

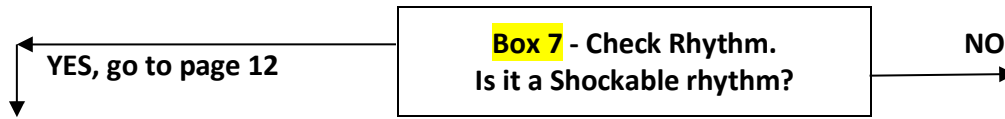
- **Minimum Systolic Blood Pressure Accepted (5th percentile)**

Age	Systolic Blood Pressure (mm HG)
Birth (12h, < 1000g)	39-59
Birth (12h, 3g)	60-76
Neonate (96h)	67-84
Infant (1-12mos)	72-104
Toddler (1 – 2 years)	86-106
Preschooler (3 – 5 years)	89-112
School Age (6 – 12 years)	97-115
Adolescent (10-11 years)	102-120

VIII. Algorithms for Pediatrics

• Pulseless Arrest





YES, continued from page 11

<p>Continue CPR while defibrillator is charging. Give 1 shock</p> <ul style="list-style-type: none"> • Manual: 4J/kg • AED: >1 year of age <p>Resume CPR immediately after the shock Consider antiarrhythmics (e.g. Amiodarone 5 mg/kg IV/IO once, or Lidocaine 1 mg/kg IV/VO) Consider Magnesium, 25 to 50 mg/kg. Max 2 g IV/VO for Torsades de Pointes After 5 cycles of CPR, go to Box 5</p>	
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	<p style="text-align: center;">During CPR</p> <ul style="list-style-type: none"> - Push hard and fast (100/min) - Ensure full chest recoil - Minimize interruptions in chest compressions - One cycle of CPR: 15 compressions then 2 breaths: 5 cycles = 2 min - Avoid hyperventilation - Secure airway and confirm placement - After an advanced airway is placed, rescuers no longer deliver “cycles” of CPR - Give continuous compressions without pauses for breaths - Give 8-10 breaths/min - Check Rhythm every 2 minutes - Rotate compressors every 2 minutes, with rhythm checks - Search for and treat possible contributing factors: <p style="text-align: center;">Hypovolemia, Hypoxia, Hydrogen Ion (acidosis) Hypo/Hyperkalemia, Hypoglycemia, Hypothermia, Toxins Tamponade (cardiac), Tension Pneumothorax, Thrombosis (coronary or pulmonary), Trauma (hypovolemia)</p>
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- **Bradycardia with a Pulse**

BRADYCARDIA with a pulse
Causing Cardiorespiratory Compromise

- **Support ABCs as needed**
- Give oxygen
- Attach Monitor/defibrillator

NO

Bradycardia still causing Cardiopulmonary compromise?

YES

- **Support ABCs as needed**
- Give oxygen if needed
- Observe
- Consider expert consultation

Perform CPR, if despite Oxygenation and ventilation HR <60, with poor perfusion

NO

Persistent symptomatic bradycardia

YES

- Reminders**
- If Pulseless Arrest develops, go to Pulseless Arrest Algorithm
 - During CPR
 - Push hard and fast (100/min)
 - Ensure full chest recoil
 - Support ABCs
 - Secure airway if needed and confirm placement
 - Minimize interruptions in chest compressions
 - Search for and treat possible contributing factors:

Hypovolemia

Hypoxia

Hydrogen Ion (acidosis)

Hypo-/Hyperkalemia

Hypoglycemia

Hypothermia

Toxins

Tamponade, Cardiac

Tension Pneumothorax

Thrombosis (coronary or pulmonary)

Trauma (hypovolemia, increased ICP)

- **Give Epinephrine**

- IV/IO: 0.01 mg/kg (1:10 000:0.1 ml/kg)
- Endotracheal tube: 0.1 mg/kg

Repeat every 3 to 5 minutes

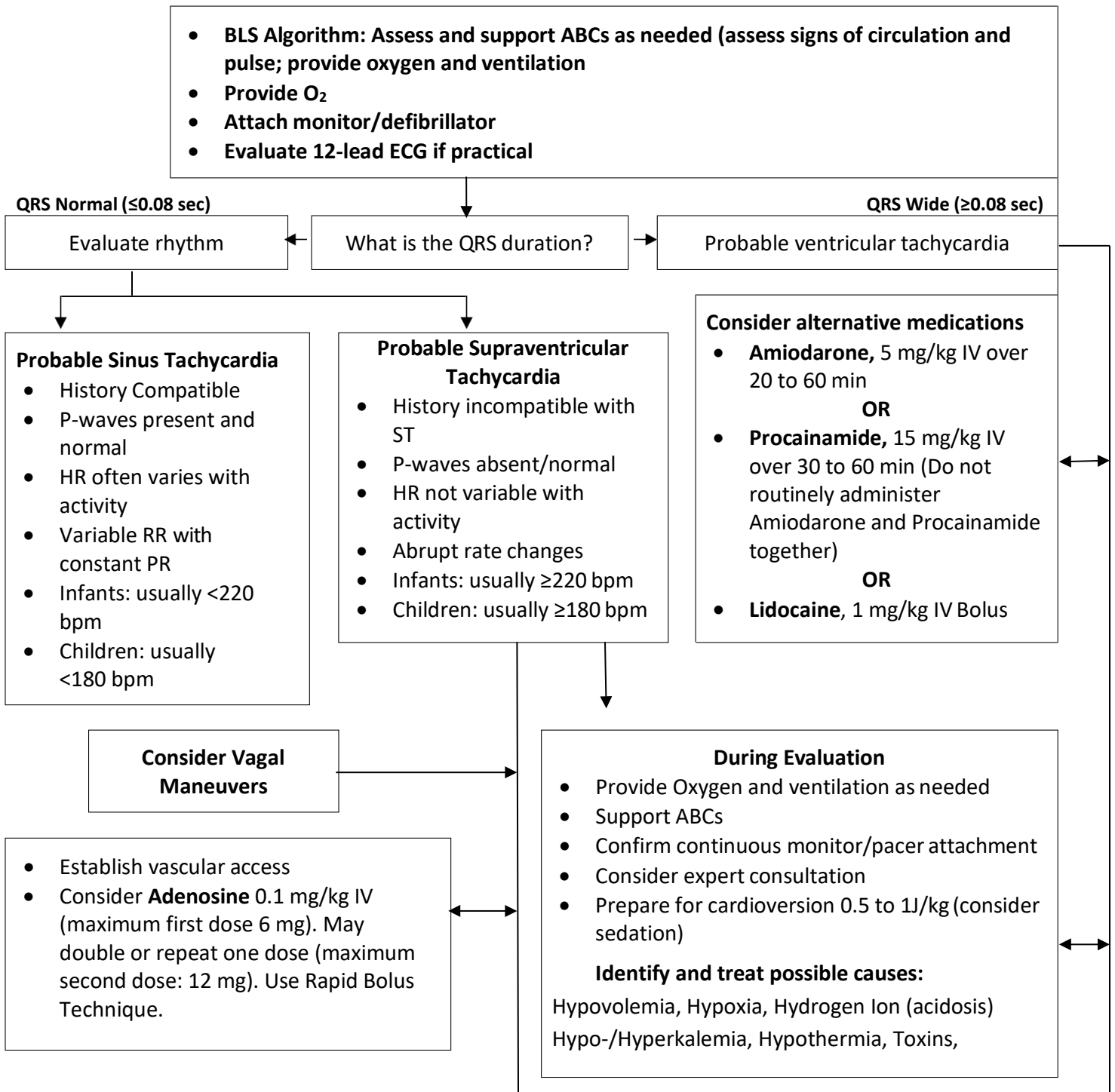
- **If increased vagal tone or Primary AV Block:**

- Give Atropine, first dose: 0.02 mg/kg. May repeat (Minimum dose: 0.1 mg; Max dose 1 mg)

- **Consider cardiac pacing**

- **If Pulseless Arrest develops go to Algorithm for Pulseless Arrest**

• **Tachycardia with Adequate Perfusion**



- Consult Pediatric cardiologist
- Attempt cardioversion 0.5 to 1J/kg; may increase to 2J/kg if initial dose is ineffective
- Sedate prior to cardioversion
- Obtain 12-lead ECG

Tamponade (cardiac), Tension Pneumothorax, Thrombosis (coronary or pulmonary), Trauma (hypovolemia), increased ICP

• **Tachycardia with Pulses and Poor Perfusion**

- Tachycardia with Pulses and Poor Perfusion**
- Assess and support ABCs as
 - Provide O₂
 - Attach monitor/defibrillator

QRS Normal (≤ 0.08 sec)

Symptoms ↓ Persists

QRS Wide (≥ 0.08 sec)

Evaluate rhythm with monitor or 12-lead ECG

What is the QRS duration?

Probable ventricular tachycardia

- Probable Sinus Tachycardia**
- History compatible
 - P-waves present and normal
 - HR often varies with activity
 - Variable RR with constant PR
 - Infants: usually <220 bpm
 - Children: usually <180 bpm

- Probable Supraventricular Tachycardia**
- History incompatible with ST
 - P-waves absent/abnormal
 - HR not variable with activity
 - Abrupt rate changes
 - Infants: usually ≥ 220 bpm
 - Children: usually ≥ 180 bpm

- Synchronized Cardioversion**
- 0.5 to 1J/kg; may increase to 2J/kg if initial dose is ineffective
 - Sedate if possible, but do not delay cardioversion
 - Consider **Adenosine**, if it does not delay electrical cardioversion

Consider Vagal Maneuvers (no delays)

Search for and treat cause!

- If vascular access is available:**
- Consider **Adenosine** 0.1 mg/kg IV (maximum first dose 6 mg. May double or repeat one dose (maximum second dose 12 mg). Use Rapid Bolus Technique

- **Expert Consultation Advised**
- **Amiodarone**, 5 mg/kg IV over 20 to 60 min
- **OR**
- **Procainamide** 15 mg/kg IV over 30 to 60 min. (Do not routinely administer Amiodarone and Procainamide together).

OR

- Attempt cardioversion 0.5 to 1 J/kg; may increase to 2J/kg if initial dose is ineffective
- Sedate prior to cardioversion, if possible

Identify and treat possible causes:

Hypovolemia, Hypoxia, Hydrogen Ion (acidosis) Hypo-/Hyperkalemia, Hypothermia, Toxins, Tamponade (cardiac), Tension Pneumothorax, Thrombosis (coronary or pulmonary), Trauma (hypovolemia), increased ICP

During Evaluation

- Provide Oxygen and ventilation as needed
- Support ABC's
- Confirm continuous monitor/pacer attachment
- Consider expert consultation
- Prepare for cardioversion 0.5 to 1J/kg (consider sedation)

IX. AED Treatment Algorithm for Pre-Hospital Care of Children >8

For Emergency Cardiovascular Care Pending Arrival of Emergency Medical Personnel

Unresponsive – 911 – AED

- Check if unresponsive
- Phone 911
- Get AED
- Identify and respond to special situations

Unresponsive

Start the ABCDs:

- Airway: open airway
- Breathing: Check breathing --- (look, listen and feel)

Yes, Breathing

- If breathing is adequate, place in a recovery position
- If breathing is inadequate: start rescue breathing (1 breath every 5 seconds)
- Monitor signs of circulation

Not Breathing

- **Provide 2 slow breaths**
- **(2 seconds per breath)**
- **Circulation: check for signs**

Yes, Circulation

- Start rescue breathing (1 breath every 5 seconds)
- Monitor signs of circulation (every 30 to 60 seconds)

No Circulation

Perform CPR (until AED arrives and is ready to attach:

- Start chest compressions (100/min)
- Start rescue breathing (10 to 12 breaths/min)
- Ratio of 15 compressions to 2 breaths

Memory aid for “no shock indicated”:

- Check for signs of circulation

- Attempt defibrillation (AED on scene):
- **POWER ON** the AED first!
- **ATTACH** AED electrode pads (stop chest compressions for pad placement)

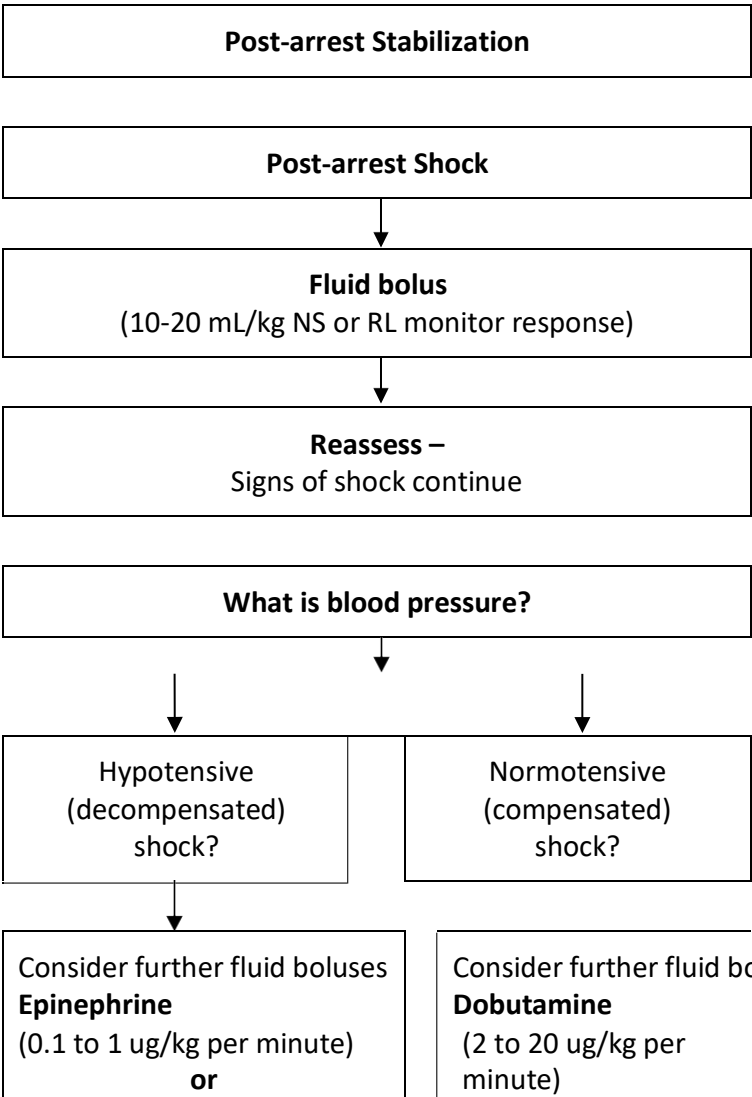
- If signs of circulation present: check breathing
 - If inadequate breathing: start rescue breathing (1 breath every 5 seconds)
 - If adequate breathing: place in a recovery position
 - If no signs of circulation, analyze rhythm: repeat :shock indicated” or “no shock indicated” sequences
- *Note: Signs of circulation:** lay rescuers check for normal breathing, coughing or movement (typically assessed after 2 rescue breaths delivered to the unresponsive, non-breathing victim).

- Analyze (“Clear!”)
- Shock (“Clear!”) up to 3 times, if advised

- After 3 shocks or after any “no shock indicated”**
- **Check for signs of circulations**
 - **If no signs of circulations: perform CPR for 1 minute**

- Check for signs of circulation: if absent:
- Press ANALYZE
 - Attempt defibrillation
 - Repeat up to 3 times

Post-arrest Treatment of Shock



And Maintenance Fluid Requirements

Estimation of Maintenance Fluid Requirements

Infants <10 kg: Infusion of 0.2@ normal saline in 5% dextrose (d5/0.2% NaCl) at a rate of 4 mL/kg per hour. For example, the maintenance rate for an 8-kg baby is as follows:

$$4 \text{ mL/kg per hour} \times 8 \text{ kg} = 32 \text{ mL/h}$$

Children 10 to 20 kg: Infusion of d5/0.2% NaCl at a rate of 40 mL/h plus 2mL/kg per hour for each kilogram between 10 and 20 kg. For example, the maintenance rate for a 15-kg child is as follows:

$$40 \text{ mL/h} + (2\text{mL/kg per hour} \times 5 \text{ kg}) = 50\text{mL/h}$$

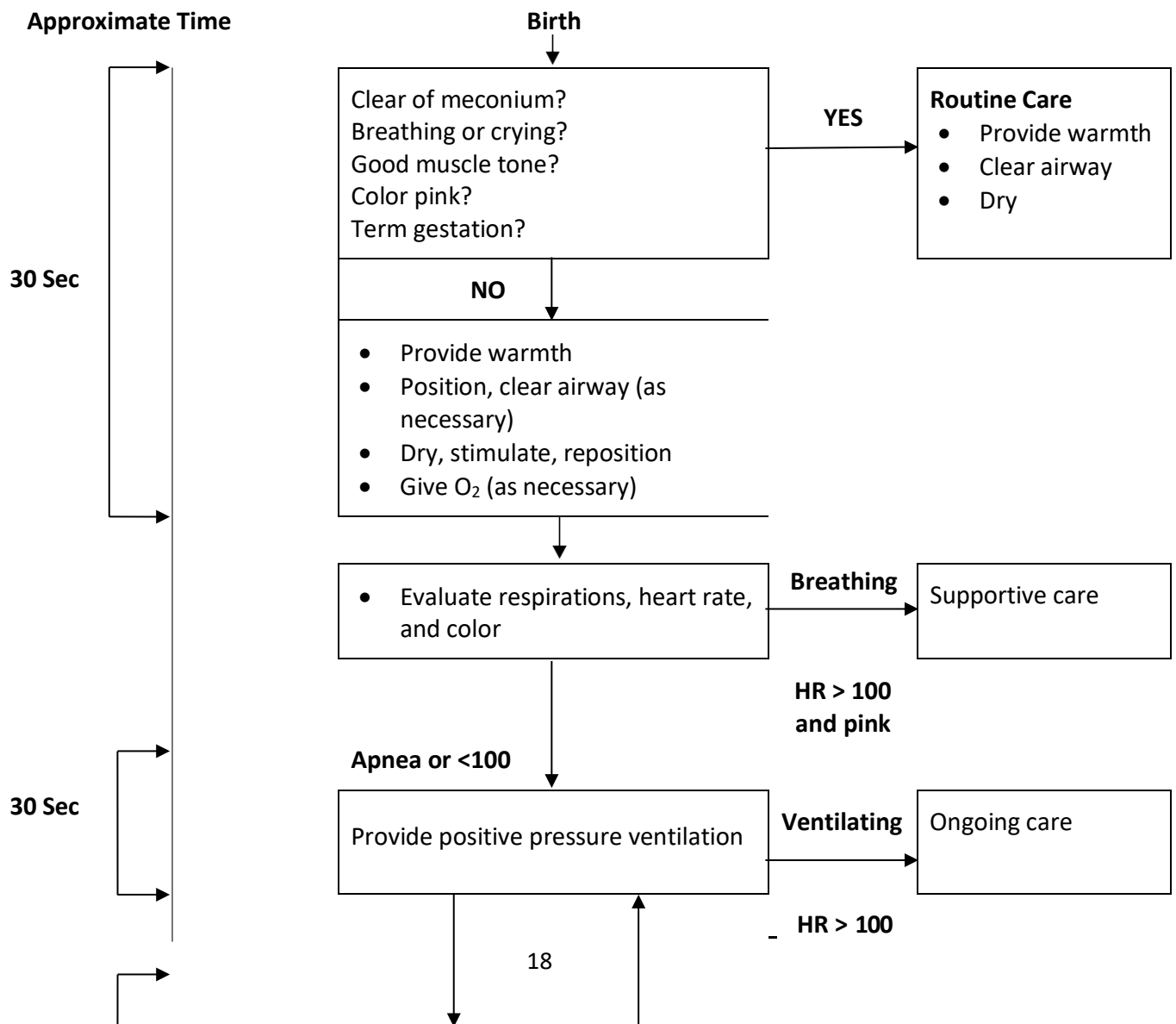
Children >20 kg: Infusion of d5/0.2% NaCl at a rate of 60 mL/h plus 1 mL/kg per hour for each kilogram above 20 kg. For example the maintenance rate for a 30-kg child is as follows:

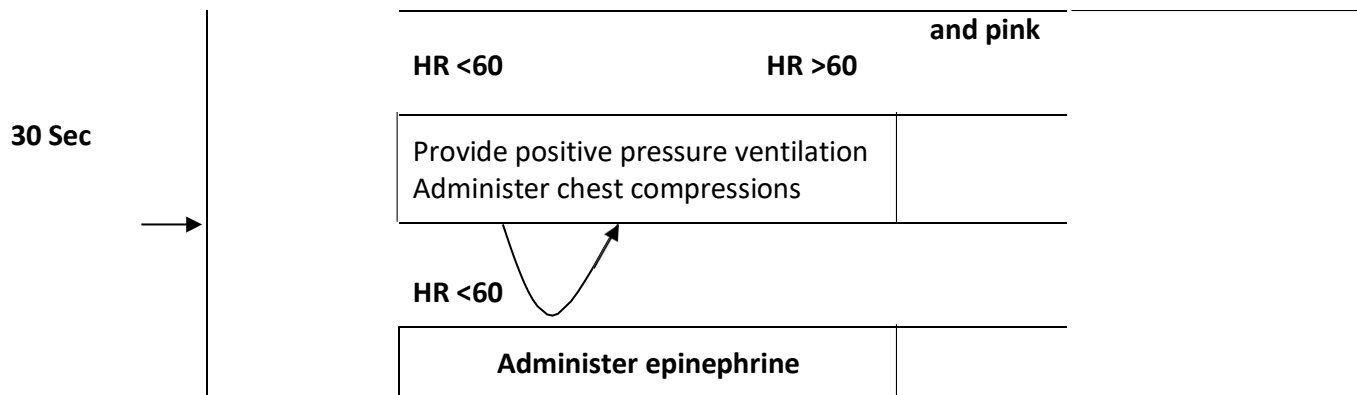
$$60 \text{ mL/h} + (1 \text{ mL/kg per hour} \times 10 \text{ kg}) = 70 \text{ mL/h}$$

Dopamine at higher doses (up to 20 ug/kg per minute)
Norepinephrine (0.1 to 2 ug/kg per minute)

or
Dopamine (1 to 20 ug/kg per minute)
or
 Low doses **epinephrine** (0.05 to 0.3 ug/kg per minute)
Inamrinone: Load with 0.75 to 1 mg/kg over 5 minutes, may repeat up to 3 mg/kg. Infusion: 5 to 10 ug/kg per minute
Milrinone: Load with 50 to 75 ug/kg. Infusion: 0.5 to .075 ug/kg per minute.

X. Overview of Resuscitation in the Delivery Room





XI. Drugs Used in Pediatric Advanced Life Support

Drugs	Dosage (Pediatric)	Remarks
Adenosine	0.1 mg/kg (up to 6 mg) 0.2 0.2 mg/kg for second dose	Rapid IV push Max single dose: 12 mg
Amiodarone: For refractory pulseless <u>VT / VF</u> for perfusing tachycardia	5 mg/kg Bolus IV/IO Loading: 5 mg/kg IV/VO over 20-60 min	Max 15 mg/kg/day Repeat to max 15 mg/kg/day IV
Atropine sulfate	0.02 mg/kg IV/VO/TT	Min dose: 0.1 MG Max single dose: 0.5 mg child, 1 mg adolescent May double 2 nd dose
Ca ₂ chloride 10%	20 mg/kg IV/VO	Slow IV 10 bolus
Dobutamine	2-20 ug/kg/min	Titrate to desired effect
Dopamine	2-20 ug/kg/min	a-Pressor effects at higher doses .15 ug/kg/min
Epinephrine for Bradycardia	IV/IO: 0.01 mg/kg (1:10 000, 0.1 mL/kg) TT: 0.1 mg/kg (1:1000, 0.1 mL/kg)	
Epinephrine for Asystolic or pulseless arrest	First dose: IV/IO: 0.01 mg/kg	Subsequent doses: IV/IO/TT: 0.01-0.1 mg/kg

	(1:10 000, 0.1 mL/kg)	(1:1000, 0.1 mL/kg. IV/VO doses as high as 0.2 mg/kg of 1:1000 may be effective Repeat q 3-5 min
Epinephrine Infusion	Initial at 0.1 ug/kg/min	Titrate to desired effect (0.1-1 ug/kg/min
Glucose	0.5-1 g/kg IV/VO Max dose: 2-4 mL/kg Of 25% solution	5% = 10-20 mL/kg 10% = 5-10 mL/kg, 25% = 2-4 mL/kg (in large vein)
Lidocaine _____	1 mg/kg	IV/IO/TT
Infusion	20-50 ug/kg/min	
Magnesium Sulfate	25-50 mg/kg/min over 10-20 min	Max dose: 2 g

Drugs	Dosage (Pediatric)	Remarks
Milrinone	Loading dose 50-70 ug/kg IV/IO over 10-60 min Infusion dose 0.5-0.75 ug/kg/min IV/IO	Monitor BP, ECG
Naloxone	If <5 years old or <20 kg: 0.1 mg/kg If <5 years old or >20 kg: 2 mg	Titrate to desired effect
Prostaglandin E1	0.05-0.1 ug/kg/min	Titrate, monitor for apnea, hypotension, hypoglycemia, hypocalcemia
Sodium bicarbonate	1 mEq/kg per dose	Infuse slowly and only if ventilation is adequate

For TT administration, dilute medication with NS to a volume of 3-5 mL and follow with several positive-pressure ventilations.

