Pediatric BLS Algorithm

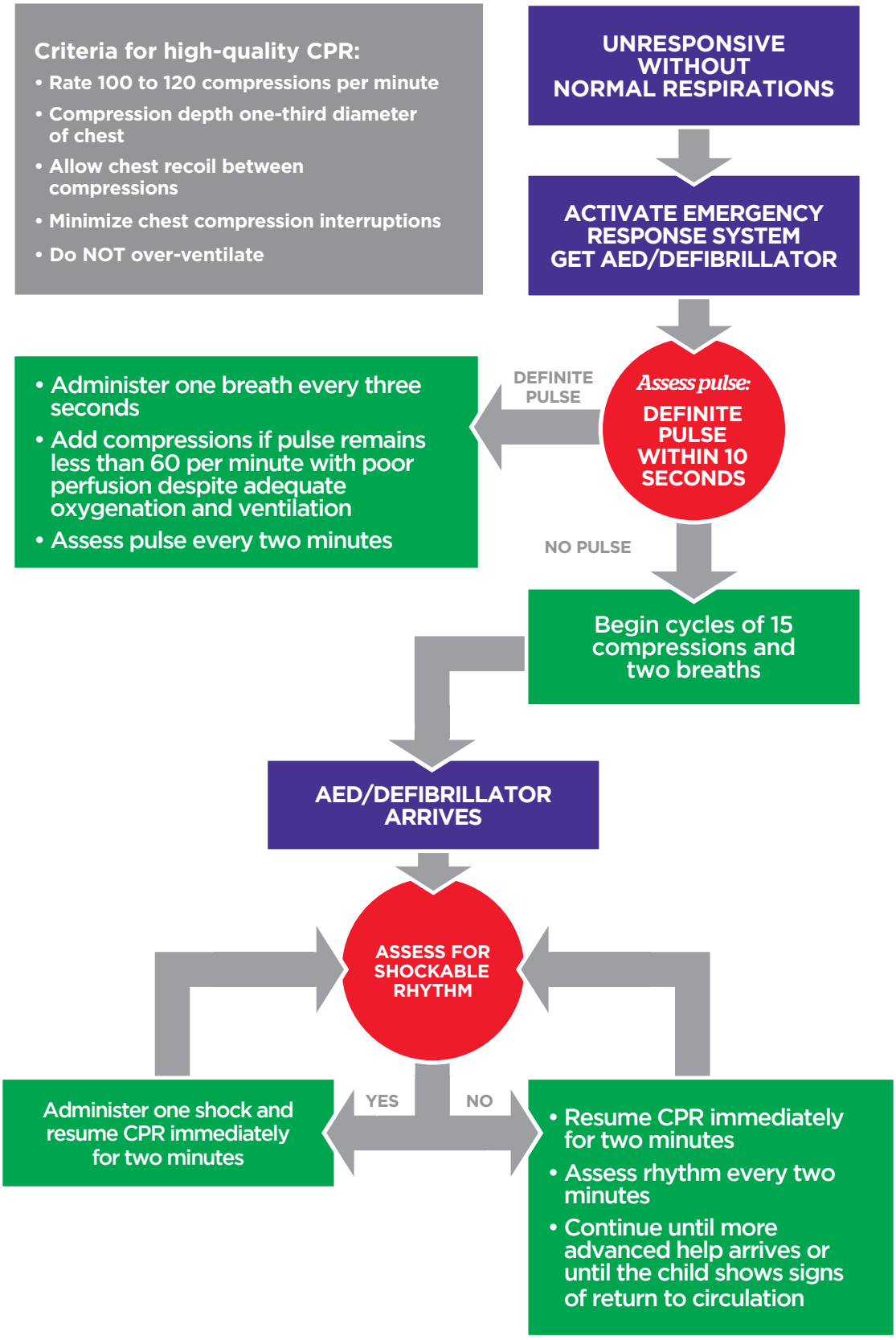

Figure 4

This atrial contraction registers on an electrocardiogram (ECG) strip as the P wave. This impulse then travels to the AV node, which in turn conducts the electrical impulse through the Bundle of His, bundle branches, and Purkinje fibers of the ventricles causing ventricular contraction. The time between the start of atrial contraction and the start of ventricular contraction registers on an ECG strip as the PR interval. The ventricular contraction registers on the ECG strip as the QRS complex. Following ventricular contraction, the ventricles rest and repolarize, which is registered on the ECG strip as the T wave. The atria also repolarize, but this coincides with the QRS complex, and therefore, cannot be observed on the ECG strip. Together a P wave, QRS complex, and T wave at proper intervals are indicative of normal sinus rhythm (NSR) (Figure 5). Abnormalities that are in the conduction system can cause delays in the transmission of the electrical impulse and are detected on the ECG. These deviations from normal conduction can result in dysrhythmias such as heart blocks, pauses, tachycardias and bradycardias, blocks, and dropped beats. These rhythm disturbances will be covered in more detail further in the handbook.

A SYSTEMATIC APPROACH

When you find an unresponsive child or infant, it is often not possible to immediately deduce the etiology. You will want to act quickly, decisively, and apply interventions that fit the needs of the individual at that moment. In order to achieve this, PALS was designed for providers to take a comprehensive approach.

While there are various causes for a child or an infant to become unresponsive, the central issues that need to be addressed include keeping blood pumping through the vasculature (perfusion) and supplying oxygen to the lungs (oxygenation). When the child or infant is experiencing poor perfusion and oxygenation, CPR manually takes over for the heart and lungs. If they are still adequately maintaining perfusion and oxygenation but are unresponsive, then rapid diagnosis and treatment may be possible without CPR.

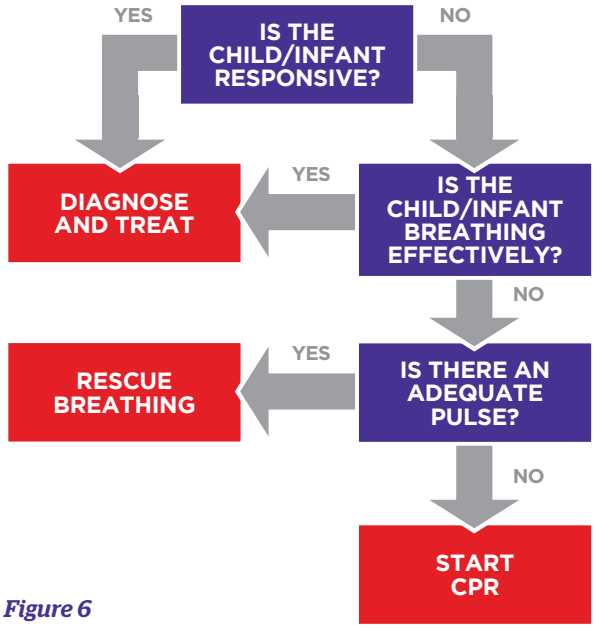

Figure 6

It is important to differentiate normal breathing from gasping (agonal breathing). Gasping is considered ineffective breathing.

Likewise, not all pulses are adequate. The rule of thumb is that at least 60 beats per minute is required to maintain adequate perfusion in a child or an infant.

The assessment must be carried out quickly. There is a low threshold for administering ventilation and/or compressions if there is evidence that the child or infant cannot do either effectively on their own.

If the problem is respiratory in nature (ineffective breathing with adequate pulses), then initiation of rescue breathing is warranted. If breathing is ineffective and pulses are inadequate, begin high-quality CPR immediately. It is important to understand that any case can change at any time, so you must reevaluate periodically and adjust the approach to treatment accordingly. Use CPR to support breathing and circulation until the cause has been identified and effectively treated.

INITIAL DIAGNOSIS AND TREATMENT

If you have reached the initial diagnosis and treatment phase of care, the child or infant is not in immediate danger of death. While this means that you likely have a brief period to find the cause of the problem and intervene with appropriate treatment, it does not mean that a life-threatening event is impossible. Always be vigilant for any indication to initiate high-quality CPR and look for life-threatening events such as respiratory distress, a change in consciousness, or cyanosis.

The ILCOR recommends following the ABCDE method when making an initial assessment *(Figure 7)*.

Figure 7

AIRWAY

Assess the airway and make a determination between one of three possibilities *(Table 3)*.

Once an airway has been established and maintained, move on to breathing.

Is the airway open?	• *This means open and unobstructed* • *If yes, proceed to Breathing*
Can the airway be kept open manually?	• *Jaw-Lift/Chin-Thrust* • *Nasopharyngeal or oropharyngeal airway*
Is an advanced airway required?	• *Endotracheal intubation* • *Cricothyrotomy, if necessary*

Table 3

BREATHING

If the child or infant is not breathing effectively, it is a life-threatening event and should be treated as respiratory arrest.

However, abnormal yet marginally effective breathing can be assessed and managed *(Table 4)*.

Is breathing too fast or too slow?	• *Tachypnea has an extensive differential diagnosis* • *Bradypnea can be a sign of impending respiratory arrest*
Is there increased respiratory effort?	• *Signs of increased respiratory effort include nasal flaring, rapid breathing, chest retractions, abdominal breathing, stridor, grunting, wheezing, and crackles*
Is an advanced airway required?	• *Endotracheal intubation* • *Cricothyrotomy, if necessary*

Table 4

CIRCULATION

Assessment of circulation in pediatrics involves more than checking the pulse and blood pressure. The color and temperature of the skin and mucous membranes can help to assess effective circulation. Pale or blue skin indicates poor tissue perfusion. Capillary refill time is also a useful assessment in pediatrics. Adequately, perfused skin will rapidly refill with blood after it is squeezed (e.g. by bending the tip of the finger at the nail bed). Inadequately perfused tissues will take longer than two seconds to respond. Abnormally, cool skin can also suggest poor circulation.

The normal heart rate and blood pressure in pediatrics are quite different than in adults and change with age. Likewise, heart rates are slower when children and infants are asleep. Most centers will have acceptable ranges that they use for normal and abnormal heart rates for a given age. While you should follow your local guidelines, approximate ranges are listed in *(Table 5)*.

AGE	NORMAL HEART RATE (AWAKE)	NORMAL HEART RATE (ASLEEP)	NORMAL BLOOD PRESSURE (SYSTOLIC)	NORMAL BLOOD PRESSURE (DIASTOLIC)	HYPOTENSION BLOOD PRESSURE (SYSTOLIC)
Neonate	*85-190*	*80-160*	*60-75*	*30-45*	*<60*
One Month	*85-190*	*80-160*	*70-95*	*35-55*	*<70*
Two Months	*85-190*	*80-160*	*70-95*	*40-60*	*<70*
Three Months	*100-190*	*75-160*	*80-100*	*45-65*	*<70*
Six Months	*100-190*	*75-160*	*85-105*	*45-70*	*<70*
One Year	*100-190*	*75-160*	*85-105*	*40-60*	*<72*
Two Years	*100-140*	*60-90*	*85-105*	*40-65*	*<74*
Child (2 to 10 years)	*60-140*	*60-90*	*95-115*	*55-75*	*<70 + (age x 2)*
Adolescent (over 10 years)	60-100	50-90	110-130	65-85	<90

Table 5

DISABILITY

In PALS, disability refers to performing a rapid neurological assessment. A great deal of information can be gained from determining the level of consciousness on a four-level scale. Pupillary response to light is also a fast and useful way to assess neurological function.

AWAKE	*May be sleepy, but still interactive*
RESPONDS TO VOICE	*Can only be aroused by talking or yelling*
RESPONDS TO PAIN	*Can only be aroused by inducing pain*
UNRESPONSIVE	*Cannot get the patient to respond*

Table 6

Neurologic assessments include the AVPU (alert, voice, pain, unresponsive) response scale and the Glasgow Coma Scale (GCS). A specially-modified GCS is used for children and infants and takes developmental differences into account *(Tables 6 and 7)*.

Glasgow Coma Scale for Children and Infants

AREA ASSESSED	INFANTS	CHILDREN	SCORE
Eye-opening	*Open spontaneously*	*Open spontaneously*	*4*
	Open in response to verbal stimuli	*Open in response to verbal stimuli*	*3*
	Open in response to pain only	*Open in response to pain only*	*2*
	No response	*No response*	*1*
Verbal response	*Coos and babbles*	*Oriented, appropriate*	*5*
	Irritable cries	*Confused*	*4*
	Cries in response to pain	*Inappropriate words*	*3*
	Moans in response to pain	*Incomprehensible words or nonspecific sounds*	*2*
	No response	*No response*	*1*
Motor response	*Moves spontaneously and purposefully*	*Obeys commands*	*6*
	Withdraws to touch	*Localizes painful stimulus*	*5*
	Withdraws in response to pain	*Withdraws in response to pain*	*4*
	Responds to pain with decorticate posturing (abnormal flexion)	*Responds to pain with flexion*	*3*
	Responds to pain with decerebrate posturing (abnormal extension)	*Responds to pain with extension*	*2*
	No response	*No response*	*1*

Table 7

PHARMACOLOGICAL TOOLS

Use of any of the medications listed in *Table 9* should be done within your scope of practice and after thorough study of the actions and side effects. This table provides only a brief reminder for those who are already knowledgeable in the use of these medications. Moreover, *Table 9* contains only pediatric doses, indications, and routes of administration (intravenous/intraosseous) for the most common PALS drugs. Although cited for reference, routine administration of drugs via an ET tube is discouraged. Rapid access and drug delivery through an IO are preferred to ET administration as drug absorption from the ET tube route is unpredictable.

DRUG	MAIN PALS USE	PEDIATRIC DOSE (IV/IO)	NOTES
Adenosine	*Supraventricular tachycardia*	*First dose: 0.1 mg/kg (MAX DOSE 6 mg)* *Second dose: 0.2 mg/kg (MAX DOSE 12 mg)*	*Rapid IV/IO bolus (no ET)* *Flush with saline* *Monitor ECG*
Amiodarone	*Tachyarrhythmia*	*5 mg/kg over 20 to 60 minutes*	*Very long half-life* *Monitor ECG & BP*
Atropine	*Bradycardia*	*0.02 mg/kg* *ET: 0.03 mg/kg* *Repeat once if needed* *(MAX single dose 0.5 mg)*	*Also used to treat specific toxins (e.g. organophosphate poisoning)*
Epinephrine	*Cardiac Arrest/ Shock*	*IV/IO: 0.01 mg/kg [1:10,000] (MAX DOSE 1 mg)* *ET: 0.1 mg/kg [1:1,000] (MAX DOSE 2.5 mg)*	*Multiple uses, multiple routes* *Repeat every 3 to 5 min if needed*
Glucose	*Hypoglycemia*	*0.5 to 1 g/kg*	*Newborn: 5 to 10 mL/kg D10W* *Infants/Children: 2 to 4 mL/kg D25W* *Adolescents: 1 to 2 mL/kg D50W*
Lidocaine	*Tachyarrhythmia*	*Initial: 1 mg/kg* *Infusion: 20 to 50 mcg/kg/min* *(MAX DOSE 100 mg)* *ET: 2 to 3 mg*	
Magnesium Sulfate	*Torsades de Pointes* *Refractory Asthma*	*20 to 50 mg/kg over 10 to 20 min (MAX DOSE 2 grams)*	*May run faster for Torsades*
Milrinone	*Cardiogenic Shock*	*Initial: 50 mcg/kg over 10 to 60 min* *Maintain: 0.5 to 0.75 mcg/kg/min*	*Longer infusion times and euvolemia will reduce risk of hypotension*
Naloxone	*Opioid Reversal*	*Less than 5 y/o OR under 20 kg: 0.1 mg/kg* *Over 5 y/o OR over 20 kg: 2 mg IV q 2 to 3 min prn*	*Decrease dose to reverse respiratory depression due to therapeutic opioid use (1 to 5 mcg/kg, titrate to effect)*
Procainamide	*Tachyarrhythmia*	*15 mg/kg over 30 to 60 minutes*	*Do NOT give with amiodarone* *Monitor ECG & BP*
Sodium Bicarbonate	*Metabolic Acidosis Hyperkalemia*	*1 mEq/kg slow bolus (MAX DOSE 50 mEq)*	*Monitor ABG & ECG* *After adequate ventilation*

Table 9

Pediatric Bradycardia with Pulse/Poor Perfusional Algorithm

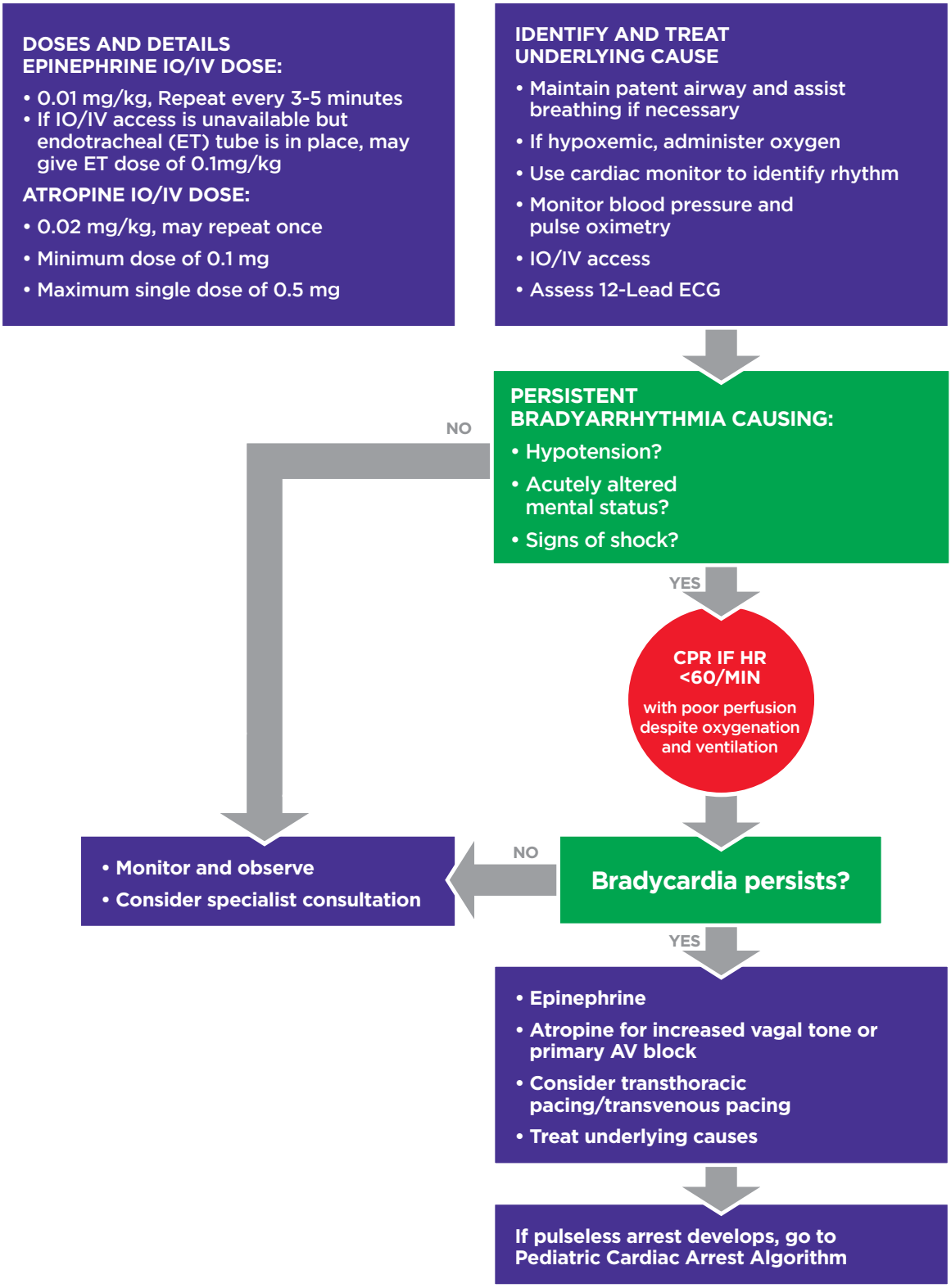

Figure 13

Responding to Tachycardia

The initial management of tachyarrhythmia is to assess pulse and perfusion.

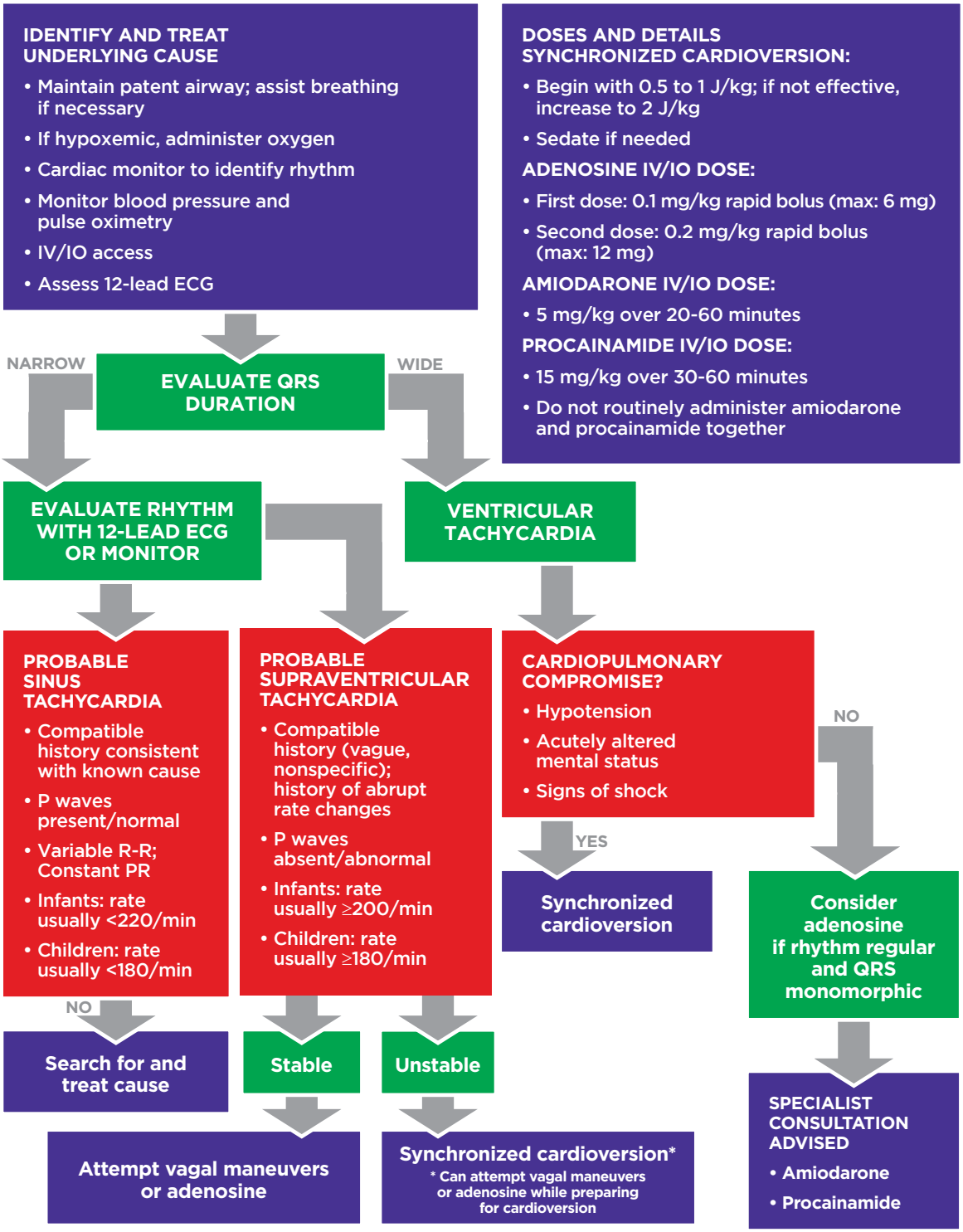

Figure 15

RESPONDING TO CARDIAC ARREST

The first management step in cardiac arrest is to begin high-quality CPR. (See BLS section of this handbook for details.)

Pediatric Cardiac Arrest Algorithm

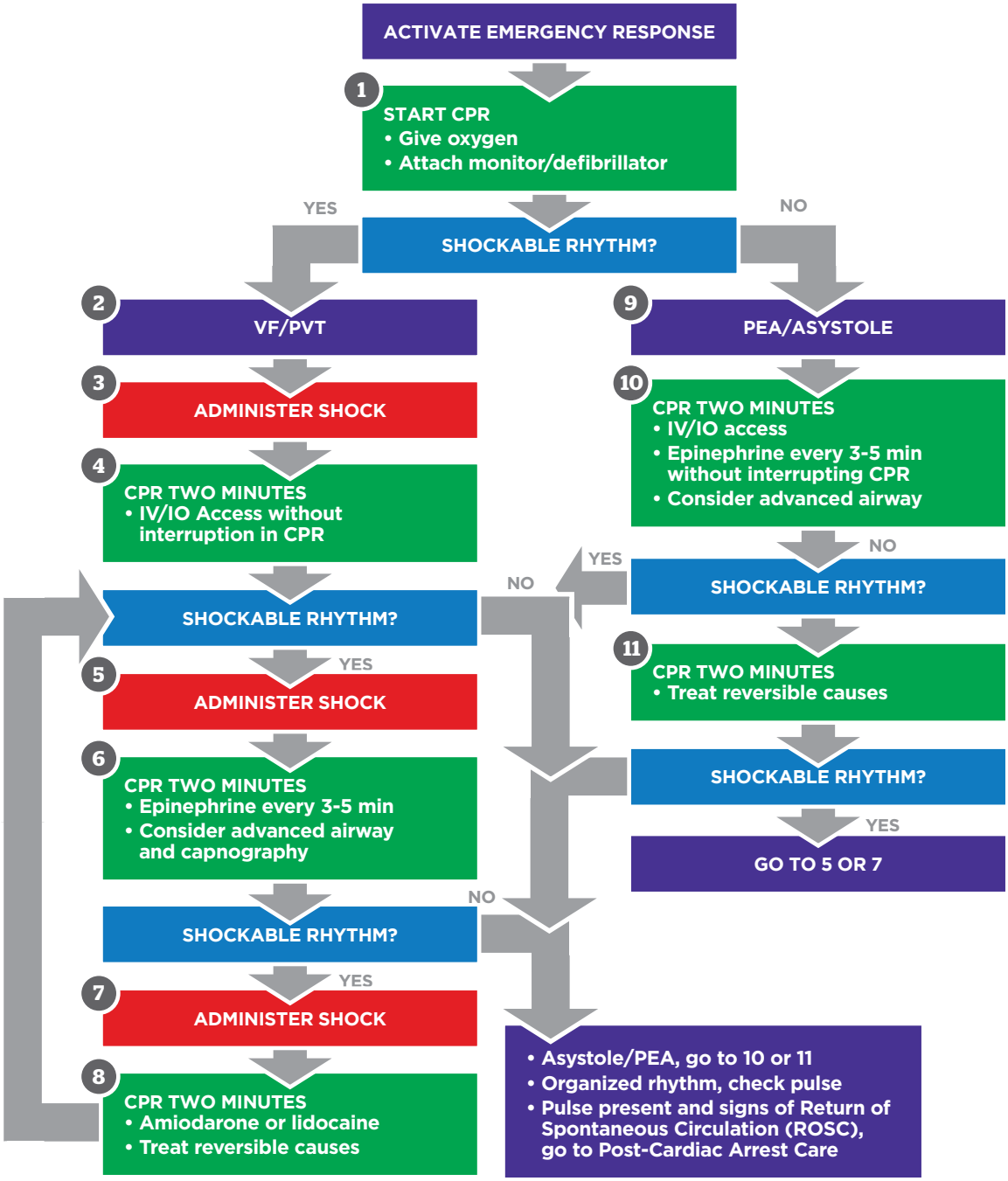

Figure 16

Pediatric Cardiac Arrest Algorithm

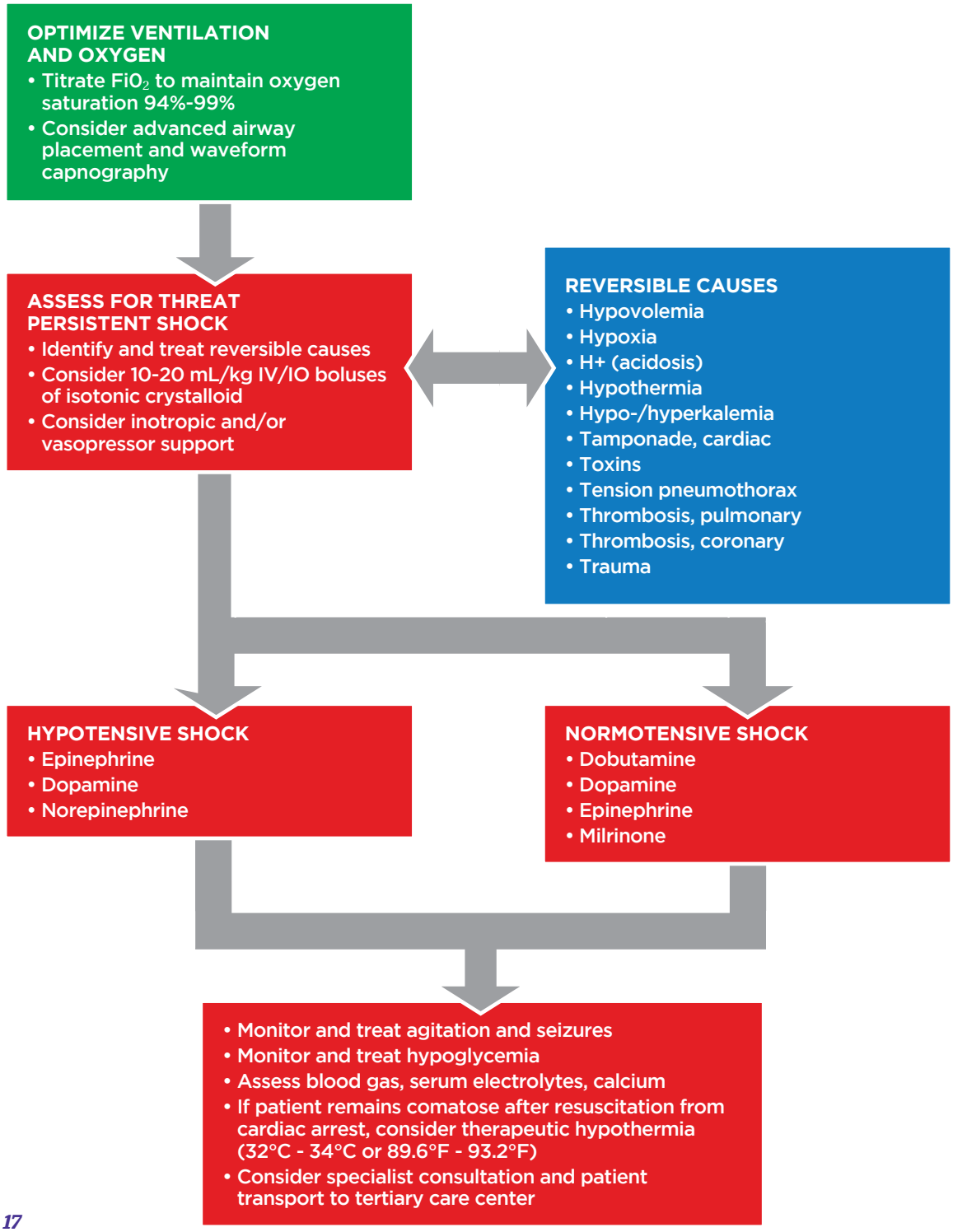

Figure 17