Fast Response
School of Health Care Education

# PALS Study Guide

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Fast Response
School of Health Care Education

Dear PALS Student:

**Please Read this letter carefully**

This letter is to confirm your registration in Pediatric Advanced Life Support (PALS) course.

Please plan to be on time because it will be difficult for late students to catch up once we start. All classes start at 9:00 am sharp. If you are more than 15 minutes late, you may be turned away, as required by the American Heart Association. Students are expected to attend and participate in the entire course.

As you are probably aware, changes were made in the AHA's Guidelines for CPR and Emergency Cardiovascular Care in October of 2010. Implementation of these guidelines by Training Centers began April 1, 2011. We are anticipating roll out of the new PALS training materials in July to September of 2011.

Since these training materials are not yet published, we will be utilizing interim materials. **You will be required to bring the following to class:**

1. 2010 ECC Handbook (2010 algorithms needed during course) http://www.emergencystuff.com/901000.html

2. 2010 Guidelines Highlights available at http://static.heart.org/eccguidelines/guidelines-highlights.html

3. 2005 PALS Provider Manual and Content Guide if you have them from a previous course. If you do not have these materials from a previous course, we will have a loaner for you to borrow.

The PALS Course does not teach CPR, ECG rhythm identification, pharmacology, or PALS algorithms. **If you do not review CPR, and if you do not learn and understand the ECG and pharmacology information in the Pre-course Assessment, it is unlikely that you can successfully complete the PALS Course.** The Pre-course Assessment is included on the Student CD which is included in the 2005 PALS Provider Manual. If you do not have a 2005 PALS Provider Manual, we will gladly provide you with a Pre-course Assessment. Please let us know so we can provide you with one

**Pre-course Requirements:**

The PALS Course is designed to teach you the lifesaving skills required to be both a team member and a team leader in in-hospital and out-of-hospital settings. Because the PALS Course covers extensive material in a short time, **you will need to prepare for the course beforehand.** You should prepare for the course by reviewing the following:

1. The 2010 ECC Handbook (2010 algorithms needed during course) http://www.emergencystuff.com/901000.html

2. The 2010 Guidelines Highlights, available at; http://static.heart.org/eccguidelines/guidelines-highlights.html

3. The 2005 PALS Provider manual and the 2005 PALS Course Guide.

**You will not be taught how to interpret ECGs in the course, nor will you be taught details about PALS pharmacology.**

1. **Be prepared to pass the child 1-rescuer CPR/AED and infant 1- and 2-rescuer CPR/AED skills tests.** You will not be taught how to do CPR or use an AED during the course; you must know this in advance. The scenarios require your BLS skills and knowledge to be current. Review and understand all BLS 2010 guidelines. You may review this using the information in The 2010 ECC Handbook and /or The 2010 Guidelines Highlights.

   **Please note that we are not able to provide or renew your BLS card based on this CPR test, which is a requirement of the PALS course itself.**

2. Review the PALS Study Guide

3. Review the Competency Checklists that will be used to evaluate you during the course (pages 21-23, 42-44, 52-54, 64-67, and 79-82 of the *PALS Course Guide*).

4. Review and understand the information in the *PALS Provider Manual, the PALS Course Guide,* and the student CD. Pay particular attention to the systematic approach to pediatric assessment, the "**Assess – Categorize – Decide – Act**" model, and the management of respiratory and circulatory abnormalities.

5. Be familiar with the PALS algorithms so that you can apply them to clinical scenarios. Note: the PALS course does not present the details of each algorithm.

6. Work through the practice cases located on the student CD to familiarize yourself with the "**Assess – Categorize – Decide – Act**" model taught in the course. When you read through each case, try to answer the questions. Check your answers to make sure you understand the concepts. Understanding and use of this model is critical to successful completion of the course.

7. Complete the Pre-course Assessment included on the Student CD. This assessment consists of three sections: ECG Rhythm Identification, Pharmacology, and Practical Application. Use this assessment to identify areas where you need to increase your knowledge.

**What to Bring and Wear**

***You must bring your 2010 ECC Handbook to class or you will not receive you PALS card or CEU. You must bring your completed Pre-course Assessment to class.***

Please wear loose, comfortable clothing to class. You will be practicing skills that may require you to work on your hands and knees, and the course requires bending, standing, and lifting. If you have any physical condition that might prevent you from engaging in these activities, please tell an instructor so that they can adjust the equipment if you have back, knee, or hip problems.

**<u>All renewal (1-day) participants must bring their current American Heart Association-issued PALS card to class.</u>**

**There are no exceptions for expired cards.** PALS cards and Continuing Education Units (CEU's) issued at the end of class.

Please be aware:

- There are no refunds for class fees
- You will charged a $25.00 rescheduling fee for when you reschedule 5 business day or more prior to day of class
- You will be charged 50% of the class fee for rescheduling with 5 business days or less of the day of class
- If you do not attend and do not inform us, you will forfeit your entire class fee.

We look forward to welcoming you at the course. Please feel free to call with any questions. We at Fast Response hope you find the PALS Course interesting, fun, and educational!!

Lisa Dubnoff, MICP / RN
ALS Program Director

Dear Student,

In order for us at Fast Response to be able to provide you with a quality program, there are strict American Heart Association guidelines that we must follow. Outlined below are the Fast Response policies that enact the AHA's requirements for possession of student manuals.

Each student must have The 2010 ECC Handbook and The 2010 Guidelines Highlights. http://static.heart.org/eccguidelines/guidelines-highlights.html

The 2010 ECC Handbook is available at; http://www.emergencystuff.com/901000.html for a discounted rate. If you show up to your class without the required manual, there are only two options. (For PALS students, the course guide alone is acceptable. The ECC Handbook alone is not sufficient for either course.)

. If you are attending this class from a contracted hospital provider, you were required to obtain the manual from your education department. If you failed to do this, you will be required to follow one of the above options.

The guidelines set forth by the American Heart Association are very specific in how the class literature is disseminated.

Thank you,

CEU Department

Fast Response School of Healthcare Education

# PALS Course Agenda – Provider
## Day 1

0900-0915 Introductions / Course Overview

0915-0920 Pre-course Self-Assessment Review

0920-0930 PALS Course Organization Video

0930-0950 Overview of PALS Science Video

0950-1040 Respiratory Emergencies (Group 1)

& CPR Practice / Test (Group 2)

1040-1050 Break

1050-1140 Respiratory Emergencies (Group 2)

& CPR Practice / Test (Group 1)

1140-1200 Vascular Access Video

1200-1300 Lunch

1300-1320 1st Rotation EKG/Electrical Therapy and Vascular Access

1320-1340 2nd Rotation EKG/Electrical Therapy and Vascular Access

1340-1355 Pediatric Assessment Video

1355-1415 Resuscitation Team Video

1415-1425 Cardiac Cases: Video and Discussion

1425-1625 Cardiac Cases Team Practice

# PALS Course Agenda – Provider
# Day 2

0900-0920 Respiratory and Shock Cases: Video and Discussion

0920-1020 Respiratory Cases: Team Practice Simulation

1020-1120 Shock Cases: Team Practice Simulation

1120-1130 Break

1130-1230 Cardiac Cases: Testing

1230-1330 Lunch

1330-1430 Respiratory/Shock Cases: Testing

1430-1500 PALS Jeopardy

1600-1645 Written Exam

1645-1700 Wrap-up

# PALS Course Agenda – Renewal

0900-0910 Introductions / Course Overview

0910-0920 Pre-course Self-Assessment Review

0920-0940 Overview of PALS Science Video

0940-1030 Respiratory Emergencies (Group 1) & CPR Practice / Test (Group 2)

1030-1040 Break

1040-1130 Respiratory Emergencies (Group 2) & CPR Practice / Test (Group 1)

1130-1140 Pediatric Assessment Video

1140-1200 Resuscitation Team Concept Video

1200-1300 Lunch

1300-1400 "Putting It All Together" Group Learning Stations

1400-1500 Cardiac Cases: Testing

1500-1600 Respiratory/Shock Cases: Testing

1600-1615 PALS Jeopardy

1615-1645 Written Exam

1645-1700 Wrap-up

**2010 Interim Materials**
***PALS Provider Manual***
**Comparison Chart**
**Based on *2010 AHA Guidelines for CPR and ECC***

American Heart Association
GUIDELINES CPR ECC 2010

## BLS Changes

| | New | Old | Rationale |
|---|---|---|---|
| **CPR** | Chest compressions, Airway, Breathing (C-A-B)<br><br>New science indicates the following order for healthcare providers:<br>1. Check the patient for responsiveness and presence/absence of breathing or gasping.<br>2. Call for help, activate emergency response system, get AED/ defibrillator.<br>3. Check the pulse for no more than 10 seconds.<br>4. Give 30 compressions.<br>5. Open the airway and give 2 breaths.<br>6. Resume compressions. | Airway, Breathing, Chest compressions (A-B-C)<br><br>Previously, after responsiveness was assessed, a call for help was made, the airway was opened, the patient was checked for breathing, and 2 breaths were given, followed by a pulse check and compressions. | Although ventilations are an important part of resuscitation, evidence shows that compressions are the critical element in adult resuscitation. In the A-B-C sequence, compressions are often delayed. Changing to CAB will delay ventilations by only ~20 seconds for the pediatric patient. |
| | Compressions should be initiated within 10 seconds of recognition of the arrest. | Compressions were to be given after airway and breathing were assessed, ventilations were given, and pulses were checked. | Providers' ability to accurately determine presence or absence of a pulse is limited. If a pulse is not detected within 10 seconds, do start compressions without further delay. |
| | Compressions should be given at a rate of at least 100/min. Each set of 30 compressions should take approximately 18 seconds or less. | Compressions were to be given at a rate of about 100/min. Each cycle of 30 compressions was to be completed in 23 seconds or less. | Faster compressions are required to generate the pressures necessary to perfuse the coronary and cerebral arteries. |
| | Compression depths are as follows:<br>• Adults: **at least** 2 inches (5 cm)<br>• Children: **at least** one third the depth of the chest, approximately 2 inches (5 cm)<br>• Infants: **at least** one third the depth of the chest, approximately 1½ inches (4 cm) | Compression depths were as follows:<br>• Adults: 1½ to 2 inches<br>• Children: one third to one half the diameter of the chest<br>• Infants: one third to one half the diameter of the chest | Deeper compressions are required to generate the pressures necessary to perfuse the coronary and cerebral arteries. |

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| **Airway and Breathing** | Cricoid pressure is not routinely recommended during intubation. | If an adequate number of rescuers were available, one could apply cricoid pressure. | Randomized studies showed that cricoid pressure can delay or prevent the placement of an advanced airway and that some aspiration can still occur despite cricoid pressure. It is also difficult to properly train providers to perform the maneuver correctly. |
| | "Look, listen, and feel for breathing" has been removed from the sequence for assessment of breathing after opening the airway. Healthcare providers briefly check for breathing when checking responsiveness to detect signs of cardiac arrest. After delivery of 30 compressions, lone rescuers open the victim's airway and deliver 2 breaths. | "Look, listen, and feel for breathing" was used to assess breathing after the airway was opened. | With the new chest compression–first sequence, CPR is performed if the adult victim is unresponsive and not breathing or not breathing normally (ie, not breathing or only gasping) and begins with compressions (C-A-B sequence). Therefore, breathing is briefly checked as part of a check for cardiac arrest. After the first set of chest compressions, the airway is opened and the rescuer delivers 2 breaths. |
| **AED Use** | For children from 1 to 8 years of age, an AED with a pediatric dose-attenuator system should be used if available. If an AED with a dose attenuator is not available, a standard AED may be used.<br><br>For infants (<1 year of age), a manual defibrillator is preferred. If a manual defibrillator is not available, an AED with a pediatric dose attenuator is desirable. If neither is available, an AED without a dose attenuator may be used. | This does not represent a change for children. In 2005 there was not sufficient evidence to recommend for or against the use of an AED in infants. | The lowest energy dose for effective defibrillation in infants and children is not known. The upper limit for safe defibrillation is also not known, but doses >4 J/kg (as high as 9 J/kg) have provided effective defibrillation in children and animal models of pediatric arrest, with no significant adverse effects.<br><br>AEDs with relatively high energy doses have been used successfully in infants in cardiac arrest, with no clear adverse effects. |

## Pediatric ALS Changes

| | New | Old | Rationale |
|---|---|---|---|
| **Defibrilla-tion** | It is acceptable to use an initial dose of 2 to 4 J/kg for defibrillation, but for ease of teaching, an initial dose of 2 J/kg may be used. For refractory VF, it is reasonable to increase the dose to 4 J/kg. Subsequent energy levels should be at least 4 J/kg, and higher energy levels (not to exceed 10 J/kg or the adult | With a manual defibrillator (monophasic or biphasic), a dose of 2 J/kg was used for the first attempt and 4 J/kg for subsequent attempts. | More data are needed to identify the optimal energy dose for pediatric defibrillation. Limited evidence is available about effective or maximum energy doses for pediatric defibrillation, but some data suggest that higher doses may be safe and potentially more effective. Given the |

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| | maximum dose) may be considered. | | limited evidence to support a change, the new recommendation is a minor modification that allows higher doses up to the maximum dose most experts believe is safe. |
| **ECG** | Wide-complex tachycardia is present if the QRS width is >0.09 second. | Wide-complex tachycardia is present if the QRS width is >0.08 second. | In a recent scientific statement, QRS duration was considered prolonged if it was >0.09 second for a child under the age of 4 years, and ≥0.1 second was considered prolonged for a child between the ages of 4 and 16 years. For this reason, the PALS Guidelines Writing Group concluded that it would be most appropriate to consider a QRS width >0.09 second as prolonged for pediatric patients. Although the human eye is not likely to appreciate a difference of 0.01 second, a computer interpretation of the ECG can document the QRS width in milliseconds. |
| **Pharma-cology** | The recommendation regarding calcium administration is stronger than in past AHA Guidelines: routine calcium administration is not recommended for pediatric cardiopulmonary arrest in the absence of documented hypocalcemia, calcium channel blocker overdose, hypermagnesemia, or hyperkalemia. Routine calcium administration in cardiac arrest provides no benefit and may be harmful.<br><br>Etomidate has been shown to facilitate endotracheal intubation in infants and children with minimal hemodynamic effect but is not recommended for routine use in pediatric patients with evidence of septic shock. | Although the *2005 AHA Guidelines for CPR and ECC* noted that routine administration of calcium does not improve the outcome of cardiac arrest, the words "is not recommended" in the *2010 AHA Guidelines for CPR and ECC* provide a stronger statement and indicate potential harm. | Stronger evidence against the use of calcium during cardiopulmonary arrest resulted in increased emphasis on avoiding the routine use of this drug except for patients with documented hypocalcemia, calcium channel blocker overdose, hypermagnesemia, or hyperkalemia.<br><br>Evidence of potential harm from the use of etomidate in both adults and children with septic shock led to the recommendation to avoid its routine use in this setting. |
| **Special Considera-tions** | Specific resuscitation guidance has been added for management of cardiac arrest in infants and children with single-ventricle anatomy, Fontan or hemi-Fontan/bidirectional Glenn physiology, and pulmonary hypertension. | These topics were not addressed in the *2005 AHA Guidelines for CPR and ECC*. | Specific anatomical variants with congenital heart disease present unique challenges for resuscitation. The *2010 AHA Guidelines for CPR and ECC* outline recommendations in each of these clinical scenarios. Common to all scenarios is the potential early use of extracorporeal membrane oxygenation as |

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| | | | rescue therapy in centers with this advanced capability. |
| **Airway and Breathing** | Once the circulation is restored, monitor oxyhemoglobin saturation. It may be reasonable, when the appropriate equipment is available, to titrate oxygen administration to maintain the arterial oxyhemoglobin saturation ≥94%; an oxyhemoglobin saturation of 100% is generally an indication to wean the $FIO_2$. | Hyperoxia and the risk for reperfusion injury were addressed in the *2005 AHA Guidelines for CPR and ECC* in general, but recommendations for titration of inspired oxygen were not as specific. | In effect, if equipment to titrate oxygen is available, titrate oxygen to keep the oxyhemoglobin saturation 94% to 99%. Data suggest that hyperoxemia (ie, a high $PaO_2$) enhances the oxidative injury observed after ischemia-reperfusion, such as occurs after resuscitation from cardiac arrest. |
| | Exhaled $CO_2$ detection (by capnography or colorimetry) is recommended in addition to clinical assessment to confirm endotracheal tube position for neonates, infants, and children with a perfusing cardiac rhythm in all settings (eg, prehospital, ED, intensive care unit, ward, operating room) and during intrahospital or interhospital transport. | In infants and children with a perfusing rhythm, a colorimetric detector or capnography was used to detect exhaled $CO_2$ to confirm endotracheal tube position in the prehospital and in-hospital settings and during intrahospital and interhospital transport. | Exhaled $CO_2$ monitoring (capnography or colorimetry) generally confirms placement of the endotracheal tube in the airway and may more rapidly indicate endotracheal tube misplacement/displacement than monitoring of oxyhemoglobin saturation. Because patient transport increases the risk for tube displacement, continuous $CO_2$ monitoring is especially important at these times. |
| **Post–Cardiac Arrest Care** | Although there have been no published results of prospective randomized pediatric trials of therapeutic hypothermia, based on adult evidence, therapeutic hypothermia (to 32°C to 34°C) may be beneficial for adolescents who remain comatose after resuscitation from sudden witnessed out-of-hospital VF cardiac arrest. Therapeutic hypothermia (to 32°C to 34°C) may also be considered for infants and children who remain comatose after resuscitation from cardiac arrest. | On the basis of extrapolation from adult and neonatal studies, when pediatric patients remain comatose after resuscitation, cooling them to 32°C to 34°C for 12 to 24 hours could be considered. | Additional adult studies have continued to show the benefit of therapeutic hypothermia for comatose patients after cardiac arrest, including those with rhythms other than VF. Pediatric data are needed. |

# Pediatric Assessment

When treating a pediatric patient, you should use the "**Assess – Categorize – Decide – Act**" model: **Assess** the patient; **Categorize** the nature and severity of their illness; **Decide** on the appropriate actions; and **Act**. Once you have completed this process, begin again by reassessing the patient, always seeking additional information that will help in determining the nature of the illness or treatment of the patient. Your assessment process should include the following four stages:

1. _General Assessment_: This first assessment is done quickly, within a minute or less. The Pediatric Assessment Triangle used rapidly to evaluate the patient's initial complaints and level of stability by assessing the patient's Appearance (Activity/Level of Consciousness), Work of Breathing, and Circulation (Skin Sign's) to categorize whether the patient's problem is likely to be *cardiac, respiratory or shock*.
2. _Primary Assessment_: This more extensive assessment evaluates the patient to better assess the nature of the illness: **A**irway (including breath sounds), **B**reathing (rate and effort), **C**irculation (pulse, blood pressure, etc.), **D**isability (Activity, Level of Consciousness), and **E**xposure (temperature, injuries, rash, etc.).
3. _Secondary Assessment:_ In addition to reassessing the patient's ABCDE's, the provider should obtain a **SAMPLE** History and perform a Detailed **Physical Examination**.
4. _Tertiary Assessment:_ These elements of the Therapeutic Endpoints be performed at any stage of treatment, however should wait until the patient is stable. They include laboratory, X-ray, and other test to confirm diagnosis, seek for underlying causes or differential diagnosis, and aid in ongoing treatment.

After each assessment/reassessment, you should categorize the nature and (if possible) severity of the problem in one (or more) areas:

- _Cardiac_: Either a life-threatening dysrhythmia or cardiac arrest.
- _Respiratory:_ Either respiratory distress or respiratory failure.
- _Shock_: Either compensated shock or decompensated (hypotensive) shock.

As you provide treatment, **you must frequently reassess your patient** (especially after initiating a therapy or intervention). Then re-categorize the patient based on the information available to you; what you first categorize (correctly) as respiratory distress may turn out to be the result of a life-threatening dysrhythmia, so you would need to recategorize the problem as cardiac once you identify the heart rhythm, and then treat the patient appropriately.

As you continue to gather information and assess the patient, you should try to determine the underlying cause or specific nature of the problem. The PALS course identifies the following specific cardiac, respiratory, and shock types, although providers need to be aware that these are not exhaustive lists:

- *Cardiac:* Common life-threatening dysrhythmias include Supraventricular Tachycardia or Bradycardia. Patients in cardiac arrest may be in Ventricular Fibrillation, Pulseless Ventricular Tachycardia, Asystole, or Pulseless Electrical Activity (PEA), which includes all other heart rhythms that present without a pulse. In pediatric patients, severely symptomatic bradycardia may require CPR.

- *Respiratory:* Respiratory problems can be broadly divided into Upper Airway Obstruction, Lower Airway Obstruction, Lung Tissue Disease, or Disordered Control of Breathing (which includes any ineffective respiratory rate, effort, or pattern.

- *Shock:* Shock (widespread inadequate tissue perfusion) can be Hypovolemic, Obstructive, Distributive (Septic), or Cardiogenic in nature.

If a patient's General Appearance indicates that they may be unconscious, you should check for responsiveness. If the patient is **Unresponsive**, get help (send someone to call 911 and bring back an AED, call a code, etc.). The BLS Algorithm should then be followed – open the *Airway*, check for *Breathing*, and assess *Circulation*. If the patient is apneic, rescue breathing started; if the patient is pulseless (or if a pediatric patient has a heart rate less than 60 with serious signs and symptoms), rescuers should begin CPR.

# Respiratory Compromise

When treating a child, providers should be vigilant for signs of respiratory compromise. Often, symptoms of shock or cardiac distress are treated without regard to respiratory status, but in many cases a cardiac dysrhythmia or compensated shock can be completely resolved by aggressive oxygenation. Whenever a pediatric patient's heart rate is too slow, or is slowing, the first and primary treatment is to give assisted ventilations if the child's airway is not maintained or their work of breathing is not effective. For pediatric patients with any symptoms, always provide oxygen, the exact flow rate depending on patient needs. Stable patients with a cardiac dysrhythmia but no respiratory distress can receive low-flow oxygen (up to 4 L/min.) via nasal cannula. Unstable cardiac patients, patients in shock (compensated or hypovolemic), or patients with respiratory distress should receive high-flow oxygen via non-rebreather mask, if they tolerate it. Patients in respiratory failure should receive assisted ventilations via bag-mask valve. O2 saturation monitoring is important, so pulse oximetry should be attached as soon as possible. It is critical that students correctly categorize the degree of respiratory compromise.

In **Respiratory Distress**, the patient will have an increased respiratory rate and effort. Be alert for patient position, nasal flaring, retractions, and accessory muscle use. Skin color may be normal or pale, and the patient may exhibit the beginnings of an Altered Level of Consciousness (ALOC). Adventitious breath sounds may or may not be present. Any patient in respiratory distress should receive high-flow oxygen via non-rebreather mask, if they tolerate it.

In **Respiratory Failure**, the patient may have an increase in respiratory effort with increased *or* decreased respiratory rate. Be alert for patient position, nasal flaring, retractions, and accessory muscle use. Head bobbing, decreased respiratory effort, "seesaw" respiratory pattern, shallow respirations, cyanosis, difficulty speaking, and poor air movement (diminished or absent breath sounds) are signs of respiratory failure.

For any child in respiratory failure or severe respiratory distress, you should consider the following interventions: *Assisted Ventilations* (provide ventilations via Bag-valve Mask); *Advanced Airway* (consider Endotracheal Intubation); or *Mechanical Ventilations* (such as CPAP or BiPAP). When providing assisted ventilations, students should remember that hyperventilation (ventilating too often, too rapidly, or with too much volume) **will diminish the effectiveness of circulation**.

After assessing the severity of respiratory compromise, you should determine the cause. Increased heart rate with no increased work of breathing is often a sign of shock, but may be seen in the early stages of respiratory distress. Any increase in work of breathing, or any decrease in respiratory rate, indicates respiratory compromise. PALS divide respiratory problems into four types:

**Upper airway obstruction:** Caused by infection (e.g., croup); loss of consciousness; anaphylaxis; secretions; or foreign bodies. Characterized by poor air movement; stridor or snoring may be heard. Airway management (such as head-tilt/chin-lift maneuver, airway adjuncts, suctioning, and removal of foreign bodies) is critical.

**Lower airway obstruction:** is commonly caused by asthma or bronchiolitis. Characterized by poor air movement, and usually presents with coarse breath sounds or wheezing. Assisted ventilations *at a relatively slow rate* will often be necessary. Suctioning may also be required.

**Parenchymal (lung tissue) disease:** involves inflammation of or fluid accumulation in the lungs, with causes including pulmonary edema and pneumonia. Characterized by poor oxygenation even in the presence of good air movement; breath sounds often include crackles or grunting.

**Disordered control of breathing:** Caused by an ineffective breathing pattern or markedly decreased respiratory rate. Management of the airway and providing assisted ventilations (as needed) are critical early actions. Many patients with respiratory compromise will degenerate to disordered control of breathing as their muscles weaken.

| Respiratory Rate (Breath/min) | |
|---|---|
| Age | Rate |
| Infant | 30 to 60 |
| Toddler | 24 to 40 |
| Preschooler | 22 to 34 |
| School-age child | 18 to 30 |
| Adolescent | 12 to 16 |

# Shock

When treating a child with respiratory distress, cardiac dysrhythmia, or circulatory compromise, providers should be vigilant for any signs of shock. Often, symptoms of compensated shock go unnoticed as providers concentrate on the child's primary complaint, but you should remember that children can decompensate very quickly. If primary interventions do not quickly resolve the patient's symptoms, assessment and treatment of shock may be necessary.

It is extremely important for students to correctly categorize the severity of shock and to be able to recognize the *Therapeutic End Points of Shock*.

**Compensated Shock**, the patient will have a Blood Pressure in the normal range but will show signs of compensation – increased heart rate and respiratory rate (often without an increase in respiratory effort); weak or absent distal pulses with delayed capillary refill; and pale, cool, or mottled extremities. The patient may or may not have a decreased Level of Consciousness.

**Hypotensive (Decompensated) Shock**, the patient will have a decreased Blood Pressure and will show signs of a weakening of compensatory mechanisms – absent distal pulses with delayed or absent capillary refill; a pale, mottled, or cyanotic core; lethargy or unconsciousness; and possibly a decreased heart rate or respiratory rate. Central pulses may be normal or weak.

| Definition of Hypotension by Systolic Blood Pressure and Age | |
|---|---|
| Age | Systolic Blood Pressure |
| Term Neonates (0 to 28 Days) | <60 mm Hg |
| Infants (1 to 12 months) | <70 mm Hg |
| Children (1 to 10 years)<br>($5^{th}$ BP Percentile) | <70 mm + (age in years x2) Hg |
| Children >10 years | <90 mm Hg |

After you assess the severity of shock, you should determine the type. Although this is done automatically, you should consciously consider the signs and symptoms, as the specific treatments for each type of shock differ, and ignoring signs may lead to incorrect or even dangerous treatments.

PALS categorize shock into four types:

1. **Hypovolemic shock**: Caused by reduced circulating fluid volume. Common causes among children are dehydration and trauma. The primary treatment is to provide 20 ml/kg of fluids.

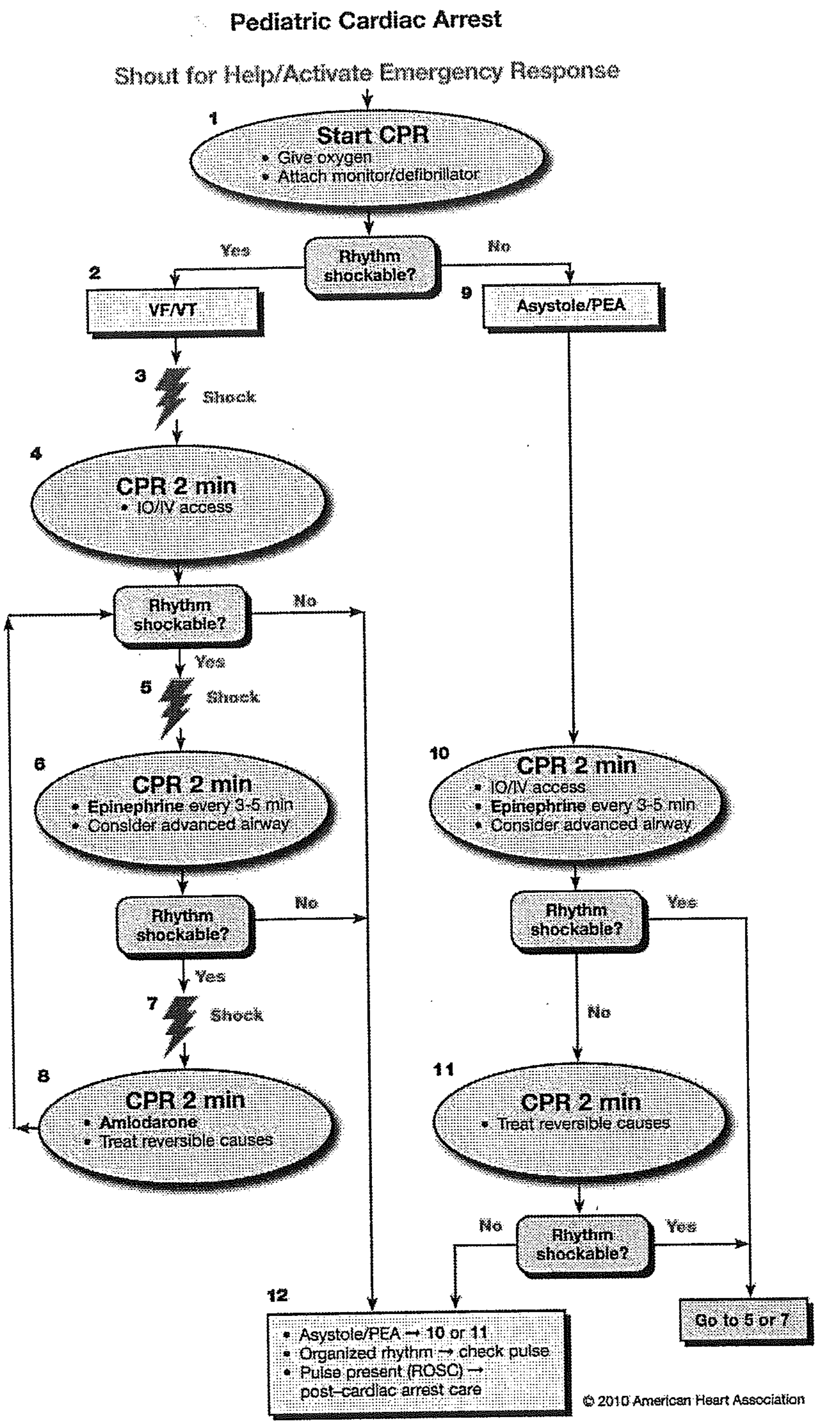
2. **Obstructive shock:** Caused by a blockage of blood flow to or from the heart. Possible causes include *tension pneumothorax*, *cardiac tamponade*, *pulmonary embolism*, and *congenital heart lesions.* In the early stages, it is often indistinguishable from hypovolemic shock. Although rapid fluid administration is needed, the provider must identify and correct the cause of the obstruction.

3. **Distributive shock:** Causes relative hypovolemia by an inappropriate distribution of blood volume. Distributive shock often shows signs of high cardiac output and low systemic vascular resistance (such as bounding pulses or warm extremities), the opposite of other types of shock. Infusion of 20 ml/kg of fluids is the initial treatment. If distributive shock caused by sepsis, administer *antibiotics* as early as possible.

4. **Cardiogenic shock** is caused by a reduced ability of the heart to pump effectively. Central pulses may be weak; pulmonary edema may be present; and cyanosis and JVD may be noted. Fluid resuscitation should be conservative (limited to 5-10 ml/kg) to avoid overloading the heart. Early consideration of vasoactive drugs (like *Dopamine* or *Milrinone*) is important. Cardiac rhythm disturbances, if present, are a likely cause of cardiogenic shock, and treated rapidly.

## Therapeutic End Points of Shock

The *Therapeutic End Points of Shock* are not clearly defined. Although systolic Blood Pressure has traditionally used to measure a return to adequate perfusion, it is often insufficient on its own. Providers should also assess some or all of the following: heart rate, respiratory rate, mental status, tissue perfusion [as indicated by strong peripheral pulses, normal capillary refill time, and good skin signs], urine output, venous oxygen saturation, and decreased serum lactate.






**Doses/Details**

**CPR Quality**
- Push hard (≥1/3 of anterior-posterior diameter of chest) and fast (at least 100/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 15:2 compression-ventilation ratio. If advanced airway, 8-10 breaths per minute with continuous chest compressions

**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.

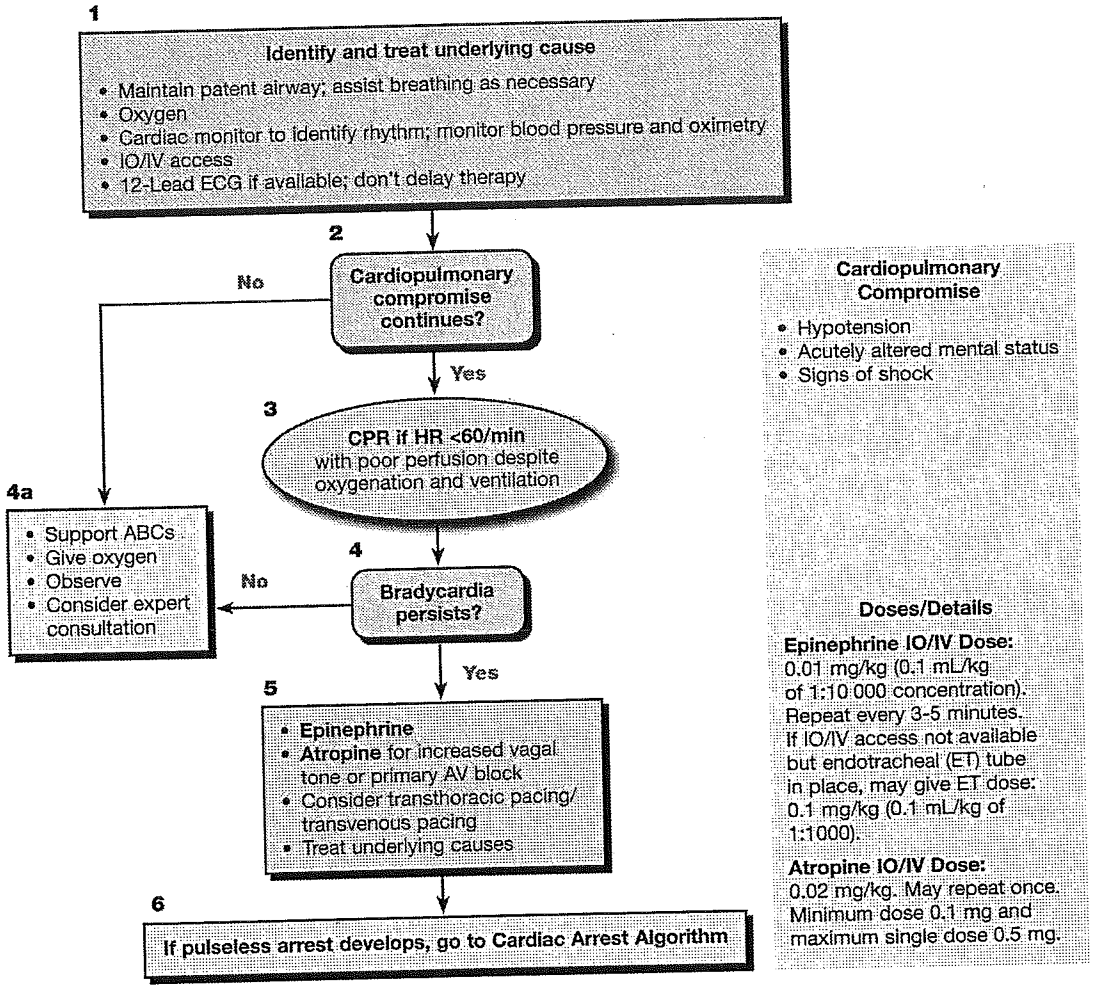
**Drug Therapy**
- **Epinephrine IO/IV Dose:** 0.01 mg/kg (0.1 mL/kg of 1:10 000 concentration). Repeat every 3-5 minutes. If no IO/IV access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of 1:1000 concentration).
- **Amiodarone IO/IV Dose:** 5 mg/kg bolus during cardiac arrest. May repeat up to 2 times for refractory VF/pulseless VT.

**Advanced Airway**
- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor ET tube placement
- Once advanced airway in place give 1 breath every 6-8 seconds (8-10 breaths per minute)

**Return of Spontaneous Circulation (ROSC)**
- Pulse and blood pressure
- Spontaneous arterial pressure waves with intra-arterial monitoring

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

## Pediatric Bradycardia
With a Pulse and Poor Perfusion



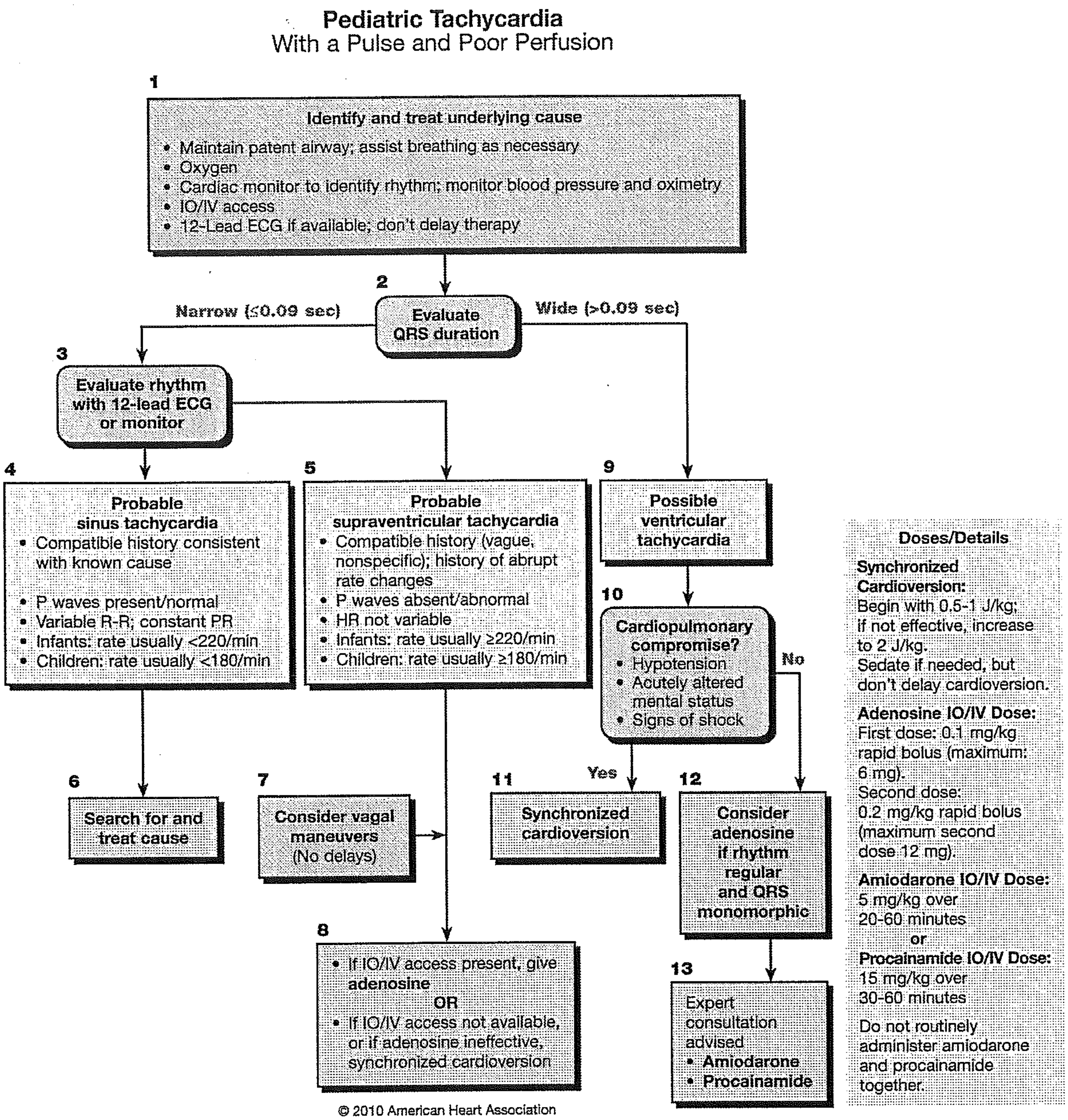
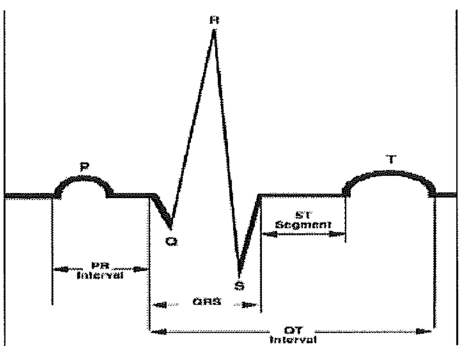
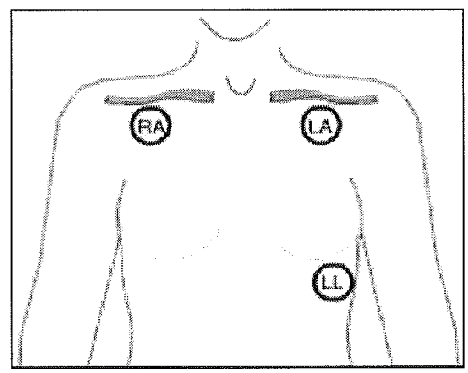



**Figure 3.** PALS Tachycardia Algorithm.

# EKG and Electrical Therapy Review

The EKG tracing represents electrical activity through the heart. The **P wave** represents depolarization of the atria; the **QRS complex** represents depolarization of the ventricles; and the **T wave** represents the latter stage of repolarization of the ventricles. The interval from the first deflection of the P wave to the beginning of the QRS complex is the P-R Interval (PRI), and should be between 0.12 and 0.20 seconds. A pediatric patient's QRS complex has duration of 0.09 seconds or less; a longer duration (*wide QRS*) indicates delayed conduction through the ventricles, often as the result of a ventricular pacemaker focus. The horizontal axis of the EKG strip measures time. Each large box represents 0.20 seconds; each small box represents 0.04 seconds.




To obtain a 3-lead EKG tracing, place the white (RA) electrode on the right chest just below the clavicle; the black electrode (LA) on the left chest just below the clavicle; and the Red electrode (LL) laterally on the lower left abdomen. Pacer and defibrillation pads generally go in the anterior/posterior positions, although on older children, defibrillation pads can go on the upper right chest and lower left abdomen.

**Rhythm Disturbances: Treat the patient, not the dysrhythmia.** Always assess your patient for pulses, perfusion, and level of consciousness – is the patient *Stable*, *Unstable*, or *Pulseless*? Next, assess the rhythm: Is it fast or slow? Is it life-threatening? As you treat the patient, try to discover the cause of the dysrhythmia – for many patients, their only chance of survival is if you can identify and treat a **reversible cause**. There are many possible causes of rhythm disturbances, especially bradycardia or PEA. Some of the most common causes in children include hypoxia, drugs/toxins, hypovolemia, and intrinsic heart problems. Although lab draws can be useful, a history of the patient and the current event obtained from a parent or caregiver is often more useful.

## Defibrillation (Unsynchronized Shock)

Fibrillation is a disorganized rhythm that, if present in the ventricles, is life-threatening. Immediate CPR combined with early defibrillation is critical to survival from sudden cardiac arrest. Defibrillation terminates all electrical activity in the pulseless heart in the hopes that it will resume beating in a coordinated fashion. A shock should be delivered about once every 2 minutes if the patient remains in Ventricular Fibrillation. With either a monophasic or a biphasic manual defibrillator, the recommendation is to deliver the first shock at 2 Joules/kg. The second shock is 4 J/kg, and subsequent defibrillation shocks are delivered at 4 J/kg or greater.

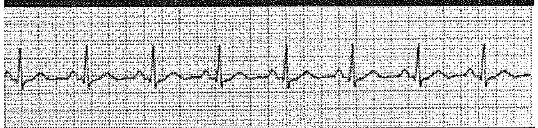
## Synchronized Cardioversion

In pediatric patients, synchronized cardioversion is a secondary treatment. Patients with a narrow-complex tachycardia (i.e., SVT), attempt vagal maneuvers first and then adenosine. For patients with a wide-complex tachycardia, expert consultation is advised if the patient is stable enough to withhold treatment. If the patient is too unstable to attempt other treatments (of if other treatments are ineffective), consider synchronized cardioversion. The shock is timed by the monitor to be delivered in coordination with the QRS complex of the heart. If the patient is conscious, consider sedation prior to cardioversion; however, **synchronized cardioversion should not be delayed while waiting for sedation** in severely symptomatic patients. The initial shock is delivered at 0.5 to 1 J/kg regardless of the type of manual defibrillator used. If the initial shock fails to terminate the rhythm, with the second shock delivered at 2 J/kg.

## Transcutaneous Pacing (TCP)

External cardiac pacing can be considered for pediatric bradycardia unresponsive to ventilation, oxygenation, CPR, and medications. Begin pacing at zero milliamps, slowly increasing until capture is achieved. Then, set the rate at 20 beats per minute above the monitored heart rate, with a minimum rate of 50 bpm.

## Normal Sinus Rhythm (NSR)



| | |
|---|---|
| Rhythm | Regular |
| Rate | See Below |
| P waves | Normal in configuration & direction; one P wave precedes each QRS |
| PRI | Normal (0.12 - 0.20 seconds) |
| QRS | Normal (0.08 seconds or less) |

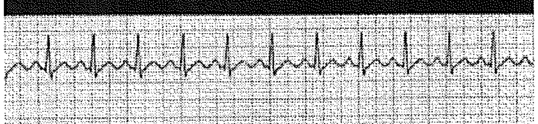
| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | 80 - 205 bpm |
| 3 months - 2 years | 75 - 190 bpm |
| 2 - 10 years | 60 - 140 bpm |
| > 10 years | 60 - 100 bpm |

## Sinus Bradycardia

| | |
|---|---|
| Rhythm | Regular |
| Rate | < 60 |
| P waves | Normal in configuration & direction; one P wave precedes each QRS |
| PRI | Normal (0.12 - 0.20 seconds) |
| QRS | Normal (0.08 seconds or less) |

| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | < 100 bpm |
| 3 months - 2 years | < 60 bpm |
| 2 - 10 years | < 60 bpm |
| > 10 years | < 60 bpm |

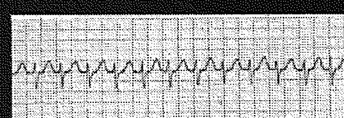
## Sinus Tachycardia (ST)



| | |
|---|---|
| Rhythm | Regular |
| Rate | See Below |
| P waves | Normal in configuration & direction; one P wave precedes each QRS |
| PRI | Normal (0.12 - 0.20 seconds) |
| QRS | Normal (0.08 seconds or less) |

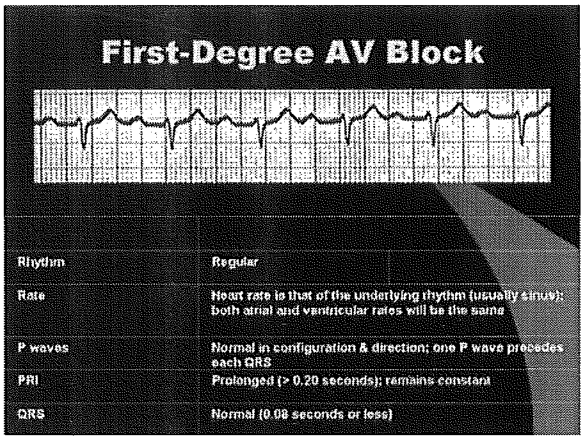
| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | 205 - 225 bpm |
| 3 months - 2 years | 190 - 225 bpm |
| 2 - 10 years | 140 - 180 bpm |
| > 10 years | 100 - 150 bpm |

## Supraventricular Tachycardia (SVT)

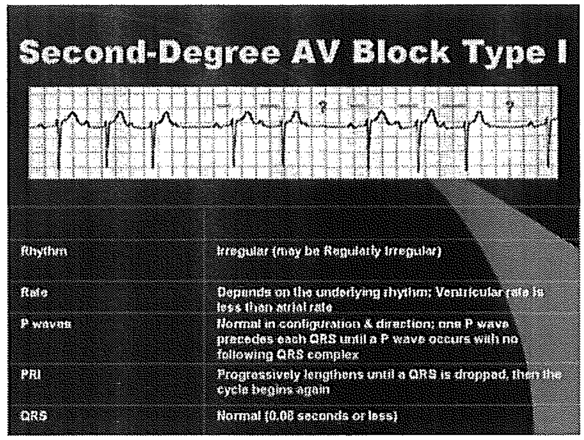


| | |
|---|---|
| Rhythm | Regular; runs of SVT may be regular or irregular. |
| Rate | See Below |
| P waves | P waves in the runs of SVT usually abnormal (often pointed); usually hidden in preceding T wave. |
| PRI | Not measurable in the runs of SVT. |
| QRS | Normal (0.08 seconds or less). |

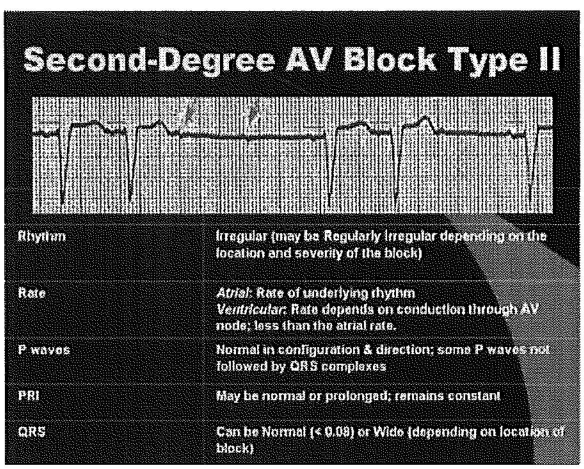
| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | > 225 bpm |
| 3 months - 2 years | > 225 bpm |
| 2 - 10 years | > 180 bpm |
| > 10 years | > 150 bpm |



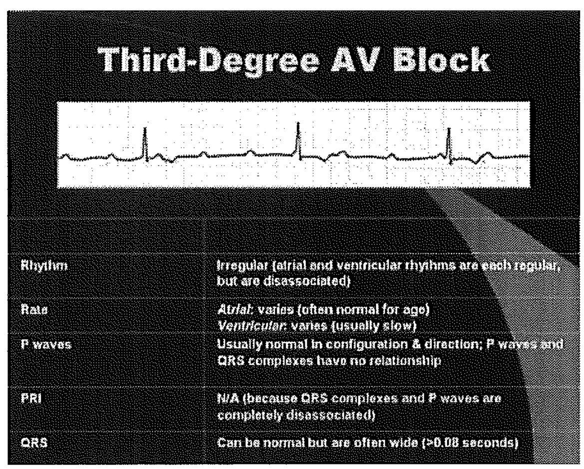

| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | Usually normal for age; may be slow. |
| 3 months - 2 years | |
| 2 - 10 years | |
| > 10 years | |



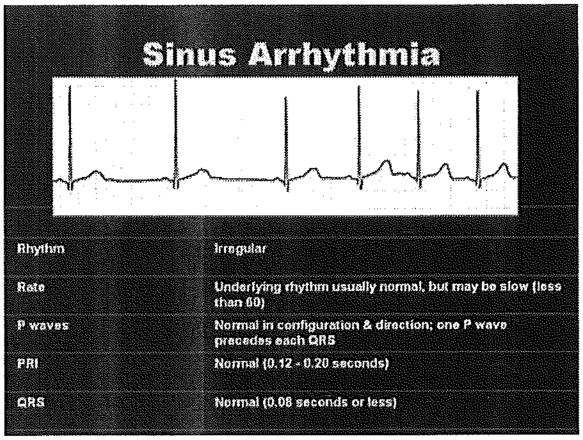

| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | Usually slow for age, especially with dropped QRS complexes. |
| 3 months - 2 years | |
| 2 - 10 years | |
| > 10 years | |



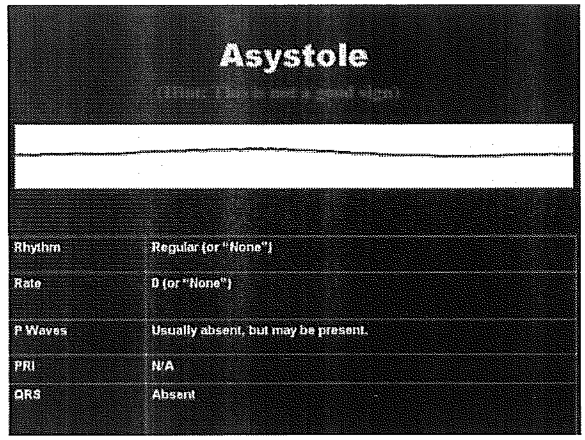

| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | Usually slow for age, especially with dropped QRS complexes. |
| 3 months - 2 years | |
| 2 - 10 years | |
| > 10 years | |



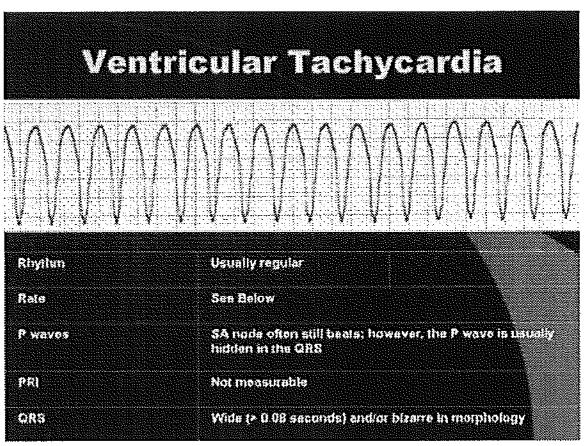

| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | Atrial rate may be slow or normal for age; ventricular rate usually 20 - 30 bpm. |
| 3 months - 2 years | |
| 2 - 10 years | |
| > 10 years | |



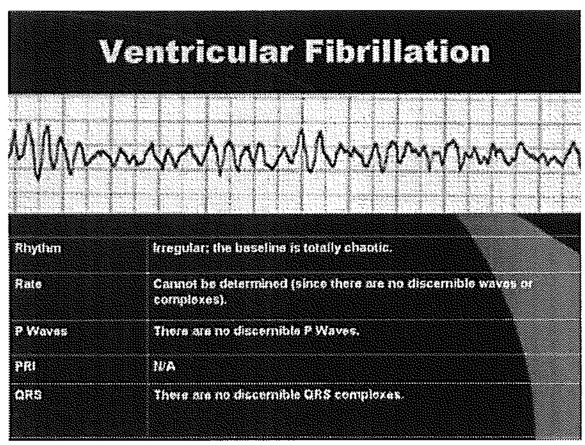

| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | Usually normal for age; may be slow. |
| 3 months - 2 years | |
| 2 - 10 years | |
| > 10 years | |




| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | 0 (may *occasionally* show P waves *only*, at normal or slow rate) |
| 3 months - 2 years | |
| 2 - 10 years | |
| > 10 years | |




| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | usually > 140 bpm |
| 3 months - 2 years | |
| 2 - 10 years | |
| > 10 years | |




| Age | Heart Rate |
|---|---|
| newborn to 3 mo. | N/A (too fast to count) |
| 3 months - 2 years | |
| 2 - 10 years | |
| > 10 years | |