The Institute of Continuing
Healthcare Education

PEDIATRIC ADVANCED LIFE SUPPORT STUDY GUIDE

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Updates to PALS in 2015

As we learn more about resuscitation science and medicine, physicians and researchers realize what works best and what works fastest in a critical, life-saving situation. Therefore, it is necessary to periodically update life-support techniques and algorithms. If you have previously certified in pediatric advanced life support, then you will probably be most interested in what has changed since the latest update in 2015. The table below also includes changes proposed since the last AHA manual was published.

Updates to the 2015 Guidelines		
Intervention	2015 Guideline	2010 Guideline
Volume for children with febrile illness	Restrictive volumes of isotonic crystalloids	Aggressive volume resuscitation
Atropine for emergency tracheal intubation	Controversial for neonates; no minimum dose	Routine premedication prior to intubation
Arterial blood pressure monitoring	If in place, may be useful to adjust CPR	No guideline
Amiodarone and Lidocaine	Acceptable for shock-refractory VFib or Pulseless VTach	No guideline
Therapeutic hypothermia	Fever should be avoided after ROSC but use of therapeutic hypothermia is controversial	Therapeutic hypothermia should be used
Blood Pressure	Fluids and vasoactive agents to maintain systolic blood pressure above the 5th percentile for age	No guideline
Compressions	100 to 120 per minute	At least 100 per minute

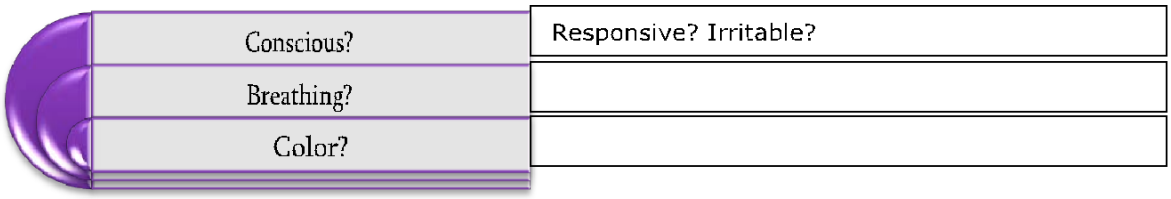
PALS Systematic Approach

The PALS systematic approach is an algorithm that can be applied to every injured or critically ill child.

First Impression

The first step is to determine if the child is in imminent danger of death, specifically cardiac arrest or respiratory failure. The PALS systematic assessment starts with a quick, first impression. The provider or rescuer makes it very quick assessment about the child's condition.

Is the child in imminent danger of death? Is there time to evaluate the child to identify and treat possible causes for the current illness? Is the child conscious? Is she breathing? What is her color?



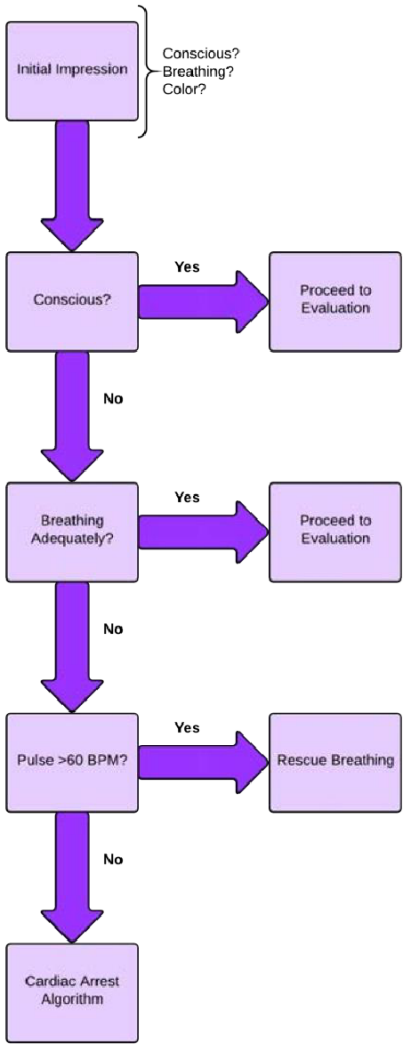
➢➢A conscious child who is breathing effectively can be managed in the next steps of PALS, Evaluate-Identify-Intervene.

➢➢A unconscious child who is breathing effectively can be managed in the next steps of PALS, Evaluate-Identify-Intervene.

➢➢A child who is not breathing adequately but who has a pulse >60 BPM should be treated with rescue breathing.

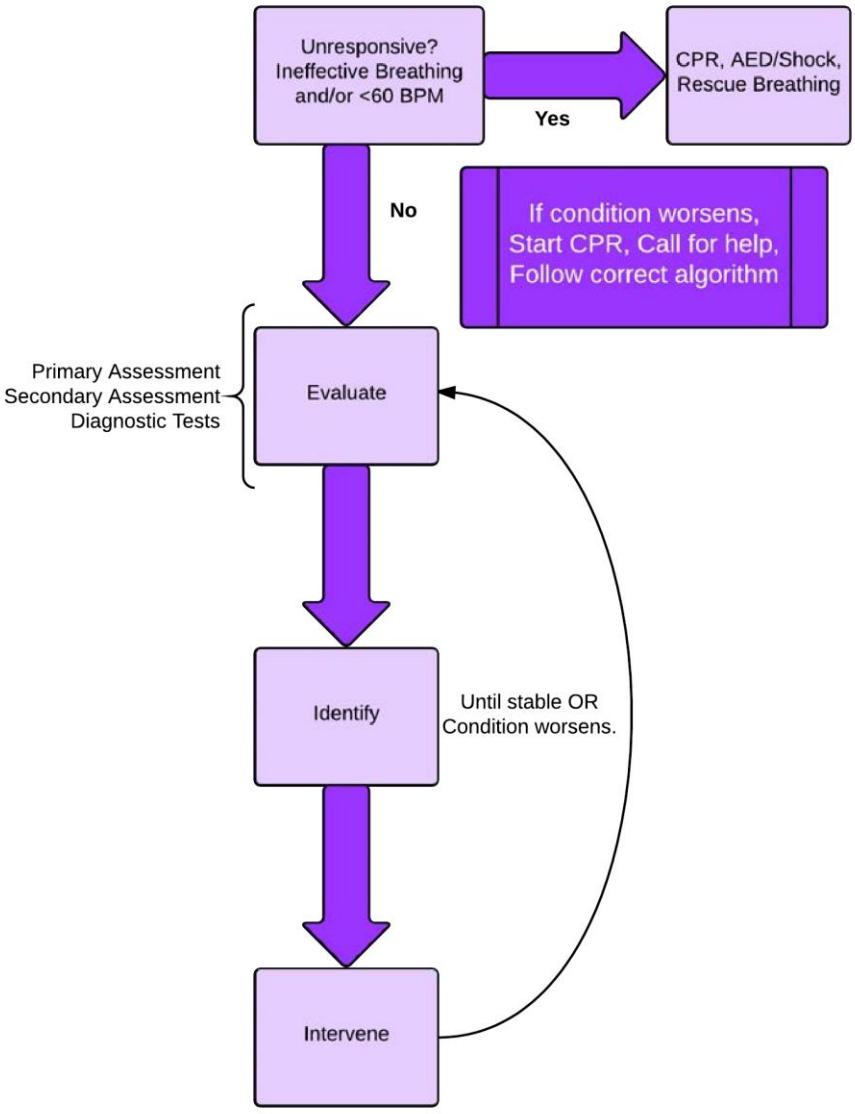
➢➢A child who has a pulse <60 BPM should be treated with CPR and according to the cardiac arrest algorithm.

➢➢A child who has a pulse <60 BPM should be treated with CPR and according to the cardiac arrest algorithm.



Evaluate Ident Intervene

➢➢Assuming that the child does not need CPR, rescue breathing, or defibrillation, the next step in this systematic approach in PALS is a circular construct that includes evaluation, identification, and intervention.



➢➢The provider will evaluate, identify, and intervene as many times as necessary until the child either stabilizes or her condition worsens, requiring CPR and other lifesaving measures.

➢➢"Evaluate" pertains to evaluation of the child's illness, but also to the success or failure of the intervention.

➢➢If the child's condition worsens at any point, revert to CPR and emergency interventions as needed.

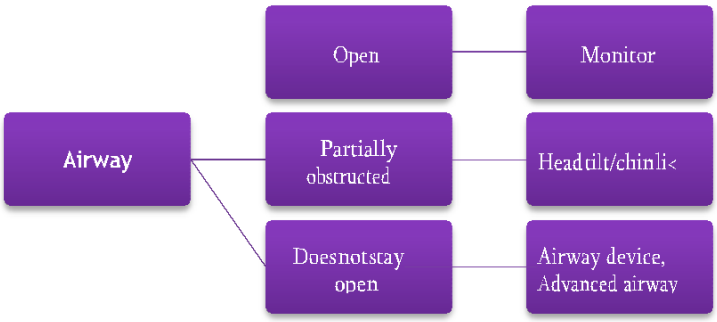
➢➢After Spontaneous Return of Circulation (ROSC), use the evaluate–identify–intervene sequence.

➢➢The evaluate phase of the sequence includes Primary Assessment, Secondary Assessment, and Diagnostic Tests that are helpful in pediatric life support situations.

Primary Assessment

Primary Assessment follows ABCDE: Airway, Breathing, Circulation, Disability, Exposure.

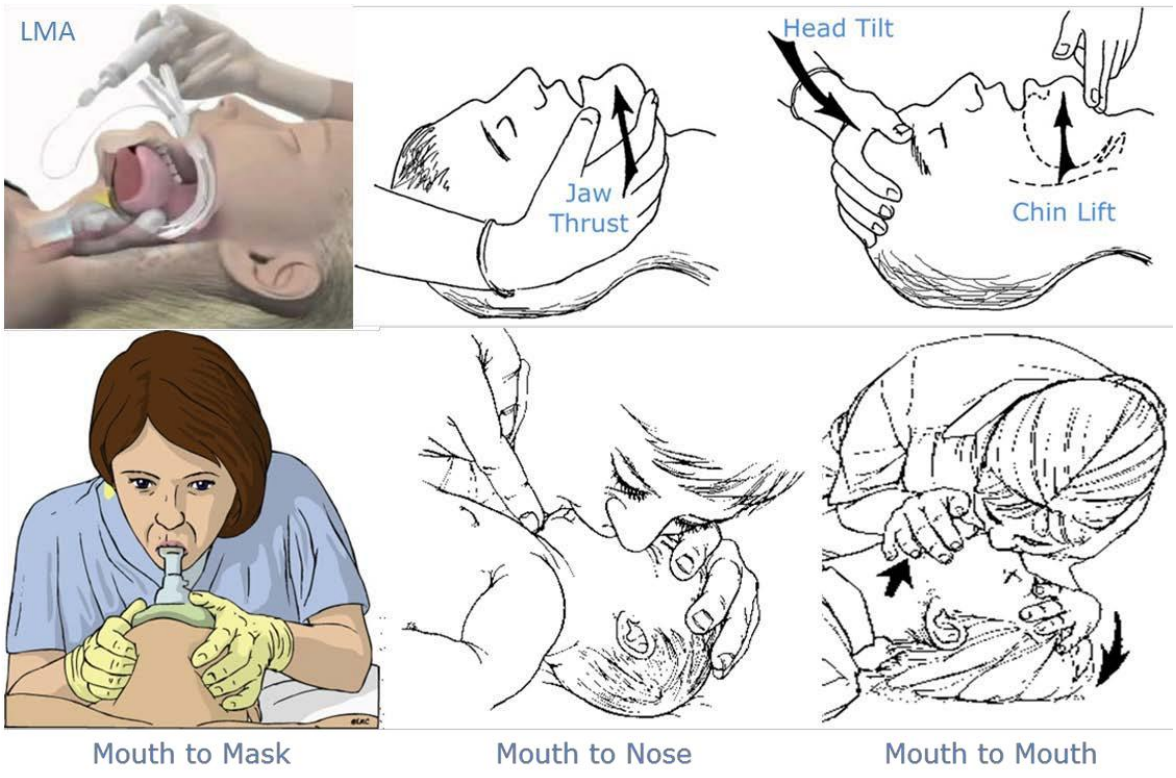
➢➢While CPR currently uses the C-A-B approach or compressions, airway, breathing, the Primary Assessment in PALS still begins with Airway.



➢➢If the child airway is open, you may move onto the next step. However, if the airway is likely to become compromised, you may consider a basic or advanced airway.

➢➢Often, in unresponsive patient or in someone who has a decreased level of consciousness, the airway will be partially obstructed. This instruction does not come from a foreign object, but rather from the tissues in the upper airway. You can improve a partially obstructed airway by performing a head tilt and chin lift. If there is suspected trauma to the cervical spine, use a jaw thrust instead.

➢➢A blocked airway would usually requires a basic or advanced airway.



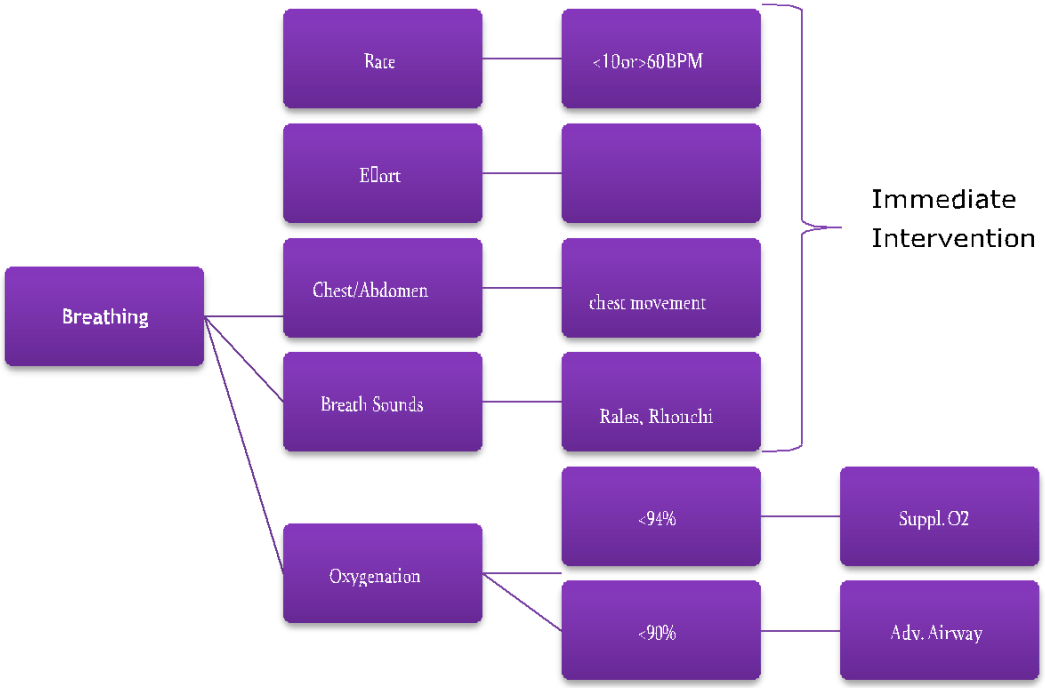
The evaluation of breathing include several signs including breathing rate, breathing effort, motion of the chest and abdomen, breath sounds, and blood oxygenation levels. Normal breathing rates vary by age and are shown in the table. The breathing rate higher or lower than the normal range indicates the need for intervention.

Normal Respiratory Rate by Age		
Age	**Range**	**Rate (BPM)**
Infant	0-12 months	30-60
Toddler	1-3 years	24-40
Preschooler	4-5 years	22-34
School Age	6-12 years	18-30
Adolescent	13-18 years	12-16

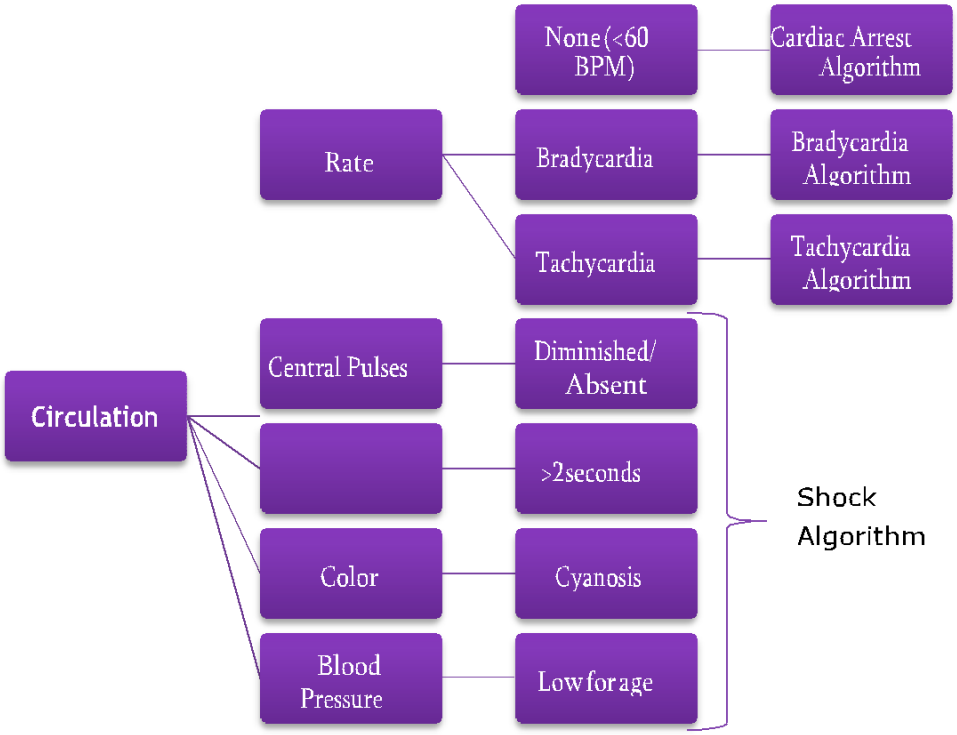
Nasal flaring, head bobbing, seesawing, and chest retractions are all signs of increased effort of breathing. The chest may show labored movement (e.g., using the chest accessory muscles), asymmetrical movement, or no movement at all.

Stridor is a high-pitched breath sounds, usually heard on inspiration, that usually indicates a blockage in the upper airway. Rales or crackles often indicate fluid in the lower airway. Rhonchi are coarse rattling sounds usually caused by fluid in the bronchi.

Blood oxygen saturation below 90% indicate that an advanced airway, such as an endotracheal tube, is needed. Blood oxygenation can be 100% during cardiopulmonary arrest but should be titrated to between 94 and 99% after ROSC or in non-acute situations.



A heart rate that is either too fast or too slow can be problematic. In children, heart rate less than 60 bpm is equivalent to cardiac arrest. Diminished central pulses, such as in the carotid, brachial, or femoral arteries, indicate shock. The same is true for capillary refill the takes longer than 2 seconds to return, cyanosis, and blood pressure that is lower than normal for the child's age. Bradycardia and tachycardia that are interfering with circulation and causing a loss of consciousness should be treated as cardiac arrest or shock, rather than as a bradycardia or tachycardia.



Normal Heart Rate by Age

Range	Rate (BPM)
0-3 months	80-205
4 months - 2 years	75-190
2-10 years	60-140
Over 10 years	50-100

Normal Blood Pressure by Age

Age	Systolic Range	Diastolic Range	Low Systolic Blood Pressure by Age
1 Day	60-76	30-45	<60
4 Days	67-84	35-53	<60
1 month	73-94	36-56	<70
1-3 months	78-103	44-65	<70
4-6 months	82-105	46-68	<70
7-12 months	67-104	20-60	<72
2-6 years	70-106	25-65	<70 + (2 X age)
7-14 years	79-115	38-78	<70 + (2 X age)
15-18 years	93-131	45-85	<90

Rapidly assess disability using the AVPU paradigm: Alert, Verbal, Pain, Unresponsive.

		AVPU paradigm
A	Alert	Appropriate, normal activity for the child's age and usual status
V	Verbal	Responds only to voice
P	Pain	Responds only to pain
U	Unresponsive	Does not respond to stimuli, even pain

A more thorough assessment would be the Pediatric Glasgow Coma Scale.

Pediatric Glasgow Coma Scale			
Response	**Score**	**Verbal Child**	**Pre-verbal Child**
Eye Opening	4	Spontaneously	Spontaneously
	3	To verbal command	To speech
	2	To pain	To pain
	1	None	None
Verbal Response	5	Oriented and talking	Cooing and babbling
	4	Confused but talking	Crying and irritable
	3	Inappropriate words	Crying with pain only
	2	Sounds only	Moaning with pain only
	1	None	None
Motor Response	6	Obeys commands	Spontaneous movement
	5	Localizes with pain	Withdraws when touched
	4	Flexion and withdrawal	Withdraws with pain
	3	Abnormal flexion	Abnormal flexion
	2	Abnormal extension	Abnormal extension
	1	None	None
Mild: 13-15 Moderate: 9-12 Severe: 3-8			

Exposure is included in the primary assessment to remind the provider to look for causes of injury or illness that may not be readily apparent. To do this, the child's clothes need to be removed in a ordered and systematic fashion. During the removal, the provider should look for signs of discomfort or distress that may point to an injury in that region.

The provider should look for and treat, at a minimum, hypothermia, hemorrhage, local and/or systemic infection, fractures, petechiae, bruising or hematoma.

When a child is experiencing an acutely life-threatening event, such as cardiopulmonary failure, it is appropriate to treat the child with CPR and the appropriate arrest algorithm.

When a child has a condition that may soon become life-threatening or if something does "not feel right", continue using the Primary Assessment sequence of Evaluate-Identify-Intervene. If at any time the child's condition worsens, treat the child with CPR and the appropriate arrest algorithm.

When a child is ill but does not likely have a life-threatening condition, you may proceed to the Secondary Assessment. The Secondary Assessment includes a focus history and focused physical examination looking for things that might cause respiratory or cardiovascular compromise.

Use SAMPLE in Secondary Assessment		
S	Signs/Symptoms	Fever Decreased intake Vomiting/Diarrhea Bleeding Shortness of breath Altered mental status Fussiness/Agitation
A	Allergies	Medication allergy Environmental allergy Food allergy
M	Medications	Prescribed Over-the-counter New meds? Last dose?
P	Past History	Birth history Chronic health issues Immunization status Surgical history
L	Last Meal	Breast/bottle/solid? When? What? How much? New foods?
E	Events/Exposures	History of present illness Onset/time course

The focused physical examination may be quite similar to the Exposure phase of the Primary Assessment, but will be guided by the data that the provider collects during the focused history. The focused history will also help determine which diagnostic tests should be ordered.

Key Diagnostic Tests Used in PALS		
Test/Study	**Identifies**	**Possible Intervention**
Arterial Blood Gas (ABG)	Hypoxemia	Increase Oxygenation
	Hypercarbia	Increase Ventilation
	Acidosis	Increase Ventilation
	Alkalosis	Reduce Ventilation
Arterial Lactate	Metabolic acidosis, Tissue hypoxia	Shock Algorithm
Central Venous Oxygen Saturation	Poor O2 delivery (SVO2 <70%)	Shock Algorithm
Central Venous Pressure	Heart contractility, others	Vasopressors, Shock Algorithm
Chest X-ray	Respiratory conditions	Specific to cause, Respiratory Algorithm
Echocardiogram	Heart anatomy and function	Specific to cause
Electrocardiogram	Rhythm Disturbances	Specific to cause
Peak Expiratory Flow Rate	Respiratory conditions	Specific to cause, Respiratory Algorithm
Venous Blood Gas (VBG)	Acidosis	Increase Ventilation
	Alkalosis	Reduce Ventilation

Respiratory Distress/Failure

Cardiac arrest in children can occur secondary to respiratory failure, hypotensive shock, or sudden ventricular arrhythmia. In most pediatric cases, however, respiratory failure, shock, and even ventricular arrhythmia are preceded by a milder form of cardiovascular compromise. For example, respiratory failure is usually preceded by some sort of respiratory distress. In fact, respiratory distress is the most common cause of respiratory failure and cardiac arrest in children. As you may expect, outcomes are better if one can intervene during respiratory distress rather than respiratory failure.

Signs and Symptoms of Worsening Respiratory Distress,				
Sign/Sx	**Mild**	**Moderate**	**Severe**	**Verge of Arrest**
Accessory Muscles Use	No	Yes	Marked	Seesawing
Activity	Walking, talking	Talking, will sit	No activity, infant will not feed	Drowsy
Alert	Slightly agitated	Agitated	Markedly agitated	Lethargic
O_2 Sat.	>95%	91 to 95%	<90%	<90%
$PaCO_2$	<45 mmHg	<45 mmHg	<45 mmHg	<45 mmHg
PaO_2	Normal	>60 mmHg	<60 mmHg ± Cyanosis	<60 mmHg + Cyanosis
Pulse	Normal	100-200 BPM	>200 BPM	<100 BPM
Respiratory Rate	Increased	Increased	Markedly Increased	Increased or Decreased
Speaking?	Sentences	Phrases	Words	Not talking
Wheeze	Audible	Loud	Very Loud	None

Respiratory distress/failure is divided into four main etiologies for the purposes of PALS: upper airway, lower airway, lung tissue disease, and disordered control of breathing.

Respiratory Distress Identification and Management	
Type of Respiratory Problem	**Possible Causes**
Upper Airway	Anaphylaxis Croup Foreign body aspiration
Lower Airway	Asthma Bronchiolitis
Lung Tissue Disorder	Pneumonia Pulmonary edema
Disordered Control of Breathing	Increased intracranial pressure Neuromuscular disease Toxic poisoning

Respiratory Distress, Key Signs and Symptoms				
	Upper Airway Obstruction	**Lower Airway Obstruction**	**Lung Disease**	**Disordered Control of Breathing**
Air Movement	Decreased			Unchanged or decreased
Airway	May or may not be fully patent in respiratory distress. Not patent in respiratory failure.			
Breath Sounds	Cough, hoarseness, stridor	Wheezing	Diminished breath sounds, grunting, crackles	Unchanged
Heart Rate	Increased in respiratory distress Decompensates rapidly to bradycardia as respiratory failure ensues			
Skin Color and Temperature	Pale, cool, and clammy in respiratory distress Decompensates rapidly to cyanosis as respiratory failure ensues			Varies
Level of Consciousness	Agitation in respiratory distress Decompensates rapidly to decreased mentation, lethargy, and LOC as respiratory failure ensues			
Respiratory Rate and Effort	Increased in respiratory distress Decompensates rapidly in respiratory failure			Varies

Respiratory Distress Management

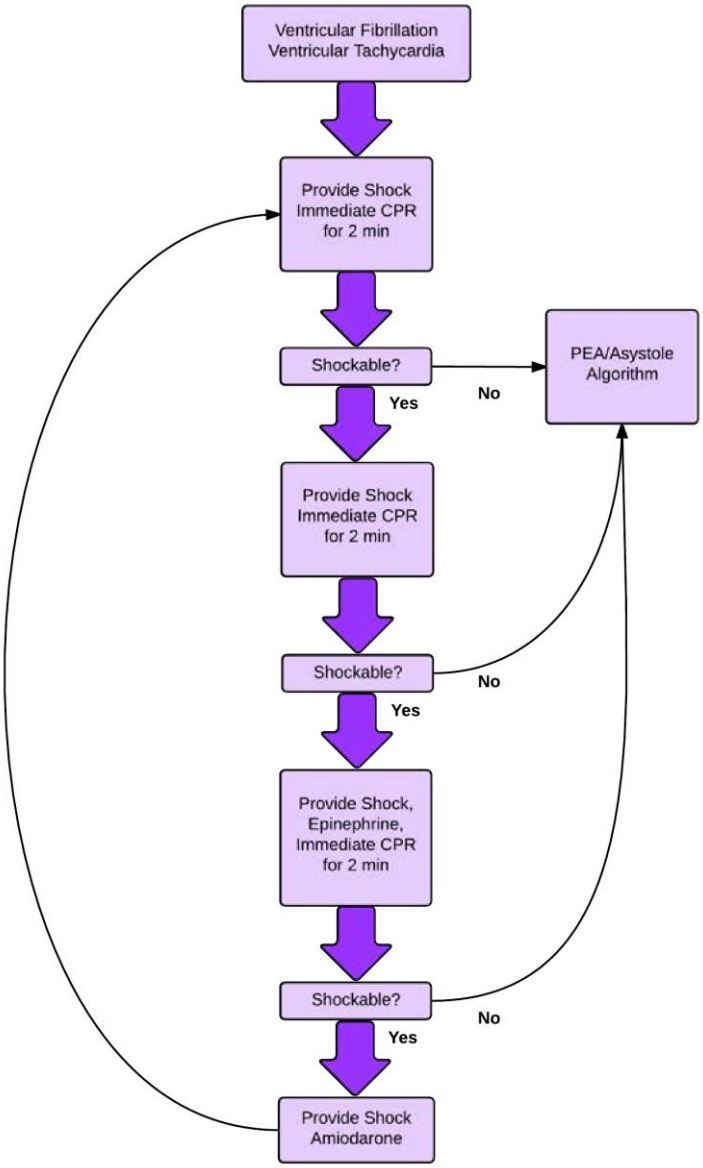
Respiratory Distress Management by Type and Cause		
Type	**Possible Causes**	**Treatment**
Upper Airway Obstruction	Anaphylaxis	Epinephrine Albuterol nebulizer Watch for and treat airway compromise, advanced airway as needed Watch for and treat shock
	Croup	Humidified oxygen Dexamethasone Nebulized epinephrine for moderate to severe croup Keep O2 sat >90%, advanced airway as needed
	Foreign body aspiration	**Do not perform a blind finger sweep**, remove foreign object if visible Infant <1 year old: Back slaps/chest thrusts Child >1 year old: Abdominal thrusts
Lower Airway Obstruction	Asthma	Nebulized epinephrine or albuterol Keep O2 sat >90%, advanced airway or non-invasive positive pressure ventilation as needed Corticosteroids PO or IV as needed Nebulized ipratropium Magnesium sulfate slow IV (moderate to severe asthma) Terbutaline SQ or IV (impending respiratory failure)
	Bronchiolitis	Oral and nasal suctioning Keep O2 sat >90%, advanced airway as needed Nebulized epinephrine or albuterol
Lung Disease	Pneumonia	Empiric antibiotics and narrow antibiotic spectrum based on culture results Nebulized albuterol for wheezing Reduce the work of breathing and metabolic demand Keep O2 sat >90%, advanced airway as needed Continuous positive airway pressure (CPAP)
	Pulmonary edema	Reduce the work of breathing and metabolic demand Keep O2 sat >90%, advanced airway as needed Diuretics if cardiogenic CPAP
Disordered Control of Breathing	Increased intracranial pressure	Pediatric neurological/neurosurgery consult Hyperventilation as directed Use medications (e.g., mannitol) as directed
	Neuromuscular disease	Identify and treat underlying disease CPAP or ETT and mechanical ventilation as needed
	Toxic poisoning	Identify toxin/poison Call Poison Control: 1.800.222.1222 Administer antidote/anti-venom when possible Maintain patent airway, advanced airway as needed Provide suctioning

Cardiac Arrest

Cardiac arrest occurs when the heart does not supply blood to the tissues. Strictly speaking, cardiac arrest occurs because of an electrical problem (i.e., arrhythmia). Shock (i.e., too little blood pressure/volume) and respiratory failure may lead to cardiopulmonary failure and hypoxic arrest.

Ventricular Fibrill

➢➢Ventricular fibrillation and pulseless ventricular tachycardia are shockable rhythms.



➢➢The first shock energy is 2 J/kg.

➢➢The second shock energy (and all subsequent shocks) is 4 J/kg.

➢➢All subsequent shocks are 4 J/kg or greater.

➢➢The maximum energy is 10 J/kg or the adult dose (200 J for biphasic, 360 J for monophasic).

➢➢Epinephrine (0.01 mg/kg IV/IO) is given every 3 to 5 minutes (two 2 minute cycles of CPR).

➢➢Amiodarone (IV/IO)

- 5 mg/kg bolus
- Can be given three times total

➢➢ Lidocaine may be used instead of Amiodarone

If the arrest rhythm is no longer shockable, move to PEA/Asystole algorithm.

➢➢If the patient regains consciousness, move to ROSC algorithm.

PEA and Asystole

➢➢As long as the patient is in PEA or asystole, the rhythm is not shockable.

➢➢Chest compressions/high-quality CPR should be interrupted as little as possible during resuscitation.

➢➢After 2 min. of high-quality CPR, give

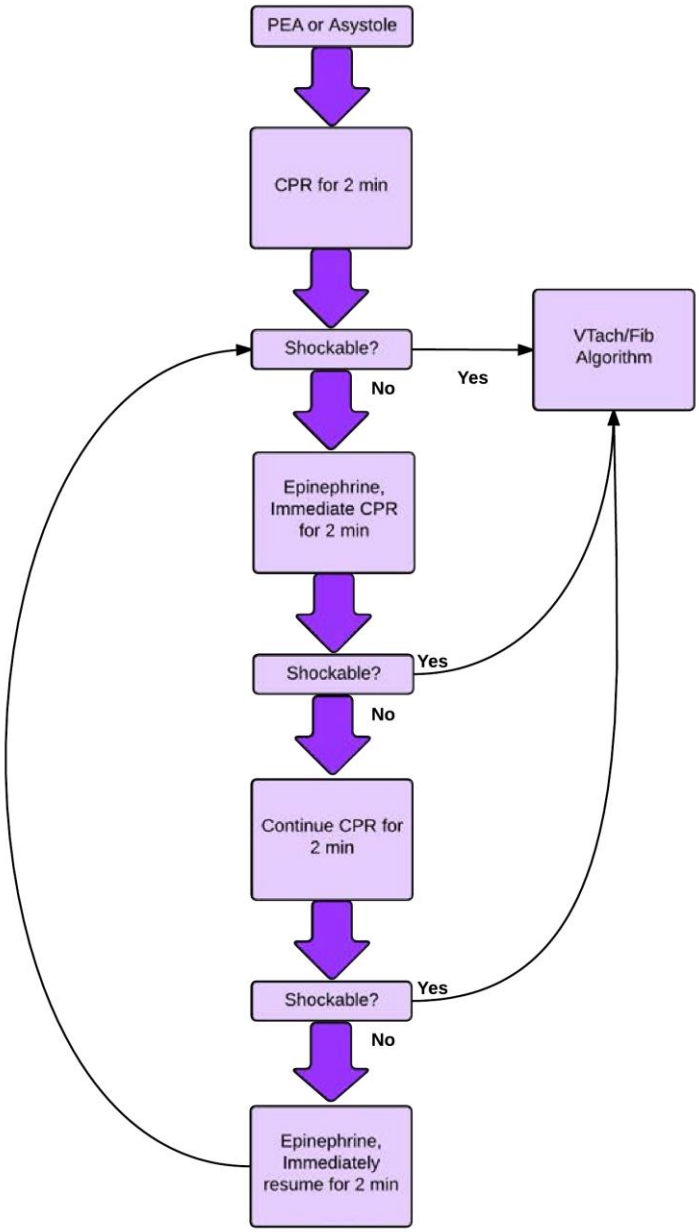
0.01 mg/kg epinephrine IV/IO every 3 to 5 minutes (two 2 minute cycles of CPR).

➢➢Remember, chest compressions are a means of artificial circulation, which should deliver the epinephrine to the heart. Without chest compressions, epinephrine is not likely to be effective.

➢➢ Chest compressions should be continued while epinephrine is administered.

➢➢Rhythm checks every 2 min.

➢➢Look for and treat reversible causes (Hs and Ts).



➢➢If the arrest rhythm becomes shockable, move to VFib/Pulseless VTach algorithm.

➢➢If the patient regains circulation, move to ROSC algorithm.

Rapid Differential Diagnosis of Cardiac Arrest

Many different disease processes and traumatic events can cause cardiac arrest, but in an emergency, it is important to be able to rapidly consider and eliminate or treat the most typical causes of cardiac arrest. To facilitate remembering the main, reversible causes of cardiac arrest, they can be organized as the Hs and the Ts.

The Hs	Symptoms/Signs/Tests	Intervention
Hypovolemia	Rapid heart rate, narrow QRS complex,	Fluid resuscitation
Hypoxia	Decreased heart rate	Airway management, oxygen
Hydrogen Ion (Acidosis)	Low amplitude QRS complex	Hyperventilation, sodium bicarb
Hypoglycemia	Fingerstick glucose testing	IV Dextrose
Hypokalemia	Flat T waves, pathological U wave	IV Magnesium
Hyperkalemia	Peaked T waves, wide QRS complex	Calcium chloride, sodium bicarb, insulin/glucose, hemodialysis
Hypothermia	History of cold exposure	Rewarming blankets/fluids

The Ts	Symptoms/Signs/Tests	Intervention
Tension Pneumothorax	Slow heart rate, narrow QRS complex, acute dyspnea, history of chest trauma	Thoracotomy, needle decompression
Tamponade (Cardiac)	Rapid heart rate and narrow QRS complex	Pericardiocentesis
Toxins	Variable, prolonged QT interval, neuro deficits	Antidote/antivenom (toxin-specific)
Thrombosis (pulmonary)	Rapid heart rate, narrow QRS complex	Fibrinolytics, embolectomy
Thrombosis (coronary)	ST segment elevation/depression, abnormal T waves	Fibrinolytics, Percutaneous intervention

Shock

The goals of shock management include:

- ➢➢Improving blood oxygenation
- ➢➢Easing oxygen demand
- ➢➢Improving volume and fluid distribution
- ➢➢Normalizing electrolyte and metabolic disturbances

Shock Identification and Management	
Treatment Goal	**Key Intervention (s)**
Improving blood oxygenation	Supplemental O2 via face mask/non-rebreather Mechanical ventilation through advanced airway Packed red blood cells
Easing oxygen demand	Reduce fever Treat pain Treat anxiety
Normalizing electrolyte and metabolic disturbances	Treat imbalances promptly IV electrolytes for deficiencies Ventilatory settings for acidosis/alkalosis Glucose for hypoglycemia
Improving volume and fluid distribution	Treatment depends on type of shock

Types of Shock, Signs and Symptoms				
	Hypovolemic	**Distributive**	**Cardiogenic**	**Obstructive**
Mechanism	Too little volume	Volume distributed to tissues	Heart problem	Cardiac outflow impediment
Potential Causes	Vomiting/Diarrhea Hemorrhage DKA Burns Poor Fluid Intake	Sepsis Head/Spine Injury Anaphylaxis	Congenital Heart Dz Poisoning Myocarditis Cardiomyopathy Arrhythmia	Cardiac Tamponade Tension Pneumo Congenital Heart Dz Pulmonary Embolus
Preload	Decreased	Normal or Decreased	Varies	Varies
Contractility	Normal/Increased	Normal or Decreased	Decreased	Normal
Afterload	Increased	Varies	Increased	Increased
Respiratory Rate and Effort	Increased rate No increased effort	Increased rate +/- Increased effort	Markedly increased effort	Markedly increased effort
Breath Sounds	Normal	+/- Rales	Rales and grunting	
Systolic BP	May be normal (compensated), but soon compromised without intervention			
Pulse Pressure	Narrow	Varies	Narrow	Narrow;
Heart Rate	Increased	Increased	Increased	Increased Distant heart sounds
Peripheral Pulses	Weak	Bounding or Weak	Weak or absent Jugular vein distention	Weak
Capillary Refill	Delayed	Varies	Delayed	Delayed
Urine Output	Decreased			
Consciousness	Irritable and anxious, early. Altered mental status, later.			

Fluid resuscitation in PALS depends on the weight of the child and the severity of the situation. While dehydration and shock are separate entities, the symptoms of dehydration can help the provider to assess the level of fluid deficit and to track the effects of fluid resuscitation. In the current guidelines, the clinician must fully evaluate the child with febrile illness since aggressive fluid resuscitation with isotonic crystalloid solution may not be indicated.

Signs and Symptoms of Dehydration			
Category	**Deficit ml/kg (% body wt.)**		**Signs/Sx**
	Infants	**Adolescents**	
Mild	50 (5%)	30 (3%)	Slightly dry buccal mucosa, increased thirst, slightly decreased urine output
Moderate	100 (10%)	50–60 (5–6%)	Dry buccal mucosa, tachycardia, little or no urine output, lethargy, sunken eyes and fontanelles, loss of skin turgor
Severe	150 (15%)	70–90 (7–9%)	Same as moderate plus a rapid, thready pulse; no tears; cyanosis; rapid breathing; delayed capillary refill; hypotension; mottled skin; coma

Interventions by Shock Type		
Broad Type	**Specific Type**	**Management**
Hypovolemic	Hemorrhagic	Fluid resuscitation, packed red blood cells
	Non-hemorrhagic	Fluid resuscitation
Distributive	Septic	*Septic Shock Algorithm*
	Anaphylactic	Epinephrine IM, fluid resuscitation
	Neurogenic	Fluid resuscitation, pressors
Cardiogenic	Bradyarrhythmia	*Bradycardia Algorithm*
	Tachyarrhythmia	*Tachycardia Algorithm*
	Heart Disease	Fluid resuscitation, pressors, expert consult
Obstructive	Ductus Arteriosis	PGE1 (alprostadil), expert consult
	Tension Pneumo	Needle decompression, tube thoracostomy
	Tamponade	Pericardiocentesis
	Pulmonary Embolism	Fluid resuscitation, fibrinolytics, expert consult

Fluid Resuscitation			
Broad Type	**Specific Type**	**Volume**	**Rate**
Hypovolemic	Hemorrhagic	3 ml of crystalloid for each ml blood lost	Over 5-10 min
	Non-hemorrhagic	20 ml/kg bolus, repeat as needed	Over 5-10 min
	Diabetic Ketoacidosis	10-20 ml/kg bolus, repeat as needed	Over 60 min
Distributive	All types	20 ml/kg bolus, repeat as needed	Over 5-10 min
Cardiogenic	All types	5-10 ml/kg bolus, repeat as needed	Over 10-20 min
Obstructive	Tamponade	20 ml/kg bolus	Over 5-10 min
	Pulmonary Embolism	20 ml/kg bolus, repeat as needed	Over 5-10 min

Return of Spontaneous Consciousness (ROSC) and Post Arrest Care

➢➢In a successful resuscitation, there will be a spontaneous return of circulation.

➢➢You can detect spontaneous circulation by feeling a palpable pulse at the carotid or femoral artery in children and the brachial artery in infants up to 1 year.

➢➢Even after Return of Spontaneous Circulation (ROSC), the patient still needs close attention and support. The patient is at risk for reentering cardiac arrest at any time. Therefore, the patient should be moved to an intensive care unit.

➢➢Titrate the patient's blood oxygen to between 94% and 99%. Wean down supplemental oxygen for blood oxygenation of 100%.

➢➢Does the person need an advanced airway? If so, it should be placed. Also, apply quantitative waveform capnography, if available.

➢➢Is the patient in shock? If not, monitor and move to supportive measures. If shock is present, determine if it is hypotensive or normotensive.

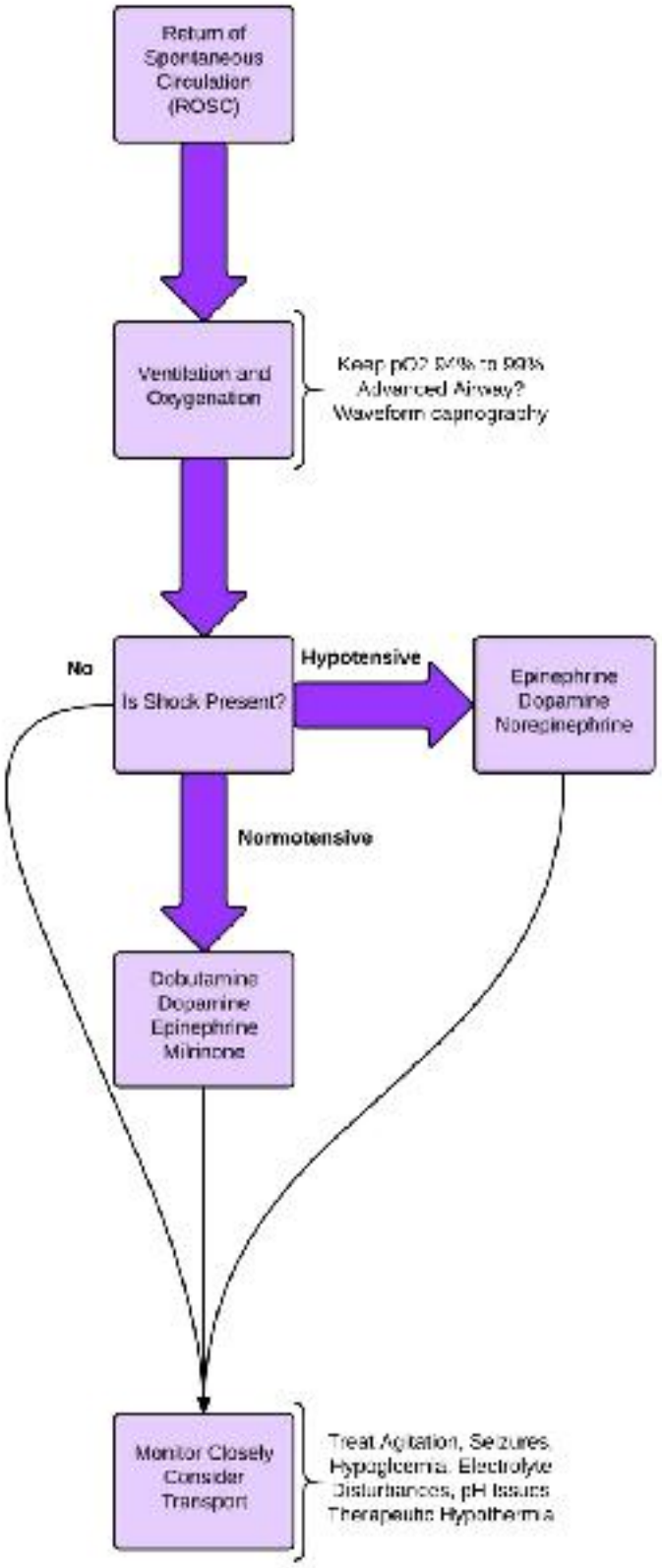
➢➢Identify and treat causes (Hs and Ts). Fluid resuscitation according to cause of shock. Consider vasopressors.

➢➢Hypotensive Shock

- Epinephrine IV 0.1-1.0 mcg/kg/min
- Dopamine IV 2-20 mcg/kg/min
- Norepinephrine IV 0.1-2 mcg/kg/min

➢➢Normotensive Shock

- Dobutamine 2-20 mcg/kg/min
- Dopamine IV 2-20 mcg/kg/min
- Epinephrine IV 0.1-1.0 mcg/kg/min
- 50 mcg/kg IV over 10-60 minutes as loading dose, then 0.25-0.75 mcg/kg/minute IV infusion as maintenance dose



The child is still in a delicate condition. All major organ systems should be assessed and supported. Maintenance fluids should be given. If the child has been resuscitated in the community or at a hospital without pediatric intensive care facilities, arrange to have the child moved to an appropriate pediatric hospital.

Fluid Maintenance	
Body Weight (kg)	**Hourly Maintainence Fluid Rate**
<10 kg	4 mL/kg/hour
10-----20 kg	40mL/hour + 2 mL/kg/hour for each kg >10
>20 kg	60mL/hour + 1 mL/kg/hour for each kg >20

Postresuscitation Management Priorities		
System	**Priority**	**Intervention**
Respiratory	Maintain oxygenation	Titrate oxygen to maintain O2 sat: 94%-99%
	Maintain ventilation	Intubate and use ventilator if needed
	Monitor vital signs	Pulse oximetry, pO2, resp. rate, end tidal CO2
	Testing	CXR, ABGs
	Control pain/anxiety	Fentanyl or morphine as needed
Cardiovascular	Testing	Heart rate, blood pressure, CVP and cardiac output, blood gases, hemoglobin/hematocrit, blood glucose, electrolytes, BUN, calcium, creatinine, ECG
	Maintain fluid volume	Use the Shock Algorithm or maintenance fluids
	Treat arrhythmias	Use drugs or electrical therapy (Bradycardia or Tachycardia Algorithms)
Neurologic	Testing	Avoid fever, do not re-----warm a hypothermic patient unless the hypothermia is deleterious, consider therapeutic hypothermia if child remains comatose after resuscitation, neurologic exam, pupillary light reaction, blood glucose, electrolytes, calcium, lumbar puncture if child is stable to rule out CNS infection
	Intracranial Pressure	Support oxygenation, ventilation and cardiac output Elevate head of bed unless blood pressure is low Consider IV mannitol for increased ICP
	Seizure Precautions and Treatment	Treat seizures per protocol, consider metabolic/toxic causes and treat
Renal	Monitor urine output	Insert urinary catheter Urine output, infants and children: > 1 ml/kg/h Urine output, adolescents: > 30 ml/h,
	Testing	Urine glucose, lactate, BUN, creatinine, electrolytes, urinalysis, fluids as tolerated, correct acidosis/alkalosis with ventilation (not sodium bicarb)
Gastrointestinal	Nasogastric tube	Maintain NG tube to low suction, watch for bleeding
	Testing	Liver function tests, amylase, lipase, abdominal ultrasound and/or CT
Hematologic	Testing	Hemoglobin/Hematocrit/Platelets, PT, PTT, INR, fibrinogen and fibrin split products, type and screen
	Consider blood therapy	If fluid resuscitation inadequate: Tranfuse packed red blood cells Active bleeding/low platelets: Tranfuse platelets Active bleeding/abnormal coags: Tranfuse fresh frozen plasma

➢➢Prepare for Transport

- Identify nearest tertiary pediatric facility with resources to care for condition
- Follow hospital transport protocol
- Provide medications/fluids/blood products for use during transport

➢➢Coordinate with Tertiary Pediatric Facility

- Contact the specific receiving provider
- Resuscitation Team Leader should "present" the patient to receiving provider

➢➢Determine Mode of Transportation

- Ground ambulance
  - Inexpensive and available in most weather conditions
  - Takes longer
- Helicopter
  - Faster than ground ambulance
  - More expensive than ground ambulance
  - Weather limited
- Fixed wing aircraft
  - Best long distances/unstable child.
  - Expensive
  - Also requires ground ambulance on both ends to trip

➢➢Prepare the Child and Family

- Inform the family of treatments
- Inform the family of plan
- Obtain consent for transport
- Answer questions and provide comfort to the child and family

➢➢Prepare Documentation

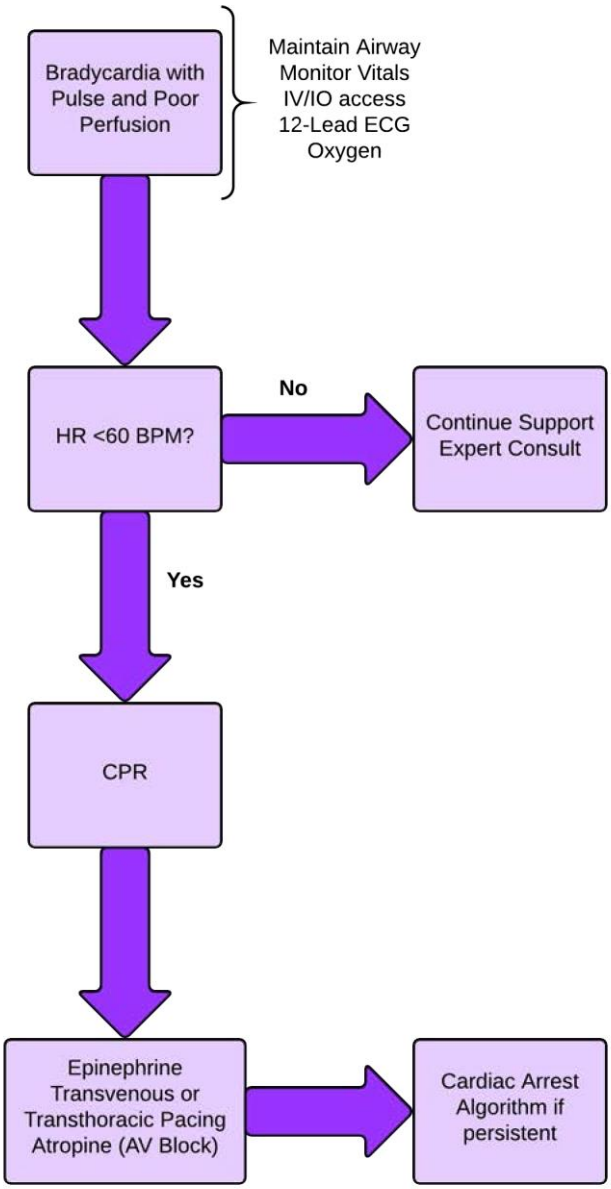
- Send copy of chart including labs and studies with the child
- Send contact information for all pending tests/studies

➢➢Use Precautions

- Universal precautions
- Isolation specific to probable pathogen
- Obtain cultures if indicated
- Give empirical antibiotics if infection suspected

Bradycardia

Bradycardia is a common cause of hypoxemia and respiratory failure in infants and children. Bradycardia is a slower than normal heart rate. Since the normal heart rate in children varies, the provider must take into account the normal values for the child's age. A heart rate less than 60 beats per minute in a child under 11 years old is worrisome for cardiac arrest (unless congenital bradycardia is present). In fact, pulseless bradycardia defines cardiac arrest.



➢➢If bradycardia interferes with tissue perfusion, maintain the child's airway and monitor vital signs. Obtain intravenous or intraosseous access. Obtain a 12 lead ECG and provide supplemental oxygen.

➢➢If the above interventions help, continue to support the patient and consult an expert regarding additional management.

➢➢If the heart rate is still less than 60 bpm despite the above interventions, begin to treat with CPR.

➢➢If the child is still experiencing bradycardia, administer epinephrine

IV/IO (0.01 mg/kg). May repeat every 3-5 minutes.

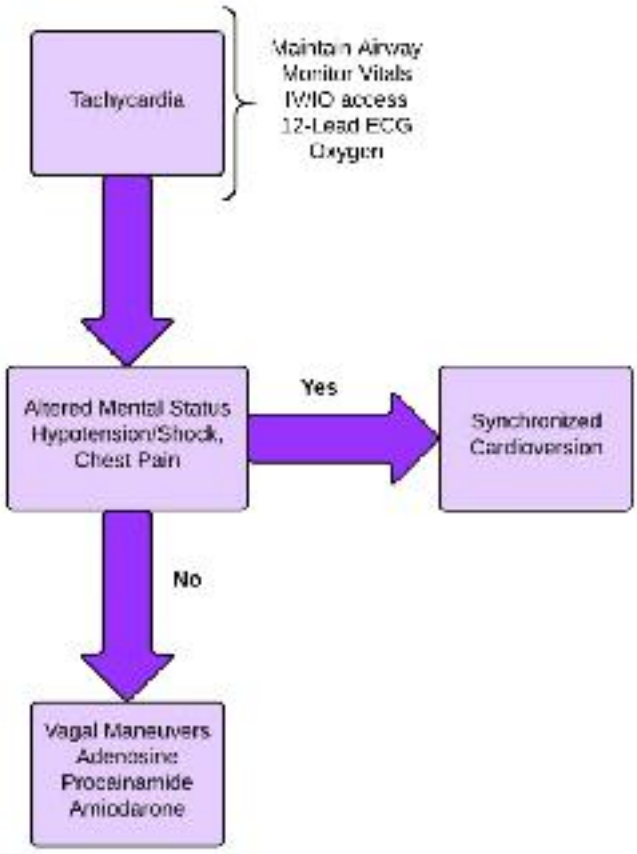
➢➢Atropine can be given at a dose of 0.02 mg/kg up to two times.

- Min Dose: 0.1 mg.
- Max Dose: 0.5 mg.

➢➢Consider transvenous or transthoracic pacing if available. You may need to move to the cardiac arrest algorithm if the bradycardia persists despite interventions.

Tachycardia

Tachycardia is a faster than normal heart rate. Since the normal heart rate in children varies, the provider must take into account the normal values for the child's age. Pulseless tachycardia is cardiac arrest.



➢➢During tachycardia, maintain the child's airway and monitor vital signs. Obtain intravenous or intraosseous access. Access. Obtain a 12 lead ECG and provide supplemental oxygen.

➢➢If the tachycardia is causing a decreased level of consciousness, hypotension or shock, or significant chest pain, move directly to synchronized cardioversion.

➢➢If the tachycardia is not causing a decreased level of consciousness, hypotension or shock, or significant chest pain, you may attempt vagal maneuvers, first.

- Cooperative children can participate in a Valsalva maneuver by blowing through a narrow straw
- Carotid sinus massage may be effective in older children. Tachycardia is a slower than normal heart rate.
- A vagal maneuvers for an infant or small child is to place ice on the face for 15 to 20 seconds
- Ocular pressure may injure the child and should be avoided

➢➢If vagal maneuvers fail, you may use

- Adenosine: 0.1 mg/kg IV push to a max of 6 mg, followed by 0.2 mg/kg IV push to a max of 12 mg
- Procainamide: 15 mg/kg over 30-60 min
- Amiodarone: 5mg/kg over 20-60 min to a max of 300 mg

It is important to determine if the tachycardia is narrow complex or wide complex. A QRS complex that is longer than 90 ms is wide QRS complex tachycardia. This should be considered possible ventricular tachycardia. If the child is not hemodynamically stable then provide cardioversion immediately.

➢➢If the wide QRS complex has a regular rhythm, then you can supply synchronized cardioversion at 100 J.

➢➢If the wide QRS complex is irregular, this is ventricular tachycardia and should be treated with unsynchronized cardioversion (i.e. shock) immediately.

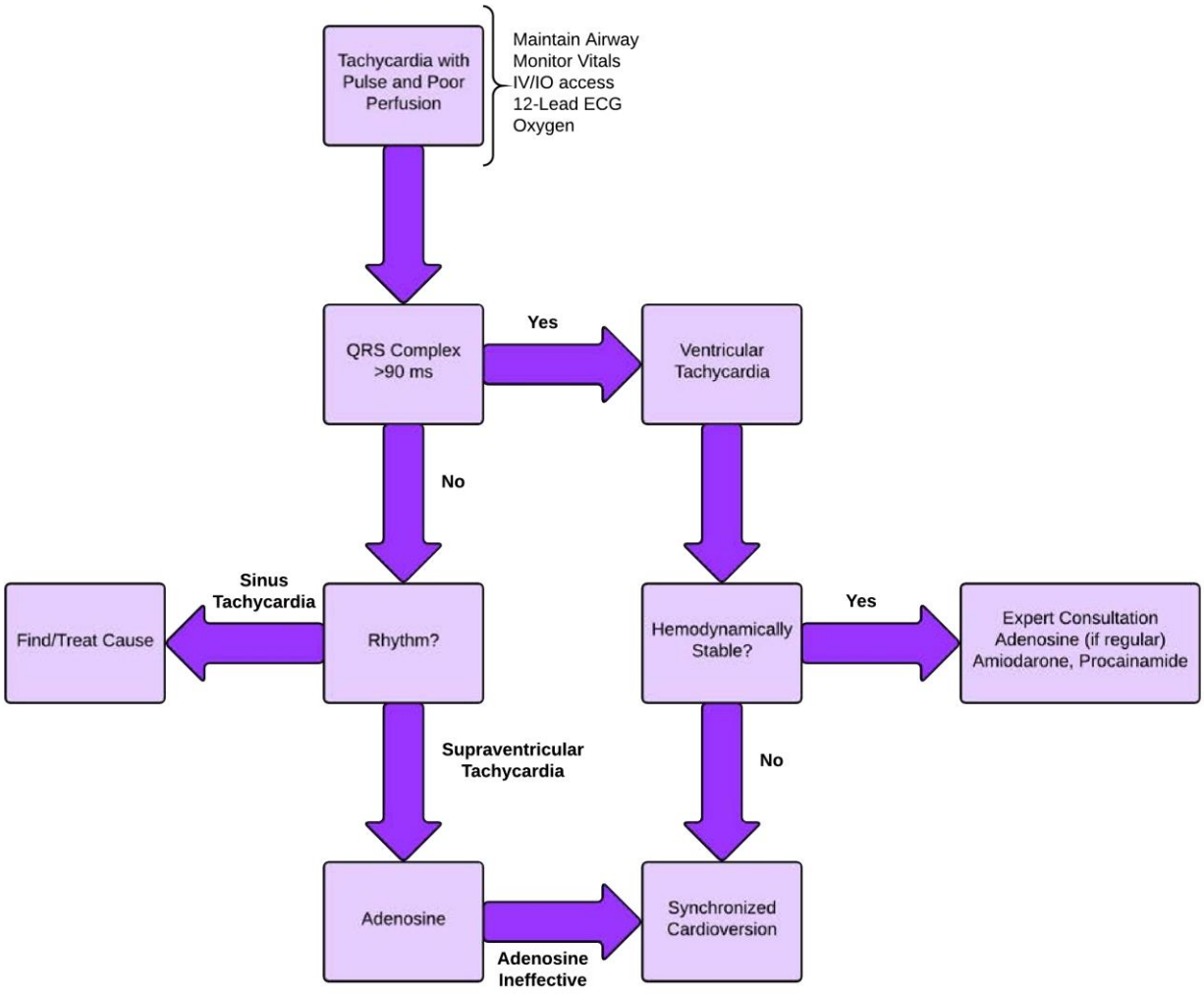
➢➢Narrow complex tachycardia may be sinus tachycardia or supraventricular tachycardia.

➢➢Sinus tachycardia has many causes; the precise cause should be identified and treated.

➢➢Supraventricular tachycardia can be treated with 0.1 mg/kg adenosine IV push to a max of 6 mg. If the first dose is unsuccessful, follow it with 0.2 mg/kg adenosine IV push to a max of 12 mg. If adenosine is unsuccessful, proceed to synchronized cardioversion.

➢➢Narrow complex supraventricular tachycardia with a regular rhythm is treated with 50-100 J of synchronized cardioversion energy.

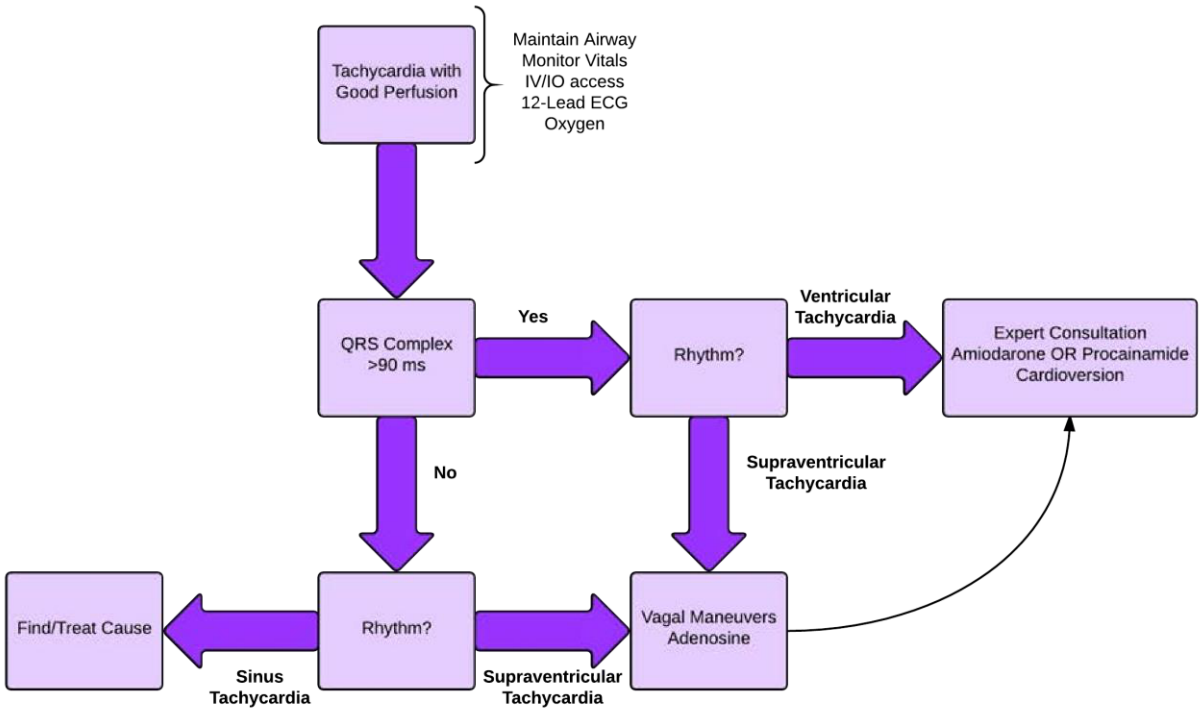
➢➢Narrow complex supraventricular tachycardia with an irregular rhythm is treated with 120-200 J of synchronized cardioversion energy.



Again, it is important to determine if the tachycardia is narrow complex or wide complex. A QRS complex that is longer than 90 ms is wide QRS complex tachycardia.

➢➢Narrow complex tachycardia may be sinus tachycardia or supraventricular tachycardia.
➢➢Wide complex tachycardia may be supraventricular tachycardia or ventricular tachycardia.
➢➢Wide QRS complex tachycardia with good perfusion can be treated with amiodarone OR procainamide (not both). Expert consultation is recommended.
➢➢Wide QRS complex is irregular, this is ventricular tachycardia and should be treated with unsynchronized cardioversion (i.e. shock) immediately.
➢➢Both wide and narrow supraventricular tachycardia with good perfusion can be treated with vagal maneuvers and adenosine by rapid bolus. If adenosine is unsuccessful, proceed to synchronized cardioversion.

➢➢Narrow complex supraventricular tachycardia with a regular rhythm is treated with 50-100 J of synchronized cardioversion energy.
➢➢Narrow complex supraventricular tachycardia with an irregular rhythm is treated with 120-200 J of synchronized cardioversion energy.



ECG Characteristics of Tachyarrhythmias		
Sinus Tachycardia	**Supraventricular tachycardia**	**Ventricular tachycardia**
Narrow QRS complex P waves normal PR interval constant R-R interval may be variable	Narrow or wide QRS complex P waves absent or abnormal R-R interval may be constant	Wide QRS complex P waves may not be present/seen QRS complexes may be uniform or variable

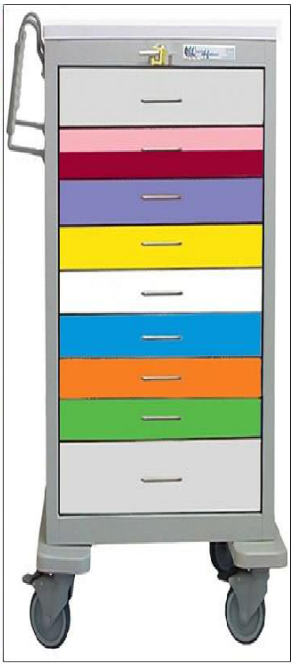
PALS Tools

Broselow

A variety of tools is available for use in PALS, each with a size adapted to the child's size. The most commonly used system for correlating tools to the size of a child is the Broselow Pediatric Emergency Tape System. The provider can quickly measure the length/height of the child using color-coded tape. The resuscitation then uses tools (and in some hospitals, medications) proportional to the child's size. The medication cart or crash cart is stocked using the color coding system.

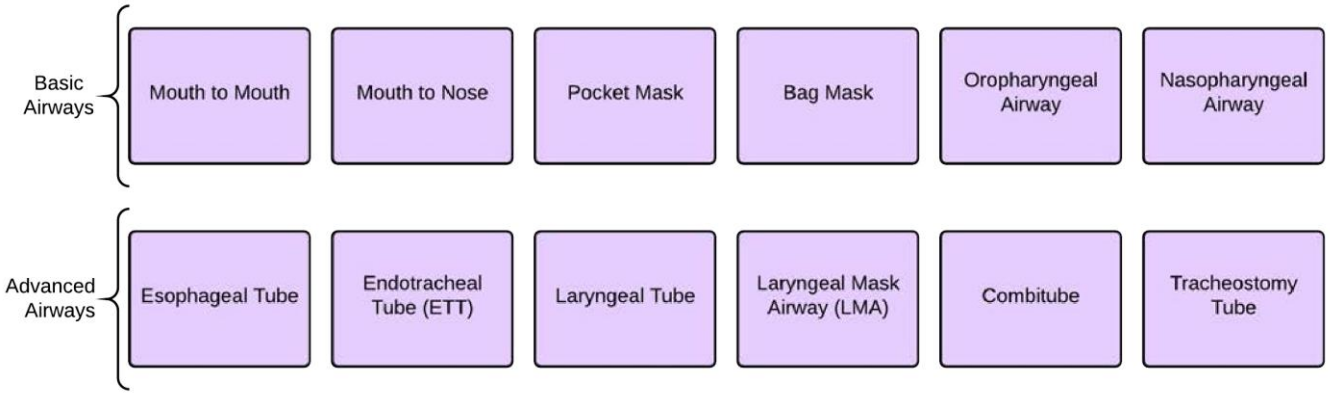
Equipment	Newborn/ Small infant (3-5 kg)	Infant (6-9 kg)	Toddler (10-11 kg)	Small Child (12-14 kg)	Child (15-18 kg)	Child (19-22 kg)	Large Child (24-30 kg)	Adult (≥32 kg)
Resuscitation bag	Infant	Child	Child	Child	Child	Child	Child/adult	Adult
O_2 mask	Newborn	Newborn	Pediatric	Pediatric	Pediatric	Pediatric	Adult	Adult
Oral airway	Infant/small child	Infant/small child	Small child	Child	Child	Child/small adult	Child/small adult	Medium adult
Laryngoscope blade (size)	0-1 straight	1 straight	1 straight	2 straight	2 straight or curved	2 straight or curved	2-3 straight or curved	3 straight or curved
Tracheal tube (mm)	Premature infant 2.5 Term infant 3.0-3.5 uncuffed	3.5 uncuffed	4.0 uncuffed	4.5 uncuffed	5.0 uncuffed	5.5 uncuffed	6.0 cuffed	6.5 cuffed
Tracheal tube length (cm at lip)	10-10.5	10-10.5	11-12	12.5-13.5	14-15	15.5-16.5	17-18	18.5-19.5
Stylet (F)	6	6	6	6	6	14	14	14
Suction catheter (F)	6-8	8	8-10	10	10	10	10	12
BP cuff	Newborn/ infant	Newborn/ infant	Infant/child	Child	Child	Child	Child/adult	Adult
IV catheter (G)	22-24	22-24	20-24	18-22	18-22	18-20	18-20	16-20
Butterfly (G)	23-25	23-25	23-25	21-23	21-23	21-23	21-22	18-21
Nasogastric tube (F)	5-8	5-8	8-10	10	10-12	12-14	14-18	18
Urinary catheter (F)	5-8	5-8	8-10	10	10-12	10-12	12	12
Defibrillation/ cardioversion external paddles	Infant paddles	Infant paddles until 1 yr or 10 kg	Adult paddles when ≥1 yr or ≥10 kg	Adult paddles	Adult paddles	Adult paddles	Adult paddles	Adult paddles
Chest tube (F)	10-12	10-12	16-20	20-24	20-24	24-32	28-32	32-40

*Adapted from the Broselow Pediatric Resuscitation Tape, with permission from Armstrong Medical Industries, Lincolnshire, Ill. Modified from Hazinski MF, ed.



PALS Airways

Basic airways do not require specialist training; however, some proficiency is needed for oropharyngeal and nasopharyngeal airway placement. Proper bag mask technique requires a tight seal between the mask and the child's face.



Intraosseus Access

➢➢Intraosseus access is an acceptable alternative to IV access in children because the bones are softer and the marrow can be accessed quickly and reliably in emergencies.

➢➢IO access also permits chest compressions to continue without interruption (arm IV placement is sometimes more difficult during chest compressions).

➢➢IO access can be obtained in the:

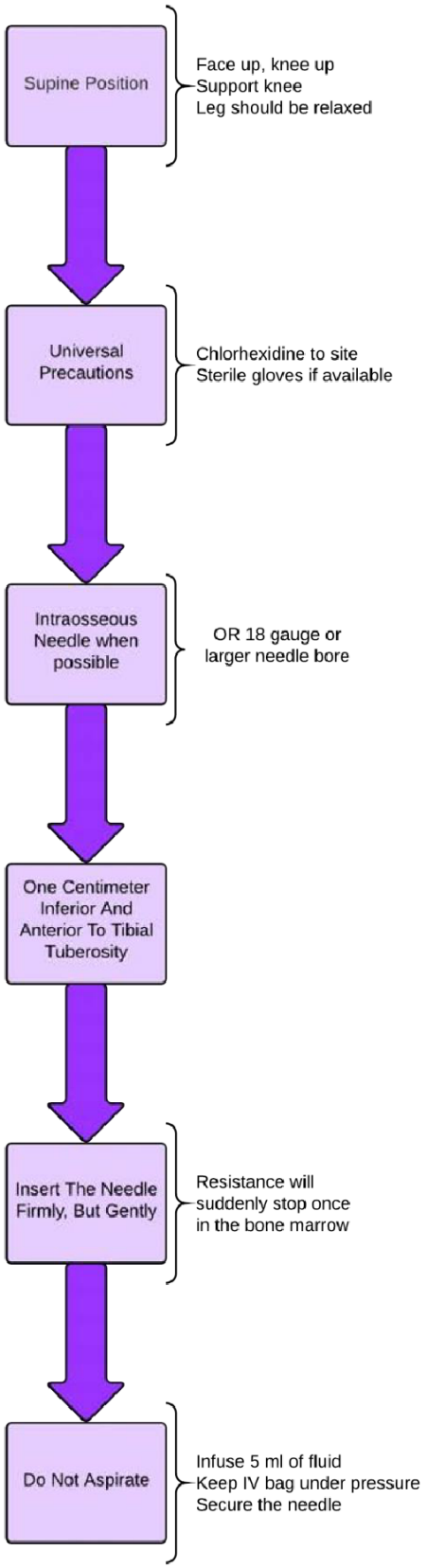
- Proximal tibia
- Distal tibia
- Distal femur
- Anterior superior iliac spine

➢➢An algorithm for obtaining IO access in the proximal tibia is shown.

➢➢Avoid IO access in fractured bones, near infection, or in the same bone after a failed access attempt.

➢➢After reaching the bone's interior, do not aspirate and immediately flush with 5 ml of fluid.

➢➢Once the resuscitation is successful, replace the IO access with large bore IV access or central line as soon as possible (<24 hours) to avoid infection.



Team Dynamics/Systems of Care

The 2015 edition of the AHA ACLS guidelines highlights the importance of effective team dynamics during resuscitation. ACLS in the hospital will be performed by several providers. These individuals must provide coordinated, organized care. Providers must organize themselves rapidly and efficiently. The AHA recommends establishing a Team Leader and several Team Members. The Team Leader is usually a physician, ideally the provider with the most experience in leading ACLS codes. Resuscitation demands mutual respect, knowledge sharing, and constructive criticism, after the code.

Team Leader Responsibilities	Team Member Responsibilities
Usually stands at the foot of the bed	Stands in a position dictated by role
Competent in all ACLS duties	Competent in specific role (at least)
Directs Team Members in a professional, calm voice	Responds with eye contact and voice affirmation
Assigns roles	Clearly states when he/she cannot perform a role
Listens for confirmation from Team Member	Informs Team Leader when task is complete
Ask for ideas from Team Members when needed	Openly share suggestions if it does not disrupt flow
Critiques Team Performance after code	Provides constructive feedback after code
Documents resuscitation in patient chart	Provides information for documentation as needed

When performing a resuscitation, the Team Leader and Team Members should assort themselves around the patient so they can be maximally effective and have sufficient room to perform the tasks of their role.

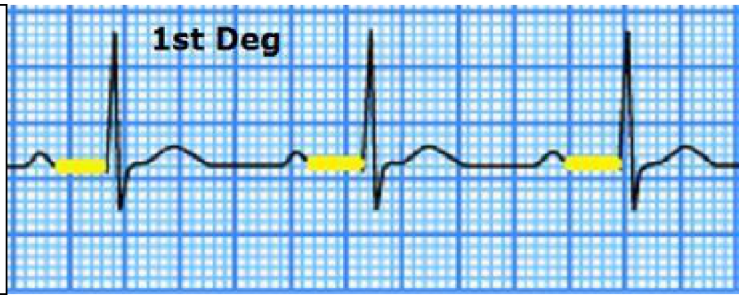
ECG Rhythms

Atrioventricular (Heart) Block

Atrioventricular block or heart block is a failure of the heart's electrical system to properly coordinate conduction. There are four main types of atrioventricular block: first degree, second degree type I, second degree type II, and third degree heart block. The types of second degree heart block are referred to as Mobitz type I and Mobitz type II. Second degree heart block Mobitz type I is also known as the Wenckebach phenomenon.Heart block is important because it can cause hemodynamic instability and can evolve into cardiac arrest.

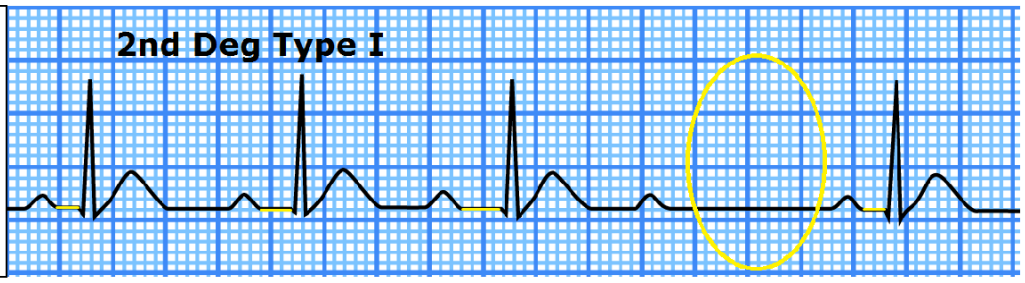
First degree atrioventricular block

The PR interval is a consistent size, but longer or larger than it should be in first degree heart block.



Second degree atrioventricular block, Mobitz type I (Wenckebach)

The PR interval increases in size until a QRS complexes dropped, resulting in missed "beat."



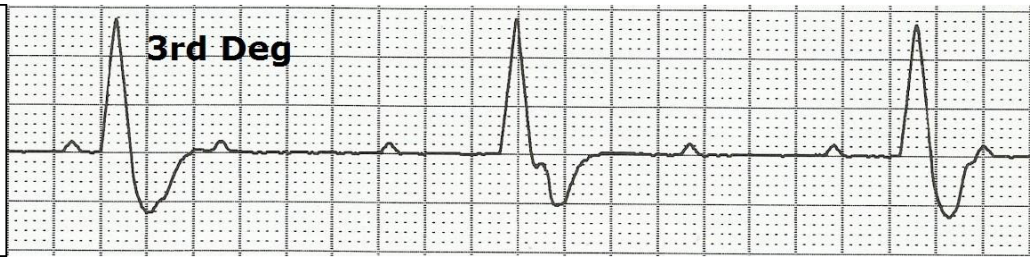
Second degree atrioventricular block, Mobitz type II

A QRS wave will occasionally drop, though the PR interval is the same size.

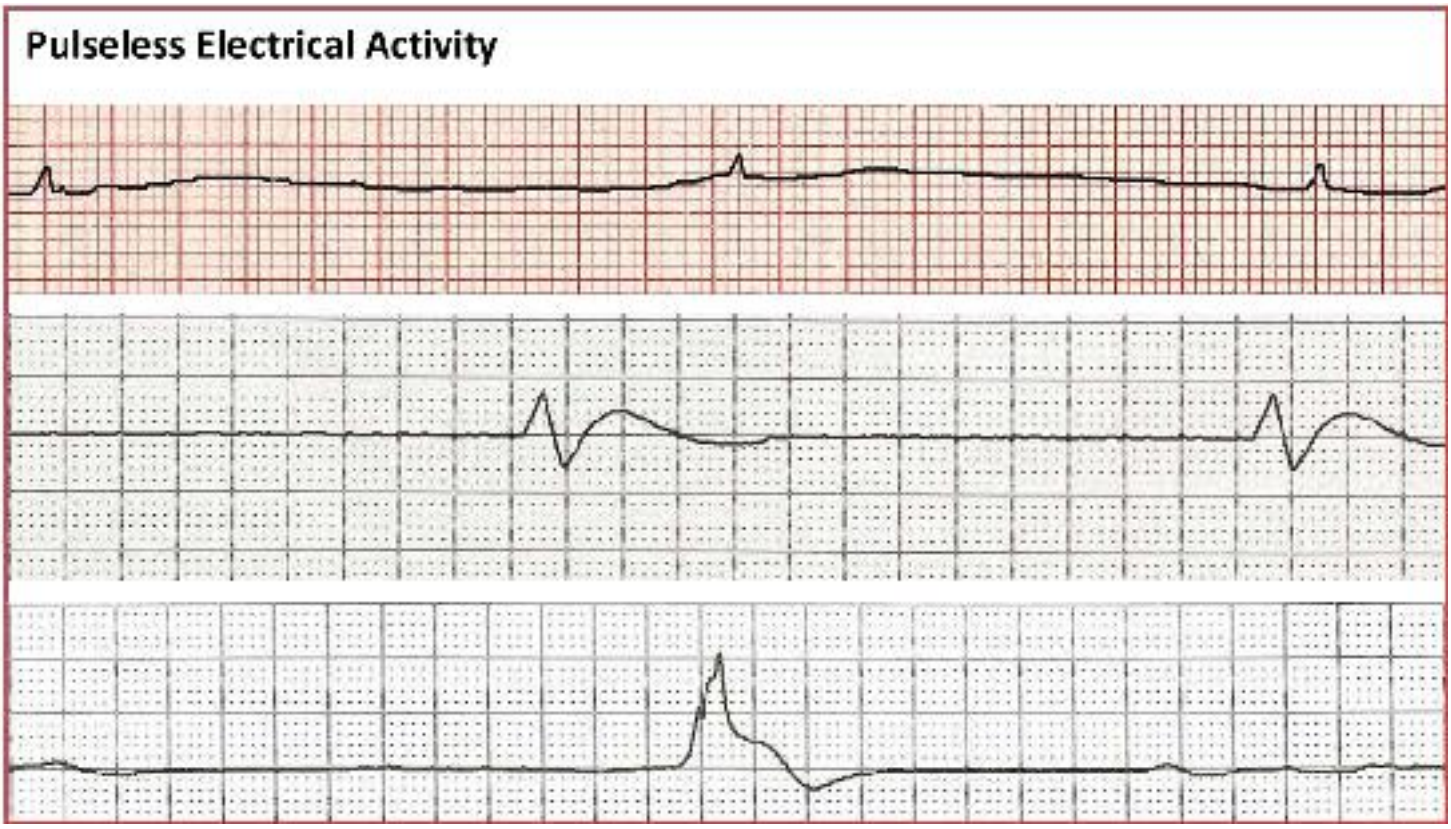
Third degree (complete) atrioventricular block

Complete dissociation between P waves and the QRS complex. No

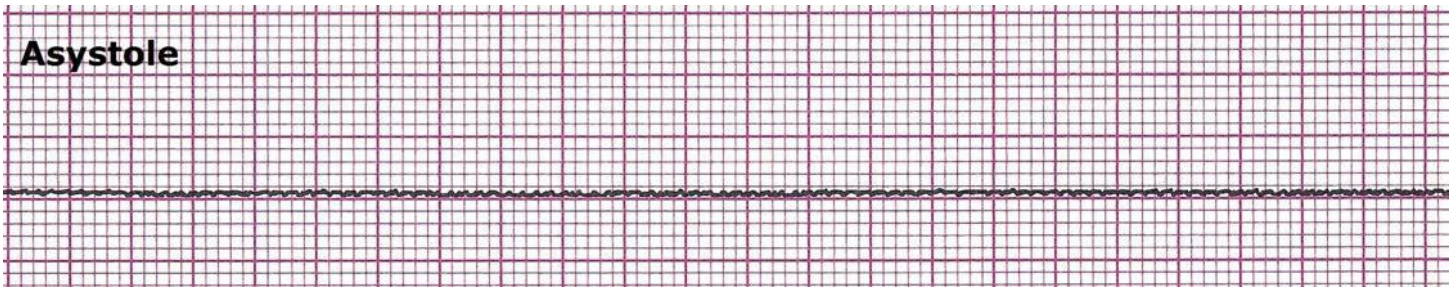
ventricle.



Pulseless electrical activity or PEA is a cardiac rhythm that does not create a palpable pulse is even though it should. A PEA rhythm can be almost any rhythm except ventricular fibrillation (incl. torsade de pointes) or pulseless ventricular tachycardia.



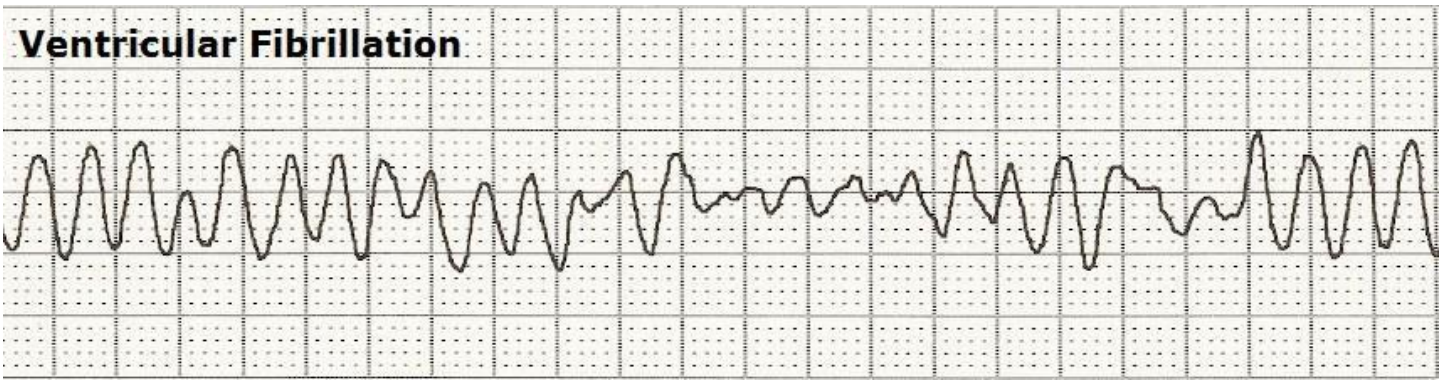
Asystole is the "flatline" on the ECG monitor. It represents a lack of electrical activity in the heart. It is critically important not to confuse true asystole with disconnected leads or an inappropriate gain setting on an in-hospital defibrillator. Asystole may also masquerade as a very fine ventricular fibrillation. If the ECG device is optimized and is functioning properly, a flatline rhythm is diagnosed as asystole. Note that asystole is also the rhythm one would expect from a person who has died. Consider halting PALS efforts in people who have had prolonged asystole.



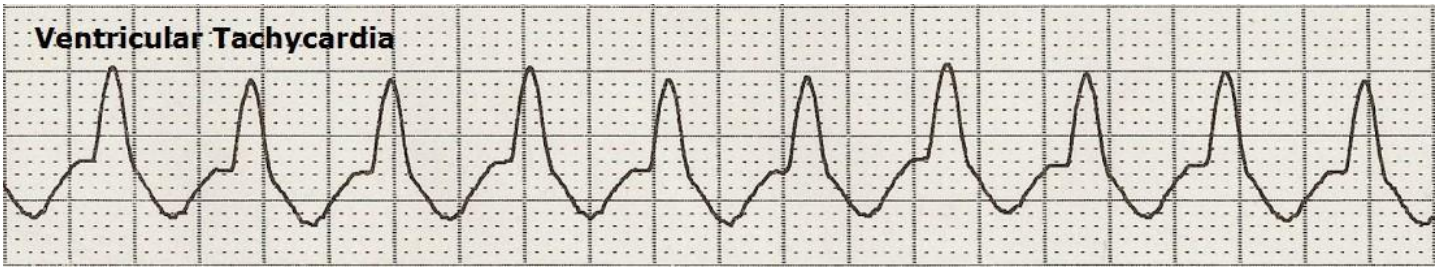
It is inappropriate to provide a shock to pulseless electrical activity or asystole. Cardiac function can only be recovered in PEA or asystole through the administration of medications.

In ventricular fibrillation or pulseless ventricular tachycardia, the heart's conduction system exhibits a disordered rhythm that can sometimes be corrected by applying energy to it. This energy may come in the form of an automated external defibrillator (AED) defibrillator paddles, or defibrillator pads. VFib and VTach are treated with unsynchronized cardioversion, since there is no way for the defibrillator to decipher the disordered waveform. In fact, it is important **not** to provide synchronized shock for these rhythms.

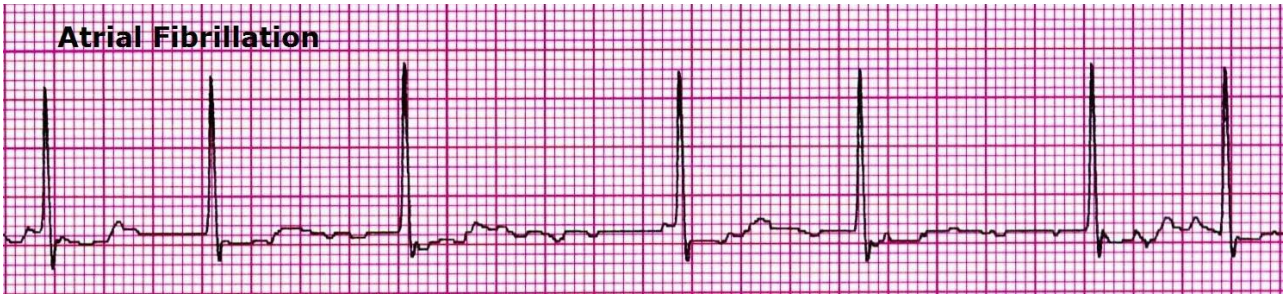
Ventricular fibrillation is recognized by a disordered waveform, appearing as rapid peaks and valleys as shown in this ECG rhythm strip:



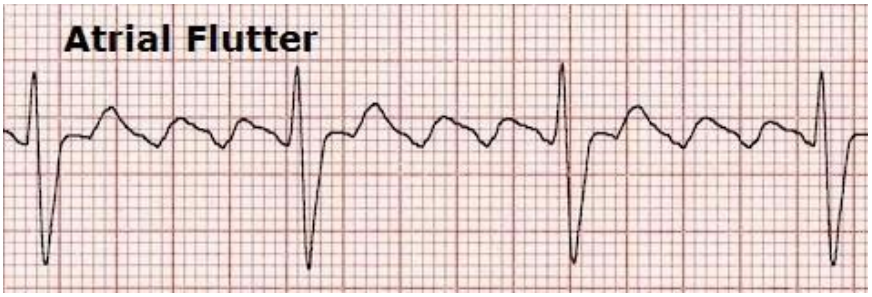
Ventricular tachycardia may provide waveform similar to any other tachycardia; however, the biggest difference in cardiac arrest is that the patient will not have a pulse and, consequently, will be unconscious and unresponsive. Two examples of ventricular tachycardia are shown in this ECG rhythm strips. The first is narrow complex tachycardia and the second is wide complex tachycardia:



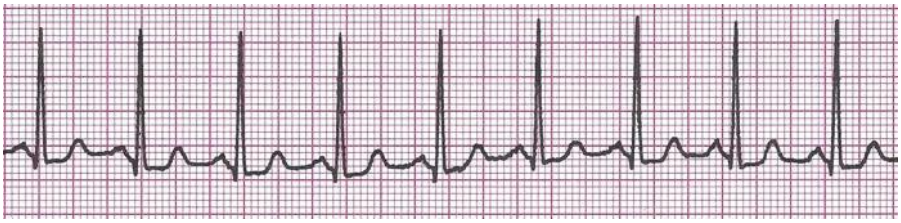
Atrial fibrillation is the most common arrhythmia. It is diagnosed by electrocardiogram, specifically the RR intervals follow no repetitive pattern. Some leads may show P waves while most leads do not. Atrial contraction rates may exceed 300 bpm. The ventricular rate often range is between 100 to 180 bpm. The pulse may be "irregularly irregular."



Atrial flutter is a cardiac arrhythmia that generates rapid, regular atrial depolarizations at a rate of about 300 bpm. This often translates to a regular ventricular rate of 150 bpm, but may be far less if there is a 3:1 or 4:1 conduction. By electrocardiogram, or atrial flutter is recognized by a sawtooth pattern sometimes called F waves. These waves are most notable in leads II, III, and aVF.



Narrow QRS complex tachycardias include several different tachyarrhythmias. A narrow QRS complex tachycardia is distinguished by a QRS complex of less than 90 ms. One of the more common narrow complex tachycardias is supraventricular tachycardia, shown below. The heart rate can exceed 220 bpm in infants and 180 bpm in children.



Wide complex tachycardias are difficult to distinguish from ventricular tachycardia. Ventricular tachycardia leading to cardiac arrest should be treated using the ventricular tachycardia algorithm. A wide complex tachycardia in a conscious child should be treated using the tachycardia algorithm. Tissue perfusion will dictate which algorithm to use.

Resuscitation and Life Support Medications

Drug	Use(s)	Dosage/Route	Contraindications/ Warnings
Adenosine	Supraventricular Tachycardia	First dose: 0.1 mg/kg IV Push Max 1st Dose: 6 mg. First dose: 0.2 mg/kg IV Push Max 1st Dose: 12 mg.	Second or third degree heart block
Albumin	Shock, trauma, burns	0.5 to 1 g/kg IV Push	Blood product
Albuterol	Asthma, bronchospasm, hyperkalemia	Weight <20kg: 2.5 mg Weight >20kg: 5 mg	Caution in tachyarrhythmias
Alprostadil	Maintain ductus arteriosis	First Dose: 0.05 to 0.1 mcg/kg/min Maintenance: 0.01 to 0.05 mcg/kg/min	Tissue sloughing in extravasation
Amiodarone	Supraventricular Tachycardia, Ventricular Tachycardia with Pulse	5 mg/kg over 20-60 min Max:300 mg max	Second or third degree heart block
	Ventricular Tachycardia Ventricular Fibrillation	5 mg/kg rapid bolus to 300 mg max Max:300 mg max	
Atropine	Symptomatic bradycardia	0.02 mg/kg IV (May give twice) Max dose: 0.5 mg 0.04-0.06 mg/kg via ETT	Dose < 0.5 mg may worsen bradycardia Do not use in glaucoma, tachycardia
	Toxins, poisons, and overdoses	0.02-0.05 mg/kg every 20-30 min	
Calcium chloride	Hypocalcemia, hyperkalemia, Calcium channel blocker overdose	20 mg/kg IV over 30-60 min	Monitor ECG and BP Contraindicated in digoxin toxicity or hypercalcemia
	PLUS Cardiac arrest	20 mg/kg IV bolus into central line	
Dexamethasone	Croup, Asthma	First Dose: 0.6mg/kg Max Dose: 16 mg	Can be given PO/IM/IV
Dextrose	Hypoglycemia	0.5 to 1 g/kg	Follow glucose
Diphenhydramine	Anaphylaxis after epinephrine	1 to 2 mg/kg every 4 to 6 h Max Dose: 50 mg	Use with caution in glaucoma, ulcer, hyperthyroidism
Dobutamine	Ventricular dysfunction	2 to 20 mcg/kg per min	Do not mix w/ sodium bicarb
Dopamine	Ventricular dysfunction, Cardiogenic or distributive shock	2 to 20 mcg/kg per min Titrate to response	Do not mix w/ sodium bicarb
Epinephrine	Anaphylaxis	0.01 mg/kg q15 min Max: 0.3mg	Make sure to distinguish and account for 1:1000 and 1:10000 concentrations.
	Asthma		
	Croup	0.25 ml via nebulizer	
	Cardiac Arrest	0.01 mg/kg (1:10000) IV or 0.1 mg/kg (1:1000) ETT q3-5 min	
	Shock	0.1 to 1 mcg/kg per min IV	
	Symptomatic Bradycardia	0.01 mg/kg IV q3-5 min Max: 1 mg	
	Toxins Overdose	0.01 mg/kg (1:10000) IV Max Dose: 1 mg	Avoid in cocaine-induced ventricular tachycardia
Etomidate	Sedation for intubation	0.2 to 0.4 mg/kg IV over 30-60 s Max Dose: 20 mg	Avoid in septic shock
Furosemide	Pulmonary Edema Diuresis	1 mg/kg IV/IM Max Dose: 20 mg	Monitor potassium
Hydrocortisone	Adrenal Insufficiency	2 mg/kg IV bolus Max Dose: 100 mg	Use with caution in infection
Inamrinone	Myocardial Dysfunction Cardiogenic Shock CHF	Loading: 0.75-1 mg/kg IV over 5-10 min. May repeat twice Max Dose: 3 mg/kg Maintenance 5-10 mcg/kg/min	Monitor ECG, oxygen, BP
Ipratropium	Asthma	250 to 500 mcg neb q 20 min	
Lidocaine	V Fib and Pulseless VT Wide Complex Tachycardia	1 mg/kg IV bolus Then 20 to 50 mcg/kg per min	Contraindicated for wide complex bradycardia
	Rapid Sequence Intubation	1-2 mg/kg IV	
Magnesium Sulfate	Asthma	25-50mg/kg IV over 15-30 min	Rapid bolus may cause hypotension and bradycardia
	Pulseless Torsades de pointes	25-50 mg/kg IV bolus	
	Ventricular Tachycardia w/ pulses	25-50 mg/kg over 10-20 m	

Drug	Use(s)	Dosage/Route	Contraindications/ Warnings
Methylprednisolone	Asthma Anaphylactic shock	Loading: 2 mg/kg IV (up to 60mg) Maintenance: 0.5 mg/kg q 6 h	Anaphylaxis possible
Milrinone	Cardiogenic shock Post-surgery CHF	Loading: 50 mcg/kg IV over 10-60 m Maintenance: 0.25-0.75 mcg/kg/min	Watch in hypovolemia
Naloxone	Narcotic reversal	Total Reversal: 0.1 mg/kg IV q 2 min Max Dose: 2 mg Partial Reversal: 1-5 mcg/kg IV	Consider airway before use
Nitroglycerine	CHF Cardiogenic Shock	Begin: 0.25-0.5 mcg/kg/min Titrate: q 15-20 minutes Max Dose: 10 mcg/kg/min	Watch for hypotension in hypovolemia
Nitroprusside	Cardiogenic Shock Hypertension	Begin: 0.3 to 1 mcg/kg/min Max Dose: 8 mcg/kg/min	Check thiocyanate and cyanide levels
Norepinephrine	Shock	0.1 to 2 mcg/kg/min Titrate to target blood pressure	Extravasation leads to tissue necrosis Give via central line
Procainamide	Atrial Flutter Supraventricular Tachycardia; Ventricular Tachycardia w/ Pulse	Loading: 15 mg/kg over 30-60 min	Follow QT int., BP Consider expert consultation
Sodium Bicarb	Severe Metabolic Acidosis Hyperkalemia	1 mEq/kg slow IV bolus Max: 50 mEq	Support ventilation *Not recommended in cardiac arrest*
Terbutaline	Asthma Hyperkalemia	10 mcg/kg SQ q 10-15 min until IV access 0.1-10 mcg/kg/min IV	Use with caution in hypokalemia
Vasopressin	Cardiac Arrest Septic Shock	0.4-1 unit/kg IV bolus Max Dose: 40 units	Check distal pulses Water intoxication Extravasation causes tissue necrosis

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