

# Pediatric Advanced Life Support Preparatory Materials

National Certification Services 1/17 Review

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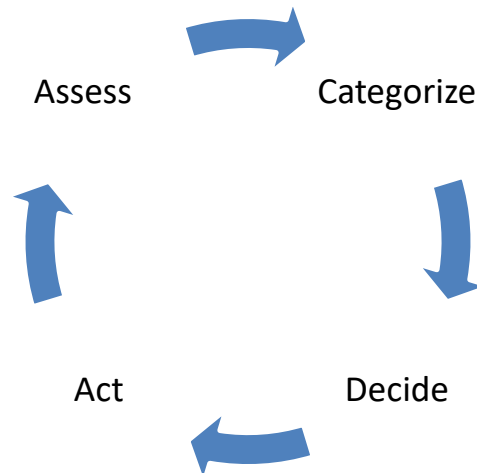


## **PEDIATRIC ADVANCED LIFE SUPPORT (PALS) RECERTIFICATION**

### **TABLE OF CONTENTS**

<b>CYCLIC APPROACH</b>	<b>03</b>
<b>PEDIATRIC ASSESSMENT FLOWCHART</b>	<b>04</b>
<b>MANAGEMENT OF RESPIRATORY EMERGENCIES FLOWCHART</b>	<b>05</b>
<b>MANAGEMENT OF SHOCK EMERGENCIES FLOWCHART</b>	<b>06</b>
<b>RECOGNITION OF SHOCK FLOWCHART</b>	<b>07</b>
<b>RECOGNITION OF RESPIRATORY PROBLEMS FLOWCHART</b>	<b>09</b>
<b>NORMAL VITAL SIGNS FOR PEDIATRIC PATIENTS</b>	<b>10</b>
<b>ALGORITHMS FOR PEDIATRICS</b>	
<b>PULSELESS ARREST</b>	<b>11</b>
<b>BRADYCARDIA WITH A PULSE</b>	<b>13</b>
<b>TACHYCARDIA WITH ADEQUATE PERFUSION</b>	<b>14</b>
<b>TACHYCARDIA WITH PULSE AND POOR PERFUSION</b>	<b>15</b>
<b>AED TREATMENT ALGORITHM FOR PRE-HOSPITAL CRE OF CHILDREN &gt;8</b>	<b>16</b>
<b>OVERVIEW OF RESUSCITATION IN THE DELIVERY ROOM</b>	<b>18</b>
<b>DRUGS USED IN PEDIATRIC ADVANCEDLIFE SUPPORT</b>	<b>19</b>

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

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

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

### Categorize Illness by Type and Severity

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

**Respiratory + Circulatory = Cardiopulmonary failure**

**III. Management of Respiratory Emergencies Flowchart**

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

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

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

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

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

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"> <li>• 20 mL/kg NS/LR bolus, repeat as needed</li> <li>• Consider colloid after 3<sup>rd</sup> NS/RL bolus</li> </ul>	<ul style="list-style-type: none"> <li>• Control external bleeding</li> <li>• 20 mL/kg NS/RL bolus repeat 2 or 3x as needed</li> <li>• Transfuse PRBC's as indicated</li> </ul>

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

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

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

## 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

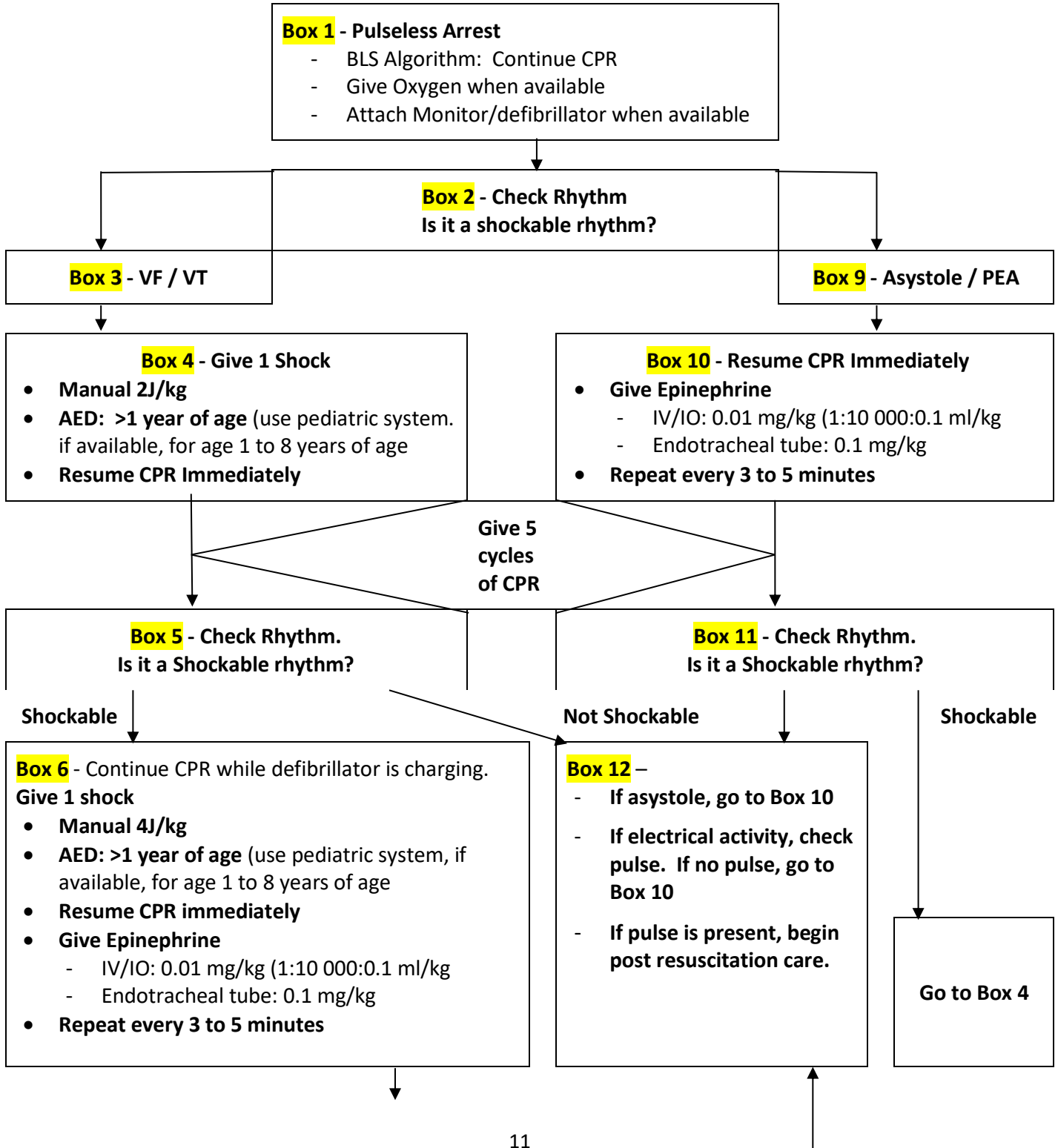
\* Heart rate should be appropriate for the child’s age, activity level and clinical condition. Heart rates vary in a sleeping or athletic child. “red Flag.”

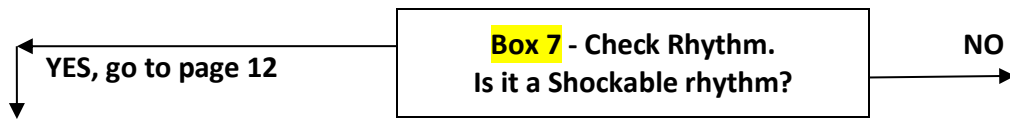
- **Minimum Systolic Blood Pressure Accepted (5<sup>th</sup> percentile)**

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

Continue CPR while defibrillator is charging.

**Give 1 shock**

- **Manual: 4J/kg**
- **AED: >1 year of age**

**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

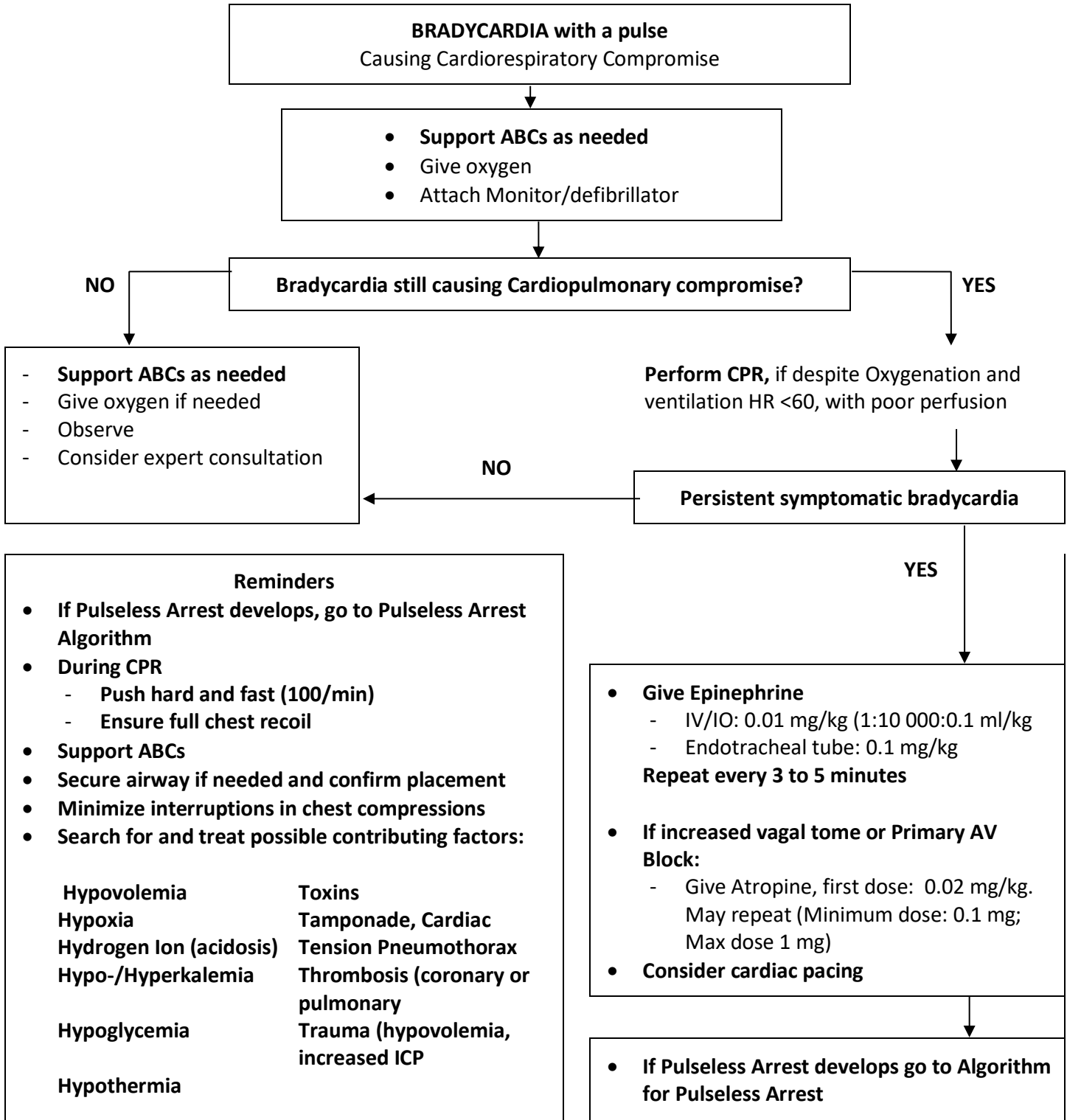
**After 5 cycles of CPR, go to Box 5**

**During CPR**

- **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:

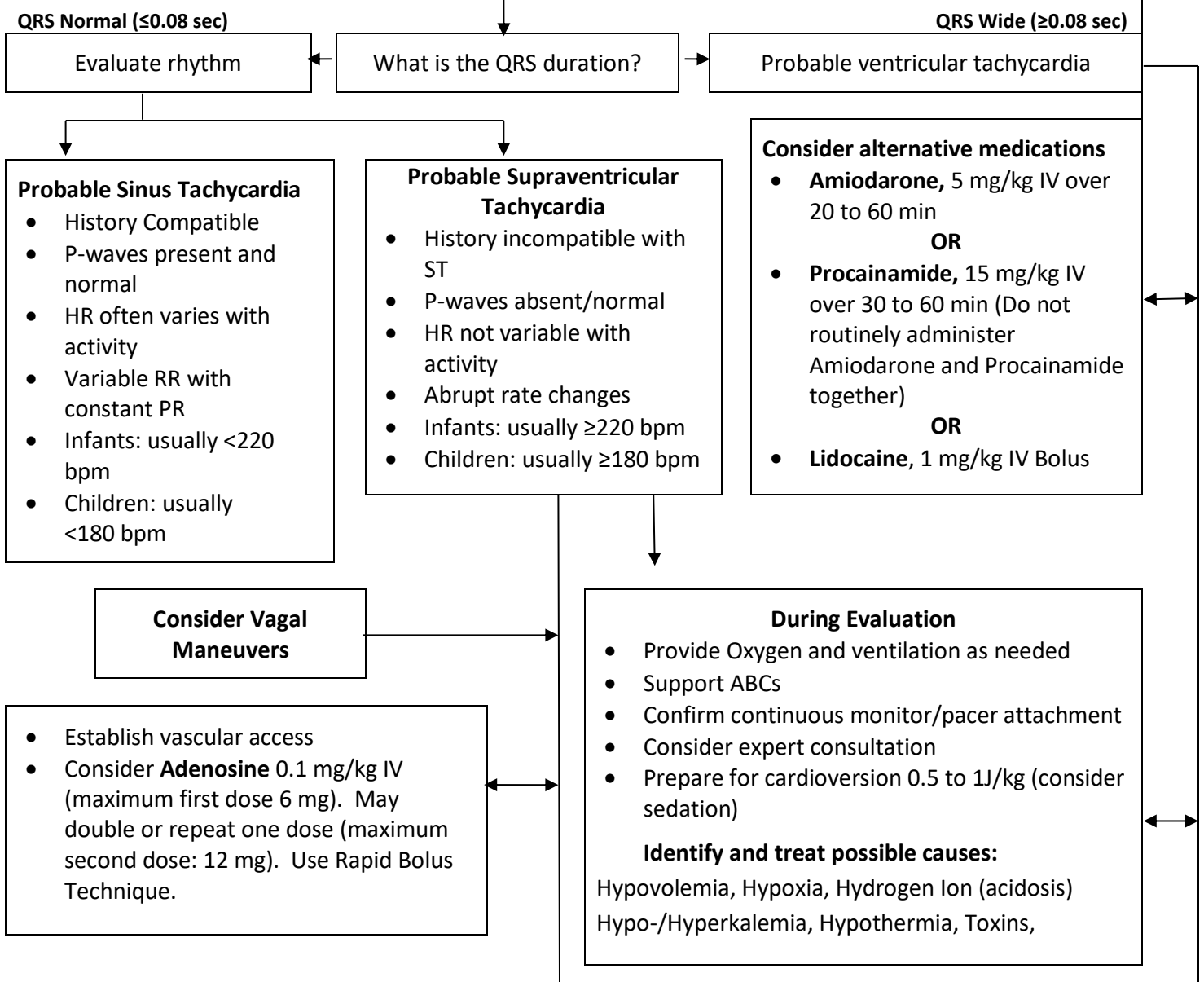
**Hypovolemia, Hypoxia, Hydrogen Ion (acidosis) Hypo/Hyperkalemia, Hypoglycemia, Hypothermia, Toxins Tamponade (cardiac), Tension Pneumothorax, Thrombosis (coronary or pulmonary), Trauma (hypovolemia)**

• **Bradycardia with a Pulse**



• Tachycardia with Adequate Perfusion

- BLS Algorithm: Assess and support ABCs as needed (assess signs of circulation and pulse; provide oxygen and ventilation)
- Provide O<sub>2</sub>
- Attach monitor/defibrillator
- Evaluate 12-lead ECG if practical



- 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

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• **Tachycardia with Pulses and Poor Perfusion**

**Tachycardia with Pulses and Poor Perfusion**

- Assess and support ABCs as
- Provide O<sub>2</sub>
- Attach monitor/defibrillator

QRS Normal ( $\leq 0.08$  sec)

Symptoms ↓ Persists

QRS Wide ( $\geq 0.08$  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  $\geq 220$  bpm
- Children: usually  $\geq 180$  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:**

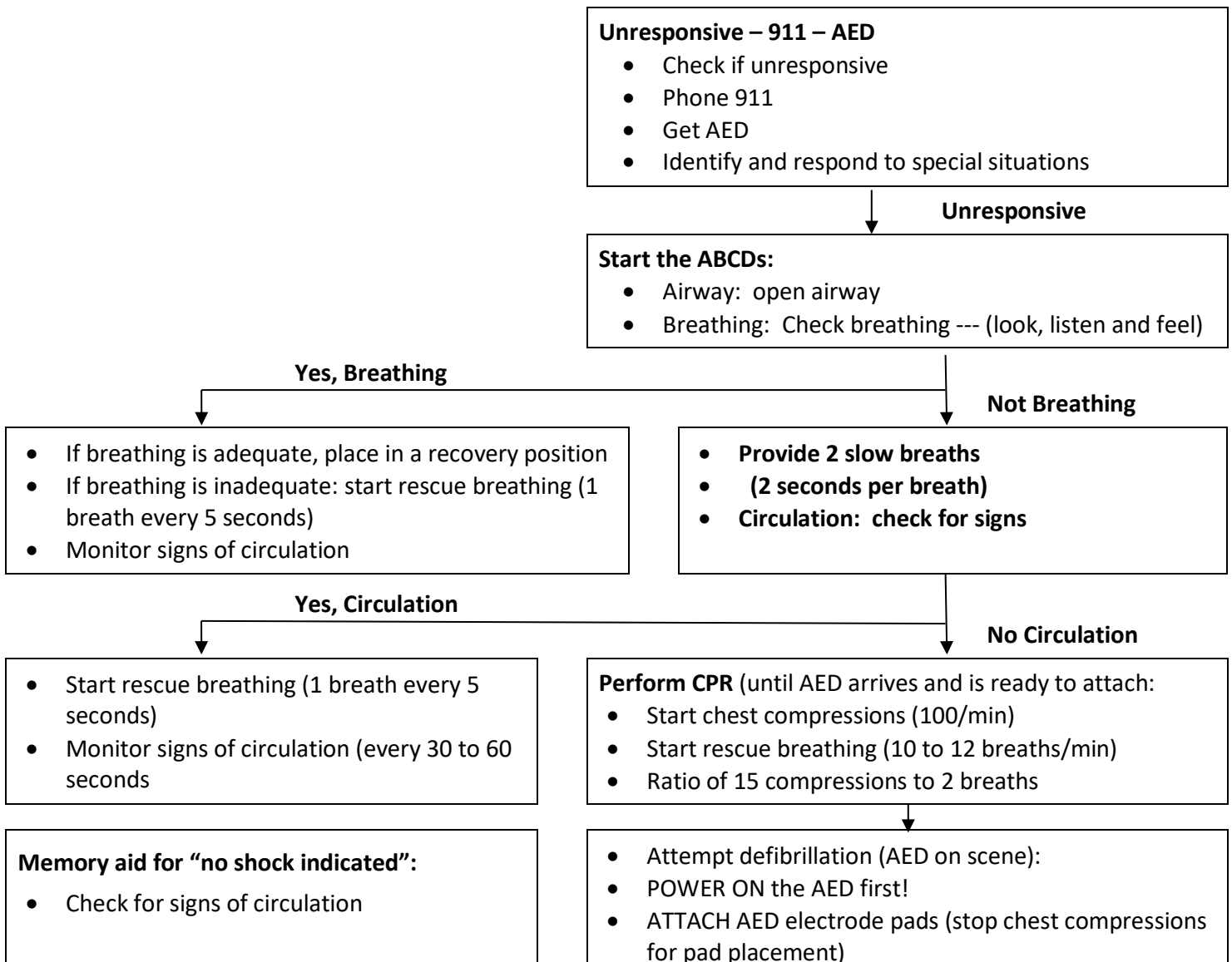
Hypovolemia, Hypoxia, Hydrogen Ion (acidosis) Hypo-/Hyperkalemia, Hypothermia, Toxins, Tamponade (cardiac), Tension Pneumothorax, Thrombosis (coronary or pulmonary), Trauma (hypovolemia), increased ICP

**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



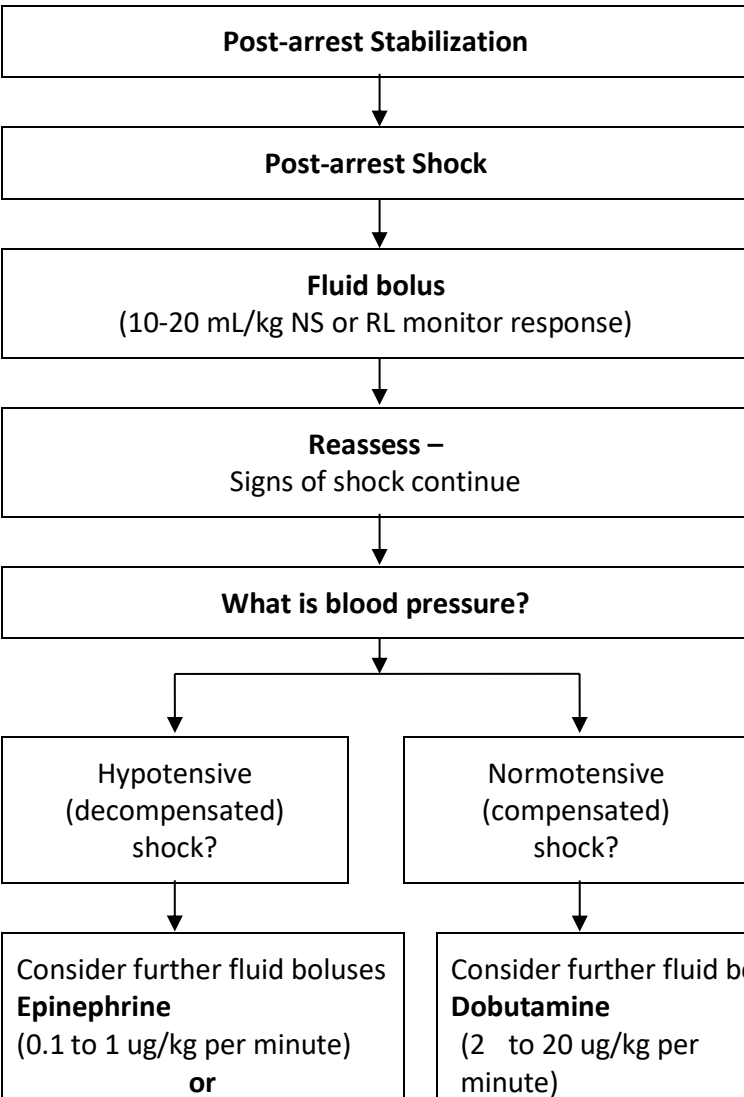


- If signs of circulation present: check breathing
  - If inadequate breathing: start rescue breathing (1 breath every 5 seconds)
  - If adequate breathing: place in a recovery position
  - If no signs of circulation, analyze rhythm: repeat :shock indicated” or “no shock indicated” sequences
- \*Note: 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

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**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:

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

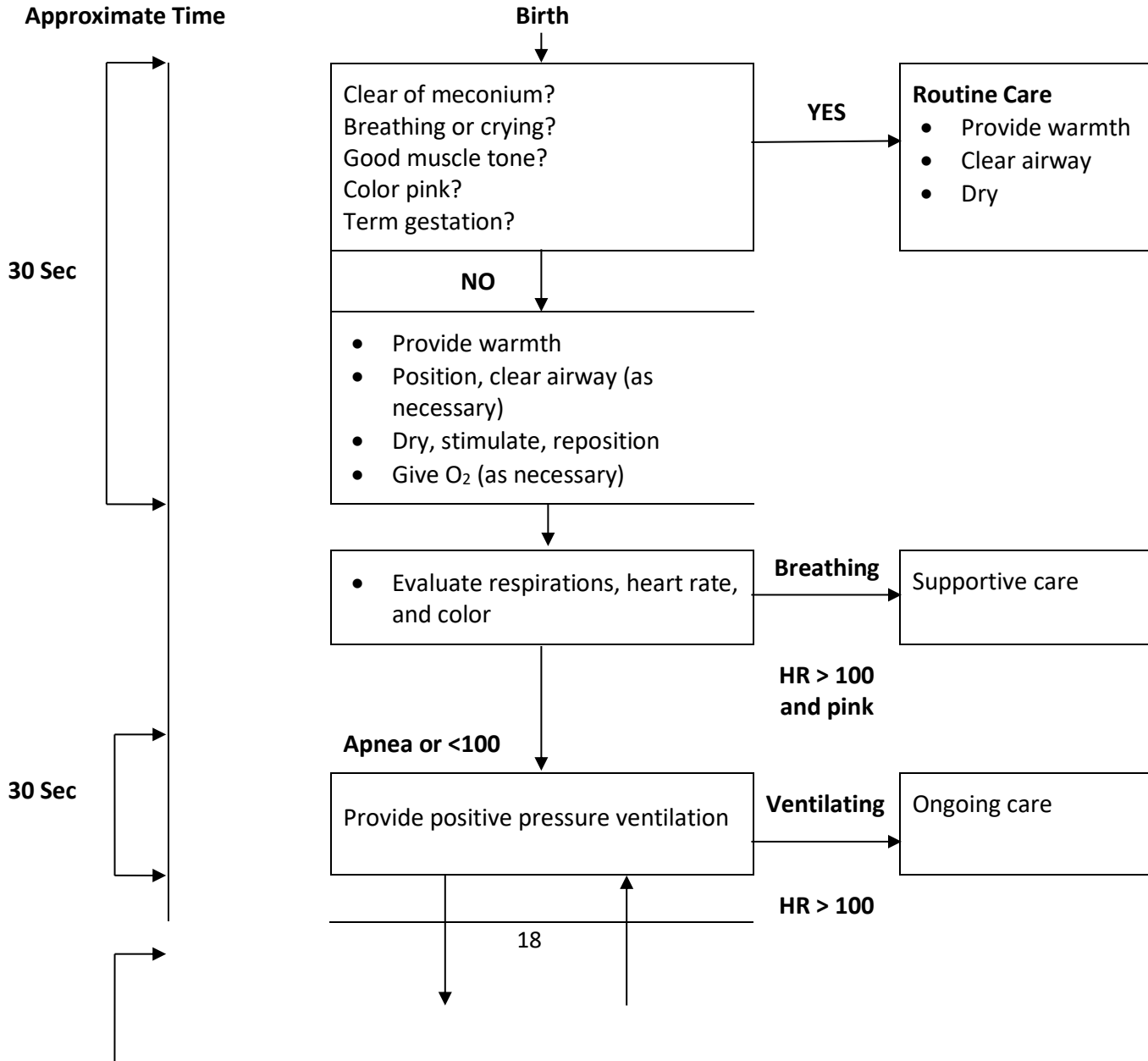
**Children >20 kg:** Infusion of d5/0.2% NaCl at a rate of 60 mL/h plus 1 mL/kg per hour for each kilogram above 20 kg. For example the maintenance rate for a 30-kg child is as follows:

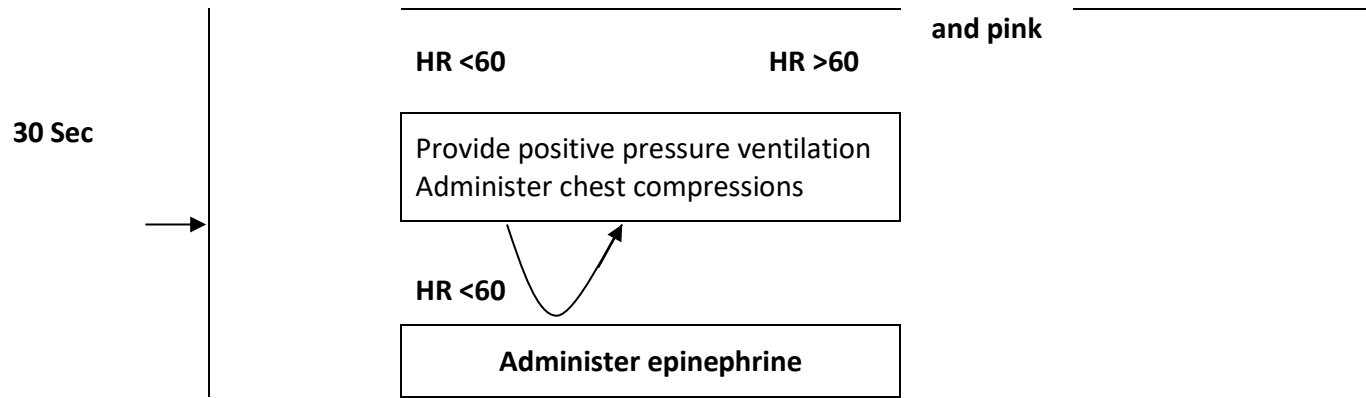
$$60 \text{ mL/h} + (1 \text{ mL/kg per hour} \times 10 \text{ kg}) = 70 \text{ mL/h}$$

**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 <sup>nd</sup> dose
Ca <sub>2</sub> 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 <hr/> Infusion	1 mg/kg  20-50 ug/kg/min	IV/IO/TT
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.

