American Red Cross

Guidelines Highlights

2021

HEALTHCARE

American Red Cross
Training Services

The American Red Cross *Guidelines Highlights 2021* is overseen by the American Red Cross Scientific Advisory Council and is part of the American Red Cross training services programs. The emergency care procedures outlined in these updates and guidelines reflect the standard of knowledge and accepted emergency practices in the United States at the time these updates and guidelines were published. It is the reader's responsibility to stay informed of changes in emergency care procedures.

Science and Technical Content

The scientific content and evidence within the American Red Cross *Guidelines Highlights 2021* are consistent with the most current science and treatment recommendations from:

- The International Liaison Committee on Resuscitation (ILCOR)
- The International Federation of Red Cross and Red Crescent Societies (IFRC)
- The Policy Statements, Evidence Reviews and Guidelines of:
    - American Academy of Pediatrics (AAP)
    - American College of Emergency Physicians (ACEP)
    - American College of Obstetrics and Gynecology (ACOG)
    - American College of Surgeons (ACS)
    - Committee on Tactical Combat Casualty Care (CoTCCC)
    - Obstetric Life Support™ (OBLS™)
    - Society of Critical Care Medicine (SCCM) and the American College of Critical Care Medicine (ACCM)
    - Surviving Sepsis Campaign (SSC)

Dedication

The American Red Cross *Guidelines Highlights 2021* is dedicated to the nurses, physicians, prehospital professionals, therapists, technicians, law enforcement, fire/rescue, advanced practice professionals, lifeguards, first responders, lay responders and all other professionals and individuals who are prepared and willing to take action when an emergency strikes or when a person is in need of care. These updates and guidelines are also dedicated to the employees and volunteers of the American Red Cross who contribute their time and talent to supporting and teaching lifesaving skills worldwide.

Acknowledgments

Many individuals shared in the development of the American Red Cross *Guidelines Highlights 2021* in various scientific, technical, editorial, creative and supportive ways. Their commitment to excellence made these updates and guidelines possible.

Content Direction

The development of these updates and guidelines would not have been possible without the leadership, valuable insights and dedication of the subject matter experts, who generously shared their time to ensure the highest quality programs.

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American Red Cross Scientific Advisory Council

Since 1909, the American Red Cross has provided best-in-class resuscitation, first aid and safety education and certification, enabling students to obtain the competency required for effective recognition and care and leading to better outcomes for all those treated.

Behind every course stands a team of experts ensuring that what is taught is based on the latest clinical and educational science. This team, known as the American Red Cross Scientific Advisory Council, is a panel of 60+ nationally and internationally recognized experts from a variety of medical, nursing, EMS, scientific, educational and academic disciplines.

With members from a broad range of professional specialties, the Council has an important advantage: a broad, multidisciplinary expertise in evaluating existing and new assessment methodologies and technologies, therapies, and procedures, and the educational methods to teach them. Additionally, with on-the-ground experience, its members bring the know-how for real-world experience. The Council provides authoritative guidance on resuscitation, first aid, CPR, nursing, prehospital medicine, emergency and critical care, rescue practices, emergency preparedness, aquatics, disaster health and education.

We encourage you to visit our Scientific Advisory Resource Center at redcross.org/science.

We would like to extend our gratitude to the members of the American Red Cross Scientific Advisory Council for their guidance and ongoing commitment:

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Introduction

The American Red Cross *Guidelines Highlights 2021* is a summary of the key guidelines found in the American Red Cross *Focused Updates and Guidelines 2021*. Whereas the American Red Cross *Focused Updates and Guidelines 2021* provides a more comprehensive summary of the scientific evidence from recent reviews, the American Red Cross *Guidelines Highlights 2021* reviews selected new guidelines and changes that are the most impactful on the delivery of education and resuscitation care. Supporting evidence reviews are unreferenced in this summary publication, but can found in the full American Red Cross *Focused Updates and Guidelines 2021*. Readers should refer to the American Red Cross *Focused Updates and Guidelines 2021* for evidence summaries and insights into each of these topics. Topics that are not discussed in the American Red Cross *Guidelines Highlights 2021* but are part of the American Red Cross *Focused Updates and Guidelines 2021* are listed in Appendix B. Readers are encouraged to review the full American Red Cross *Focused Updates and Guidelines 2021* to ensure education delivered and care provided is based on the latest science and American Red Cross guidelines.

The American Red Cross *Guidelines Highlights 2021* presents a summary of key guidelines in the topic areas of Basic Life Support, Advanced Life Support, Pediatric Advanced Life Support, Neonatal Life Support and Education Science.

In the *Guidelines Highlights 2021*, each guideline is noted as New, Updated or Reaffirmed. Guidelines that are new are classified as *New*. Guidelines that existed previously but now have minor wording changes (primarily for clarity) are classified as *Updated*. Guidelines that have undergone an updated systematic review, scoping review or search for new scientific literature and determined to still be valid are classified as *Reaffirmed*. Refer to Appendix A, Key Reaffirmed Guidelines, that provides a summary of past guidelines that have been reaffirmed. Related updated guidelines are presented with the reaffirmed guidelines, where needed, for context.

Examples include:

In Basic Life Support, new and updated guidelines are presented for the optimal surface for providing cardiopulmonary resuscitation (CPR) following in-hospital cardiac arrest. In Advanced Life Support, new guidelines are presented for providing CPR and defibrillation to a prone patient and for use of coronary angiography in post-cardiac arrest patients. In Pediatric Advanced Life Support, new guidelines are presented for the use of post-cardiac arrest active temperature control. In Neonatal Life Support, guidelines are presented for cord clamping for preterm and term infants. In Education Science, key guidelines focus on the use of blended learning activities in addition to traditional, instructor-led training to adults and high school-aged children for BLS course content and skills.

Accompanying the *Guidelines Highlights 2021* and reflecting updated science and guidelines are one new and two updated American Red Cross Emergency Code Cards for Advanced Life Support and Pediatric Advanced Life Support including the new Advanced Life Support Sepsis and Septic Shock: Screening, Early Intervention and Resuscitation Code Card. (Refer to Appendix C, New and Updated Code Cards, and see the Red Cross Learning Center).

Key Messages from New and Updated Guidelines

The American Red Cross *Guidelines Highlights 2021* includes several important new and updated guidelines, which are summarized as follows:

- A person in cardiac arrest in a hospital setting does not need to be moved from their bed to the floor to improve chest compression depth, but if their bed has CPR mode, this may be quickly activated to provide a firmer surface.
- The initial resuscitation of an adult or pediatric drowning victim by trained responders and healthcare professionals may include providing up to 5 rescue breaths/manual ventilations prior to compressions.
- When an adult or pediatric patient is in the prone position without an advanced airway and develops cardiac arrest, they should be turned to the supine position immediately and CPR initiated. For patients with an advanced airway in place who develop cardiac arrest while prone and who cannot be immediately supinated, CPR should begin while the patient is prone, and defibrillation attempted as indicated while prone.
- When caring for unresponsive adult post-cardiac arrest patients without ST-segment elevation, an early or delayed approach to coronary angiography may be considered, while an early approach should be considered for those with ST-segment elevation.
- Post-cardiac arrest temperature control for adult and pediatric patients who remain unconscious after ROSC from out-of-hospital cardiac arrest (OHCA) or in-hospital cardiac arrest (IHCA) should focus on active fever prevention and maintaining a core temperature of 37.5° C (99.5° F) or less. In certain clinical presentations, hypothermic temperature control may be considered for adult and pediatric patients who remain unconscious after ROSC. The use of surface or endovascular temperature control techniques is suggested, while temperature control devices that include a feedback system with continuous temperature monitoring are preferred to maintain a target temperature.
- For adults with sepsis-induced hypoperfusion or septic shock, at least 30 ml/kg of intravenous crystalloid fluids may be administered within the first 3 hours of resuscitation. Fluid resuscitation of adults with sepsis or septic shock may be further guided by dynamic measures, such as stroke volume or pulse pressure variation in response to fluid boluses; by cardiac output response to passive leg raising; by echocardiography; by capillary refill time; and by decreasing serum lactate levels.
- Antimicrobials should be administered immediately or within 1 hour of recognition of septic shock, when there is a high likelihood of sepsis, and for adults with undifferentiated shock and possible sepsis. Adults with possible sepsis without shock may be evaluated first and if concern for sepsis persists, antimicrobials should be given within 3 hours from the time when sepsis was first recognized.

- When treating an adult with septic shock unresponsive to fluid resuscitation, if vasopressors are required, an initial target mean arterial pressure (MAP) of 65 mmHg should be used.
- Use norepinephrine as first-line vasopressor; if unavailable, epinephrine or dopamine remain alternative vasopressors. Rather than increasing the dose of norepinephrine when hypotension (MAP less than 65 mmHg) persists, consider adding vasopressin; should hypotension persist despite adding vasopressin, consider adding epinephrine. For adults with septic shock and cardiac dysfunction, add dobutamine to norepinephrine or use epinephrine alone.
- For term and late preterm infants (born at 34+0 weeks' gestation) who do not require immediate resuscitation at birth, clamping of the cord may be delayed for 60 or more seconds. For preterm infants (born at 34+0 weeks' gestation) who do not require immediate resuscitation at birth, it is suggested that umbilical cord clamping be delayed for at least 30 seconds. For preterm infants (born at 28+0 weeks' to 33+6 weeks' gestation) who do not require immediate resuscitation after birth, intact cord milking is a reasonable alternative to deferred cord clamping, while intact cord milking is not advised for infants born at less than 28+0 weeks' gestation.
- A T-piece resuscitator should be used for newborns requiring positive pressure ventilation (PPV) at birth, or if unavailable, a self-inflating bag, with or without a positive end-expiratory pressure valve, can be used.

Basic Life Support

Optimal Surface for CPR

UPDATED
- It is reasonable to perform manual chest compressions on a firm surface when possible.

NEW
- It is suggested that a person in cardiac arrest in the hospital setting not be moved from their bed to the floor to improve chest compression depth.

NEW
- If a person in cardiac arrest is in a bed with CPR mode to increase mattress stiffness, it is reasonable to activate this mode.

Insights

Manikin studies of CPR performed on various hospital mattresses show little or no improvement in compression depth when compared with CPR performed on the floor or with the use of a backboard between the manikin and mattress. In addition, moving a person from a hospital bed to the floor poses risks of harm to both patient and healthcare professionals.

Head-Up CPR

NEW
- Head-up CPR should not be routinely used for cardiac arrest.

Insights

Additional clinical trials are needed to determine if active compression decompression with the use of an impedance threshold device, deferred PPVs and gradual head and torso elevation may lead to improved short-term outcomes from cardiac arrest.

Harm to Those Performing CPR

UPDATED
- Although the risk of harm while performing CPR is considered low, precautions should be taken to minimize the risk of transmission of infectious disease or defibrillator-associated injury. This may include, but is not limited to:
  - Using standard precautions to provide patient care in all settings, to include performance of hand hygiene and use of personal protective equipment (PPE) (i.e., gloves, gown and a face mask) based on activities being performed and the risk assessment.
  - Using additional PPE, including an N95 or higher-level respirator, and eye protection (goggles or face shield) for aerosol-generating procedures or resuscitation of patients. Disposable N95 respirators should be discarded after leaving the patient's room or care area.
  - Using an inline filter for mouth-to-mask or bag-valve-mask ventilation.
  - Performing hand hygiene after removal and disposal of PPE or after providing CPR without PPE.
  - Avoiding touching a person in cardiac arrest when advised by automated external defibrillator prompts prior to the delivery of a shock.

Insights

Harm to rescuers from providing CPR is uncommon, but may be due to physical injury such as muscle strains, defibrillator-associated injury, fatigue or infectious disease transmission. The guidelines reflect measures to reduce the risk of harm when providing CPR.

CPR for Drowning Process Resuscitation

REAFFIRMED
- Initiate compression-ventilation CPR (CV-CPR) for cardiac arrest following drowning in adults, children and infants. If CV-CPR is not possible, compression-only CPR should be performed.

REAFFIRMED
- For adults, children and infants with the drowning process and after determining the presence of cardiac arrest, resuscitation should start by opening the airway, providing 2 rescue breaths/manual ventilations and then continuing CPR by providing cycles of 30 compressions followed by 2 rescue breaths/manual ventilations.

NEW
- Trained lay responders and healthcare professionals may consider providing more than 2 initial breaths when starting resuscitation of a drowning victim. Five initial rescue breaths/manual ventilations are suggested based on current practice.

UPDATED
- A CPR compression-to-ventilation ratio of 15:2 should be used for children and infants with the drowning process and cardiac arrest when two healthcare professionals or trained lay responders are available.

Insights

Hypoxemia plays a major role in most cases of cardiac arrest following drowning, and ventilations and oxygenation should be a priority of treatment. This includes beginning resuscitation with ventilations prior to chest compressions. Observational studies report an association between CV-CPR and survival, between CV-CPR and neurologically favorable survival in children 5 years old to 15 years old, and between providing ventilations alone and the return of consciousness. Additional ventilations may help overcome high lung resistance from fluid and foam occlusion of airways and contribute to early successful resuscitation.

Prehospital Oxygen in Drowning Process Resuscitation

NEW
- If available, supplemental oxygen may be provided empirically to drowning victims who are conscious and with respiratory symptoms. Low-flow oxygen is suggested for those with mild symptoms and high-flow oxygen at 15 liters per minute through a facemask is suggested for severe symptoms. Once pulse oximetry is available, supplemental oxygen therapy should be appropriately titrated.

NEW
- For the drowning victim in cardiopulmonary arrest, supplemental oxygen should be provided, if available, with ventilations.

Insights

The drowning process typically begins with asphyxia followed by hypoxemia, global ischemia and eventual cardiac arrest—suggesting that the use of oxygen in the prehospital setting may be beneficial. In the prehospital setting, oxygen administration is guided by pulse oximetry; however, pulse oximetry can be unreliable in drowning victims, particularly following cold-water submersion—supporting the guidelines for empirical use of oxygen, when available, for those with respiratory distress or in cardiac arrest.

Advanced Life Support

CPR and Defibrillation in the Prone Patient

NEW

- For patients in a prone position who develop cardiac arrest:
  - If an advanced airway is not in place, the patient should be turned to a supine position as quickly as possible, and CPR initiated.
  - If an advanced airway is in place and immediate supination is not feasible or poses a risk to the patient, CPR should begin while the patient is prone.
  - If the patient cannot be immediately supinated, defibrillation should be attempted in the prone position.
  - For patients with an advanced airway in place in the prone position while receiving CPR, the quality of CPR should be assessed with end-tidal carbon dioxide and arterial blood pressure monitoring, if feasible.

Insights

The prone position is used to improve oxygenation with or without an advanced airway in place. It may not be feasible to supinate a patient who is prone, mechanically ventilated and connected to hemodynamic monitors. Studies are needed to compare outcomes following CPR in the prone position with CPR in a supine position.

Consciousness During CPR

NEW

- Sedatives and/or analgesics used in critical care may be considered in small doses for patients with possible consciousness during CPR.

Insights

Some degree of consciousness of a person in cardiac arrest during CPR is occasionally described by rescuers or survivors. While pharmacological intervention has been described, dosing during resuscitation is unclear—but may be based on local protocols for critically ill patients.

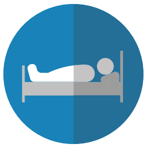
Performing CPR and Defibrillation in the Prone Patient

Advanced Airway?

NO

→ Rapidly turn the patient to a supine position.

→ Begin CPR.



YES

RAPID SUPINATION FEASIBLE:

→ Turn the patient to a supine position.

→ Begin CPR.

YES

RAPID SUPINATION NOT FEASIBLE:

→ Begin CPR while prone.

→ Defibrillate while prone.

→ Assess quality of CPR with $ETCO_2$ and arterial BP, if feasible.

Advanced Airway Management in Drowning Process Resuscitation

NEW • Advanced airway management for victims of drowning with cardiac arrest should be by supraglottic airway or tracheal intubation, depending on local protocol or the skill/experience of the healthcare professional.

Insights

There is no direct evidence to show a benefit from one airway management technique compared with another following cardiac arrest in drowning victims, and guidelines for airway management during cardiac arrest apply to drowning victims.

Mechanical Ventilation in Drowning Process Resuscitation

NEW • Healthcare professionals caring for adults and children with oxygenation or ventilation compromise following submersion or the drowning process may consider the use of noninvasive ventilation strategies (i.e., continuous positive airway pressure and bilevel positive airway pressure) or mechanical ventilation, based on clinical judgment.

Insights

Evidence suggests that both mechanical ventilation and noninvasive ventilation in adults and children with moderate to severe lung injury following drowning are associated with rapid improvement of oxygenation and a short intensive care unit length of stay. Noninvasive ventilation is a viable option for moderate to severe lung injury in hemodynamically stable patients with a higher Glasgow Coma Scale score and based on clinical judgment.

Extracorporeal Membrane Oxygenation in Drowning Process Resuscitation

NEW • Use of extracorporeal CPR may be considered by healthcare professionals as a rescue therapy for select patients in cardiac arrest secondary to drowning.

NEW • The use of extracorporeal membrane oxygenation (ECMO) may be considered by healthcare professionals in select patients with severe acute respiratory distress syndrome (ARDS) following drowning.

Insights

Survival has been reported following drowning in patients requiring CPR prior to ECMO, with factors including hyperkalemia, asystole as an initial rhythm, submersion duration greater than 10 minutes and a low blood pH associated with worse outcomes. A core body temperature less than 26° C (78.8° F) and normal serum potassium have been reported as associated with good outcomes. ECMO use has also been reported for respiratory failure, with higher survival to discharge rates among patients without a cardiac arrest.

Early Coronary Angiography After Return of Spontaneous Circulation (ROSC)

NEW • An early or a delayed approach is reasonable for unresponsive post-arrest patients without ST-segment elevation when coronary angiography is being considered.

NEW • Early coronary angiography should be considered in comatose post-cardiac arrest patients without ST-segment elevation.

Insights

Evidence from observational studies of cardiac arrest patients post-ROSC, and with all electrocardiogram (ECG) patterns regardless of the initial rhythm, indicate a survival benefit from early coronary angiography, while evidence from a randomized controlled trial does not show improved survival outcomes with early coronary angiography. Despite this conflicting evidence, an ECG post-ROSC may not be reliable for identifying myocardial infarction, and acute coronary lesions are common in patients with ST-elevation myocardial infarction (STEMI) or new left bundle-branch block post-ROSC. Early coronary angiography is considered standard of care for STEMI without cardiac arrest, and evidence has not been identified to alter this strategy for STEMI following cardiac arrest with ROSC.

Post-Cardiac Arrest Temperature Control

NEW • For patients who remain unconscious after return of spontaneous circulation (ROSC) from cardiac arrest, it is reasonable to actively prevent fever and maintain a core temperature of 37.5° C (99.5° F) or less for at least 72 hours.

NEW • While a normothermic temperature control approach is preferred, patients with mild hypothermia who remain unconscious after ROSC should not be actively warmed to achieve normothermia.

NEW • Surface or endovascular temperature control techniques may be considered when temperature control is used in patients who remain unconscious after ROSC.

NEW • Temperature control devices that include a feedback system based on continuous temperature monitoring are preferred to maintain a target temperature in post-cardiac arrest patients who remain unconscious after ROSC.

UPDATED • Hypothermic temperature control may be considered in certain subpopulations of cardiac arrest patients who remain unconscious after ROSC.

NEW • Rapid infusion of large volumes of cold intravenous fluid immediately after ROSC should not be used for prehospital cooling of post-cardiac arrest patients.

Insights

Hypothermic temperature control has been advocated for adults with sustained ROSC following OHCA and who remain unconscious to reduce global oxygen demand and improve clinical outcomes. A recent large randomized controlled trial (the targeted temperature management [TTM2] trial) and a systematic review did not find statistically significant improvement for survival or neurological outcome after cardiac arrest with hypothermic temperature control at 32° C to 34° C (89.6° F to 93.2° F) compared with normothermia. However, most cardiac arrest cases included in large trials have been due to a primary cardiac etiology, making results potentially not generalizable to all cardiac arrests, such as those following hypoxemia. Thus, while post-cardiac arrest temperature control should focus primarily on fever avoidance and maintaining normothermia, hypothermic temperature control remains an option in certain clinical situations.

Initial Resuscitation of Adults with Sepsis and Septic Shock

NEW

- Adult patients with sepsis and septic shock should be treated immediately and resuscitated, to include:
    - Administering at least 30 ml/kg of intravenous crystalloid fluid within the first 3 hours of resuscitation of patients with sepsis-induced hypoperfusion or septic shock.
    - Use of dynamic parameters, such as response to passive leg raise or fluid bolus, stroke volume variation, or pulse pressure variation over static parameters or physical examination alone to guide fluid resuscitation.
    - Using capillary refill time as an adjunct to other measures of perfusion to help guide resuscitation. Use of capillary refill time to guide resuscitation should be accompanied by frequent and repeated comprehensive patient evaluation to predict or improve early recognition of fluid overload.
    - Using a decrease in serum lactate to help guide resuscitation of patients with an elevated lactate level.
    - Using an initial target MAP of 65 mmHg for septic shock requiring vasopressors.

Insights

Sepsis and septic shock remain significant healthcare burdens with high mortality rates. Early recognition and resuscitation are key to management, with evidence supporting the use of an initial intravenous crystalloid fluid bolus followed by use of serum lactate level trends and dynamic measures to further guide resuscitation with additional fluid boluses or vasopressor therapy.

Initial Resuscitation of Sepsis and Septic Shock in Adults

0

Initial resuscitation

→ Begin treatment and resuscitation immediately.

3

Within first 3 hours for sepsis-induced hypoperfusion or septic shock

→ Intravenous crystalloids fluids 30 ml/kg

Antibiotics

1

SEPSIS	SEPTIC SHOCK	ANTIMICROBIAL TIMING
Definite or Probable	Present or Absent	Immediately, ideally within 1 hour of recognition of septic shock
Possible	Present	Immediately, ideally within 1 hour of recognition of septic shock

3

SEPSIS	SEPTIC SHOCK	ANTIMICROBIAL TIMING
Possible	Absent	Rapid evaluation, and if concern for infection persists, it is reasonable to administer antimicrobials within 3 hours from the time when sepsis was first recognized

Measuring Response to Therapy

Dynamic parameters

(response to passive leg raise or fluid bolus, stroke volume variation, pulse pressure variation)

→ May help guide resuscitation over static parameters or physical examination alone

Capillary refill time

→ May be used as an adjunct to other measures of perfusion to help guide resuscitation

→ Should be accompanied by frequent and repeated comprehensive patient evaluation to predict or improve early recognition of fluid overload

Change in serum lactate

→ May help guide resuscitation of patients with an elevated serum lactate level

Mean arterial pressure

→ Use an initial target MAP of 65 mmHg for septic shock requiring vasopressors

Timing of Antimicrobial Administration for Sepsis and Septic Shock

NEW • For adults with a high likelihood of sepsis, with or without shock, antimicrobials should be administered immediately, ideally within 1 hour of recognition of septic shock.

NEW • For adults with shock and possible sepsis, antimicrobials should be administered immediately, ideally within 1 hour of recognition.

NEW • For adults with possible sepsis without shock, it is reasonable to rapidly evaluate the patient and if concern for infection persists, administer antimicrobials within 3 hours from the time when sepsis was first recognized.

NEW • For adults with sepsis or septic shock who are at high risk for methicillin-resistant *Staphylococcus aureus* (MRSA), empiric antimicrobials with coverage for MRSA should be initiated.

NEW • For adults with sepsis or septic shock who are at low risk for MRSA, it is reasonable to not include empiric antimicrobial coverage for MRSA.

NEW • For adults with sepsis or septic shock who are at high risk of multidrug resistant (MDR) organisms, use two antimicrobials with gram-negative coverage for empiric treatment.

NEW • For adults with sepsis or septic shock who are at low risk of MDR organisms, use one gram-negative antimicrobial for empiric treatment.

Insights

Larger studies have reported a strong association between each hour of delay from emergency department arrival to antimicrobial administration and in-hospital mortality for septic shock patients, while evidence suggests an increase in mortality for sepsis patients without shock when the time to antimicrobial administration exceeds 3 hours to 5 hours from hospital arrival and/or sepsis recognition. Thus, guidelines now emphasize the immediate (or within 1 hour of recognition) administration of antimicrobials for adults with a high likelihood of sepsis with or without shock, and for adults with shock and possible sepsis. For other patients with possible sepsis without shock, it is suggested that rapid investigation be pursued with the administration of antimicrobials within 3 hours from the time sepsis is first recognized.

Vasoactive Agents for Adults with Septic Shock

- NEW • Adults with septic shock should have vasopressors begun through peripheral access to improve MAP, rather than waiting for central access.
- NEW • Norepinephrine should be used as the first-line vasopressor agent in adults with septic shock unresponsive to IV fluid resuscitation.
- NEW • It is reasonable to use epinephrine or dopamine for adults with septic shock when norepinephrine is not available.
- NEW • For adults with septic shock and persistent MAP less than 65 mmHg on norepinephrine, consider adding vasopressin rather than increasing the dose of norepinephrine.
- NEW • For adults with septic shock and persistent MAP less than 65 mmHg on norepinephrine and vasopressin, consider adding epinephrine.
- NEW • For adults with septic shock and cardiac dysfunction, add dobutamine to norepinephrine or use epinephrine alone.
- NEW • For adults with septic shock, consider invasive arterial blood pressure monitoring as soon as practical and if resources are available.

Insights

Patients with septic shock who do not respond to fluid resuscitation will require vasopressor support to maintain a MAP of 65 mmHg. Compared with dopamine, norepinephrine has been shown to increase MAP with lower mortality or risk of arrhythmia and, if available, remains the initial choice for vasopressor therapy. When septic shock persists following the use of norepinephrine, rather than increasing the dose of norepinephrine, the addition of vasopressin may improve survival for some patients. Epinephrine may be added for persistent hypotension or for patients with cardiac dysfunction and persistent hypoperfusion despite adequate fluid resuscitation and arterial blood pressure.

Oxygenation and Ventilatory Management of Sepsis with Respiratory Failure

- NEW • For adults with sepsis-induced hypoxemic respiratory failure, it is reasonable to use high-flow nasal oxygen when tolerated. Consider the use of noninvasive ventilation based on clinical judgment.
- NEW • For mechanically ventilated adults with sepsis-induced acute respiratory distress syndrome (ARDS) and for sepsis-induced respiratory failure without ARDS, use a low-tidal volume strategy over a high-tidal volume strategy.
- NEW • For mechanically ventilated adults with sepsis-induced severe ARDS, target an upper limit goal of 30 mmHg for plateau pressure.
- NEW • For adults with moderate to severe sepsis-induced ARDS, use a prone position for greater than 12 hours per day.

Vasoactive Agents Pathway for Adults in Septic Shock*

For patients in septic shock:

- Use norepinephrine as the first-line vasopressor.
- Consider using epinephrine or dopamine when norepinephrine is not available.
- Consider initiating invasive arterial blood pressure monitoring.

If central access has not been obtained:

- Consider starting vasopressors peripherally in a vein in or proximal to the antecubital fossa until central access is secured.

For patients in septic shock on norepinephrine with persistent MAP less than 65 mmHg:

- Consider adding vasopressin rather than increasing the dose of norepinephrine.

For patients in septic shock with persistent MAP less than 65 mmHg on norepinephrine and vasopressin:

- Consider adding epinephrine.

For patients in septic shock with cardiac dysfunction and persistent hypoperfusion despite adequate volume status and arterial blood pressure:

- Consider adding dobutamine to norepinephrine or use epinephrine alone.

*Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021

Insights

A strategy of high-flow nasal cannula oxygen therapy has been shown in one controlled trial to improve 90-day survival compared with noninvasive ventilation for hypoxemic respiratory failure in the absence of hypercapnia. A high-flow nasal cannula oxygen strategy is less effective than noninvasive ventilation at reducing the work of breathing and providing positive end-expiratory pressure; thus, patients managed with this strategy are considered at high risk of needing intubation and require close monitoring for ventilatory failure. Previous meta-analyses have shown increased survival in patients with ARDS and a partial pressure of oxygen (PaO_2)/ fraction of inspired oxygen (FiO_2) ratio less than 200 mmHg who were placed in a prone position for greater than 12 hours a day and within the first 36 hours of intubation, compared with use of the supine position.

Pediatric Advanced Life Support

CPR and Defibrillation in the Prone Patient

NEW
- For pediatric patients in a prone position who develop cardiac arrest:
  - If an advanced airway is not in place, the patient should be turned to a supine position as quickly as possible and CPR initiated.
  - If an advanced airway is in place and immediate supination is not feasible or poses a risk to the patient, CPR should begin while the patient is prone.
  - If the patient cannot be immediately supinated, defibrillation should be attempted in the prone position.
  - For patients with an advanced airway in place in the prone position while receiving CPR, the quality of CPR should be assessed with end-tidal carbon dioxide and arterial blood pressure monitoring, if feasible.

Insights

Survival to hospital discharge has been reported in the majority of case reports of children who were in a prone position in an operating room setting when CPR was started. For children who are prone, mechanically ventilated and with hemodynamic monitoring, immediate supination may not be feasible; in this case, CPR should be initiated while prone, and defibrillation attempted as indicated. For cardiac arrest in the prone position without an advanced airway in place, the child should be quickly turn to a supine position and CPR begun.

Post-Cardiac Arrest Temperature Control in Children and Infants

- NEW • For children and infants who remain unconscious after return of spontaneous circulation (ROSC) from cardiac arrest, it is reasonable to actively prevent fever and maintain a core temperature of 37.5° C (99.5° F) or less
- NEW • While a normothermic temperature control approach is preferred, patients with mild hypothermia who remain unconscious after ROSC should not be actively warmed to achieve normothermia.
- NEW • Surface or endovascular temperature control techniques may be considered when temperature control is used in patients who remain unconscious after ROSC.
- NEW • Temperature control devices that include a feedback system based on continuous temperature monitoring are preferred to maintain a target temperature in post-cardiac arrest patients who remain unconscious after ROSC.
- NEW • Hypothermic temperature control may be considered in certain clinical presentations for children and infants after out-of-hospital and in-hospital (IHCA) cardiac arrest and who remain unconscious after ROSC.
- NEW • Rapid infusion of large volumes of cold intravenous fluid immediately after ROSC should not be used for prehospital cooling of post-cardiac arrest patients.

Insights

The use of therapeutic hypothermia between 32° C to 34° C (89.6° F to 93.2° F) has not been shown to be associated with a survival benefit in children and infants who remain unconscious following ROSC from cardiac arrest, when compared with maintaining a target temperature between 36° C and 37.5° C (96.8° F to 99.5° F) However, most cardiac arrest cases included in large trials have been due to a primary cardiac etiology, making results potentially not generalizable to all cardiac arrests, such as those seen commonly in children with hypoxemia. Thus, while post-cardiac arrest temperature control should focus primarily on fever avoidance and maintaining normothermia, hypothermic temperature control remains an option in certain clinical situations.

Neonatal Life Support

Preterm Cord Management

NEW • Delayed umbilical cord clamping for at least 30 seconds is suggested for preterm infants born at less than 34+0 weeks' gestation not requiring immediate resuscitation after birth.

NEW • For infants born at 28+0 weeks' to 33+6 weeks' gestation who do not require immediate resuscitation after birth, intact cord milking is a reasonable alternative to deferred cord clamping.

NEW • For infants born at less than 28+0 weeks' gestation, intact cord milking is not advised.

Insights

Clamping the umbilical cord at birth triggers cardiovascular physiological changes in newborns. Recent evidence suggests that for preterm infants, early cord clamping may be harmful, while delayed cord clamping may be associated with some benefit for infants born at less than 34+0 weeks' gestation who do not require immediate resuscitation after birth. The evidence for intact cord milking of preterm infants is less clear and this approach to cord management is considered an alternative to deferred cord clamping for infants born at 28+0 weeks' to 33+6 weeks' gestation and who do not require immediate resuscitation after birth. However, one study suggested harm for infants born at less than 28+0 weeks' gestation.

Term Cord Management

NEW • It is reasonable to delay clamping of the cord for 60 or more seconds for term and late preterm infants born at 34 weeks' or more gestation and who are vigorous or considered to not require immediate resuscitation at birth.

Insights

Umbilical cord management at birth can impact the volume of placental transfusion to the infant, potentially contributing to development of iron deficiency anemia. Recent evidence shows that delayed cord clamping for greater than or equal to 30 seconds may improve hematological measures within 24 hours and 7 days after birth.

Positive Pressure Ventilations at Birth

NEW • For newborns requiring positive pressure ventilation at birth, a T-piece resuscitator should be used. If a T-piece resuscitator is unavailable, or staff are untrained/not competent in its use, a self-inflating bag, with or without a positive end-expiratory pressure valve, can be used.

Insights

There is evidence that the use of a T-piece resuscitator for newborns requiring PPV reduces the duration of PPV and risk of bronchopulmonary dysplasia as compared with use of a self-inflating bag, although there is no difference in the risk of in-hospital mortality.

Family Presence During Neonatal Resuscitation

NEW • It is reasonable for parents to be present, if they desire, during the resuscitation of neonates and where resources permit.

Insights

Studies suggest that parents wish to be offered the opportunity to be present during the resuscitation of their child. While an organized approach to family presence during resuscitation, including use of trained support staff, is offered in some medical centers, the decision to be present, if offered, needs to be the choice or personal preference of the parent.

Education Science

Self-Directed Digital Basic Life Support Training

NEW
- Basic Life Support (BLS) course content and skills may be offered to adult and high-school aged children through:
  - Instructor-led training, including manikin practice.
  - Blended learning as:
    - A self-directed online session to gain knowledge and understanding of the information and an in-person automated manikin practice session with feedback for skill training.
    - A self-directed online session to gain knowledge and understanding of the information and an in-person instructor-led session for manikin practice and feedback.

Insights

Most studies do not report a difference in educational outcomes and skills competency for BLS immediately post-training and up to 1 year later following either instructor-led training or digital training with video or interactive computer programs and manikin practice with a feedback device. This supports the use of flexible, hybrid-learning opportunities.

Appendix A: Key Reaffirmed Guidelines

Basic Life Support

Early Access to Care

- Public access defibrillation programs should be an essential part of the management of out-of-hospital cardiac arrest, with availability at locations that have high incidences of cardiac arrest.
- Standardized, evidence-based protocols should be used by dispatch centers to enable recognition of cardiac arrest. Instructions should be provided for performing compression-only CPR for suspected out-of-hospital cardiac arrest to callers who are untrained in CPR or who are unable to recall CPR performance steps.

Starting CPR and CPR Sequence

- If available, use a mobile phone with speaker mode to call 9-1-1 in parallel with beginning CPR.
- Bystanders should begin CPR based on their assessment and without concern for harm to persons not in cardiac arrest.
- Once cardiac arrest is recognized, resuscitation should begin with compressions. Healthcare professionals may consider ventilations first in pediatric patients with primary respiratory etiologies of cardiac arrest.
- For the drowning process resuscitation, once cardiac arrest is recognized, resuscitation should begin with rescue breaths/manual ventilations.
- A compression-to-ventilation (CV) ratio of 30:2 should be used for CPR in adults with cardiac arrest without an advanced airway.
- A CV ratio of 30:2 should be used for CPR in children and infants with cardiac arrest with one lay responder/ healthcare professional and without an advanced airway.
- A CV ratio of 15:2 should be used in children and infants with cardiac arrest and with two healthcare or prehospital professionals trained in this technique.
- With an advanced airway in place, healthcare and prehospital professionals should not pause compressions for ventilations during CPR.

CPR Techniques/Metrics

- Chest compressions should be performed at a rate of 100 to 120 per minute for adults, children and infants.
- During CPR, an adult chest should be compressed to a depth of at least 2 inches (5 cm).
- During CPR, a child's and infant's chest should be compressed to a depth of at least one-third the anteroposterior diameter of the chest. For children, a compression depth of about 2 inches (5 cm), and for infants, about 1½ inches (3.8 cm) should be used.

- During compressions for adults, children and infants, the chest wall should be allowed to fully recoil, and compression and recoil times should be approximately equal.
- CPR should be performed prior to the availability of an automated external defibrillator (AED) and analysis of rhythm.
- When performing CPR, if signs of return of spontaneous circulation (ROSC) are observed:
    - Stop CPR and AED use.
    - Check for breathing and a pulse. Check the carotid or femoral pulse when there are signs of ROSC and multiple providers are present.
    - Pauses should be minimized and not exceed 10 seconds.
- Routine pulse checks without signs of ROSC are not recommended.
- A precordial thump and percussion pacing should not be used for cardiac arrest.
- "Cough CPR" should not be used for cardiac arrest.
- Healthcare professionals may consider using feedback devices during real-time CPR performance.

Ventilations

- For adults with a pulse but insufficient respiratory effort, and during CPR with an advanced airway in place, 1 rescue breath/manual ventilation should be provided every 6 seconds.
- For children and infants with a pulse but insufficient respiratory effort, and during CPR with an advanced airway in place, 1 rescue breath/manual ventilation should be provided every 2 to 3 seconds.
- Rescue breaths and manual ventilations should be delivered over 1 second in adults, children and infants and with a tidal volume that produces visible initiation of chest rise.
- A single person providing ventilations should use the mouth-to-mask technique rather than the bag-mask ventilation (BMV) technique.
- Multiple basic life support providers may use the two-person BMV technique if properly trained and experienced in this method.

Defibrillation

- Use adult defibrillator electrode pads and energy levels on adult patients. Defibrillator pad size and selection should be as recommended by the defibrillator manufacturer.
- Adult electrode pads should be applied per defibrillator manufacturer instructions in either an anterolateral or an anteroposterior position.
- Defibrillator electrode pads should not incorporate any breast tissue.

Opioid-Associated Emergency Resuscitation

- CPR and AED use remain the first interventions for cardiac arrest in opioid overdose and should not be delayed or interrupted.
- For suspected cardiac arrest due to opioids, naloxone should be administered as soon as possible without disrupting or delaying CPR and AED use.

CPR for Drowning Process Resuscitation

- Initiate compression-ventilation CPR (CV-CPR) for cardiac arrest following drowning in adults, children and infants. If CV-CPR is not possible, compression-only CPR should be performed.
- A CV ratio of 30:2 should be used for adults, 30:2 for children and infants with a single rescuer and a 15:2 ratio for children and infants with 2 rescuers.
- For the drowning process resuscitation, once cardiac arrest is recognized, resuscitation should begin with 2 rescue breaths/manual ventilations, delivered as early as possible.
- In-water resuscitation can be considered in cases where a responder has proper training in the in-water resuscitation technique and is comfortable performing it without causing an unsafe environment for the responder or the drowning victim.
- Though in-water resuscitation can be performed without the aid of additional equipment, floating and propelling equipment should be considered.
- If an adult, child or infant is in cardiac arrest following a drowning event, begin CPR and initiate AED use as soon as one is available and where feasible and safe.

Advanced Life Support

Rhythm Analysis

- Immediately after a shock is delivered, CPR should be resumed for 2 minutes before pausing compressions to check for or analyze a rhythm.
- Based on the clinical situation, performing rhythm analysis after defibrillation may be considered by healthcare professionals.
- Compressions should be paused for rhythm analysis, even when using devices with artifact-filtering algorithms.
- After every 2 minutes of CPR, the rhythm should be reassessed (while minimizing interruptions to CPR for no more than 10 seconds).
- If there are physiological signs of ROSC, briefly pausing compressions for rhythm analysis may be considered.

Oxygen Dose During CPR

- During resuscitation of cardiac arrest in adults and children, supplemental high-concentration oxygen should be administered, once available, by a pocket mask, a bag-mask device or an advanced airway.

Double-Sequence Defibrillation

- Standard defibrillation rather than double-sequence external defibrillation should be used for cardiac arrest with a shockable rhythm.

Advanced Airway Management in Drowning Process Resuscitation

- For drowning process resuscitation, once cardiac arrest is recognized, resuscitation should begin with ventilations (rescue breaths or bag-mask).

Initial Resuscitation of Adults with Sepsis and Septic Shock

- Intravenous crystalloid fluids should be used for initial resuscitation.

Opioid-Overdose Education

- Overdose education programs and naloxone distribution programs should be widely available to the community.
- Overdose education programs should include training on naloxone administration, the potential complications of naloxone administration and the management of these complications.

Appendix B

Guidelines Not Covered in the American Red Cross *Guidelines Highlights 2021*

Please refer to the American Red Cross *Focused Updates and Guidelines 2021* for updates and guidelines related to the following topics that are not included in this document:

Basic Life Support

Early Access

- Public Access Defibrillation Programs

Dispatcher/Telecommunicator-Assisted CPR

- Video-Based Dispatcher-Assisted Instruction
- Dispatcher Recognition of Cardiac Arrest
- Harm from CPR to Victims Not in Arrest
- Dispatcher-Assisted Compression-Only CPR Versus Conventional CPR

CPR Techniques and Sequence

- Starting CPR (A-B-C versus C-A-B)
- CPR Prior to Call for Help
- Compression-Only CPR Versus Conventional CPR: EMS
- Compression-to-Ventilation Ratios for CPR
- Chest Compression Rate
- Chest Compression Depth
- Chest Wall Recoil
- Pulse Check During CPR
- CPR Prior to Defibrillation
- Alternative Cardiac Resuscitation Techniques
- Tidal Volumes and Ventilation Rates
- Bag-Mask Ventilation Versus Mouth-to-Mask Ventilation
- Feedback for CPR Quality

Defibrillation

- Defibrillator Electrode Pad Size and Placement

Opioid-Associated Emergencies

- Suspected Opioid-Associated Emergency Resuscitation

Advanced Life Support

Cardiopulmonary Resuscitation: Techniques and Process

- Steroids and Vasopressin for In-Hospital Cardiac Arrest

Drowning Process Resuscitation

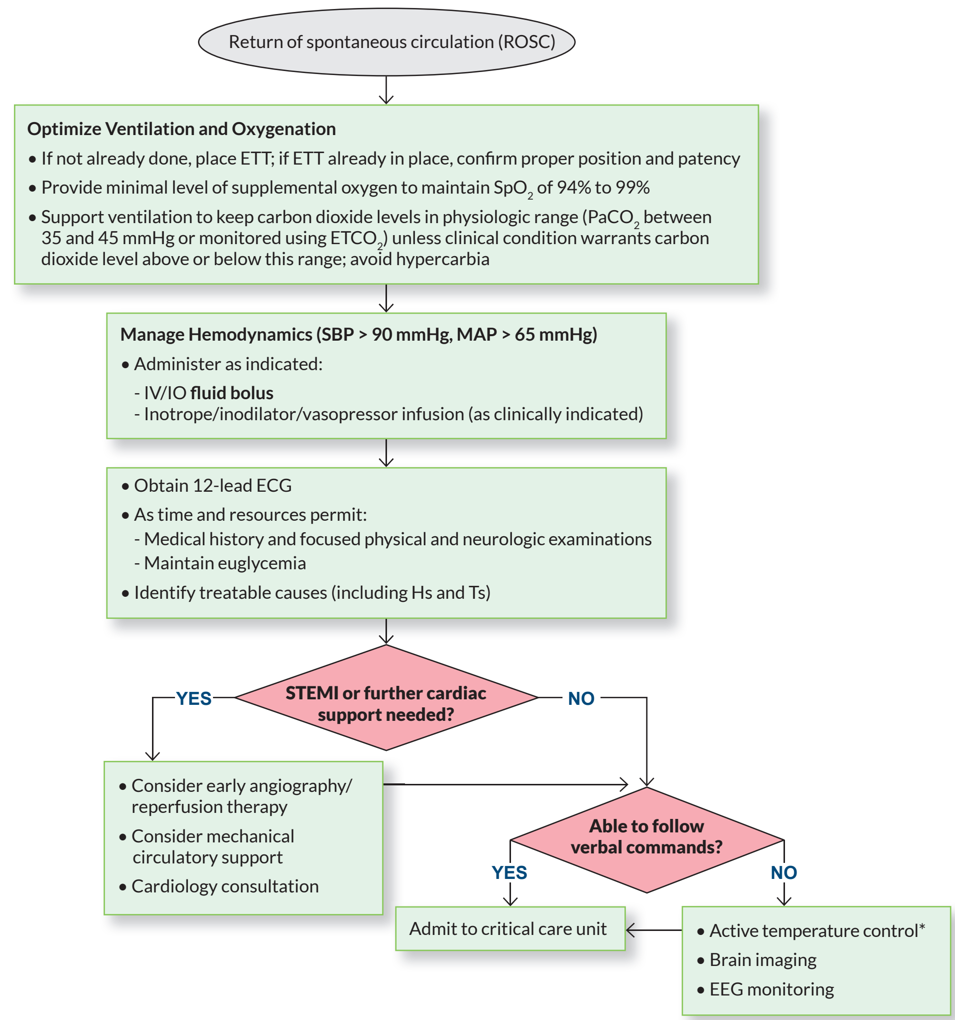
- Criteria for Discharge in Patients Who Have Had a Drowning Event

Appendix C: New and Updated Code Cards

Advanced Life Support: Adult Post-Cardiac Arrest Care (Updated)

ADULT POST–CARDIAC ARREST CARE

ALS - 2021 VERSION



Medications

IV/IO fluid bolus
- 1 to 2 L NS or LR solution

Dopamine
- 5 to 20 mcg/kg/min IV/IO

Epinephrine
- 2 to 10 mcg/min IV/IO

Norepinephrine
- 0.1 to 0.5 mcg/kg/min IV/IO

Ventilation and Oxygenation Goals

Ventilation
- Start at 10 breaths/min; adjust as needed
- $PaCO_2$: 35 to 45 mmHg

Oxygenation
- Provide minimal level needed to maintain SpO_2 of 94% to 99%

Hs and Ts

- Hypovolemia
- Hypoxemia
- Hydrogen ion excess (acidosis)
- Hyperkalemia/hypokalemia
- Hypothermia
- Hyperglycemia/hypoglycemia
- Tamponade (cardiac)
- Tension pneumothorax
- Thrombosis (pulmonary embolism)
- Thrombosis (myocardial infarction)
- Toxins

Active Temperature Control*

Actively prevent fever and maintain a temperature of 37.5° C or less for at least 72 hours

Consider hypothermic temperature control in select subpopulations. If targeting a hypothermic range, monitor for negative consequences of hypothermia

Use fever prevention/temperature control methods (e.g., uncovering patient, acetaminophen, surface cooling devices with temperature monitoring/ feedback)

Continuously monitor core temperature via esophageal, rectal or bladder catheter

*In the prehospital setting, providers should not initiate active temperature control or rapid infusion of large volumes of cold intravenous fluid immediately after ROSC. The evidence for active temperature control is constantly evolving. Defer to institutional protocols and clinician judgment based on the latest evidence.

American Red Cross
Training Services

Advanced Life Support: Adult Post-Cardiac Arrest Care (Updated)

ADULT POST–CARDIAC ARREST CARE

ALS - 2021 VERSION

Prognostication Following Return of Spontaneous Circulation (ROSC)		
Clinical management	Active Temperature Control (if indicated) Initiate fever prevention/temperature control methods or normothermic temperature control: • Consider hypothermic temperature control	For at least 72 hours post-ROSC
	Rewarming (if indicated)	30 to 54 hours post-ROSC
	Minimize sedation and analgesia as possible; controlled normothermia	54 to 72+ hours post-ROSC
Multimodal prognostication in the post–cardiac arrest period should not be determined before 72 hours after ROSC and following return to normothermia.		
Modality	**Predictor**	**Timeframe Post-ROSC**
Imaging	Brain computed tomography (CT) • Gray-to-white matter ratio (GWR)	0 to 24 hours
	Brain diffusion-weighted MRI (DWMRI) • Apparent diffusion coefficient (ADC)	24 to 72+ hours
Electrophysiology	Somatosensory evoked potentials (SSEPs) • Bilaterally absent N20 SSEPs	24 to 72+ hours
	Electroencephalography (EEG) • Seizure activity • Burst suppression	72+ hours
Clinical examination	Myoclonus or status myoclonus*	24 to 72 hours
	Pupillary light reflexes	72+ hours
	Quantitative pupillometry	72+ hours
	Corneal reflexes	72+ hours
Serum biomarkers	Serum neuron-specific enolase (NSE)	24 to 72 hours

*Obtain EEG with myoclonic jerks.

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Advanced Life Support: Sepsis and Septic Shock (New)

SEPSIS AND SEPTIC SHOCK: SCREENING, EARLY INTERVENTION AND RESUSCITATION

ALS - 2021 Version

- Use screening tools such as SIRS, NEWS, MEWS and qSOFA* to identify sepsis/septic shock
- Perform primary assessment (**A**irway, **B**reathing, **C**irculation, **D**isability, **E**xposure) and emergent/initial interventions, if not already done
- Rapidly identify and control source of infection, if possible†
- Obtain vascular access, clinically relevant laboratory studies, lactate and blood cultures
  - Re-measure lactate if initial lactate is elevated > 2.0 mmol/L
  - Consider alternative causes of elevated lactate
  - Do not delay antimicrobials to obtain cultures
- Perform secondary assessment as patient condition allows

Sepsis?

- High likelihood → A
- Low likelihood → Shock present?

A — Immediately; Ideally Within 1 Hour of Recognition

- Ensure adequate airway, oxygenation, ventilation and perfusion, if not already done
  - Consider high-flow nasal oxygen, noninvasive ventilation or invasive ventilation with low tidal volume (6 mL/kg)
- If shock/hypoperfusion: Administer 30 mL/kg of **balanced IV crystalloid fluid**; complete infusion within 3 hours‡
- Administer **broad spectrum IV antimicrobials**

Shock present?

- YES (sepsis suspected) → A
- YES (sepsis not supected) → Evaluate for other causes of shock
- NO → Within 3 Hours of Presentation

Within 3 Hours of Presentation

- Perform ongoing assessments
- Rapidly test for infectious versus noninfectious causes of acute illness
- Immediately treat for acute conditions that mimic sepsis§

Sepsis identified?

- NO → Follow appropriate code cards
- YES → Go to A

Hypotension (MAP < 65 mmHg) despite IV fluid?

- YES → See reverse side
- NO → Continue monitoring and re-evaluate patient

Continue monitoring and re-evaluate patient:

- Continue to ensure adequate airway, oxygenation, ventilation and perfusion
- Guide resuscitation with lactate level, capillary refill time and changes in dynamic measures
- Titrate medications and continue interventions as appropriate
- Continue assessment for etiology of sepsis and shock and direct therapy accordingly
- Continue source control
- Continue to assess for comorbidities and complications
- Obtain further diagnostic laboratory studies as clinically indicated

Antimicrobial Therapy: Timing, Dose and Duration

- Initiate antimicrobial coverage based on suspected source and institutional protocols:
  - For septic shock, administer broad spectrum IV antimicrobials **immediately**, ideally within 1 hour of recognition of sepsis/septic shock
  - For possible sepsis, administer broad spectrum IV antimicrobials **within 3 hours** if concern for infection persists
- When using a beta-lactam antibiotic, use a prolonged infusion for maintenance after an initial bolus; use specific pharmacokinetic/dosing guidance for different drugs/drug classes

Antimicrobial Therapy: Guidelines For Sepsis/Septic Shock

Methicillin-resistant *Staphylococcus aureus* (MRSA)
- High risk: Use empiric antimicrobials with MRSA coverage
- Low risk: Use antimicrobials without MRSA coverage

Multidrug resistance (MDR) organisms
- High risk: Use two antimicrobials with gram-negative coverage for empiric treatment
- Low risk: Use one gram-negative antimicrobial

Fungal infection
- High risk: Use empiric antifungal coverage

* qSOFA compared with SIRS, NEWS or MEWS should not be used as a single screening tool for sepsis or septic shock.

† Rapidly identify or exclude specific diagnoses of infection that require emergent source control. Implement any required source control interventions as soon as medically and logistically practical. Promptly remove intravascular access devices that are possible sources of sepsis or septic shock after other vascular access has been established.

‡ Use of balanced crystalloids (Lactated Ringer's, Plasma-Lyte A) is recommended over 0.9% sodium chloride. Also, albumin is recommended in patients who have received large volumes of crystalloids.

§ Sepsis mimics include pulmonary embolism, diabetic ketoacidosis, adrenal insufficiency, anaphylaxis, pancreatitis, bowel obstruction, hypovolemia, vasculitis, toxin ingestion/withdrawal or medication effect.

Advanced Life Support: Sepsis and Septic Shock (New)

SEPSIS AND SEPTIC SHOCK: SCREENING, EARLY INTERVENTION AND RESUSCITATION

ALS - 2021 Version

Hypotension (MAP < 65 mmHg) or signs of poor perfusion despite IV fluid resuscitation

- Administer **norepinephrine**‖ as first-line vasopressor
- If no central line, consider short-term peripheral administration in a vein proximal to antecubital fossa
- Consider invasive monitoring of arterial blood pressure

Persistent hypotension (MAP < 65 mmHg)?

YES: Consider adding **vasopressin**¶

Persistent hypotension (MAP < 65 mmHg)?

YES:

- **Without cardiac dysfunction:** Add **epinephrine**
- **With cardiac dysfunction:** Consider adding **dobutamine** or switching to **epinephrine**
- Consider adding IV **corticosteroids** for patients requiring ongoing vasopressor therapy
  - Consider commencing hydrocortisone when the dose of norepinephrine or epinephrine is ≥ 0.25 mcg/kg/min at least 4 hours after initiation

B

Provide ongoing care (goal = ICU within 6 hours as needed)

- Continue to ensure adequate airway, oxygenation, ventilation and perfusion; conduct daily assessment for de-escalation of oxygenation and ventilation support
- Continue source control
- Adjust vasopressors as clinically indicated
- Manage blood glucose levels:
  - Initiate **insulin therapy** at a blood glucose level of ≥ 180 mg/dL
  - Following the initiation of insulin therapy, a typical target blood glucose range is 144 to 180 mg/dL
- Treat comorbidities
- Ensure adequate nutritional support
- Conduct a daily assessment for antimicrobial de-escalation

NO: Maintain on low-to-moderate dose **norepinephrine**

Continue monitoring and re-evaluate patient:

- Continue to ensure adequate airway, oxygenation, ventilation and perfusion
- Guide additional fluid resuscitation with lactate level, capillary refill time and changes in dynamic measures
- Titrate medications and continue interventions as appropriate
- Continue assessment for etiology of sepsis and shock and direct therapy accordingly
- Continue source control
- Continue to assess for comorbidities and complications
- Obtain further diagnostic laboratory studies as clinically indicated

Go to B

Medications	Dosage
Crystalloid fluid bolus	30 mL/kg IV/IO
Norepinephrine‖	0.1 to 0.5 mcg/kg/min (2 to 80 mcg/min) IV/IO
Vasopressin¶	0.01 to 0.04 units/min (usual dose: 0.03 units/min) IV/IO
Epinephrine	0.01 to 0.5 mcg/kg/min (2 to 10 mcg/min) IV/IO
Dobutamine	2 to 20 mcg/kg/min IV/IO
Dopamine	2 to 20 mcg/kg/min IV/IO
IV Hydrocortisone#	50 mg IV every 6 hours or as a continuous infusion

Dynamic Parameters

For adults with sepsis/septic shock, dynamic measures are recommended to guide fluid resuscitation over physical examination or static parameters alone. Dynamic parameters that may be assessed following passive leg raise or a fluid bolus include:
- Stroke volume (SV)
- Stroke volume variation (SVV)
- Pulse pressure variation (PPV)
- Echocardiography, where available

‖ In settings where norepinephrine is not available, epinephrine or dopamine can be used as an alternative.

¶ Vasopressin is usually started when the dose of norepinephrine is in the range of 0.25 to 0.5 mcg/kg/min.

For IV Hydrocortisone, higher doses may be used if clinically indicated

American Red Cross Training Services

Pediatric Advanced Life Support: Pediatric Post-Cardiac Arrest Care (Updated)

PEDIATRIC POST–CARDIAC ARREST CARE

PALS - 2021 VERSION

Optimize Oxygenation and Ventilation

- Continuously monitor with capnography and pulse oximetry
- Consider advanced airway[*]
  - If ETT already in place, confirm proper position and patency
- Provide lowest concentration of supplemental oxygen needed to maintain saturation of 94% to 99%[†]; avoid hyperoxia
- Assist ventilation as needed, maintaining normocarbia ($PaCO_2$ between 35 and 45 mmHg or physiological $ETCO_2$) unless clinical condition warrants a carbon dioxide level above or below this range[‡]

↓

Assess and Manage Perfusion

- Maintain blood pressure within the normal range for age, including SBP above 5th percentile for age
- Treat hypotension aggressively
- Initiate fluid therapy (to maintain normovolemia) with **crystalloid fluid bolus** of 20 mL/kg IV/IO; repeat as needed[§]
- Initiate pharmacological therapies (e.g., vasopressors, inotropes, inodilators) as indicated
  - *Hypotensive shock:* **epinephrine, norepinephrine**[‖]
  - *Normotensive shock:* **epinephrine, milrinone**[¶]
- Consider Extracorporeal Life Support [ECLS]
- Measure perfusion by clinical exam and by assessing urine output, non-invasive and invasive BP, CVO_2, ABG and lactate levels

↓

Initiate Neuroprotective Measures

- Optimize cerebral perfusion (ensure adequate MAP, manage increased ICP, avoid hyperventilation unless indicated)[‡]
- Initiate Active Temperature Control[#] (See Active Temperature Control box)
- Assess for seizures (including continuous EEG, especially if unconscious, encephalopathic or sedated) and treat them if they occur
- Provide sedation and anxiolysis as needed

↓

Provide Other Interventions

- Manage glucose
  - Treat hypoglycemia
  - Consider insulin for severe or persistent hyperglycemia (but use extreme caution to avoid hypoglycemia and dose based on institutional protocol)
- Treat reversible causes
- Continue to assess electrolytes, calcium, CBC, lactic acid and blood gas values as clinically indicated

*Use spinal motion restriction techniques during airway interventions in patients with suspected or confirmed cervical spine injury.
[†]Unless clinical condition warrants an oxygen saturation below this range.
[‡]Avoid hyperventilation unless clinically warranted for acute management when herniation seems imminent.
[§]Assess for perfusion and signs of heart failure or worsening heart failure (e.g., pulmonary edema, hepatomegaly) after each fluid bolus. Administer smaller (10-mL/kg) fluid bolus volumes in neonates. Also consider smaller (5- to 10-mL/kg) fluid bolus volumes in children with poor cardiac function/heart failure.
[#]Providers should not initiate hypothermic temperature control in the prehospital setting. See Active Temperature Control box.
[‖]May consider dopamine if epinephrine and norepinephrine are not available
[¶]May consider dopamine and dobutamine in special clinical situations or based on availability of agents

American Red Cross
Training Services

Pediatric Advanced Life Support: Pediatric Post-Cardiac Arrest Care (Updated)

PEDIATRIC POST–CARDIAC ARREST CARE

PALS - 2021 VERSION

Active Temperature Control

- Actively prevent fever and maintain a temperature of 37.5° C or less for at least 72 hours**
- Consider hypothermic temperature control in select subpopulations. If targeting a hypothermic range, monitor for negative consequences of hypothermia
- Use fever prevention/temperature control methods (e.g., uncovering patient, acetaminophen, surface cooling devices with temperature monitoring/feedback)
- Continuously monitor core temperature via esophageal, rectal or bladder catheter

Normal Pediatric Blood Pressure

Age Group	Systolic Blood Pressure, mmHg	Diastolic Blood Pressure, mmHg	Mean Arterial Pressure (MAP) Value
Newborn	60–85	35–55	45-55
Infant (1 to 12 months)	70–100	35–60	50-60
Toddler (1 to 2 years)	85–105	40–65	50-60
Preschooler (3 to 5 years)	89–115	45–70	55-70
School Age (6 to 12 years)	94-120	55–80	65-75
Adolescent (13 to 17 years)	110–135	60–85	70-80

Hs and Ts

- **H**ypovolemia
- **H**ypoxemia
- **H**ydrogen ion excess (acidosis)
- **H**yperkalemia/hypokalemia
- **H**ypothermia
- **H**ypoglycemia
- **T**amponade
- **T**ension pneumothorax
- **T**hrombosis (pulmonary embolism)
- **T**hrombosis (myocardial infarction)
- **T**oxins

**The evidence for active temperature control is constantly evolving. Defer to institutional protocols and clinician judgment based on the latest evidence.

American Red Cross Training Services

Pediatric Advanced Life Support: Priorities of Pediatric Post-Cardiac Arrest Care (Updated)

PRIORITIES OF PEDIATRIC POST-CARDIAC ARREST CARE

PALS - 2021 VERSION

Optimize Oxygenation and Ventilation	Check
• Consider advanced airway: - If ETT already in place, confirm proper position and patency	
• Institute capnography and pulse oximetry, if not already done	
• Provide lowest concentration of supplemental oxygen needed to maintain saturation of 94% to 99% and/or physiological PaO_2 (if arterial line present or ABG obtained); avoid hypoxia but be cautious about causing hyperoxia	
• Adjust ventilation to maintain normocarbia, unless different target is clinically warranted, using end-tidal CO_2 or $PaCO_2$ (if arterial line present or ABG obtained)	

Assess and Manage Perfusion	Check
• Establish perfusion goals • Maintain blood pressure within the normal range for age, including SBP above 5th percentile for age	
• Treat hypotension aggressively	
• Initiate fluid therapy (to maintain normovolemia) with crystalloid fluid bolus of 20 mL/kg IV/IO; repeat as needed*	
• Initiate pharmacological therapies (e.g., vasopressors, inotropes, inodilators) as indicated: - Hypotensive shock: epinephrine, norepinephrine; may consider dopamine if epinephrine and norepinephrine are not available - Normotensive shock: epinephrine, milrinone; may consider dopamine and dobutamine in special clinical situations or based on availability of agents	
• Consider Extracorporeal Life Support (ECLS) if unable to obtain perfusion goals with other measures	
• Measure perfusion by clinical exam and by assessing urine output, non-invasive and invasive BP, CVO_2 and lactate levels	

Initiate Neuroprotective Measures	Check
• Optimize cerebral perfusion (ensure adequate MAP, manage increased ICP, decrease metabolic demands as feasible, avoid hyperventilation unless clinical condition warrants brief hyperventilation)	
• Initiate Active Temperature Control: - Monitor core temperature - Treat fever aggressively (antipyretics or active cooling) • Consider hypothermic temperature control in select subpopulations: - If targeting a hypothermic range, monitor for negative consequences of hypothermia	
• Actively assess for seizures and treat them if they occur: - Initiate continuous EEG monitoring as indicated, especially if unconscious, encephalopathic or sedated	
• Provide sedation and anxiolysis as needed	
• Consider neuroimaging to identify treatable causes if patient is clinically able to tolerate imaging modality and transport if needed	

Provide Other Interventions	Check
• Manage glucose: - Treat hypoglycemia - Consider insulin for severe or persistent hyperglycemia (should be based on facility protocol and care should be taken to avoid hypoglycemia)	
• Assess electrolytes and calcium	
• Treat reversible causes	

Provide Prognostication	Check
• Follow facility specific evidence-based guidelines for assessment and diagnostics to assist with prognostication • These may need to be modified in the setting of hypothermic management, sedation and metabolic abnormalities	

*Assess for perfusion and signs of heart failure or worsening heart failure (e.g., pulmonary edema, hepatomegaly) after each fluid bolus. Administer smaller (10-mL/kg) fluid bolus volumes in neonates. Also consider smaller (5- to 10-mL/kg) fluid bolus volumes in children with poor cardiac function/heart failure.

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