Bulletin: New resuscitation science and American Heart Association treatment guidelines were released October 28, 2010!

The new AHA Handbook of Emergency Cardiac Care (ECC) contains these 2010 Guidelines and is required study for this course. The 2010 PALS Provider Manual is not yet available. This study guide will provide you with additional study information.

What is required to successfully complete PALS?

♥ Completed PALS Pre-test is required for admission to the course.

♥ 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 can not 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:

<table>
<thead>
<tr>
<th></th>
<th>Respiratory Rate</th>
<th>Heart Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Rate</td>
<td>Age</td>
</tr>
<tr>
<td>Infant</td>
<td>30 - 60</td>
<td>&lt; 3 months</td>
</tr>
<tr>
<td>Toddler</td>
<td>24 - 40</td>
<td>3 months - 2 years</td>
</tr>
<tr>
<td>Preschooler</td>
<td>22 - 34</td>
<td>2 – 10 years</td>
</tr>
<tr>
<td>School-age child</td>
<td>18 - 30</td>
<td>10 + years</td>
</tr>
</tbody>
</table>

ECC Handbook p. 74

Hypotension by Systolic Blood Pressure (SBP)

<table>
<thead>
<tr>
<th>Age</th>
<th>SBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 month</td>
<td>&lt; 60</td>
</tr>
<tr>
<td>1 month – 1 year</td>
<td>&lt; 70</td>
</tr>
<tr>
<td>1 – 10 years</td>
<td>&lt; 70 + (2 x age in years)</td>
</tr>
<tr>
<td>10 + years</td>
<td>&lt; 90</td>
</tr>
</tbody>
</table>

ECC Handbook p. 74

Hypotension + signs of poor perfusion = decompensated shock.

Treat Possible Causes

<table>
<thead>
<tr>
<th>5 Hs</th>
<th>5 Ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypoxia</td>
<td>T amputation</td>
</tr>
<tr>
<td>Hypovolemia</td>
<td>T tension pneumothorax</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>T oxins – poisons, drugs</td>
</tr>
<tr>
<td>Hypo/hyperkalemia</td>
<td>T thrombosis – coronary (AMI)</td>
</tr>
<tr>
<td>Hydrogen ion (acidosis)</td>
<td>T thrombosis – pulmonary (PE)</td>
</tr>
</tbody>
</table>

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 ABCs: (stop and give immediate support when needed, then continue with assessment)

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? |

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? |

<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 Endotracheal Tube (ET)** may be used on Infants and children.

To estimate tube size: ECC Handbook p. 87

\[
\begin{align*}
\text{Uncuffed} &= (\text{Age in years } \div 4) + 4. \quad \text{Example: (4 years } \div 4) = 1 + 4 = 5 \\
\text{Cuffed} &= (\text{Age in years } \div 4) + 3. \quad \text{Example: (4 years } \div 4) = 1 + 3 = 4
\end{align*}
\]

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 CO2 Detector (ETD):** if weight > 2 kg
  - 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** O2 is being inhaled: expected.
  - **Color change** on exhalation = **CO2!!** 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 mainstem 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
- \( \mu \)ET: 0.1 mg/kg of 1:1000 solution (equals 0.1 mL/kg of the 1:1000 solution); repeat q. 3–5 min

**Antiarrhythmics:**

**Amiodarone:** atrial and ventricular antiarrhythmic  
ECC Handbook p. 89
Slows AV nodal and ventricular conduction, increases the QT interval and may cause vasodilation.
- VF/PVT: IV/IO: 5 mg/kg bolus
- 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
- 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 q. 5-15 min
- \( \mu \)ET: 2-3 mg/kg
- Perfusing VT: IV/IO: 1 mg/kg bolus q. 5-15 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

**Procaainamide:** 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. 92
Dose is the same as listed above.

**Atropine:** vagolytic to consider after oxygen, ventilation and epinephrine  
ECC Handbook p. 89
Blocks vagal input therefore increases SA node activity and improves AV conduction.
- IV/IO: 0.02 mg/kg; may double amount for second dose
- \( \mu \)ET: 0.03 mg/kg
- Child max: 1 mg
- Adolescent max: 2 mg
- Caution: do not give less than 0.1 mg or may worsen the bradycardia
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; use ET 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?**
   - Send someone to call 911 and bring an AED (AEDs are approved for children 0 – until puberty).

2. **Open the airway with the head-tilt/chin lift.**
   - Assess breathing.
   - If inadequate: give 2 breaths over 1 second each.
   - Each breath should make the chest rise.

3. **Check carotid 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.
   - One cycle of CPR is 30 compressions and 2 breaths.
   - Give 5 cycles of CPR; minimize interruptions (about 2 minutes).

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 5 cycles of CPR.

2. **When an advanced airway is in place:**
   - Give 100 continuous compressions per minute.
   - Give 8-10 breaths per minute (one every 6-8 seconds).

3. **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.
   - 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
- 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.
**Bradycardia with a Pulse**

ECC Handbook

**ABCs:** rapid head-to-toe assessment  
(refer back to p. 3 of this guide)

**Give oxygen:** hypoxia is #1 cause of bradycardia in infants/children

Attach monitor/defibrillator

---

**Is bradycardia still causing symptoms?**

Such as altered level of consciousness, respiratory distress, poor perfusion

---

**NO**

Consider expert consult

---

**YES**

**Give oxygen**

If HR < 60 with poor perfusion, **start CPR**

**Give epinephrine:**

- IV/IO: 0.01 mg/kg of 1:10 000 (0.1 mL/kg)
- ET: 0.1 mg/kg of 1:1000 (0.1 mL/kg)

Repeat every 3 to 5 minutes at same dose

**Consider atropine:**

- IV/IO: 0.02 mg/kg  
  may repeat  
  minimum dose: 0.1 mg  
  max dose, child: 1 mg

**Consider** cardiac pacing

---

**Consider and treat possible causes: 5Hs and 5Ts**

Refer back to p. 2 of this study guide.
Tachycardia with Adequate Perfusion

ABCs: rapid head-to-toe assessment
Give oxygen
Attach monitor/defibrillator and identify rhythm

Narrow QRS

Sinus Tachycardia
Infants: HR < 220 bpm
Children: HR < 180 bpm
History makes sense for HR
HR varies
P waves present and normal

Give oxygen if needed
Treat the cause

SVT
Infants: HR > 220 bpm
Children: HR > 180 bpm
History is vague, nonspecific
HR does not vary
HR changes abruptly
P waves absent or abnormal

Give oxygen if needed
Consider vagal maneuvers
Obtain IV access
Give adenosine IV SLAM!
- first dose: 0.1 mg/kg
- repeat dose: 0.2 mg/kg

Wide QRS

Ventricular Tachycardia
Give oxygen if needed
Obtain IV access

Consider:
Mono Morphic VT Give Adenosine IV SLAM:
- first dose: 0.1 mg/kg
- second dose 0.2 mg/kg
- amiodarone 5 mg/kg IV over 30-60 min
- lidocaine 1 mg/kg IV bolus
- procainamide 15 mg/kg IV over 30-60 min

Consult pediatric cardiologist
Consider synchronized cardioversion
- first dose: 0.5 – 1 J/kg
- next dose: 2 J/kg
Sedate before cardioversion
Obtain 12-lead ECG

Consider and treat possible causes: 5Hs and 5Ts
Tachycardia with Poor Perfusion

ECC Handbook

ABCs: rapid head-to-toe assessment
Give oxygen and support as needed
Attach monitor/defibrillator and identify rhythm

Narrow QRS

Sinus Tachycardia
- Infants: HR < 220 bpm
- Children: HR < 180 bpm
- History makes sense for HR
- HR varies
- P waves present and normal

Give oxygen if needed
Treat the cause

SVT
- Infants: HR > 220 bpm
- Children: HR > 180 bpm
- History is vague, nonspecific
- HR does not vary
- HR changes abruptly
- P waves absent or abnormal

Give oxygen
Consider vagal maneuvers but do not delay

If IV access is present:
- adenosine IV SLAM!
  - first dose: 0.1 mg/kg
  - repeat dose: 0.2 mg/kg

or

Synchronized cardioversion:
- first dose: 0.5 – 1J/kg
- next dose: 2J/kg

Ventricular Tachycardia

Sedate before cardioversion but do not delay

Synchronized cardioversion:
- first dose: 0.5 – 1J/kg
- next dose: 2J/kg

Expert consultation advised
Consider:
- amiodarone 5 mg/kg IV over 30-60 min
  or
- procainamide 15 mg/kg IV over 30-60 min

Consider and treat possible causes: 5Hs and 5Ts
Pulseless Arrest – VF and Pulseless VT

ECC Handbook

ABCs: Give CPR
Give oxygen as soon as available
Attach monitor /defibrillator

Check rhythm: VF/ VT
Check pulse: none
Resume CPR until defibrillator is charged

Give 1 shock at 2 J/kg
Resume CPR immediately
Give 5 cycles of CPR

Consider:
- amiodarone 5 mg/kg IV
  or
- lidocaine 1 mg/kg IV
  or
- magnesium 25-50 mg/kg IV/IO if Torsade

Give 5 cycles of CPR

Consider and treat possible causes: 5Hs and 5Ts
Pulseless Arrest – Asystole and PEA

ECC Handbook

**ABCs:** Give CPR
Give oxygen as soon as available
Attach monitor/defibrillator

Check rhythm: Asystole/PEA
Check pulse: none
Resume CPR immediately

Give epinephrine:
IV/IO: 0.01 mg/kg of 1:10 000 (0.1 mL/kg)
ET: 0.1 mg/kg of 1:1000 (0.1 mL/kg)
Repeat: every 3-5 min
Give 5 cycles of CPR

Check rhythm: Asystole/PEA
Check pulse: none
Resume CPR immediately

Consider and Treat Possible Causes

<table>
<thead>
<tr>
<th>5 Hs</th>
<th>5 Ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypoxia, Hypo</td>
<td>T amponade</td>
</tr>
<tr>
<td>Hvolemia</td>
<td>Tension pneumothorax</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>Toxins – poisons, drugs</td>
</tr>
<tr>
<td>Hypo/hyperkalemia</td>
<td>Thrombosis – coronary (AMI)</td>
</tr>
<tr>
<td>Hydrogen ion (acidos)</td>
<td>Thrombosis – pulmonary (PE)</td>
</tr>
</tbody>
</table>