PALS Systematic Approach Algorithm

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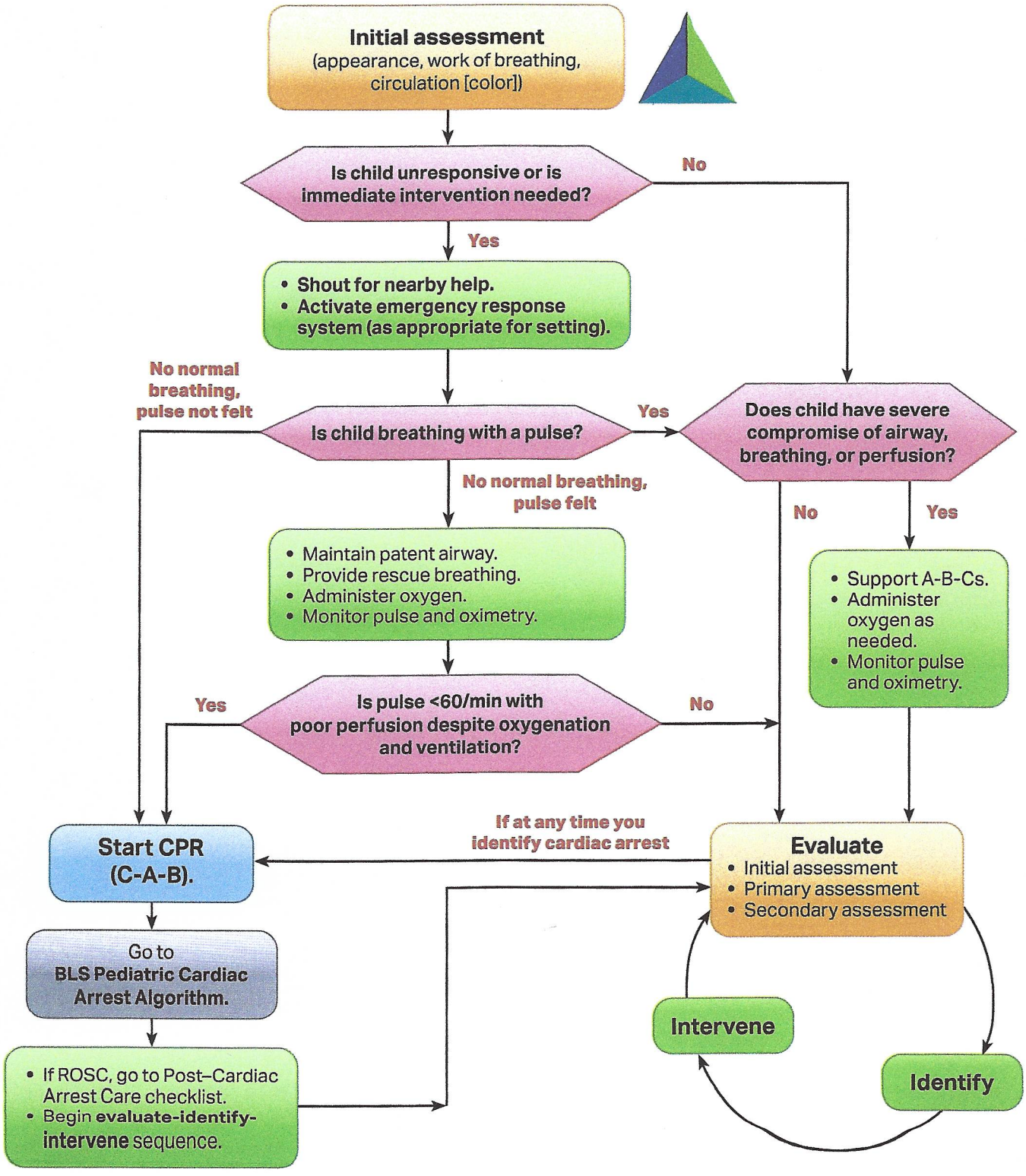

Pediatric Color-Coded Length-Based Resuscitation Tape

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Zone	3 kg	4 kg	5 kg	Pink	Red	Purple	Yellow	White	Blue	Orange	Green
ETT uncuffed (mm)	3.5	3.5	3.5	3.5	3.5	4.0	4.5	5.0	5.5	N/A	N/A
ETT cuffed (mm)	3.0	3.0	3.0	3.0	3.0	3.5	4.0	4.5	5.0	5.5	6.0
Lip-tip (cm)	9-9.5	9.5-10	10-10.5	10-10.5	10.5-11	11-12	12.5-13.5	14-15	15.5-16.5	17-18	18.5-19.5
Suction (F)	8	8	8	8	8	8	10	10	10	10	12
L-scope blade	1 straight	1 straight	1 straight	1 straight	1 straight	1-1.5 straight	2 straight/ curved	2 straight/ curved	2 straight/ curved	2-3 straight/ curved	2-3 straight/ curved
Stylet	6 F	6 F	6 F	6 F	6 F	6 F	10 F	10 F	10 F	14 F	14 F
OPA (mm)	50	50	50	50	50	60	60	60	70	80	80
NPA (F)	14	14	14	14	14	18	20	22	24	26	26
Bag-mask device (minimum mL)	450	450	450	450	450	450	450	450-750	750-1000	750-1000	1000
$ETCO_2$ detector	Ped	Ped	Ped	Ped	Ped	Ped	Ped	Adult	Adult	Adult	Adult
LMA	1	1	1	1.5	1.5	2	2	2	2-2.5	2.5	3
Tidal volume (mL)	20-30	24-40	30-50	40-65	50-85	65-105	80-130	100-165	125-210	160-265	200-330
Frequency	20-25/min	20-25/min	20-25/min	20-25/min	20-25/min	15-25/min	15-25/min	15-25/min	12-20/min	12-20/min	12-20/min

Abbreviations: ETT, endotracheal tube; F, French; LMA, laryngeal mask airway; NPA, nasopharyngeal airway; OPA, oropharyngeal airway; Ped, pediatric.

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Pediatric Cardiac Arrest Algorithm

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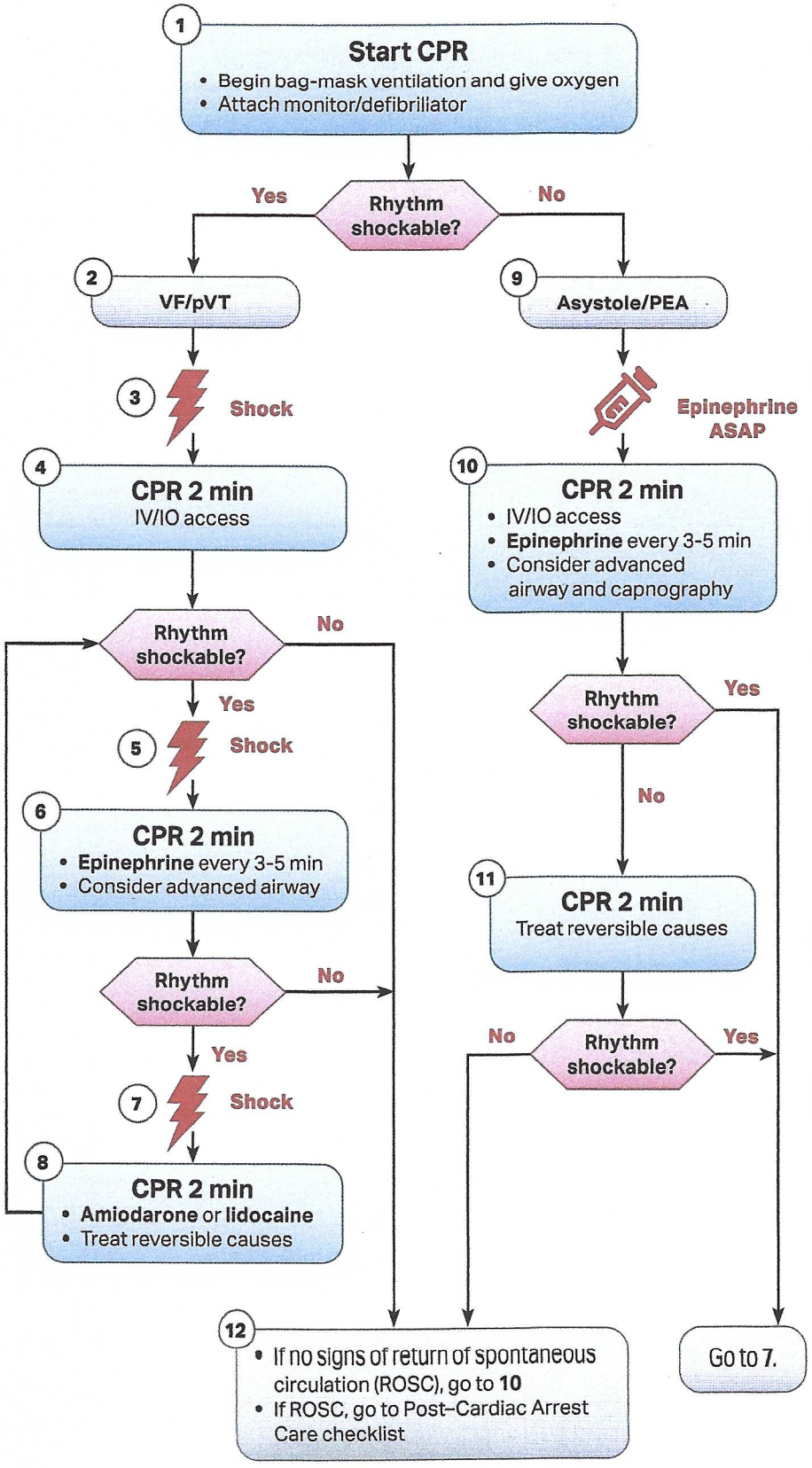

CPR Quality

- 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

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

- **H**ypovolemia
- **H**ypoxia
- **H**ydrogen ion (acidosis)
- **H**ypoglycemia
- **H**ypo-/hyperkalemia
- **H**ypothermia
- **T**ension pneumothorax
- **T**amponade, cardiac
- **T**oxins
- **T**hrombosis, pulmonary
- Thrombosis, coronary

Management of Shock After ROSC Algorithm

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Optimize Ventilation and Oxygenation

- Titrate FIO_2 to maintain oxyhemoglobin saturation 94%-99% (or as appropriate to the patient's condition); if possible, wean FIO_2 if saturation is 100%.
- Consider advanced airway placement and waveform capnography.
- If possible, target a PCO_2 that is appropriate for the patient's condition and limit exposure to severe hypercapnia or hypocapnia.

Assess for and Treat Persistent Shock

- Identify and treat contributing factors.
- Consider 20 mL/kg IV/IO boluses of isotonic crystalloid. Consider smaller boluses (eg, 10 mL/kg) if poor cardiac function suspected.
- Consider the need for inotropic and/or vasopressor support for fluid-refractory shock.

Possible Contributing Factors

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

Hypotensive Shock

- Epinephrine
- Norepinephrine

Normotensive Shock

- Epinephrine
- Milrinone*

- Monitor for and treat agitation and seizures.
- Monitor for and treat hypoglycemia.
- Assess blood gas, serum electrolytes, and calcium.
- If patient remains comatose after resuscitation from cardiac arrest, maintain targeted temperature management, including aggressive treatment of fever.
- Consider consultation and patient transport to tertiary care center.

*Milrinone can cause hypotension, so use and initiation of it should generally be reserved for those experienced with its use, initiation, and side effects (eg, ICU personnel).

Estimation of Maintenance Fluid Requirements

- **Infants <10 kg:** 4 mL/kg per hour

  Example: For an 8-kg infant, estimated maintenance fluid rate
  = 4 mL/kg per hour × 8 kg
  = 32 mL per hour

- **Children 10-20 kg:** 4 mL/kg per hour for the first 10 kg + 2 mL/kg per hour for each kg above 10 kg

  Example: For a 15-kg child, estimated maintenance fluid rate
  = (4 mL/kg per hour × 10 kg)
  + (2 mL/kg per hour × 5 kg)
  = 40 mL/hour + 10 mL/hour
  = 50 mL/hour

- **Children >20 kg:** 4 mL/kg per hour for the first 10 kg + 2 mL/kg per hour for 11-20 kg + 1 mL/kg per hour for each kg above 20 kg.

  Example: For a 28-kg child, estimated maintenance fluid rate
  = (4 mL/kg per hour × 10 kg)
  + (2 mL/kg per hour × 10 kg)
  + (1 mL/kg per hour × 8 kg)
  = 40 mL per hour + 20 mL per hour
  + 8 mL per hour
  = 68 mL per hour

After initial stabilization, adjust the rate and composition of intravenous fluids based on the patient's clinical condition and state of hydration. In general, provide a continuous infusion of a dextrose-containing solution for infants. Avoid hypotonic solutions in critically ill children; for most patients use isotonic fluid such as normal saline (0.9% NaCl) or lactated Ringer's solution with or without dextrose, based on the child's clinical status.

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Components of Post–Cardiac Arrest Care

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Oxygenation and ventilation	Check
Measure oxygenation and target normoxemia 94%-99% (or child's normal/appropriate oxygen saturation).	☐
Measure and target $Paco_2$ appropriate to the patient's underlying condition and limit exposure to severe hypercapnia or hypocapnia.	☐
Hemodynamic monitoring	
Set specific hemodynamic goals during post–cardiac arrest care and review daily.	☐
Monitor with cardiac telemetry.	☐
Monitor arterial blood pressure.	☐
Monitor serum lactate, urine output, and central venous oxygen saturation to help guide therapies.	☐
Use parenteral fluid bolus with or without inotropes or vasopressors to maintain a systolic blood pressure greater than the fifth percentile for age and sex.	☐
Targeted temperature management (TTM)	
Measure and continuously monitor core temperature.	☐
Prevent and treat fever immediately after arrest and during rewarming.	☐
If patient is comatose apply TTM (32°C-34°C) followed by (36°C-37.5°C) or only TTM (36°C-37.5°C).	☐
Prevent shivering.	☐
Monitor blood pressure and treat hypotension during rewarming.	☐
Neuromonitoring	
If patient has encephalopathy and resources are available, monitor with continuous electroencephalogram.	☐
Treat seizures.	☐
Consider early brain imaging to diagnose treatable causes of cardiac arrest.	☐
Electrolytes and glucose	
Measure blood glucose and avoid hypoglycemia.	☐
Maintain electrolytes within normal ranges to avoid possible life-threatening arrhythmias.	☐
Sedation	
Treat with sedatives and anxiolytics.	☐
Prognosis	
Always consider multiple modalities (clinical and other) over any single predictive factor.	☐
Remember that assessments may be modified by TTM or induced hypothermia.	☐
Consider electroencephalogram in conjunction with other factors within the first 7 days after cardiac arrest.	☐
Consider neuroimaging such as magnetic resonance imaging during the first 7 days.	☐

Pediatric Tachycardia With a Pulse Algorithm

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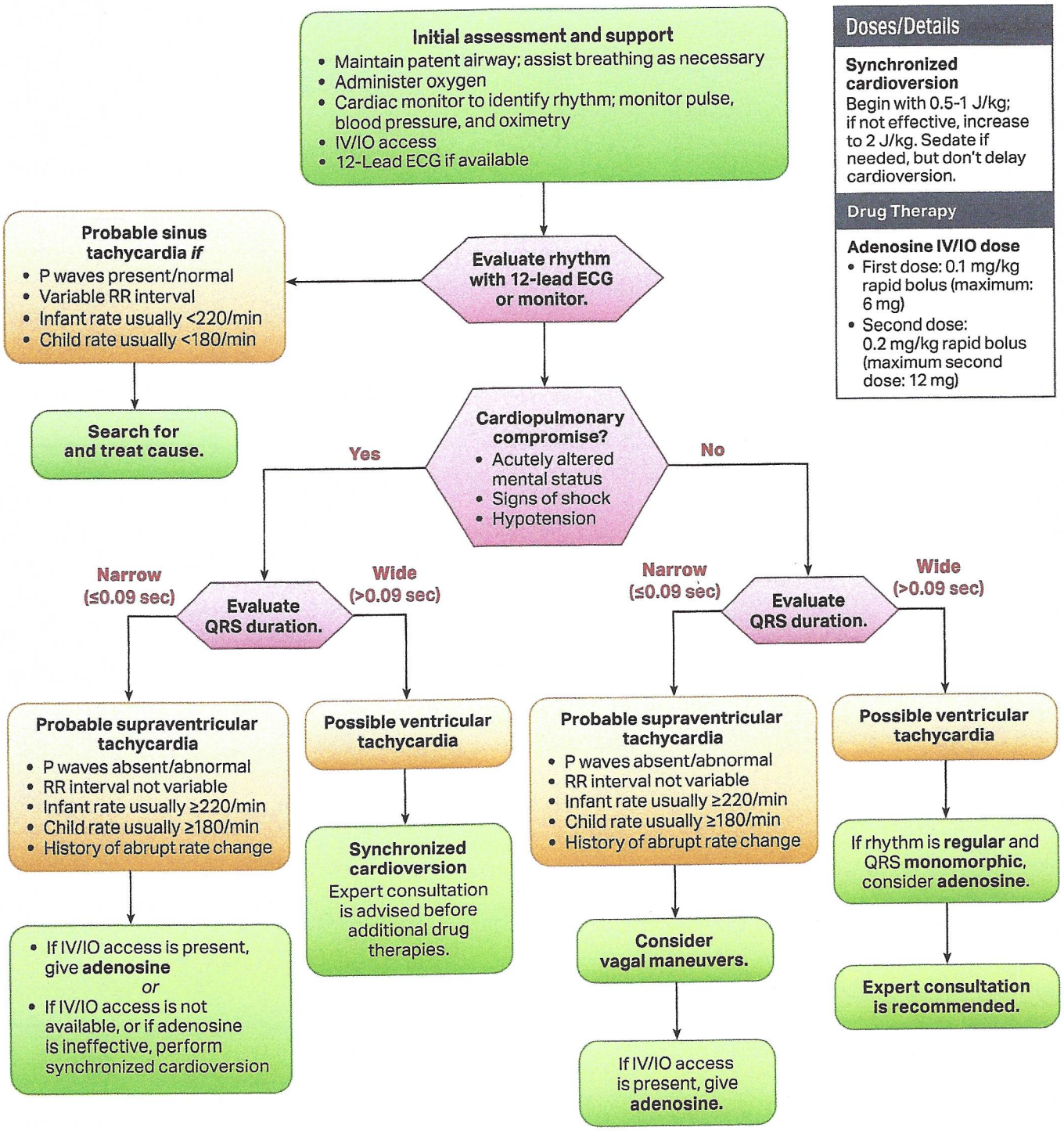

Pediatric Bradycardia With a Pulse Algorithm

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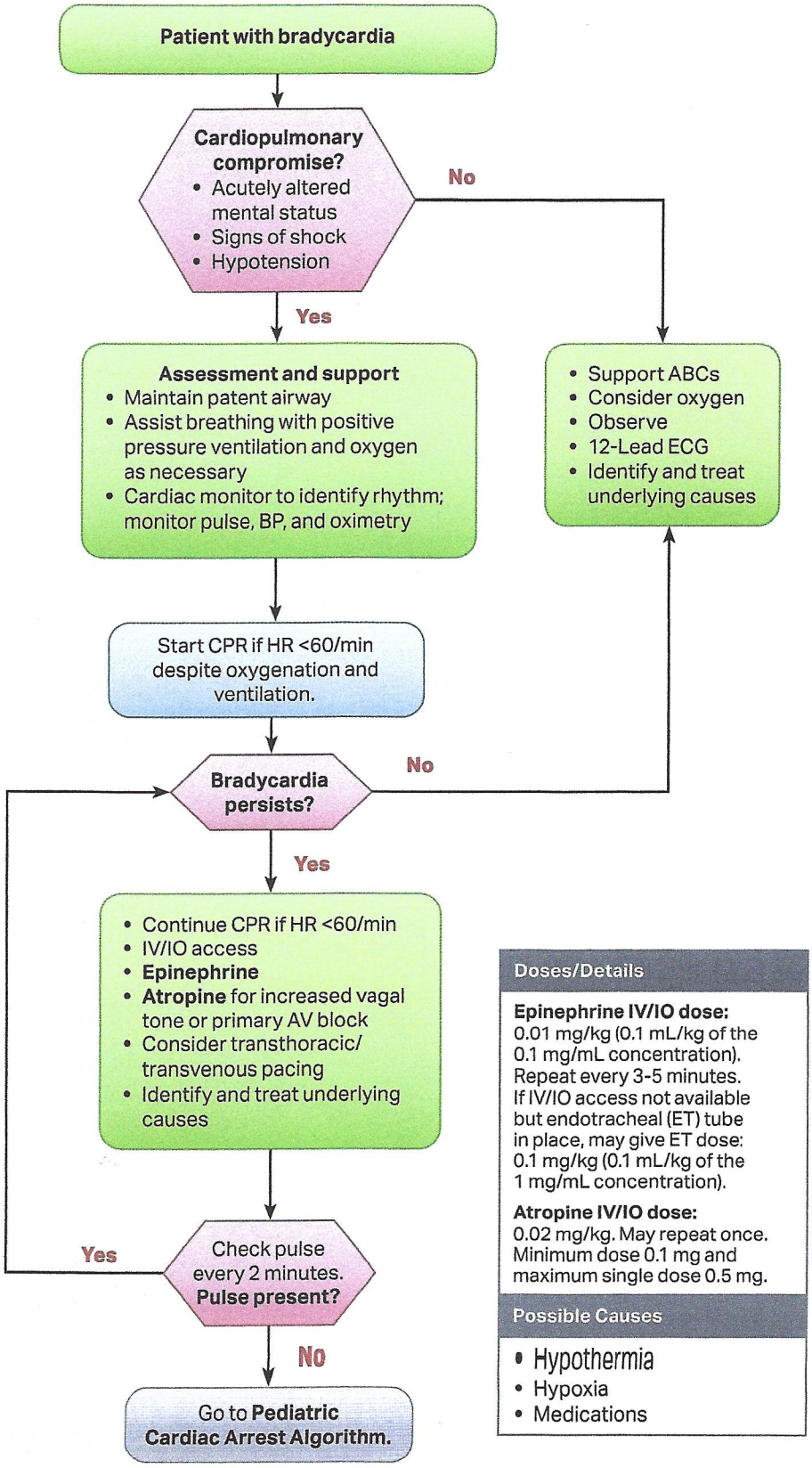

Doses/Details

Epinephrine IV/IO dose:
0.01 mg/kg (0.1 mL/kg of the 0.1 mg/mL concentration). Repeat every 3-5 minutes. If IV/IO access not available but endotracheal (ET) tube in place, may give ET dose: 0.1 mg/kg (0.1 mL/kg of the 1 mg/mL concentration).

Atropine IV/IO dose:
0.02 mg/kg. May repeat once. Minimum dose 0.1 mg and maximum single dose 0.5 mg.

Possible Causes

- Hypothermia
- Hypoxia
- Medications

Pediatric Septic Shock Algorithm

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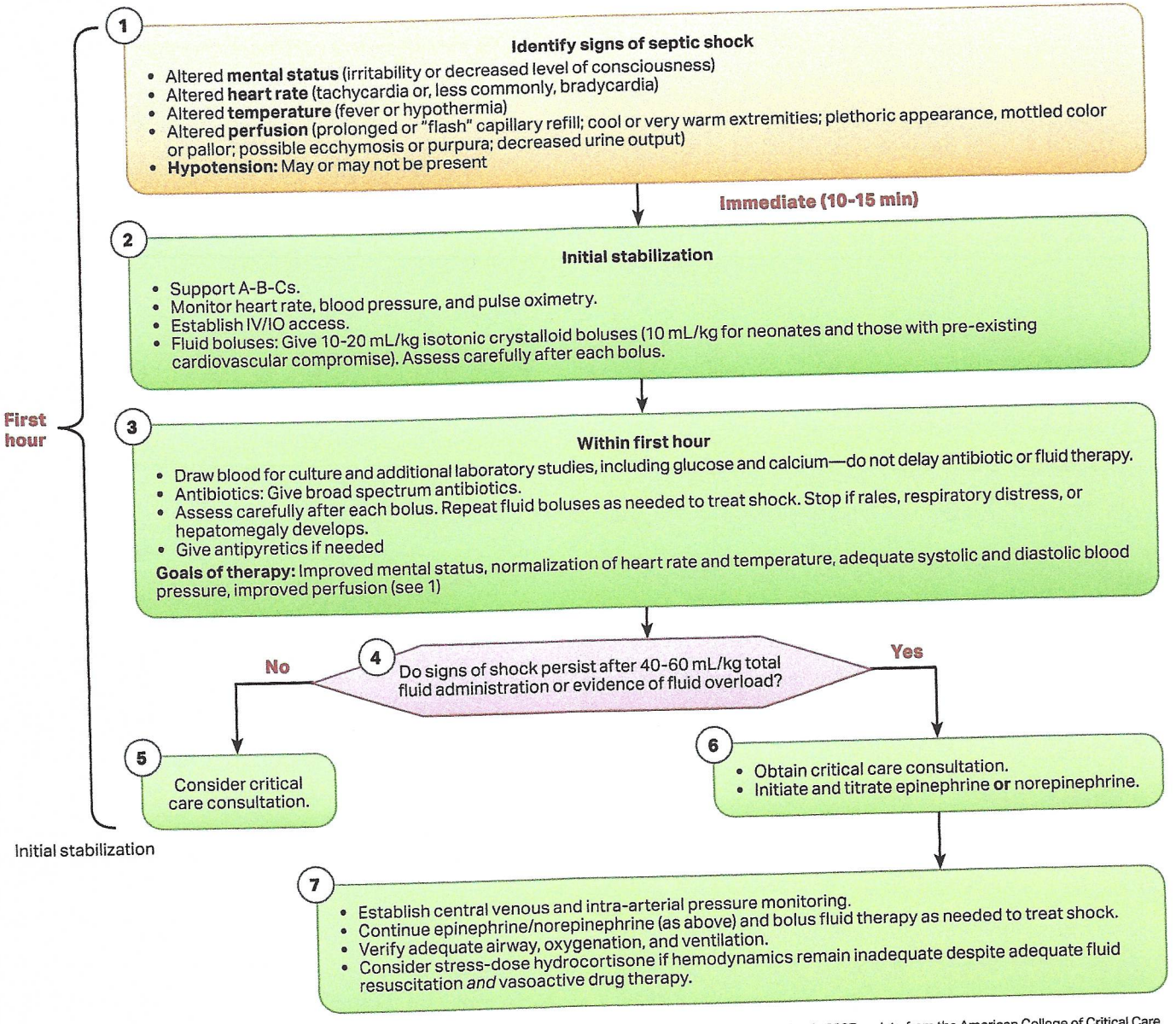

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Recognizing Respiratory Problems Flowchart

PALS: Signs of respiratory problems					
Clinical signs		**Upper airway obstruction**	**Lower airway obstruction**	**Lung tissue disease**	**Disordered control of breathing**
Airway	Patency	Airway open and maintainable/not maintainable			
Breathing	Respiratory rate/effort	Increased			Variable
	Breath sounds	Stridor (typically inspiratory)	Barking cough Hoarseness Wheezing (typically expiratory) Prolonged expiratory phase	Grunting Crackles Decreased breath sounds	Normal
	Air movement	Decreased			Variable
Circulation	Heart rate	Tachycardia (early); bradycardia (late)			
	Skin	Pallor, cool skin (early); cyanosis (late)			
Disability	Level of consciousness	Anxiety, agitation (early); lethargy, unresponsiveness (late)			
Exposure	Temperature	Variable			

PALS: Identifying respiratory problems by severity	
Progression of respiratory distress to respiratory failure*	
Airway	Respiratory distress: open and maintainable Respiratory failure: not maintainable
Breathing	Respiratory distress: tachypnea Respiratory failure: bradypnea to apnea
	Respiratory distress: work of breathing (nasal flaring/retractions) Respiratory failure: increased effort progresses to decreased effort and then to apnea
	Respiratory distress: good air movement Respiratory failure: poor to absent air movement
Circulation	Respiratory distress: tachycardia Respiratory failure: bradycardia
	Respiratory distress: pallor Respiratory failure: cyanosis
Disability	Respiratory distress: anxiety, agitation Respiratory failure: lethargy to unresponsiveness
Exposure	Variable temperature

*Respiratory failure requires immediate intervention.

Managing Respiratory Emergencies Flowchart

Managing respiratory emergencies flowchart		
• Airway positioning • Suction as needed	• Oxygen • Pulse oximetry	• ECG monitor as indicated • BLS as indicated
Upper airway obstruction **Specific management for selected conditions**		
Croup	**Anaphylaxis**	**Aspiration foreign body**
• Nebulized epinephrine • Corticosteroids	• IM epinephrine (or autoinjector) • Albuterol • Antihistamines • Corticosteroids	• Allow position of comfort • Specialty consultation
Lower airway obstruction **Specific management for selected conditions**		
Bronchiolitis	**Asthma**	
• Nasal suctioning • Consider bronchodilator trial	• Albuterol ± ipratropium • Corticosteroids • Magnesium sulfate • IM epinephrine (if severe) • Terbutaline	
Lung tissue disease **Specific management for selected conditions**		
Pneumonia/pneumonitis **Infectious, chemical, aspiration**	**Pulmonary edema** **Cardiogenic or noncardiogenic (ARDS)**	
• Albuterol • Antibiotics (as indicated) • Consider noninvasive or invasive ventilatory support with PEEP	• Consider noninvasive or invasive ventilatory support with PEEP • Consider vasoactive support • Consider diuretic	
Disordered control of breathing **Specific management for selected conditions**		
Increased ICP	**Poisoning/overdose**	**Neuromuscular disease**
• Avoid hypoxemia • Avoid hypercarbia • Avoid hyperthermia • Avoid hypotension	• Antidote (if available) • Contact poison control	• Consider noninvasive or invasive ventilatory support

Recognizing Shock Flowchart

Clinical signs		Hypovolemic shock	Distributive shock	Cardiogenic shock	Obstructive shock
Airway	**Patency**	Airway open and maintainable/not maintainable			
Breathing	**Respiratory rate**	Increased			
	Respiratory effort	Normal to increased		Labored	
	Breath sounds	Normal	Normal (± crackles)	Crackles, grunting	
Circulation	**Systolic blood pressure**	Compensated shock can progress to hypotensive shock if left untreated			
	Pulse pressure	Narrow	Variable	Narrow	
	Heart rate	Increased			
	Peripheral pulse quality	Weak	Bounding or weak	Weak	
	Skin	Pale, cool	Warm or cool	Pale, cool	
	Capillary refill	Delayed	Variable	Delayed	
	Urine output	Decreased			
Disability	**Level of consciousness**	Irritable early, lethargic late			
Exposure	**Temperature**	Variable			

Managing Shock Flowchart

Managing shock flowchart	
• Oxygen • Pulse oximetry • ECG monitor	• IV/IO access • BLS as indicated • Point-of-care glucose testing

Hypovolemic shock: Specific management for selected conditions	
Nonhemorrhagic	**Hemorrhagic**
• 20 mL/kg NS/LR bolus, repeat as needed • Consider colloid	• Control external bleeding • 20 mL/kg NS/LR bolus, repeat 2 or 3x as needed • Transfuse PRBCs as indicated

Distributive shock: Specific management for selected conditions		
Septic	**Anaphylactic**	**Neurogenic**
Management algorithm: • Septic Shock	• IM epinephrine (or autoinjector) • Fluid boluses (10-20 mL/kg NS/LR) • Albuterol • Antihistamines, corticosteroids • Epinephrine infusion	• 20 mL/kg NS/LR bolus, repeat PRN • Vasopressor

Cardiogenic shock: Specific management for selected conditions	
Bradyarrhythmia/tachyarrhythmia	**Other (eg, CHD, myocarditis, cardiomyopathy, poisoning)**
Management algorithms: • Bradycardia • Tachycardia	• 5 to 10 mL/kg NS/LR bolus, repeat PRN • Inotropic and/or vasoactive infusion • Consider expert consultation • Antidote for poisoning

Obstructive shock: Specific management for selected conditions			
Ductal-dependent (LV outflow obstruction)	**Tension pneumothorax**	**Cardiac tamponade**	**Pulmonary embolism**
• Prostaglandin E1 • Expert consultation	• Needle decompression • Tube thoracostomy	• Pericardiocentesis • 20 mL/kg NS/LR bolus	• 20 mL/kg NS/LR bolus, repeat PRN • Consider thrombolytics, anticoagulants • Expert consultation