# PALS *Study Guide*

# 2020

**Bulletin:** **New resuscitation science and American Heart Association treatment guidelines were released October 28, 2020!**

**The new AHA Handbook of Emergency Cardiac Care (ECC) contains these 2020 Guidelines and is required study for this course.** The 2020 PALS Provider Manual is available. This study guide will provide you with additional study information.

**Website:** [https://elearning.heart.org/course/427](https://elearning.heart.org/course/427)
[www.phsinstitute.com](http://www.phsinstitute.com) **(study info. For class for rhythm review)**

## ***What is required to successfully complete PALS?***

- ♥ Completed **PALS Pre-test is required for admission** to the course. All students must complete the Precourse Self-Assessment and achieve a score of at least 70% before taking the ACLS Course.
- ***** Students must print their scoring report and bring it with them to class.

♥ Score **84% on the multiple-choice post-test**.
It is a timed test and you may be allowed to **use your ECC Handbook**.

♥ You **must be able to demonstrate**:

- The PALS rapid cardiopulmonary assessment
- Effective infant and child CPR
- using an AED on a child
- Safe defibrillation with a manual defibrillator
- maintaining an open airway
- Confirmation of effective ventilation
- addressing vascular access
- stating rhythm appropriate drugs, route and dose
- Consideration of treatable causes

## ***What happens if I do not do well in the course?***

The Course Director or Instructor will first "remediate" **(tutor)** you and you may be allowed to continue in the course. If it is decided you need more time to study, you will be placed into the next course.

## ***Where do I start?***

- **CPR/AED: You will be tested with no coaching**. **If you cannot perform these skills well without coaching**, you can/may be directed to take the course at another time. **Know p. 7 of this study guide well**.
- **Arrhythmias: Before you come be sure you can identify:** Sinus Rhythm **(SR)**, Sinus Bradycardia **(SB)**, Sinus Tachycardia **(ST)**, Supraventricular Tachycardia **(SVT)**, Ventricular Tachycardia **(VT)**, Ventricular Fibrillation **(VF)**, Torsades de Pointes, Pulseless Electrical Activity **(PEA)** and Asystole.

***You will need to know:***

* **Respiratory Rate**

| Age | Rate |
|---|---|
| **Infant** | 30 - 53 |
| **Toddler** | 22 - 37 |
| **Preschooler** | 20 - 28 |
| **School-age child** | 18 - 25 |
| **Adolescent** | 12 - 20 |

**Heart Rate**

| Age | Sleeping - Awake |
|---|---|
| **1- 12 months** | 90 - 205 |
| **12 months - 2 years** | 90 - 180 |
| **2 – 5 years** | 80 - 140 |
| **5 - 10 years** | 58 - 118 |
| **10-15 years** | 50 - 100 |

ECC Handbook p. 77

* **Hypotension by Systolic Blood Pressure (SBP)**

| Age | SBP |
|---|---|
| **< 1 month** | < 60 |
| **1 month – 1 year** | < 70 |
| **1 – 10 years** | < 70 **+ (2 x age in years)** |
| **10 + years** | < 90 |

**Hypotension + signs of poor perfusion = <u>Decompensated shock</u>.**

ECC Handbook p. 77

* **Treat Possible Causes**

.

| 5 Hs | 5 Ts |
|---|---|
| **H** ypoxia | **T** amponade |
| **H** ypo-volemia | **T** ension pneumothorax |
| **H** ypo-thermia | **T** oxins – poisons, drugs |
| **H**ypo /hyper kalemia | **T** hrombosis – coronary **(AMI)** |
| **H**ydro gen ion **(acidosis)** | **T** hrombosis – pulmonary **(PE)** |
| **H**ydro- Glycemia | **T** rauma |

Spacing separations may help as a memory aid.

# Rapid Cardiopulmonary Assessment *and* Algorithms

**This is a systematic head-to-toe assessment** used to identify infants and children in respiratory distress and failure, shock and pulseless arrest. **Algorithms** are "menus" that guide you through recommended treatment interventions.

**Know the following assessment** because it begins all PALS case scenarios. The information you gather during the assessment will determine which algorithm you choose for the patient's treatment. **After each intervention** you will reassess the patient again using the head-to-toe assessment.

## ***Start with child's general appearance:***

**Is the level of consciousness:** **A**= awake **V**= responds to verbal **P**= responds to pain **U**= unresponsive
**Is the overall color:** good or bad?
**Is the muscle tone:** good or floppy?

## ***Then assess CABs:*** **(stop and give immediate support when needed, then continue with assessment)**

**Circulation:**

| | | |
|---|---|---|
| **Is central pulse** present | or absent? | |
| **Is the rate** normal | or too slow | or too fast? |
| **Is the rhythm** regular | or irregular? | |
| **Is the QRS** narrow | or wide? | |

**Airway:** **Open and hold** with head tilt-chin lift

**Breathing:**

| | | |
|---|---|---|
| **Is it** present | or absent? | |
| **Is the rate** normal | or too slow | or too fast? |
| **Is the pattern** regular | or irregular | or gasping? |
| **Is the depth** normal | or shallow | or deep? |
| **Is there** nasal flaring | or sternal retractions | or accessory muscle use? |
| **Is there** stridor | or grunting | or wheezing? |

## ***Next look at perfusion:***

| | |
|---|---|
| **Is the central pulse** versus peripheral pulse strength equal | or unequal? |
| **Is skin** color, pattern and temperature normal | or abnormal? |
| **Is capillary refill** normal | or abnormal **(greater than 2 seconds)**? |
| **Is the liver edge** palpated at the costal margin **(normal or dry)** | or below the costal margin **(fluid overload)**? |

## ***And check:***

| | |
|---|---|
| **Is systolic BP** acceptable for age **(normal or compensated)** | or hypotensive? |
| **Is urine output** adequate for: infants and children **(1– 2cc/kg/hr)** | or adolescents **(30cc/hr)**? |

## ***Now classify the physiologic status:***

**Stable:** needs little support; **reassess frequently**

**Unstable:** needs **immediate support** and intervention

**Respiratory distress:** increased rate, effort and noise of breathing; requires much energy
**Respiratory failure:** slow or absent rate, weak or no effort and is **very quiet**

**Compensated shock:** SBP is acceptable but perfusion is poor: central vs. peripheral pulse strength is unequal
peripheral color is poor and skin is cool
capillary refill is prolonged

**Decompensated shock:** Systolic hypotension with poor or absent pulses, poor color, weak compensatory effort.

**<*Apply the appropriate treatment algorithm*:**

- Bradycardia with a Pulse
- Tachycardia with Adequate Perfusion
- Tachycardia with Poor Perfusion
- Pulseless Arrest: VF/VT and Asystole/PEA

# Advanced Airway

A **cuffed or uncuffed E**ndotracheal **T**ube **(ET)** may be used on Infants and children.

To estimate tube size: ECC Handbook p. 94

Uncuffed = **(Age** in years ÷ **4) + 4** Example: (**4** years ÷ 4) = **1 + 4** = **5**

Cuffed = **(Age** in years ÷ **4) + 3**.5 Example: (**4** years ÷ 4) = **1 + 3.5** = **4.5**

Depth = (Age in years ÷ **2) + 12** Example: (**4** years ÷ 2) = **2 + 12** = **14**

**Immediately confirm** tube placement **by clinical assessment and a device**:

▶ **Clinical assessment:**

- Look for bilateral chest rise.
- Listen for breath sounds over stomach and the 4 lung fields **(left and right anterior and midaxillary)**.
- Look for water vapor in the tube **(if seen this is helpful but not definitive)**.

▶ **Devices:**

- **End-Tidal $CO_2$ Detector** (**ETD**): if weight > 2 kg
  - ƒ Attaches between the ET and Ambu bag; give 6 breaths with the Ambu bag:
    - Litmus paper center should change color with **each inhalation** and **each exhalation**.
    - **Original color** on inhalation = **Okay** **$O_2$ is being inhaled:** expected.
    - **Color change** on exhalation = **$CO_2$!!** **Tube is in** trachea.
    - **Original color on exhalation** = **Oh-OH!!** **Litmus paper is wet**: replace ETD.
      **Tube is not in** trachea: remove ET.
      **Cardiac output is low** during CPR.
- **Esophageal Detector** (**EDD**): if weight > 20 kg and in a perfusing rhythm
  - * Resembles a turkey baster:
    - Compress the bulb and attach to end of ET.
    - Bulb **inflates quickly!** Tube is in the trachea.
    - Bulb **inflates poorly?** Tube is **in the esophagus**.
  - * No recommendation for its use in cardiac arrest.

▶ **When sudden deterioration of an intubated patient occurs, immediately check:**

**D**isplaced = tube is not in trachea or has moved into a bronchus **(right main stem most common)**

**O**bstruction = consider secretions or kinking of the tube

**P**neumothorax = consider chest trauma or barotraumas or non-compliant lung disease

**E**quipment = check oxygen source and Ambu bag and ventilator

# PALS Drugs

## In Arrest:

**Epinephrine: catecholamine** ECC Handbook p. 92
Increases heart rate, peripheral vascular resistance and cardiac output; **during CPR** increases myocardial and cerebral blood flow.
IV/IO: 0.01 mg/kg of 1:10 000 solution (equals 0.1 mL/kg of the 1:10 000 solution); repeat q. 3–5 min
ET: 0.1 mg/kg of 1:1000 solution (equals 0.1 mL/kg of the 1:1000 solution); repeat q. 3–5 min

## Anti-arrhythmic Drugs:

**Amiodarone: atrial and ventricular antiarrhythmic** ECC Handbook p. 89
Slows AV nodal and ventricular conduction, increases the QT interval and may cause vasodilation.
Refractory VF/PVT: IV/IO: 5 mg/kg bolus (may repeat up to 2 times)
Perfusing VT: IV/IO: 5 mg/kg over 20-60 min
Perfusing SVT: IV/IO: 5 mg/kg over 20-60 min
Max: 15 mg/kg per 24 hours – Max single dose 300mg
Caution: hypotension, Torsade; half-life is up to 40 days

**Lidocaine: ventricular antiarrhythmic to consider when amiodarone is unavailable** ECC Handbook p. 94
Decreases ventricular automaticity, conduction and repolarization.
VF/PVT: IV/IO: 1 mg/kg bolus repeat >15 min
ÆET: 2 -3 mg/kg
Perfusing VT: IV/IO: 1 mg/kg bolus repeat >15 min
Infusion: 20-50 mcg/kg/min
Caution: neuro toxicity → seizures

**Magnesium: ventricular antiarrhythmic for Torsade and hypomagnesemia** ECC Handbook p. 94
Shortens ventricular depolarization and repolarization **(decreases the QT interval)**.
IV/IO: 25-50 mg/kg over 10–20 min; give faster in Torsade
Max: 2 gm
Caution: hypotension, bradycardia

**Procainamide: atrial and ventricular antiarrhythmic to consider for perfusing rhythms** ECC Handbook p. 96
Slows conduction speed and prolongs ventricular de- and repolarization **(increases the QT interval)**.
Perfusing recurrent VT: IV/IO: 15 mg/kg infused over 30–60 min
Recurrent SVT: IV/IO: 15 mg/kg infused over 30–60 min
Caution: hypotension; use it with extreme caution with amiodarone as it can cause AV block or Torsade

## Increase heart rate:

**Epinephrine: drug of choice for pediatric bradycardia after oxygen and ventilation** ECC Handbook p. 80
Increases heart rate, peripheral vascular resistance and cardiac output; **during CPR** increases myocardial and cerebral blood flow.
IV/IO: 0.01 mg/kg of 1:10 000 solution (equals 0.1 mL/kg of the 1:10 000 solution); repeat q. 3–5 min
ET: 0.1 mg/kg of 1:1000 solution (equals 0.1 mL/kg of the 1:1000 solution); repeat q. 3–5 min

**Atropine: vagolytic to consider after oxygen, ventilation and epinephrine** ECC Handbook p. 87
Blocks vagal input therefore increases SA node activity and improves AV conduction.
IV/IO: 0.02 mg/kg; (max dose 0.5mg)
Caution: **do not give less than 0.1 mg** or may worsen the bradycardia

***2010 (New):*** **Atropine is not** recommended for routine use in the management of PEA/asystole and has been removed from the PALS Cardiac Arrest Algorithm. The treatment of PEA/asystole is now consistent in the PALS

## Decrease heart rate:

**Adenosine: drug of choice for symptomatic SVT & Wide Complex Monomorphic VT** See ECC Handbook p. 88 for injection technique

Blocks AV node conduction for a few seconds to interrupt AV node re-entry.

IV/IO: first dose: 0.1 mg/kg max: 6 mg
second dose: 0.2 mg/kg max: 12 mg
Caution: transient AV block or asystole; has very short half-life

## Increase blood pressure:

**Dobutamine: synthetic catecholamine** ECC Handbook p. 92

Increases force of contraction and heart rate; causes mild peripheral dilation; may be used to treat shock.

IV/IO infusion: 2- 20 mcg/kg/min infusion
Caution: tachycardia

**Dopamine: catecholamine** ECC Handbook p. 92

May be used to treat shock; effects are dose dependent.

Low dose: increases force of contraction and cardiac output.
Moderate: increases peripheral vascular resistance, BP and cardiac output.
High dose: higher increase in peripheral vascular resistance, BP, cardiac work and oxygen demand.
IV/IO infusion: 2–20 mcg/kg/min
Caution: tachycardia

## Miscellaneous:

**Glucose:** ECC Handbook p. 93

Increases blood glucose in hypoglycemia; prevents hypoglycemia when insulin is used to treat hyperkalemia.

IV/IO: 0.5–1 g/kg; this equals: 2–4 mL/kg of D25 **or** 5–10 mL/kg of D10 **or** 10–20 mL/kg of D5
Caution: maximum recommended concentration should not exceed D25%; hyperglycemia may worsen neuro outcome

**Naloxone: opiate antagonist** ECC Handbook p. 95

Reverses respiratory depression effects of narcotics.

< 5 yr or 20 kg: IV/IO: 0.1 mg/kg
> 5 yr or 20 kg: IV/IO: up to 2 mg
Caution: half-life is usually less than the half-life of narcotic, so repeat dosing is often required;
ÆET dose can be given but is **not preferred**; can also give IM or SQ.

**Sodium bicarbonate: pH buffer for prolonged arrest, hyperkalemia, tricyclic overdose:** ECC Handbook p. 97

Increases blood pH helping to correct metabolic acidosis.

IV/IO: 1mEq/kg slow bolus; give **only** after effective ventilation is established
Caution: causes other drugs to precipitate so flush IV tubing before and after

**ET drug administration**: distribution is unpredictable as is the resulting blood level of the drug; **if there is no IV/IO** access, give the drug down the ET and flush with 5 mL NS then give 5 ventilations to disperse the drug.

# Child *and* Infant CPR

## Child CPR

- **1. Tap and ask: Are you OK?**
  - If inadequate:

• Send someone to call 911/call cod blue and bring an AED **(AEDs are approved for children** 0 – until puberty**)**.

**C. Check Brachial or femoral pulse for no more than 10 seconds.**

- If pulse is felt, give **12-20** breaths per minute **(one every 3-5 seconds)**.
- If pulse **not definitely felt**, give 30 compressions in center of chest on low half of the Sternum.
- Compress 2" **depth** of chest wall with **one or two** hands. (at least 1/3 of the depth of the chest
- One cycle of CPR is **30** compressions and **2** breaths.
- **Give 5 cycles** of CPR; minimize interruptions **(about 2 minutes)**.

**A. Open the airway with the head-tilt/chin lift.**

- give 2 breaths over 1 second each.
- Each breath should make the chest rise.

**4. When an AED arrives:**

- **After 5 cycles** of CPR, turn it on and follow AED's voice prompts.
- **Use child pads or adult pads in** victim's age are 0 – until puberty.
- After the AED shocks or says "no shock advised", **resume CPR**.
- After 5 cycles of CPR, check rhythm/pulse.

## Child Two-rescuer CPR

**1. When using a basic airway:**

- One rescuer gives **15 compressions and pauses**.
- Other rescuer gives **2 breaths during pause**.
- One cycle of CPR is **15** compressions and **2** breaths **(over 1 second each)**.
- Rescuers change "compressor" role after every 10 cycles of CPR.

**2. When an advanced airway is in place:**

- Give **100-120 continuous** compressions per minute.
- give **12-20** breaths per minute **(one every 3-5 seconds)**.

**3. When an AED arrives:**

- turn it on immediately and follow AED's voice prompts.
- **Use child pads or adult pads in** victim's age are 0 – until puberty.
- **Continue CPR** while attaching the AED until it says to not touch victim.

## Infant CPR

- Same as Child CPR except compress sternum with two fingers and depth 1/3 of the chest Depth or 1 ½ inches in depth or at least 1/3 of the depth of the chest
- AED is recommendation for use in infants under 1 year old.

## Infant Two-rescuer CPR

- Same as Two-rescuer Child CPR except use the 2 thumb-encircling hands technique.

**Pediatric Bradycardia With a Pulse Algorithm.**

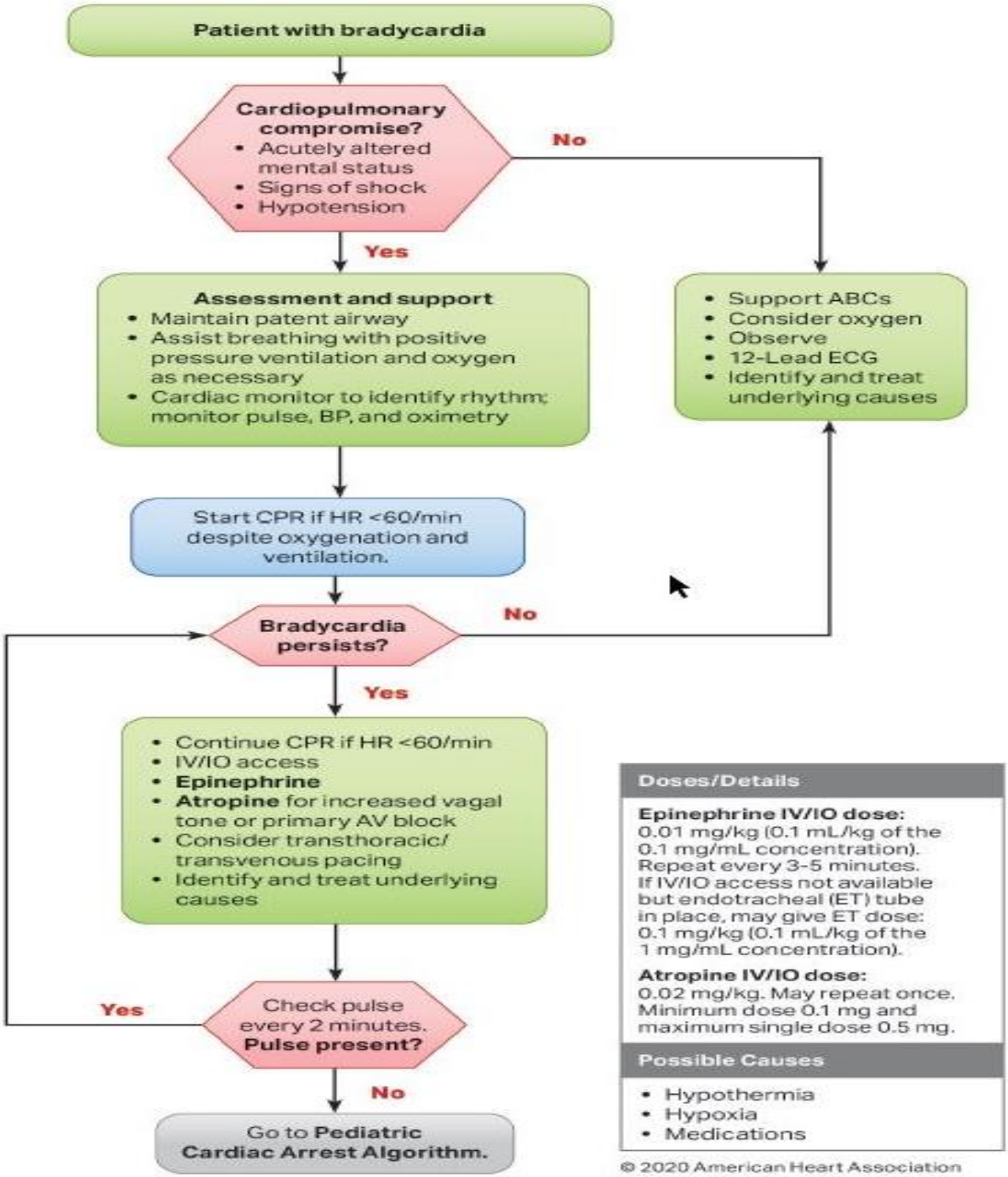
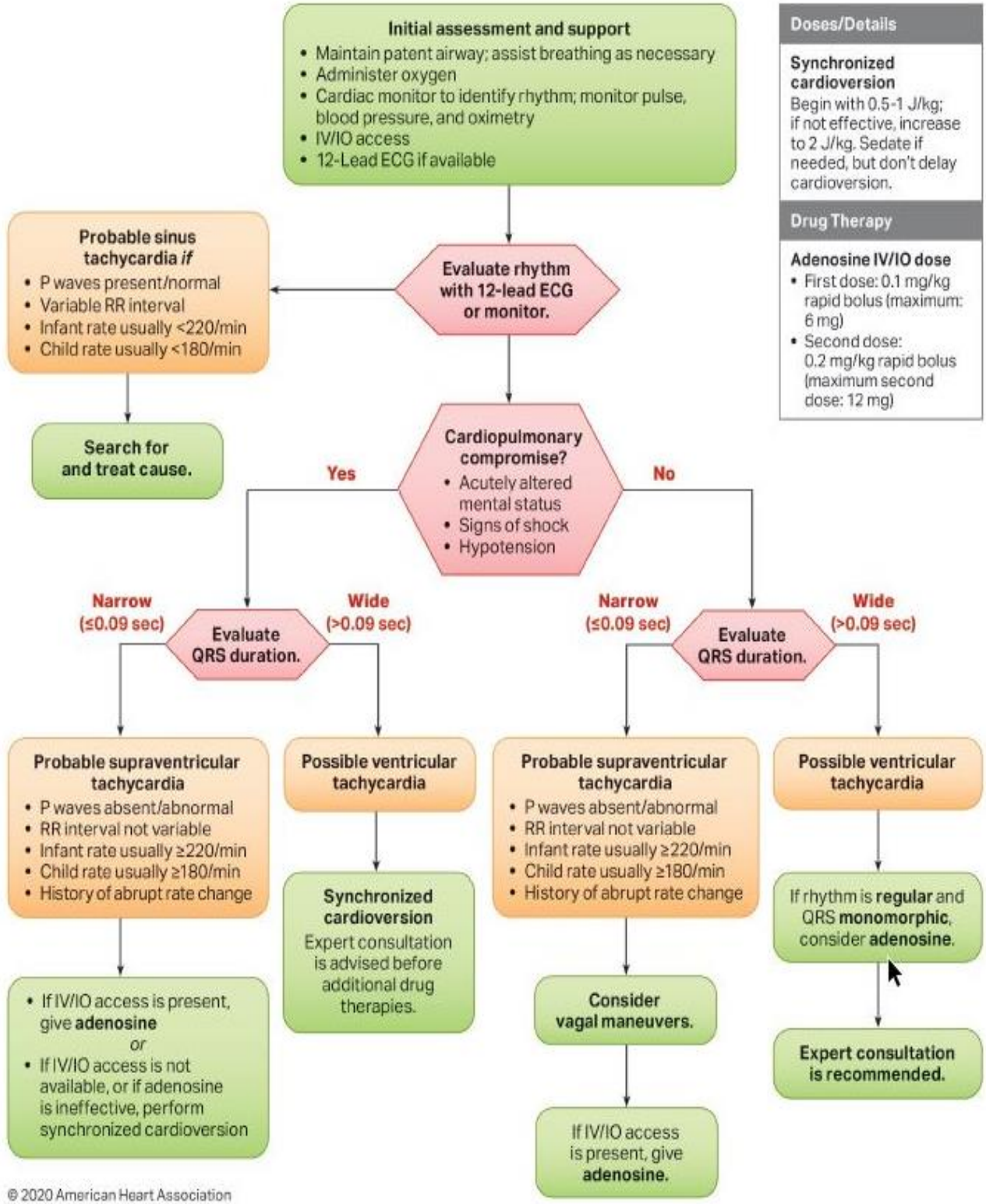
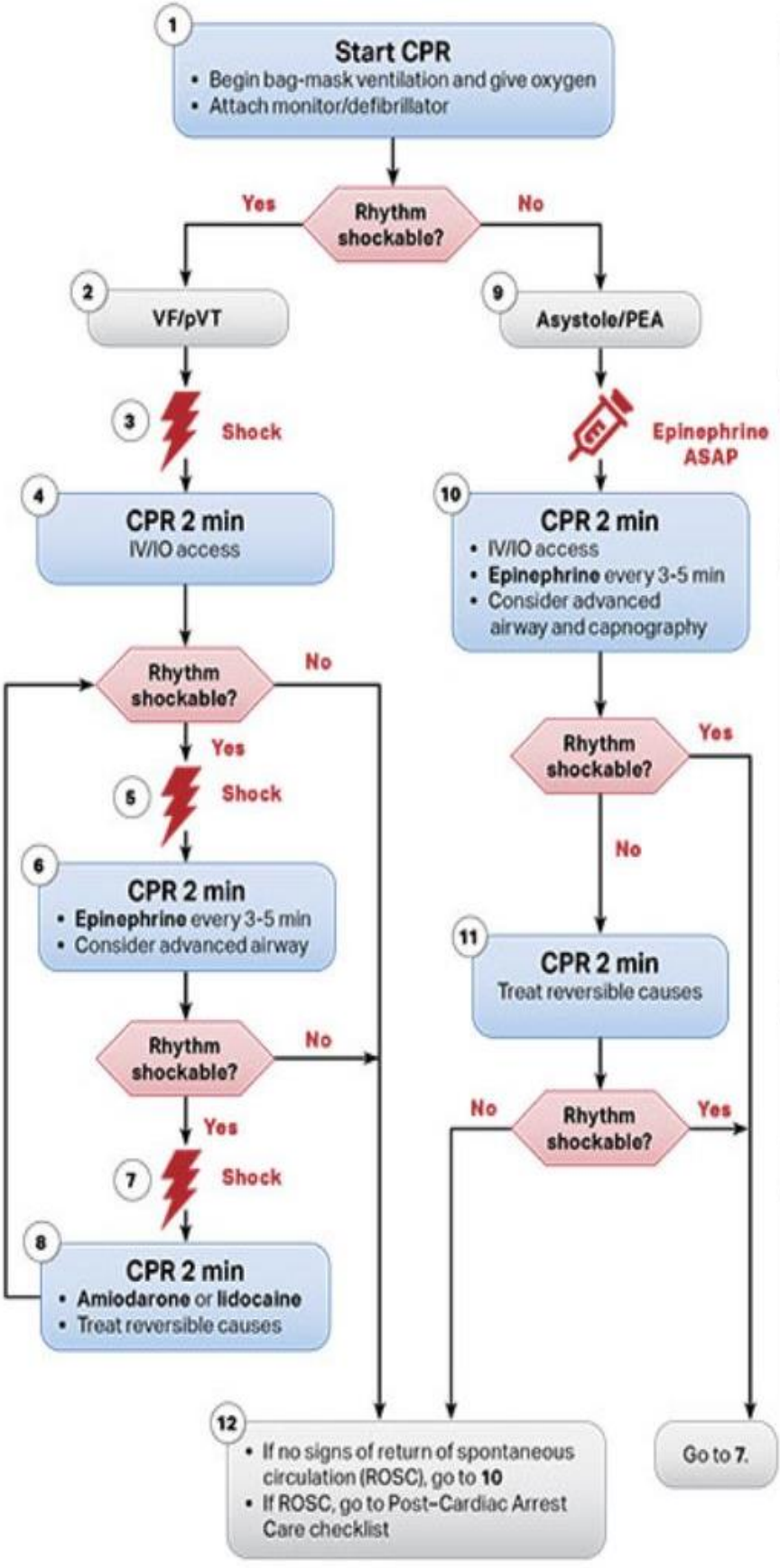


Figure 13. Pediatric Tachycardia With a Pulse Algorithm.



## Pediatric Cardiac Arrest Algorithm




**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
- **T**hrombosis, coronary

Figure 14. Pediatric Post-Cardiac Arrest Care Checklist.

| Components of Post–Cardiac Arrest Care | Check |
|---|---|
| **Oxygenation and ventilation** | |
| 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. | ☐ |