American Heart Association®

HIGHLIGHTS

of the 2020 AMERICAN HEART ASSOCIATION

GUIDELINES FOR CPR AND ECC

Pediatric Basic and Advanced Life Support

Summary of Key Issues and Major Changes

More than 20 000 infants and children have a cardiac arrest each year in the United States. Despite increases in survival and comparatively good rates of good neurologic outcome after pediatric IHCA, survival rates from pediatric OHCA remain poor, particularly in infants. Recommendations for pediatric basic life support (PBLS) and CPR in infants, children, and adolescents have been combined with recommendations for pediatric advanced life support (PALS) in a single document in the 2020 Guidelines. The causes of cardiac arrest in infants and children differ from cardiac arrest in adults, and a growing body of pediatric-specific evidence supports these recommendations. Key issues, major changes, and enhancements in the 2020 Guidelines include the following:

- Algorithms and visual aids were revised to incorporate the best science and improve clarity for PBLS and PALS resuscitation providers.
- Based on newly available data from pediatric resuscitations, the recommended assisted ventilation rate has been increased to 1 breath every 2 to 3 seconds (20-30 breaths per minute) for all pediatric resuscitation scenarios.
- Cuffed ETTs are suggested to reduce air leak and the need for tube exchanges for patients of any age who require intubation.
- The routine use of cricoid pressure during intubation is no longer recommended.
- To maximize the chance of good resuscitation outcomes, epinephrine should be administered as early as possible, ideally within 5 minutes of the start of cardiac arrest from a nonshockable rhythm (asystole and pulseless electrical activity).
- For patients with arterial lines in place, using feedback from continuous measurement of arterial blood pressure may improve CPR quality.
- After ROSC, patients should be evaluated for seizures; status epilepticus and any convulsive seizures should be treated.
- Because recovery from cardiac arrest continues long after the initial hospitalization, patients should have formal assessment and support for their physical, cognitive, and psychosocial needs.
- A titrated approach to fluid management, with epinephrine or norepinephrine infusions if vasopressors are needed, is appropriate in resuscitation from septic shock.
- On the basis largely of extrapolation from adult data, balanced blood component resuscitation is reasonable for infants and children with hemorrhagic shock.
- Opioid overdose management includes CPR and the timely administration of naloxone by either lay rescuers or trained rescuers.
- Children with acute myocarditis who have arrhythmias, heart block, ST-segment changes, or low cardiac output are at high risk of cardiac arrest. Early transfer to an intensive care unit is important, and some patients may require mechanical circulatory support or extracorporeal life support (ECLS).
- Infants and children with congenital heart disease and single ventricle physiology who are in the process of staged reconstruction require special considerations in PALS management.
- Management of pulmonary hypertension may include the use of inhaled nitric oxide, prostacyclin, analgesia, sedation, neuromuscular blockade, the induction of alkalosis, or rescue therapy with ECLS.

Algorithms and Visual Aids

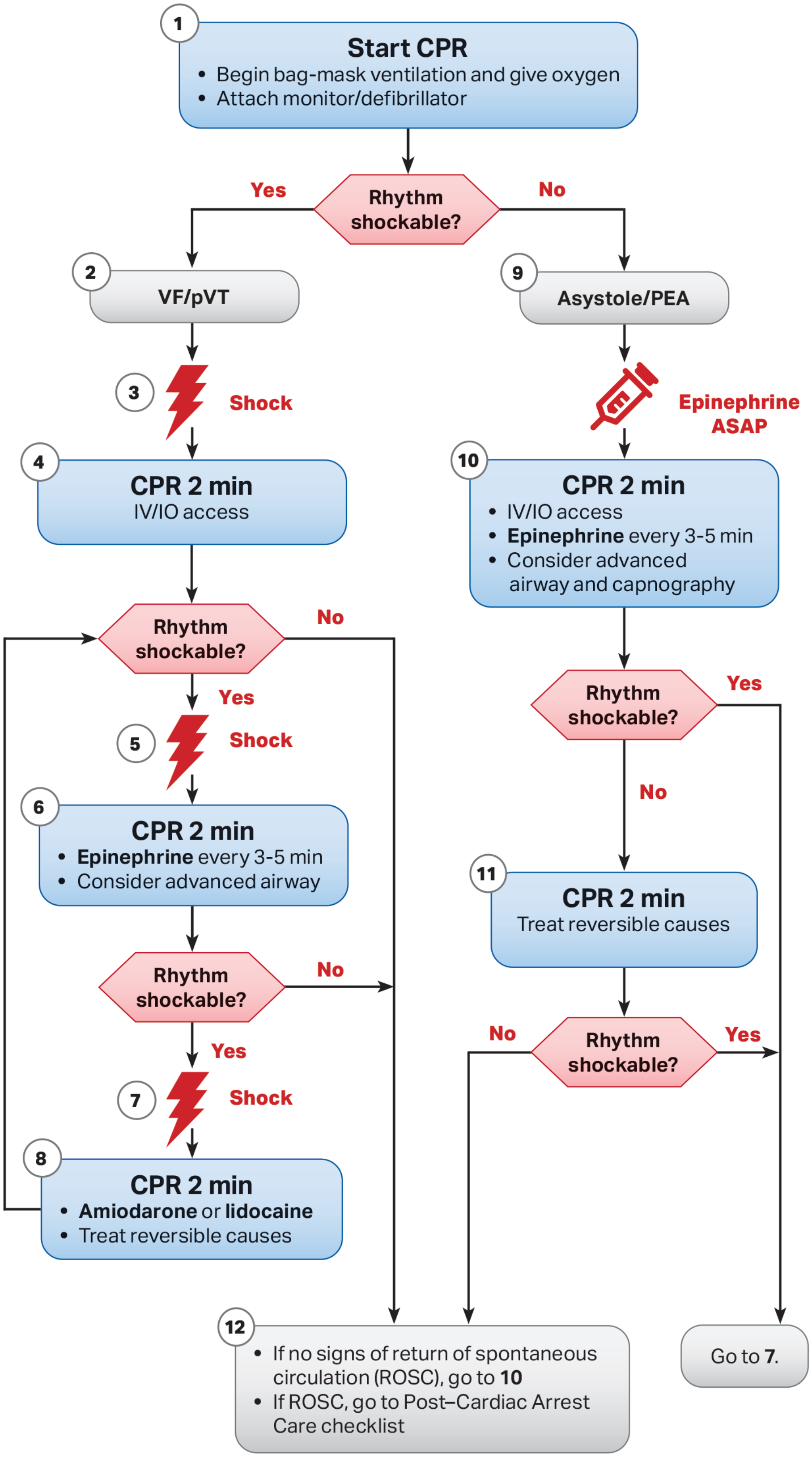
The writing group updated all algorithms to reflect the latest science and made several major changes to improve the visual training and performance aids:

- A new pediatric Chain of Survival was created for IHCA in infants, children, and adolescents (Figure 10).
- A sixth link, Recovery, was added to the pediatric OHCA Chain of Survival and is included in the new pediatric IHCA Chain of Survival (Figure 10).
- The Pediatric Cardiac Arrest Algorithm and the Pediatric Bradycardia With a Pulse Algorithm have been updated to reflect the latest science (Figures 11 and 12).
- The single Pediatric Tachycardia With a Pulse Algorithm now covers both narrow- and wide-complex tachycardias in pediatric patients (Figure 13).
- Two new Opioid-Associated Emergency Algorithms have been added for lay rescuers and trained rescuers (Figures 5 and 6).
- A new checklist is provided for pediatric post–cardiac arrest care (Figure 14).

The causes of cardiac arrest in infants and children differ from cardiac arrest in adults, and a growing body of pediatric-specific evidence supports these recommendations.

Figure 10. AHA Chains of Survival for pediatric IHCA and OHCA.

Figure 11. Pediatric Cardiac Arrest Algorithm.



CPR Quality

- Push hard (≥⅓ of anteroposterior diameter of chest) and fast (100-120/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Change compressor every 2 minutes, or sooner if fatigued
- If no advanced airway, 15:2 compression-ventilation ratio
- If advanced airway, provide continuous compressions and give a breath every 2-3 seconds

Shock Energy for Defibrillation

- First shock 2 J/kg
- Second shock 4 J/kg
- Subsequent shocks ≥4 J/kg, maximum 10 J/kg or adult dose

Drug Therapy

- **Epinephrine IV/IO dose:** 0.01 mg/kg (0.1 mL/kg of the 0.1 mg/mL concentration). Max dose 1 mg. Repeat every 3-5 minutes. If no IV/IO access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of the 1 mg/mL concentration).
- **Amiodarone IV/IO dose:** 5 mg/kg bolus during cardiac arrest. May repeat up to 3 total doses for refractory VF/pulseless VT
  or
  Lidocaine IV/IO dose: Initial: 1 mg/kg loading dose

Advanced Airway

- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor ET tube placement

Reversible Causes

- **H**ypovolemia
- **H**ypoxia
- **H**ydrogen ion (acidosis)
- **H**ypoglycemia
- **H**ypo-/hyperkalemia
- **H**ypothermia
- **T**ension pneumothorax
- **T**amponade, cardiac
- **T**oxins
- **T**hrombosis, pulmonary
- **T**hrombosis, coronary

Figure 12. Pediatric Bradycardia With a Pulse Algorithm.

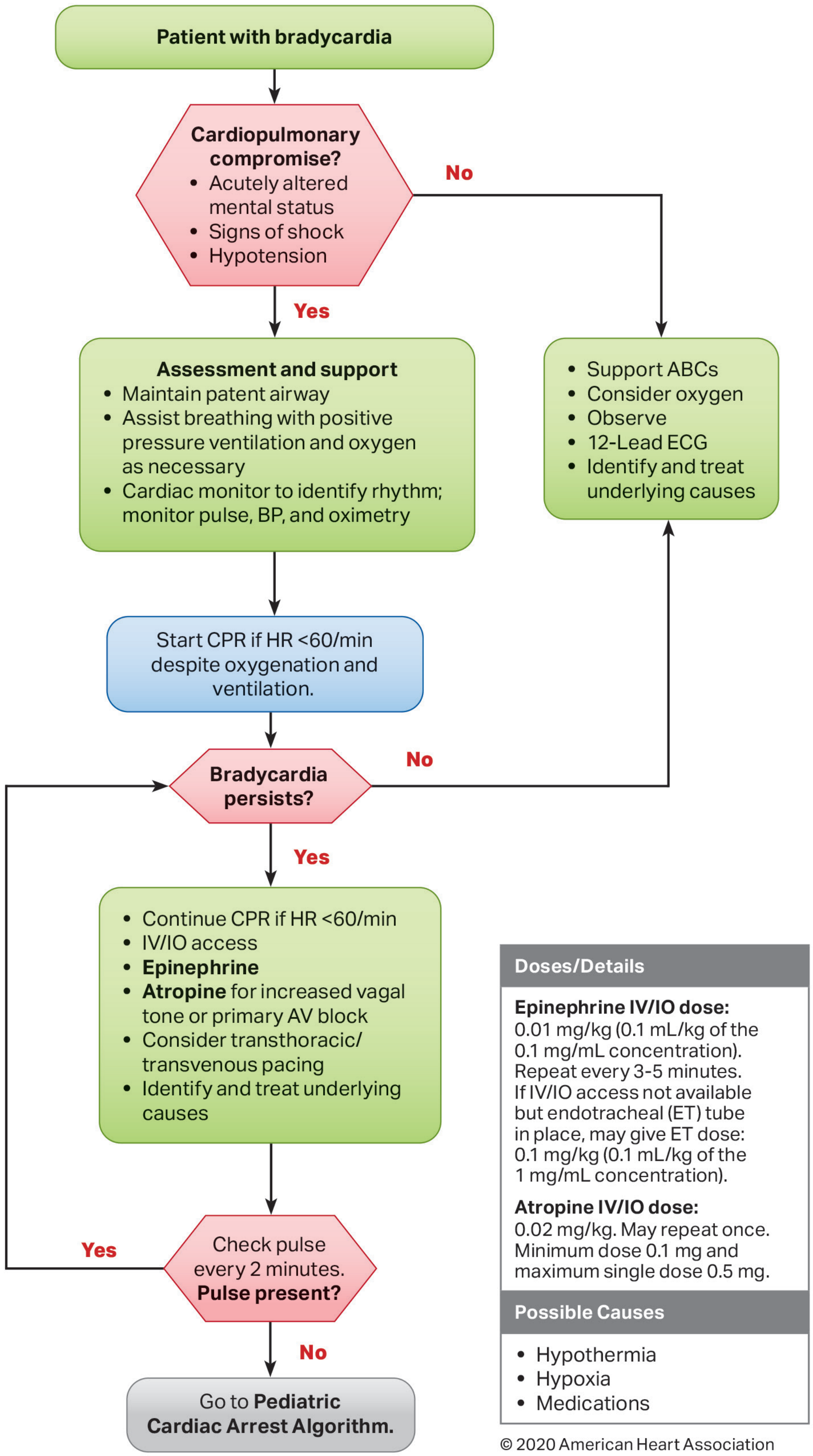


Figure 13. Pediatric Tachycardia With a Pulse Algorithm.

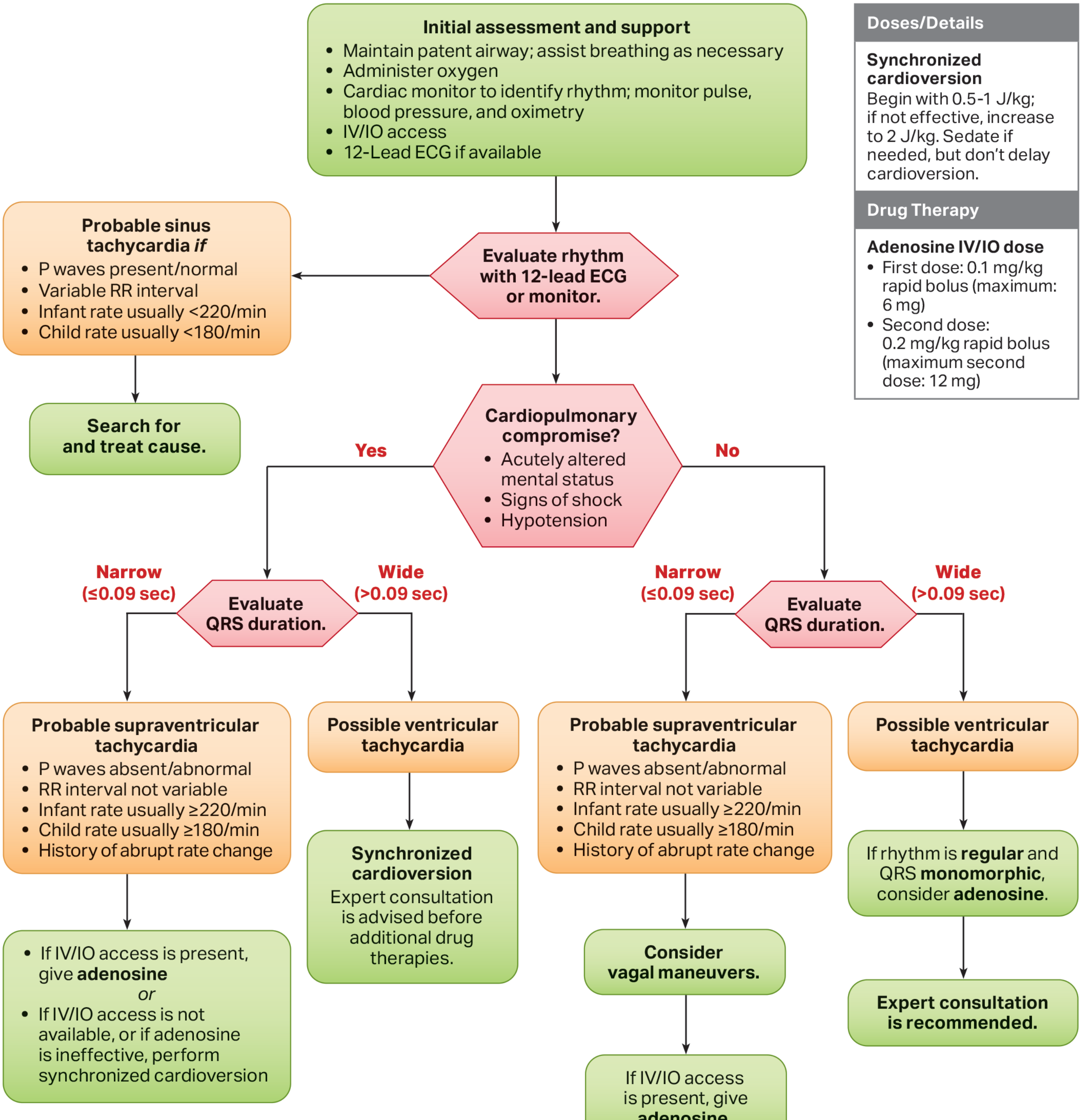


Figure 14. Pediatric Post–Cardiac Arrest Care Checklist.

Components of Post–Cardiac Arrest Care	Check
Oxygenation and ventilation	
Measure oxygenation and target normoxemia 94%-99% (or child's normal/appropriate oxygen saturation).	☐
Measure and target Pa_{CO_2} appropriate to the patient's underlying condition and limit exposure to severe hypercapnia or hypocapnia.	☐
Hemodynamic monitoring	
Set specific hemodynamic goals during post–cardiac arrest care and review daily.	☐
Monitor with cardiac telemetry.	☐
Monitor arterial blood pressure.	☐
Monitor serum lactate, urine output, and central venous oxygen saturation to help guide therapies.	☐
Use parenteral fluid bolus with or without inotropes or vasopressors to maintain a systolic blood pressure greater than the fifth percentile for age and sex.	☐
Targeted temperature management (TTM)	
Measure and continuously monitor core temperature.	☐
Prevent and treat fever immediately after arrest and during rewarming.	☐
If patient is comatose apply TTM (32˚C-34˚C) followed by (36˚C-37.5˚C) or only TTM (36˚C-37.5˚C).	☐
Prevent shivering.	☐
Monitor blood pressure and treat hypotension during rewarming.	☐
Neuromonitoring	
If patient has encephalopathy and resources are available, monitor with continuous electroencephalogram.	☐
Treat seizures.	☐
Consider early brain imaging to diagnose treatable causes of cardiac arrest.	☐
Electrolytes and glucose	
Measure blood glucose and avoid hypoglycemia.	☐
Maintain electrolytes within normal ranges to avoid possible life-threatening arrhythmias.	☐
Sedation	
Treat with sedatives and anxiolytics.	☐
Prognosis	
Always consider multiple modalities (clinical and other) over any single predictive factor.	☐
Remember that assessments may be modified by TTM or induced hypothermia.	☐
Consider electroencephalogram in conjunction with other factors within the first 7 days after cardiac arrest.	☐
Consider neuroimaging such as magnetic resonance imaging during the first 7 days.	☐

Major New and Updated Recommendations

Changes to the Assisted Ventilation Rate: Rescue Breathing

2020 (Updated): (PBLS) For infants and children with a pulse but absent or inadequate respiratory effort, it is reasonable to give 1 breath every 2 to 3 seconds (20-30 breaths/min).

2010 (Old): (PBLS) If there is a palpable pulse 60/min or greater but there is inadequate breathing, give rescue breaths at a rate of about 12 to 20/min (1 breath every 3-5 seconds) until spontaneous breathing resumes.

Changes to the Assisted Ventilation Rate: Ventilation Rate During CPR With an Advanced Airway

2020 (Updated): (PALS) When performing CPR in infants and children with an advanced airway, it may be reasonable to target a respiratory rate range of 1 breath every 2 to 3 seconds (20-30/min), accounting for age and clinical condition. Rates exceeding these recommendations may compromise hemodynamics.

2010 (Old): (PALS) If the infant or child is intubated, ventilate at a rate of about 1 breath every 6 seconds (10/min) without interrupting chest compressions.

Why: New data show that higher ventilation rates (at least 30/min in infants [younger than 1 year] and at least 25/min in children) are associated with improved rates of ROSC and survival in pediatric IHCA. Although there are no data about the ideal ventilation rate during CPR without an advanced airway, or for children in respiratory arrest with or without an advanced airway, for simplicity of training, the respiratory arrest recommendation was standardized for both situations.

Cuffed ETTs

2020 (Updated): It is reasonable to choose cuffed ETTs over uncuffed ETTs for intubating infants and children. When a cuffed ETT is used, attention should be paid to ETT size, position, and cuff inflation pressure (usually <20-25 cm H_2O).

2010 (Old): Both cuffed and uncuffed ETTs are acceptable for intubating infants and children. In certain circumstances (eg, poor lung compliance, high airway resistance, or a large glottic air leak) a cuffed ETT may be preferable to an uncuffed tube, provided that attention is paid to [ensuring appropriate] ETT size, position, and cuff inflation pressure.

Why: Several studies and systematic reviews support the safety of cuffed ETTs and demonstrate decreased need for tube changes and reintubation. Cuffed tubes may decrease the risk of aspiration. Subglottic stenosis is rare when cuffed ETTs are used in children and careful technique is followed.

Cricoid Pressure During Intubation

2020 (Updated): Routine use of cricoid pressure is not recommended during endotracheal intubation of pediatric patients.

2010 (Old): There is insufficient evidence to recommend routine application of cricoid pressure to prevent aspiration during endotracheal intubation in children.

Why: New studies have shown that routine use of cricoid pressure reduces intubation success rates and does not reduce the rate of regurgitation. The writing group has reaffirmed previous recommendations to discontinue cricoid pressure if it interferes with ventilation or the speed or ease of intubation.

Emphasis on Early Epinephrine Administration

2020 (Updated): For pediatric patients in any setting, it is reasonable to administer the initial dose of epinephrine within 5 minutes from the start of chest compressions.

2015 (Old): It is reasonable to administer epinephrine in pediatric cardiac arrest.

Why: A study of children with IHCA who received epinephrine for an initial nonshockable rhythm (asystole and pulseless electrical activity) demonstrated that, for every minute of delay in administration of epinephrine, there was a significant decrease in ROSC, survival at 24 hours, survival to discharge, and survival with favorable neurological outcome.

Patients who received epinephrine within 5 minutes of CPR initiation compared with those who received epinephrine more than 5 minutes after CPR initiation were more likely to survive to discharge. Studies of pediatric OHCA demonstrated that earlier epinephrine administration increases rates of ROSC, survival to intensive care unit admission, survival to discharge, and 30-day survival.

In the 2018 version of the Pediatric Cardiac Arrest Algorithm, patients with nonshockable rhythms received epinephrine every 3 to 5 minutes, but early administration of epinephrine was not emphasized. Although the sequence of resuscitation has not changed, the algorithm and recommendation language have been updated to emphasize the importance of giving epinephrine as early as possible, particularly when the rhythm is nonshockable.

Invasive Blood Pressure Monitoring to Assess CPR Quality

2020 (Updated): For patients with continuous invasive arterial blood pressure monitoring in place at the time of cardiac arrest, it is reasonable for providers to use diastolic blood pressure to assess CPR quality.

2015 (Old): For patients with invasive hemodynamic monitoring in place at the time of cardiac arrest, it may be reasonable for rescuers to use blood pressure to guide CPR quality.

Why: Providing high-quality chest compressions is critical to successful resuscitation. A new study shows that, among pediatric patients receiving CPR with an arterial line in place, rates of survival with favorable neurologic outcome were improved if the diastolic blood pressure was at least 25 mm Hg in infants and at least 30 mm Hg in children.[8]

Detecting and Treating Seizures After ROSC

2020 (Updated): When resources are available, continuous electroencephalography monitoring is recommended for the detection of seizures following cardiac arrest in patients with persistent encephalopathy.

2020 (Updated): It is recommended to treat clinical seizures following cardiac arrest.

2020 (Updated): It is reasonable to treat nonconvulsive status epilepticus following cardiac arrest in consultation with experts.

2015 (Old): An electroencephalography for the diagnosis of seizure should be promptly performed and interpreted and then should be monitored frequently or continuously in comatose patients after ROSC.

2015 (Old): The same anticonvulsant regimens for the treatment of status epilepticus caused by other etiologies may be considered after cardiac arrest.

Why: For the first time, the Guidelines provide pediatric-specific recommendations for managing seizures after cardiac arrest. Nonconvulsive seizures, including nonconvulsive status epilepticus, are common and cannot be detected without electroencephalography. Although outcome data from the post–cardiac arrest population are lacking, both convulsive and nonconvulsive status epilepticus are associated with poor outcome, and treatment of status epilepticus is beneficial in pediatric patients in general.

Evaluation and Support for Cardiac Arrest Survivors

2020 (New): It is recommended that pediatric cardiac arrest survivors be evaluated for rehabilitation services.

2020 (New): It is reasonable to refer pediatric cardiac arrest survivors for ongoing neurologic evaluation for at least the first year after cardiac arrest.

Why: There is growing recognition that recovery from cardiac arrest continues long after the initial hospitalization. Survivors may require ongoing integrated medical, rehabilitative, caregiver, and community support in the months to years after their cardiac arrest. A recent AHA scientific statement highlights the importance of supporting patients and families during this time to achieve the best possible long-term outcome.[6]

Septic Shock

Fluid Boluses

2020 (Updated): In patients with septic shock, it is reasonable to administer fluid in 10 mL/kg or 20 mL/kg aliquots with frequent reassessment.

2015 (Old): Administration of an initial fluid bolus of 20 mL/kg to infants and children with shock is reasonable, including those with conditions such as severe sepsis, severe malaria, and dengue.

Choice of Vasopressor

2020 (New): In infants and children with fluid-refractory septic shock, it is reasonable to use either epinephrine or norepinephrine as an initial vasoactive infusion.

2020 (New): In infants and children with fluid-refractory septic shock, if epinephrine or norepinephrine are unavailable, dopamine may be considered.

Corticosteroid Administration

2020 (New): For infants and children with septic shock unresponsive to fluids and requiring vasoactive support, it may be reasonable to consider stress-dose corticosteroids.

Why: Although fluids remain the mainstay of initial therapy for infants and children in shock, especially in hypovolemic and septic shock, fluid overload can lead to increased morbidity. In recent trials of patients with septic shock, those who received higher fluid volumes or faster fluid resuscitation were more likely to develop clinically significant fluid overload and require mechanical ventilation. The writing group reaffirmed previous recommendations to reassess patients after each fluid bolus and to use either crystalloid or colloid fluids for septic shock resuscitation.

Previous versions of the Guidelines did not provide recommendations about choice of vasopressor or the use of corticosteroids in septic shock. Two RCTs suggest that epinephrine is superior to dopamine as the initial vasopressor in pediatric septic shock, and norepinephrine is also appropriate. Recent clinical trials suggest a benefit from corticosteroid administration in some pediatric patients with refractory septic shock.

Hemorrhagic Shock

2020 (New): Among infants and children with hypotensive hemorrhagic shock following trauma, it is reasonable to administer blood products, when available, instead of crystalloid for ongoing volume resuscitation.

Why: Previous versions of the Guidelines did not differentiate the treatment of hemorrhagic shock from other causes of hypovolemic shock. A growing body of evidence (largely from adults but with some pediatric data) suggests a benefit to early, balanced resuscitation using packed red blood cells, fresh frozen plasma, and platelets. Balanced resuscitation is supported by recommendations from the several US and international trauma societies.

Opioid Overdose

2020 (Updated): For patients in respiratory arrest, rescue breathing or bag-mask ventilation should be maintained until spontaneous breathing returns, and standard PBLS or PALS measures should continue if return of spontaneous breathing does not occur.

2020 (Updated): For a patient with suspected opioid overdose who has a definite pulse but no normal breathing or only gasping (ie, a respiratory arrest), in addition to providing standard PBLS or PALS, it is reasonable for responders to administer intramuscular or intranasal naloxone.

2020 (Updated): For patients known or suspected to be in cardiac arrest, in the absence of a proven benefit from the use of naloxone, standard resuscitative measures should take priority over naloxone administration, with a focus on high-quality CPR (compressions plus ventilation).

2015 (Old): Empiric administration of intramuscular or intranasal naloxone to all unresponsive opioid-associated life-threatening emergency patients may be reasonable as an adjunct to standard first aid and non–healthcare provider BLS protocols.

2015 (Old): ACLS providers should support ventilation and administer naloxone to patients with a perfusing cardiac rhythm and opioid-associated respiratory arrest or severe respiratory depression. Bag-mask ventilation should be maintained until spontaneous breathing returns, and standard ACLS measures should continue if return of spontaneous breathing does not occur.

2015 (Old): We can make no recommendation regarding the administration of naloxone in confirmed opioid-associated cardiac arrest.

Why: The opioid epidemic has not spared children. In the United States in 2018, opioid overdose caused 65 deaths in children younger than 15 years and 3618 deaths in people 15 to 24 years old,[9] and many more children required resuscitation. The 2020 Guidelines contain new recommendations for managing children with respiratory arrest or cardiac arrest from opioid overdose.

These recommendations are identical for adults and children, except that compression-ventilation CPR is recommended for all pediatric victims of suspected cardiac arrest. Naloxone can be administered by trained providers, laypersons with focused training, and untrained laypersons. Separate treatment algorithms are provided for managing opioid-associated resuscitation emergencies by laypersons, who cannot reliably check for a pulse (Figure 5), and by trained rescuers (Figure 6). Opioid-associated OHCA is the subject of a 2020 AHA scientific statement.[10]

Myocarditis

2020 (New): Given the high risk of cardiac arrest in children with acute myocarditis who demonstrate arrhythmias, heart block, ST-segment changes, and/or low cardiac output, early consideration of transfer to ICU monitoring and therapy is recommended.

2020 (New): For children with myocarditis or cardiomyopathy and refractory low cardiac output, prearrest use of ECLS or mechanical circulatory support can be beneficial to provide end-organ support and prevent cardiac arrest.

2020 (New): Given the challenges to successful resuscitation of children with myocarditis and cardiomyopathy, once cardiac arrest occurs, early consideration of extracorporeal CPR may be beneficial.

Why: Although myocarditis accounts for about 2% of sudden cardiovascular deaths in infants,[11] 5% of sudden cardiovascular deaths in children,[11] and 6% to 20% of sudden cardiac death in athletes, previous[12,13] PALS guidelines did not contain specific recommendations for management. These recommendations are consistent with the 2018 AHA scientific statement on CPR in infants and children with cardiac disease.[14]

Single Ventricle: Recommendations for the Treatment of Preoperative and Postoperative Stage I Palliation (Norwood/Blalock-Tausig Shunt) Patients

2020 (New): Direct (superior vena cava catheter) and/or indirect (near infrared spectroscopy) oxygen saturation monitoring can be beneficial to trend and direct management in the critically ill neonate after stage I Norwood palliation or shunt placement.

2020 (New): In the patient with an appropriately restrictive shunt, manipulation of pulmonary vascular resistance may have little effect, whereas lowering systemic vascular resistance with the use of systemic vasodilators (alpha-adrenergic antagonists and/or phosphodiesterase type III inhibitors), with or without the use of oxygen, can be useful to increase systemic delivery of oxygen (DO_2.)

2020 (New): ECLS after stage I Norwood palliation can be useful to treat low systemic DO_2.

2020 (New): In the situation of known or suspected shunt obstruction, it is reasonable to administer oxygen, vasoactive agents to increase shunt perfusion pressure, and heparin (50-100 units/kg bolus) while preparing for catheter-based or surgical intervention.

2020 (Updated): For neonates prior to stage I repair with pulmonary overcirculation and symptomatic low systemic cardiac output and DO_2, it is reasonable to target a $PaCO_2$ of 50 to 60 mm Hg. This can be achieved during mechanical ventilation by reducing minute ventilation or by administering analgesia/sedation with or without neuromuscular blockade.

2010 (Old): Neonates in a prearrest state due to elevated pulmonary-to-systemic flow ratio prior to Stage I repair might benefit from a $PaCO_2$ of 50 to 60 mm Hg, which can be achieved during mechanical ventilation by reducing minute ventilation, increasing the inspired fraction of CO_2, or administering opioids with or without chemical paralysis.

Single Ventricle: Recommendations for the Treatment of Postoperative Stage II (Bidirectional Glenn/Hemi-Fontan) and Stage III (Fontan) Palliation Patients

2020 (New): For patients in a prearrest state with superior cavopulmonary anastomosis physiology and severe hypoxemia due to inadequate pulmonary blood flow (Qp), ventilatory strategies that target a mild respiratory acidosis and a minimum mean airway pressure without atelectasis can be useful to increase cerebral and systemic arterial oxygenation.

2020 (New): ECLS in patients with superior cavopulmonary anastomosis or Fontan circulation may be considered to treat low DO_2 from reversible causes or as a bridge to a ventricular assist device or surgical revision.

Why: Approximately 1 in 600 infants and children are born with critical congenital heart disease. Staged surgery for children born with single ventricle physiology, such as hypoplastic left heart syndrome, spans the first several years of life.[15] Resuscitation of these infants and children is complex and differs in important ways from standard PALS care. Previous PALS guidelines did not contain recommendations for this specialized patient population. These recommendations are consistent with the 2018 AHA scientific statement on CPR in infants and children with cardiac disease.[14]

Pulmonary Hypertension

2020 (Updated): Inhaled nitric oxide or prostacyclin should be used as the initial therapy to treat pulmonary hypertensive crises or acute right-sided heart failure secondary to increased pulmonary vascular resistance.

2020 (New): Provide careful respiratory management and monitoring to avoid hypoxia and acidosis in the postoperative care of the child with pulmonary hypertension.

2020 (New): For pediatric patients who are at high risk for pulmonary hypertensive crises, provide adequate analgesics, sedatives, and neuromuscular blocking agents.

2020 (New): For the initial treatment of pulmonary hypertensive crises, oxygen administration and induction of alkalosis through hyperventilation or alkali administration can be useful while pulmonary-specific vasodilators are administered.

2020 (New): For children who develop refractory pulmonary hypertension, including signs of low cardiac output or profound respiratory failure despite optimal medical therapy, ECLS may be considered.

2010 (Old): Consider administering inhaled nitric oxide or aerosolized prostacyclin or analogue to reduce pulmonary vascular resistance.

Why: Pulmonary hypertension, a rare disease in infants and children, is associated with significant morbidity and mortality and requires specialized management. Previous PALS guidelines did not provide recommendations for managing pulmonary hypertension in infants and children. These recommendations are consistent with guidelines on pediatric pulmonary hypertension published by the AHA and the American Thoracic Society in 2015,[16] and with recommendations contained in a 2020 AHA scientific statement on CPR in infants and children with cardiac disease.[14]

Neonatal Life Support

There are over 4 million births every year in the United States and Canada. Up to 1 of every 10 of these newborns will need help to transition from the fluid-filled environment of the womb to the air-filled room. It is essential that every newborn have a caregiver dedicated to facilitating that transition and for that caregiver to be trained and equipped for the role. Also, a significant proportion of newborns who need facilitated transition are at risk for complications that require additional trained personnel. All perinatal settings should be ready for this scenario.

The process of facilitating transition is described in the Neonatal Resuscitation Algorithm that starts with the needs of every newborn and proceeds to steps that address the needs of at-risk newborns. In the 2020 Guidelines, we provide recommendations on how to follow the algorithm, including anticipation and preparation, umbilical cord management at delivery, initial actions, heart rate monitoring, respiratory support, chest compressions, intravascular access and therapies, withholding and discontinuing resuscitation, postresuscitation care, and human factors and performance. Here, we highlight new and updated recommendations that we believe will have a significant impact on outcomes from cardiac arrest.

Summary of Key Issues and Major Changes

- Newborn resuscitation requires anticipation and preparation by providers who train individually and as teams.
- Most newly born infants do not require immediate cord clamping or resuscitation and can be evaluated and monitored during skin-to-skin contact with their mothers after birth.
- Prevention of hypothermia is an important focus for neonatal resuscitation. The importance of skin-to-skin care in healthy babies is reinforced as a means of promoting parental bonding, breastfeeding, and normothermia.

- Inflation and ventilation of the lungs are the priority in newly born infants who need support after birth.
- A rise in heart rate is the most important indicator of effective ventilation and response to resuscitative interventions.
- Pulse oximetry is used to guide oxygen therapy and meet oxygen saturation goals.
- Routine endotracheal suctioning for both vigorous and nonvigorous infants born with meconium-stained amniotic fluid (MSAF) is not recommended. Endotracheal suctioning is indicated only if airway obstruction is suspected after providing positive-pressure ventilation (PPV).
- Chest compressions are provided if there is a poor heart rate response to ventilation after appropriate ventilation-corrective steps, which preferably include endotracheal intubation.
- The heart rate response to chest compressions and medications should be monitored electrocardiographically.
- When vascular access is required in newly born infants, the umbilical venous route is preferred. When IV access is not feasible, the IO route may be considered.
- If the response to chest compressions is poor, it may be reasonable to provide epinephrine, preferably via the intravascular route.
- Newborns who fail to respond to epinephrine and have a history or an exam consistent with blood loss may require volume expansion.
- If all these steps of resuscitation are effectively completed and there is no heart rate response by 20 minutes, redirection of care should be discussed with the team and family.

Major New and Updated Recommendations

Anticipation of Resuscitation Need

2020 (New): Every birth should be attended by at least 1 person who can perform the initial steps of newborn resuscitation and initiate PPV and whose only responsibility is the care of the newborn.

Why: To support a smooth and safe newborn transition from being in the womb to breathing air, every birth should be attended by at least 1 person whose primary responsibility is to the newly born and who is trained and equipped to begin PPV without delay. Observational and quality-improvement studies indicate that this approach enables identification of at-risk newborns, promotes use of checklists to prepare equipment, and facilitates team briefing. A systematic review of neonatal resuscitation training in low-resourced settings showed a reduction in both stillbirth and 7-day mortality.

Temperature Management for Newly Born Infants

2020 (New): Placing healthy newborn infants who do not require resuscitation skin-to-skin after birth can be effective in improving breastfeeding, temperature control, and blood glucose stability.

Why: Evidence from a Cochrane systematic review showed that early skin-to-skin contact promotes normothermia in healthy newborns. In addition, 2 meta-analyses of RCTs and observational studies of extended skin-to-skin care after initial resuscitation and/or stabilization showed reduced mortality, improved breastfeeding, shortened length of stay, and improved weight gain in preterm and low-birth-weight babies.

Clearing the Airway When Meconium Is Present

2020 (Updated): For nonvigorous newborns (presenting with apnea or ineffective breathing effort) delivered through MSAF, routine laryngoscopy with or without tracheal suctioning is not recommended.

2020 (Updated): For nonvigorous newborns delivered through MSAF who have evidence of airway obstruction during PPV, intubation and tracheal suction can be beneficial.

2015 (Old): When meconium is present, routine intubation for tracheal suction in this setting is not suggested because there is insufficient evidence to continue recommending this practice.

Why: In newly born infants with MSAF who are not vigorous at birth, initial steps and PPV may be provided. Endotracheal suctioning is indicated only if airway obstruction is suspected after providing PPV. Evidence from RCTs suggests that nonvigorous newborns delivered through MSAF have the same outcomes (survival, need for respiratory support) whether they are suctioned before or after the initiation of PPV. Direct laryngoscopy and endotracheal suctioning are not routinely required for newborns delivered through MSAF, but they can be beneficial in newborns who have evidence of airway obstruction while receiving PPV.

Vascular Access

2020 (New): For babies requiring vascular access at the time of delivery, the umbilical vein is the recommended route. If IV access is not feasible, it may be reasonable to use the IO route.

Why: Newborns who have failed to respond to PPV and chest compressions require vascular access to infuse epinephrine and/or volume expanders. Umbilical venous catheterization is the preferred technique in the delivery room. IO access is an alternative if umbilical venous access is not feasible or care is being provided outside of the delivery room. Several case reports have described local complications associated with IO needle placement.

Termination of Resuscitation

2020 (Updated): In newly born babies receiving resuscitation, if there is no heart rate and all the steps of resuscitation have been performed, cessation of resuscitation efforts should be discussed with the healthcare team and the family. A reasonable time frame for this change in goals of care is around 20 minutes after birth.

2010 (Old): In a newly born baby with no detectable heart rate, it is appropriate to consider stopping resuscitation if the heart rate remains undetectable for 10 minutes.

Why: Newborns who have failed to respond to resuscitative efforts by approximately 20 minutes of age have a low likelihood of survival. For this reason, a time frame for decisions about discontinuing resuscitation efforts is suggested, emphasizing engagement of parents and the resuscitation team before redirecting care.

Human and System Performance

2020 (Updated): For participants who have been trained in neonatal resuscitation, individual or team booster training should occur more frequently than every 2 years at a frequency that supports retention of knowledge, skills, and behaviors.

2015 (Old): Studies that explored how frequently healthcare providers or healthcare students should train showed no differences in patient outcomes but were able to show some advantages in psychomotor performance and knowledge and confidence when focused training occurred every 6 months or more frequently. It is therefore suggested that neonatal resuscitation task training occur more frequently than the current 2-year interval.

Why: Educational studies suggest that cardiopulmonary resuscitation knowledge and skills decay within 3 to 12 months after training. Short, frequent booster training has been shown to improve performance in simulation studies and reduce neonatal mortality in low-resource settings. To anticipate and prepare effectively, providers and teams may improve their performance with frequent practice.

Resuscitation Education Science

Effective education is a key variable in improving survival outcomes from cardiac arrest. Without effective education, lay rescuers and healthcare providers would struggle to consistently apply the science supporting the evidence-based treatment of cardiac arrest. Evidence-based instructional design is critical to improving provider performance and patient-related outcomes from cardiac arrest. Instructional design features are the active ingredients, the key elements of resuscitation training programs that determine how and when content is delivered to students.

In the 2020 Guidelines, we provide recommendations about various instructional design features in resuscitation training and describe how specific provider considerations influence resuscitation education. Here, we highlight new and updated recommendations in education that we believe will have a significant impact on outcomes from cardiac arrest.

Summary of Key Issues and Major Changes

- The use of deliberate practice and mastery learning during life support training, and incorporating repetition with feedback and minimum passing standards, can improve skill acquisition.
- Booster training (ie, brief retraining sessions) should be added to massed learning (ie, traditional course based) to assist with retention of CPR skills. Provided that individual students can attend all sessions, separating training into multiple sessions (ie, spaced learning) is preferable to massed learning.
- For laypersons, self-directed training, either alone or in combination with instructor-led training, is recommended to improve willingness and ability to perform CPR. Greater use of self-directed training may remove an obstacle to more widespread training of laypersons in CPR.
- Middle school– and high school–age children should be trained to provide high-quality CPR.
- In situ training (ie, resuscitation education in actual clinical spaces) can be used to enhance learning outcomes and improve resuscitation performance.
- *Virtual reality*, which is the use of a computer interface to create an immersive environment, and *gamified learning*, which is play and competition with other students, can be incorporated into resuscitation training for laypersons and healthcare providers.
- Laypersons should receive training in how to respond to victims of opioid overdose, including the administration of naloxone.
- Bystander CPR training should target specific socioeconomic, racial, and ethnic populations who have historically exhibited lower rates of bystander CPR. CPR training should address gender-related barriers to improve rates of bystander CPR performed on women.
- EMS systems should monitor how much exposure their providers receive in treating cardiac arrest victims. Variability in exposure among providers in a given EMS system may be supported by implementing targeted strategies of supplementary training and/or staffing adjustments.
- All healthcare providers should complete an adult ACLS course or its equivalent.

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