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 American Heart Association's Guidelines for CPR and Emergency Cardiovascular Care in fall 2005. Implementation of these guidelines by Training Centers began July 1, 2006. **This new format requires all students to be fully prepared prior to coming to class.**

The PALS Course does not teach CPR, ECG rhythm identification, pharmacology, or PALS algorithms. **If you do not review CPR, or do not understand 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.

What you received:

1. PALS Study Guide
2. PALS Provider Manual
3. PALS Course Guide with Student CD

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 doing the following:

1. Review the PALS Study Guide
2. Review the Competency Checklists that will be used to evaluate you during the course (pages 16-17, 21-23, 42-44, 52-54, 64-67, and 79-82 of the *PALS Course Guide*).
3. 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.

4. **Be prepared to pass the child 1-rescuer CPR/AED and infant 1- and 2-rescuer CPR 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 2005 guidelines, especially as they relate to pediatric patients. You will find this information in this Study Guide, the *PALS Content Guide*, or in the 2005 ECC Handbook (*not provided with this course*). *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*.
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.
8. PALS cards and Continuing Education Units (CEU's) are issued at the end of the course.

What to Bring and Wear

You must bring your PALS Course Guide and completed Pre-course Assessment to class. ***All renewal (1-day course) participants must bring their current American Heart Association-issued PALS card to class.*** *There are no exceptions for expired cards.*

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.

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Please be aware:

Reschedule Policy

- **No refunds will be issued**. **All registrations are final.**
- You may reschedule your course by calling us at least 5 business days prior to your scheduled course date. **You will be charged a rescheduling fee of $25.**
- If you reschedule your course fewer than 5 business days prior to the course start date, **you will be charged 50% of the course fee**.
- **If you reschedule within fewer than 48 hours prior to the course start date, you will forfeit the entire course fee.**
- Course must be rescheduled and attended within 30 days from the original start date. No additional rescheduling requests will be honored.
- Only one reschedule request will be honored per course.
- Our Administrative Offices are closed on weekends and holidays. We do not accept rescheduling requests on weekends or holidays.
- We do not accept requests left on the answering machine.

Cancellation Policy

- **We do not issue refunds for course fees. All registrations are final.**
- If you cancel or do not attend the class you have registered for, you will forfeit your entire course fee.

Late Arrival

- Our classes start on time. Please plan your trip accordingly and remember to allow time for parking.
- If you are late for your scheduled class, you will be not be admitted into class and you must reschedule.

Parking and Public Transportation

- Parking in Downtown Berkeley is limited to Metered Street Parking and Garage Parking. Fast Response does not have an agreement for Validated Parking.
- We are conveniently located ½ blocks away from the Downtown Berkeley BART station.
- Visit our website for additional information on parking and public transportation options

We look forward to welcoming you at the course. Please feel free to call with any questions.

Lisa Dubnoff, R.N, EMT-P
PALS Program Director

Christopher Ché King, EMT-P
CEU Director

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School of Health Care Education

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 (AHA) guidelines that we must follow. Outlined below are the Fast Response policies that enact the AHA's requirements for student/provider manuals.

1. Each student must have the **current** (2006) provider manual available to them before, during, and after the course per AHA guidelines. These books are available at www.emsbooks.com for a discounted rate. If you show up to your class without the required manual, there are only two options. The ECC Handbook is not sufficient for any AHA course. (For PALS students, the course guide alone is acceptable.)

   A: You must purchase the book to attend the class. Books can be purchased at the reception desk. The cost is $48.50 for the Advanced Cardiac Life Support provider manual and $55.00 for the Pediatric Advanced Life Support provider manual (including the course guide, which is not available separately).

   B: If you previously purchased the book, or if you are not able to purchase it at that time, the lead instructor may allow you to attend the class with a loaner book. However, we will withhold your certification card and CEU certificate until you provide us with your purchase receipt for the book.

2. 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.

Fast Response would like to apologize for any inconvenience this may cause, but 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 and 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

1425-1700 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

1020-1030 Break

1030-1130 Shock Cases:

Team Practice Simulation

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

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 or decompensated shock (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.

PALS Algorithm Review

Always start with the ABCD survey!

BRADYCARDIA

Algorithm: Bradycardia with a pulse (*Course Guide*, page 49)

- **V**entilations – provide assisted ventilations as needed – aggressive oxygenation is the highest priority for pediatric bradycardia.
- **C**PR – perform chest compressions if heart rate still < 60 with poor perfusion!
- **E**pinephrine 0.01 mg/kg (1:10,000 solution) IV/IO (if unresponsive to ventilations and CPR).
- Consider **T**ranscutaneous Pacing if patient unresponsive to ventilations, CPR, and epinephrine.
- **D**ifferential Diagnosis – consider the 6 H's and 5 T's (see next page).

Note: Atropine is indicated bradycardia secondary to vagal tone stimulation or 1° heart block only (dose is 0.02 mg/kg, with a minimum dose of 0.1 mg).

TACHYCARDIA

Algorithm: Tachycardia with Pulses and Poor Perfusion (*Course Guide*, page 51)
Remember: The first-line treatment for any pediatric dysrhythmia is oxygenation and, if necessary, assisted ventilations. Otherwise:

- **Regular Narrow Complex** Tachycardia (*rate < 180 for children, < 220 for infants*) – Probable *Sinus Tachycardia* (ST):
    1. Obtain 12-lead ECG (if appropriate).
    2. Seek for and treat underlying cause.

- **Regular Narrow Complex** Tachycardia (*rate > 180 for children, > 220 for infants*) – Probable *Supraventricular Tachycardia* (SVT):
    1. Obtain 12-lead ECG; consider expert consultation.
    2. Attempt vagal maneuvers (if attempted without delays).
    3. Adenosine 0.1 mg/kg rapid IV push (maximum initial dose: 6 mg) if IV access readily available. If no conversion, may double the initial dose once (only).
    4. Synchronized Cardioversion (0.5 to 1 J/kg, increase to 2 J/kg if rhythm does not convert). Sedate if possible, but do not delay cardioversion.
    5. Seek for and treat underlying causes (6 H's and 5 T's; see next page).

- **Wide Complex** Tachycardia (probable *Ventricular Tachycardia*):
    1. Immediate Synchronized Cardioversion (0.5 to 1 J/kg, increase to 2 J/kg if rhythm does not convert). Sedate if possible, but do not delay cardioversion.
    2. May attempt adenosine one time (0.1 mg/kg) *if it does not delay cardioversion*.
    3. Obtain 12-lead ECG; expert consultation advised.
    4. Convert rhythm using Amiodarone (5 mg/kg IV over 20-60 minutes) **OR**
    5. Procainamide (15 mg/kg IV over 30-60 minutes).

Ventricular Fibrillation/Pulseless Ventricular Tachycardia

Algorithm: Pulseless Arrest – **Shockable** (*Course Guide*, page 39)
Remember: Good ACLS starts with good BLS:

- **CPR** – start immediately. Push hard and push fast.
- **Shock** – analyze rhythm, and shock if in VF/pulseless VT (2 J/kg).
- **CPR** – resume CPR immediately after shock delivery. Continue for 10 c cycles / 2 minutes.
- **Vasopressor** – Epinephrine 0.01 mg/kg (1:10,000 solution) q 3-5 min I IV/IO. Give as soon as possible after resuming CPR, circulate with chest Compressions.
- **Shock** – analyze rhythm, and shock if in VF/pulseless VT (4 J/kg).
- **CPR** – resume CPR immediately after shock delivery. Continue for 10 cycles / 2 minutes.
- **Antiarrhythmic** – Amiodarone 5 mg/kg IV/IO or Lidocaine 1 mg/kg. Give as soon as possible after resuming CPR, circulate with chest compressions.
- **Shock** – analyze rhythm, and shock if in VF/pulseless VT (4 J/kg).
- **CPR** – resume CPR immediately after shock delivery. Continue for 10 cycles / 2 minutes.

Note: **Minimize interruptions to chest compressions – do not check a pulse or evaluate the heart rhythm after a shock**. After each shock, resume CPR immediately and continue for 10 cycles prior to rhythm analysis and possible pulse check. Even though Epi can be given every 3-5 minutes (in practical terms, every 10 cycles/4 minutes), only one antiarrhythmic dose should be given to a pediatric patient.

PULSELESS ELECTRICAL ACTIVITY

Algorithm: Pulseless Arrest – **Not Shockable** (*Course Guide*, page 39)
Remember: **PEA**:

- **P**ossible causes (consider the 6 H's and 5 T's).
- **E**pinephrine 0.01 mg/kg IV/IO q 3-5 minutes. Give as soon as possible after resuming CPR, circulate with chest compressions.
- **A**ggressive oxygenation – use compression: ventilation ratio of 15:2 consider an advanced airway. Avoid hyperventilation – do not ventilate too quickly, too often, or with too much volume.

Note: In PEA, the electrical system of the heart is functioning, but there is a problem with the *pump*, *pipes*, or *volume* – a mechanical part of the system is not working. You can use the **6 H's and 5 T's** to remember the most common reversible causes of PEA:

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

ASYSTOLE

Algorithm: Pulseless Arrest – **Not Shockable** (*Course Guide*, page 39)
Remember: **DEAD**:

- **D**etermine whether to initiate resuscitative efforts.
- **E**pinephrine 0.01 mg/kg (1:10,000 solution) q 3-5 min IV/IO. Give as soon as possible after resuming CPR, circulate with chest compressions.
- **A**ggressive oxygenation – use compression: ventilation ratio of 15:2 consider advanced airway. Avoid hyperventilation – do not ventilate too often, too quickly, or with too much volume.
- **D**ifferential Diagnosis or **D**iscontinue resuscitation – Are they still dead? Consider the 6 H's and 5 T's (see above) – check blood glucose; check core temperature; consider Naloxone; etc.

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 (page 55 of the *PALS Course Guide*) and provide appropriate oxygenation.

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 (see page 18), 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 (see page 74 of the *PALS Course Guide*) 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) (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: C**aused 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: Ca**uses 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

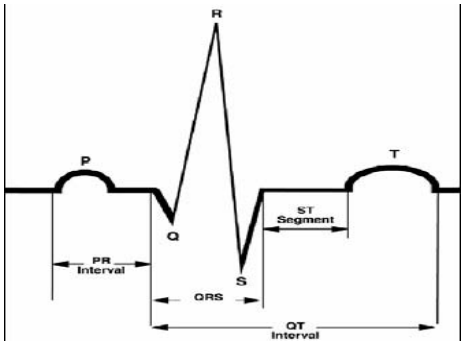
The *Therapeutic End Points of Shock* are not clearly defined. Although systolic Blood Pressure has traditionally used to measure a return to adequate perfusion, it is often insufficient on its own. Providers should also assess some or all of the following: heart rate, respiratory rate, mental status, 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.

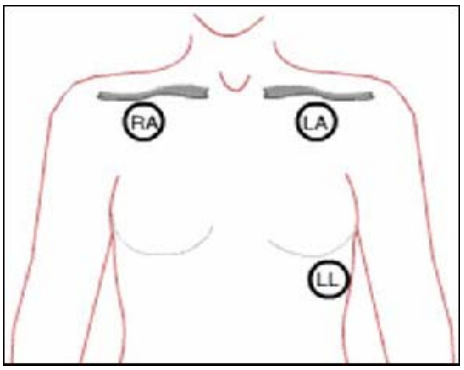
MEDICATIONS FOR PEDIATRIC RESUSCITATION AND ARRHYTHMIAS

Medications	Dose	Remarks
Adenosine	0.1 mg/kg (maximum 6 mg) Repeat: 0.2 mg/kg (maximum 12 mg)	Monitor ECG Rapid IV/IO bolus Monitor ECG and blood pressure Adjust administration rate to urgency
Amiodarone	5 mg/kg IV/IO; repeat up to 15 mg/kg Maximum: 300 mg	perfusing rhythm present, use caution when administering with other drugs that prolong QT
Atropine	0.02 mg/kg IV/IO 0.03 mg/kg ET* Repeat once if needed Minimum dose: 0.1 mg Maximum single dose: Child 0.5 mg Adolescent 1 mg	Higher doses may be used with organophosphate poisoning
Calcium chloride (10%)	20 mg/kg IV/IO (0.2 mL/kg)	
Epinephrine	0.01 mg/kg (0.1 mL/kg 1:10 000) IV/IO 0.1 mg/kg (0.1 mL/kg 1:1000) ET* Maximum dose: 1 mg IV/IO; 10 mg ET	
Glucose	0.5–1 g/kg IV/IO	D10W: 5–10 mL/kg D25W: 2–4 mL/kg D50W: 1–2 mL/kg
Lidocaine	Bolus: 1 mg/kg IV/IO Maximum dose: 100 mg Infusion: 20–50 µg/kg per minute ET*: 2–3 mg	
Magnesium sulfate	25–50 mg/kg IV/IO over 10–20 min; faster in torsades Maximum dose: 2g	
Milrinone	50 to 75 mcg/kg loading dose over 10 to 60 minutes, then .5 to .75 mcg/kg/minute IV/IO	Longer infusion times reduce risk of hypotension.
Naloxone	<5 y or 20 kg: 0.1 mg/kg IV/IO/ET* 5 y or >20 kg: 2 mg IV/IO/ET*	Use lower doses to reverse respiratory depression associated with therapeutic opioid use (1–15 µg/kg)
Procainamide	15 mg/kg IV/IO over 30–60 min Adult dose: 20 mg/min IV infusion up to total maximum dose 17 mg/kg	Monitor ECG and blood pressure Use caution when administering with other drugs that prolong QT
Sodium bicarbonate	1 mEq/kg per dose IV/IO slowly	

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 0.08 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 and subsequent defibrillation shocks are delivered at 4 J/kg.

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

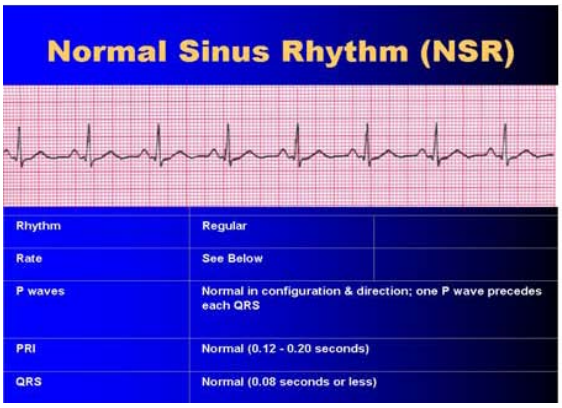
Age	Heart Rate
newborn to 3 mo.	< 100 bpm
3 months - 2 years	< 60 bpm
2 - 10 years	< 60 bpm
> 10 years	< 60 bpm

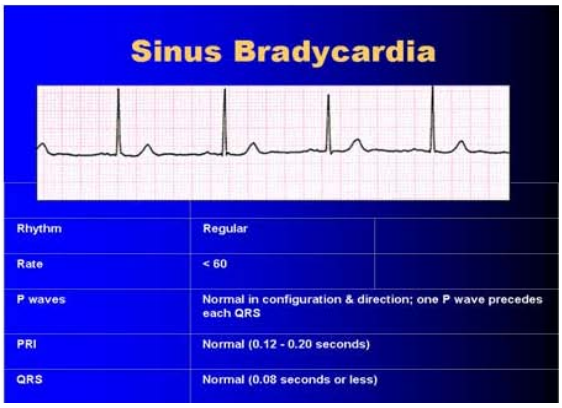
Synchronized Cardioversion

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.





Age	Heart Rate
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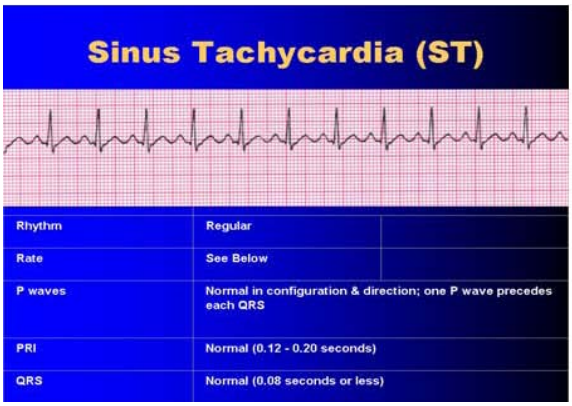
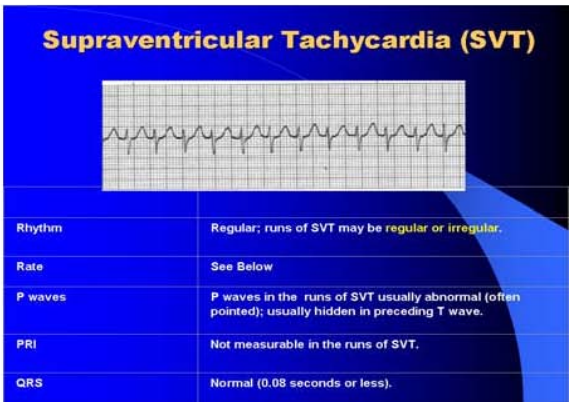
3 months - 2 years	75 - 190 bpm
2 - 10 years	60 - 140 bpm
> 10 years	60 - 100 bpm

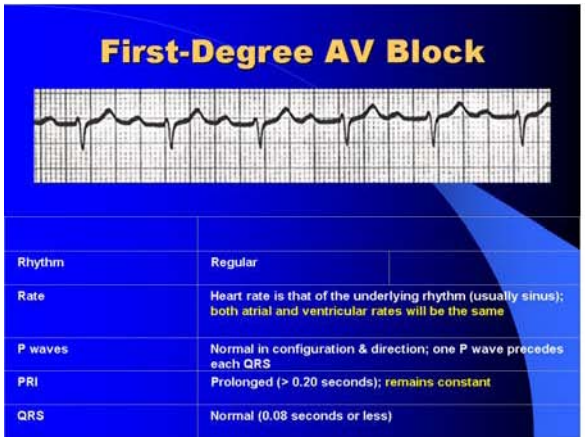
Age	Heart Rate
newborn to 3 mo.	< 100 bpm
3 months - 2 years	< 60 bpm
2 - 10 years	< 60 bpm
> 10 years	< 60 bpm

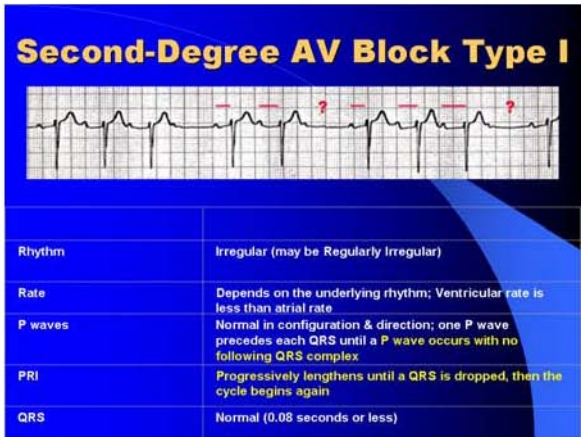




Age	Heart Rate
newborn to 3 mo.	205 - 225 bpm
3 months - 2 years	190 - 225 bpm
2 - 10 years	140 - 180 bpm
> 10 years	100 - 150 bpm

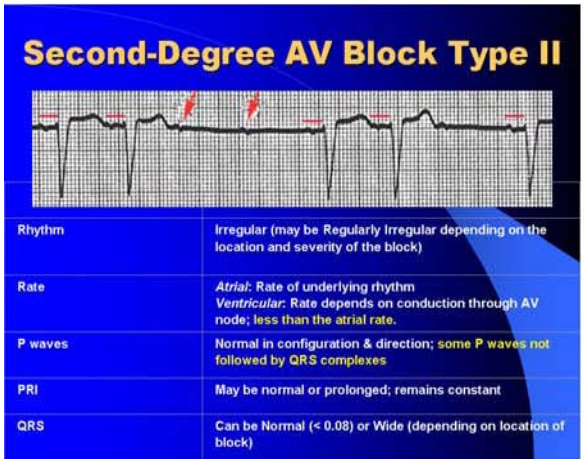
Age	Heart Rate
newborn to 3 mo.	> 225 bpm
3 months - 2 years	> 225 bpm
2 - 10 years	> 180 bpm
> 10 years	> 150 bpm

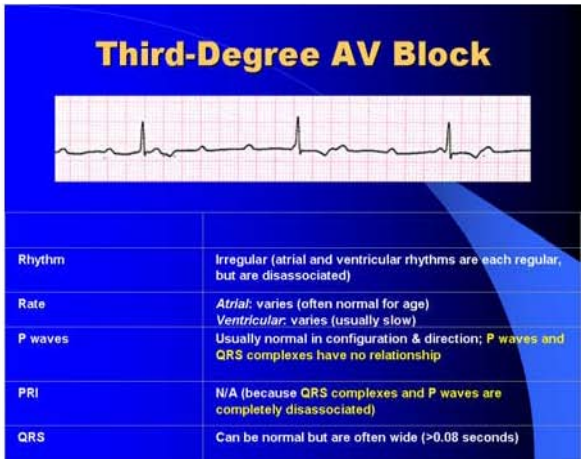




Age	Heart Rate
newborn to 3 mo.	Usually normal for age; may be slow.
3 months - 2 years	
2 - 10 years	
> 10 years	

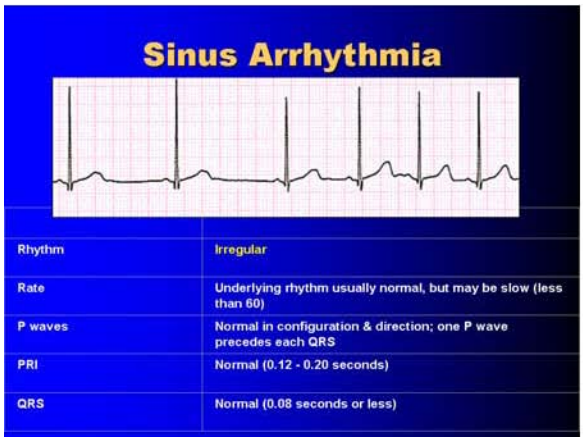
Age	Heart Rate
newborn to 3 mo.	Usually slow for age, especially with dropped QRS complexes.
3 months - 2 years	
2 - 10 years	
> 10 years	

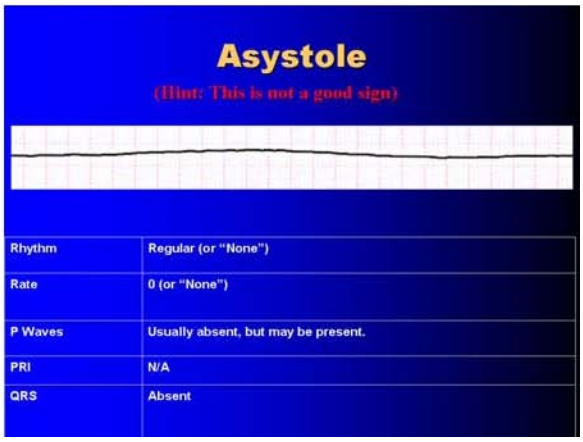




Age	Heart Rate
newborn to 3 mo.	Usually slow for age, especially with dropped QRS complexes.
3 months - 2 years	
2 - 10 years	
> 10 years	

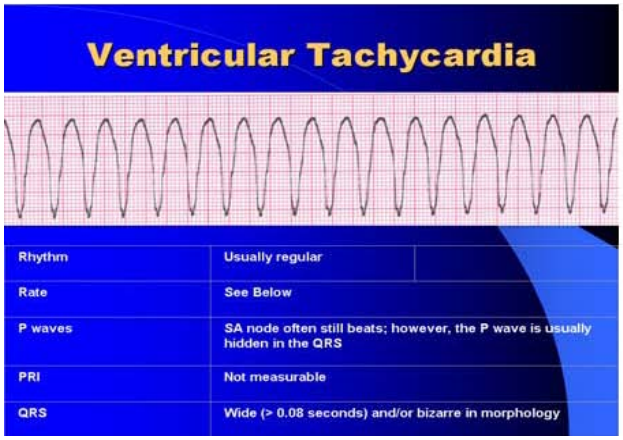
Age	Heart Rate
newborn to 3 mo.	Atrial rate may be slow or normal for age; ventricular rate usually 20 - 30 bpm.
3 months - 2 years	
2 - 10 years	
> 10 years	

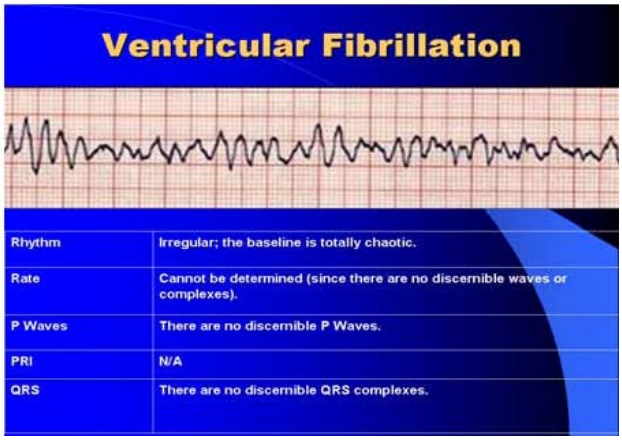




Age	Heart Rate
newborn to 3 mo.	Usually normal for age; may be slow.
3 months - 2 years	
2 - 10 years	
> 10 years	

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	