



# Updated AHA Basic and Advanced Cardiac Life Support guidance with COVID-19 considerations

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**Abstract:** The American Heart Association released an updated Basic and Advanced Cardiac Life Support guidance that incorporates the latest knowledge regarding COVID-19 and its transmissibility. This article details the new guidance, including strategies for reducing provider risk and exposure and for special patient-care situations.

**Keywords:** ACLS, Advanced Cardiovascular Life Support, AHA, American Heart Association, Basic Life Support, BLS, COVID-19, PALS, Pediatric Advanced Life Support, neonates

WITH RECENT ADVANCES in knowledge about the transmissibility of SARS-CoV-2, increasing personal protection equipment (PPE) availability, and more healthcare workers (HCWs) vaccinated

against COVID-19, the American Heart Association (AHA) has issued new interim guidance for HCWs for Basic Life Support (BLS) and Advanced Cardiovascular Life Support (ACLS) in adults, children, and neonates with suspected or confirmed COVID-19.<sup>1</sup>

Initial interim guidance for BLS and ACLS in adults, children, and neonates with suspected or confirmed COVID-19 was issued by the AHA in June 2020.<sup>2</sup> Updated interim guidance was published in October 2021. The latest information regarding COVID-19 and its transmissibility, recommendations for reducing provider risk and exposure, and strategies for special patient-care situations and timely provision of care

was released in January 2022.<sup>1</sup> (See *Key points*). This updated guidance is presented within the 2020 AHA guidelines issued for adult BLS and ACLS, pediatric BLS and ACLS, and neonatal resuscitation.<sup>3-5</sup>

## Reducing provider risk and exposure

Since SARS-CoV-2 is primarily transmitted through respiratory droplets and aerosolization, frequent contact with symptomatic patients puts HCWs at significant risk for contracting the virus. Vaccination with approved boosters can significantly reduce the risk of infection. Even those fully vaccinated must continue to take appropriate precautions against COVID-19 since CPR can

generate aerosols. The AHA strongly encourages all HCWs to receive the vaccines and comply with updated recommendations for boosters.

The data regarding which procedures are aerosol generating are conflicting and continue to develop. CPR is considered to be an aerosol-generating procedure (AGP). AGPs include but are not limited to chest compressions, defibrillation, bag-valve-mask (BVM) ventilation, intubation, and positive pressure ventilation, as well as any breaks in respiratory circuits. The updated guidance emphasizes fully protecting HCWs who perform resuscitation. HCWs should wear a respirator, such as an N95 mask, along with other PPE (gown, gloves, and eye protection) when performing AGPs on patients with suspected or confirmed COVID-19 infection. In the event initial responders are not already wearing appropriate PPE, they should immediately don it and then begin CPR.

Chest compressions should be started without delay or interruption while wearing appropriate PPE. All HCWs not wearing appropriate PPE should be immediately excused from the room or area. Provided there is sufficient PPE, additional compressors may be required due to increased fatigue or potential for N-95 respirator slippage resulting from compressions. (See *PPE for performing BLS and ACLS*.<sup>1</sup>) The COVID-19 status of the

patient should be clearly communicated to arriving HCWs, resuscitative roles assigned immediately, and risk-appropriate PPE worn by HCWs.

AGPs include but are not limited to chest compressions, BVM ventilation, positive pressure ventilation, endotracheal intubation, defibrillation, and any break in circuit continuity that could cause particle aerosolization.<sup>1</sup> A high-efficiency particulate air (HEPA) filter on the exhalation port of a BVM, supraglottic airway, endotracheal tube (ETT), or mechanical ventilation circuits can capture any aerosolized particles and should be used as soon as available. If a HEPA filter is unavailable, a low-dead space viral filter with greater than 99.99% viral filtration efficiency may be placed between the airway and the ventilation device.<sup>1</sup> Before endotracheal intubation, secure placement of a supraglottic airway with a HEPA filter, which can help maximize compression fraction and control aerosol generation.<sup>1</sup> When changing ventilation devices, the viral filter or the heat and moisture exchanging filter should remain attached to the airway to reduce aerosolization.

Intubation boxes (also known as aerosol boxes) are protective enclosures placed around the patient's head and neck.<sup>6</sup> Their use requires the application of appropriate negative pressure and an HCW familiar with the device. In addition, placement of the intubation box may interfere with

## PPE for performing BLS and ACLS<sup>1</sup>

- N95 respirator masks
- Positive airway pressure respirators
- Eye protection
- Gloves
- Gowns appropriate for AGPs

compressions and other critical care interventions and increase intubation time.<sup>6</sup> Unless there is an intubator with institutional experience in using an intubation box during resuscitations, there is insufficient evidence to support their use at this time.

The use of mechanical compression devices can reduce the number of compressors needed. These devices require training and regular practice and may be inappropriate for adults with morbid obesity, infants, children, and small adolescents.<sup>1</sup>

When the resuscitative effort occurs out of the hospital, Emergency Medical Services personnel should don PPE in accordance with state and local protocols. Consider ventilating the patient's room by opening windows and doors if this does not risk contaminating other spaces in the adjacent vicinity.<sup>1</sup>

When the resuscitative effort occurs in the hospital, wear appropriate PPE, minimize the number of people in the room and close doors to prevent contamination of any adjacent areas.<sup>1</sup> If the patient is endotracheally intubated on mechanical ventilation prior to cardiac arrest, the provider should consider implementing the following strategies during the resuscitative effort.<sup>1</sup>

- Leave the patient on the ventilator with a HEPA filter attached to maintain a closed circuit and reduce aerosolization.
- Adjust ventilator settings to deliver ventilations with asynchronous chest compressions. Increase the fraction of inspired oxygen to 1.0, use pressure or volume control ventilation settings, limiting pressure or tidal volume 4-6 mL/kg ideal body weight for adults

## Key points

- The goal of resuscitation is to achieve the best possible patient outcomes and simultaneously ensure optimal protection for HCWs.
- All HCWs should wear a respirator along with other PPE for suspected or confirmed COVID-19 when performing AGPs.
- AGPs include but are not limited to chest compressions, defibrillation, BVM ventilation, intubation, and positive pressure ventilation, as well as any breaks in respiratory circuits.
- CPR, including chest compressions, is considered to be aerosol-generating.
- PPE must be donned BEFORE performing components of resuscitation.
- Continuous use of an N95 respirator and eye protection should be considered when the COVID-19 status is unknown and resuscitation involves AGPs.

and neonates; 5-8 mL/kg for children to generate adequate chest rise.

- Adjust trigger settings to prevent ventilator autotriggering with chest compressions and possibly prevent hyperventilation and air trapping.
- Adjust respiratory rate to 10 breaths/min for adults, 20-30 breaths/min for infants and children, and 30 breaths/min for neonates.
- Adjust the positive end-expiratory pressure to balance lung volumes and venous return.
- Ensure continuity of ETT and tracheotomy tubes and ventilator circuit tubing to prevent accidental dislodgment.
- With return of spontaneous circulation (ROSC), adjust ventilator settings to the patient's clinical status.

### Prearrest

With initial hospital admission and any change in clinical status, review advanced directives and goals of care with the patient or their proxy. These discussions should guide decision-making regarding starting and discontinuing resuscitative efforts. Consider moving a patient with suspected or confirmed COVID-19 and at high risk for cardiac arrest to a negative pressure room. Monitor patients for early signs of clinical deterioration to minimize the need for emergent endotracheal intubations.<sup>1</sup>

### Strategies for adults

#### Adult BLS

The CDC considers CPR and all of its components (chest compression, ventilation and defibrillation) aerosol generating. Therefore, all HCWs should wear appropriate PPE when performing CPR. After verifying scene safety, the rescuer determines unresponsiveness, calls for help, activates emergency responders by mobile phone if appropriate, and gets the automated external defibrillator (AED) or sends a second on-scene provider to do so. The rescuer scans for breathing and simultaneously checks for a pulse, taking no longer than 10 seconds.

**If the patient is breathing and has a pulse:** monitor until advanced providers arrive. **If there is no breathing with a pulse, or if gasping or agonal breathing is noted:** passive oxygenation with a surgical facemask overlaying an oxygen device such as a nasal cannula or an oxygen (O<sub>2</sub>) facemask can be used if a BVM with 100% O<sub>2</sub> and a HEPA filter are not available.

HCWs wearing PPE appropriate for AGPs should use a BVM with 100% O<sub>2</sub> and a HEPA filter attached to the exhalation port of the airway device.<sup>1</sup> Rescue breathing should be provided 1 breath every 6 seconds (10 breaths/min), and the rescuer with the BVM should be positioned

at the patient's head using a practiced two-handed technique to maintain a tight mask seal.<sup>1</sup> (See *Two-handed BVM technique*.<sup>7</sup>)

Rescue breathing continues with pulse checks every 2 minutes. If there is suspicion of opioid overdose, naloxone should be administered, if available, per protocol.<sup>1</sup>

**If the patient is apneic and pulseless:** CPR should be performed in cycles of 30 compressions and 2 breaths. Chest compressions should be provided by pushing hard (2-2.4 in), pushing fast (100-120/min), allowing for complete chest recoil, minimizing interruptions, and rotating compressors every 2 minutes. Ventilation should be provided using a BVM with 100% O<sub>2</sub> and a HEPA filter attached to the exhalation port of the breathing device using a two-handed mask technique to obtain a tight mask seal.<sup>1</sup> Use the AED promptly, delivering shocks and resuming compressions as directed. Continue to follow prompts from the AED until advanced care providers arrive.

#### Adult ACLS

Advanced care providers should arrive wearing PPE appropriate for AGPs. AGPs include, but are not limited to, chest compressions, ventilation, placement of an advanced airway, defibrillation, and any breaks in circuit continuity after the airway is secured,

CPR in 2-minute cycles must be performed as noted in the BLS guidelines. In the patient with suspected or confirmed COVID-19, ventilation continues with 100% O<sub>2</sub> and BVM with a HEPA filter attached to the exhalation port of the breathing device. Aerosolization is reduced by a tight mask seal using a two-handed technique by a second provider.<sup>1</sup>

In ventricular fibrillation (VF)/pulseless ventricular tachycardia (pVT), an unsynchronized shock (biphasic 120-200 J or monophasic 360 J) is delivered. CPR continues with rhythm checks every 2 minutes.

### Two-handed BVM technique<sup>7</sup>

The two-handed BVM technique to maintain a good seal involves two rescuers. Standing at the patient's head, rescuer 1 performs a head tilt and places the narrow portion of the mask on the bridge of the patient's nose. Use the "E-C" clamp technique to hold the mask in place. To form the "C," place the thumb and index finger of each hand on either side of the mask holding the mask edges to the patient's face. The remaining three fingers on each hand lift the angles of the jaw on both sides, forming an "E." Open the airway and press the mask to the face. Avoid pressing too hard on the mask as this could push the jaw down and block the airway. Rescuer 2, positioned at the patient's side, squeezes the bag to deliver breaths watching for chest rise.

If only one rescuer is providing ventilations, the rescuer stands above the patient's head, performs a head tilt and positions the narrow portion of the mask over the bridge of the patient's nose. While lifting the jaw and opening the airway, use the "E-C" clamp technique with one hand to hold the mask in place. The rescuer squeezes the bag with the other hand, watching for chest rise.

An I.V. or intraosseous (I.O.) access is obtained.

If VF/pVT persists, another unsynchronized shock (120-200 J biphasic or 360 J monophasic) is delivered. CPR is continued for 2 minutes. Epinephrine (1 mg) is given I.V./I.O. every 3-5 minutes and an advanced airway is considered. Prior to intubation, ventilate with a 100% O<sub>2</sub> and BVM with a HEPA filter attached to the exhalation port of the airway device using a two-person technique to obtain a tight mask seal. Aerosolization of respiratory droplets can be minimized during endotracheal intubation by placement of a cuffed ETT. Minimize interruptions in CPR to less than 10 seconds and pause compressions to intubate only if needed. Use video laryngoscopy, depending on availability and provider skill, to reduce provider exposure to respiratory droplets. When assigning roles, endotracheal intubation should always be performed by the most experienced HCW present.<sup>1</sup> Continuous waveform capnography is used to confirm and monitor ETT placement and CPR quality. Avoid administering medications via the ETT since disconnection of the system will cause aerosolization of unfiltered particles.<sup>1</sup> Once an advanced airway is placed, give 1 breath every 6 sec (10 breaths/min) and continue chest compressions. If VF/pVT persists, continue CPR, ventilation, and oxygenation; administer amiodarone or lidocaine; and evaluate for reversible causes.<sup>1</sup>

In asystole or pulseless electrical activity (PEA), the AHA recommends continued CPR, ventilation with 100% O<sub>2</sub> using a BVM with a HEPA filter attached to the exhalation port of the airway device using a two-handed technique to obtain a tight mask seal, I.V./I.O. placement, airway management (ETT or supraglottic) with continuous waveform capnography, early administration of I.V./I.O. epinephrine, and evaluation for reversible causes.<sup>3</sup> As in VF/pVT,

advanced providers should wear PPE appropriate for AGPs as AGP risk in the patient with suspected or confirmed COVID-19 with asystole/PEA is the same as in VF/pVT.<sup>1</sup>

Postarrest care of patients with suspected or confirmed COVID-19 who achieve ROSC should be conducted based on the 2020 AHA Guidelines for Adult ACLS with providers wearing risk-appropriate PPE.<sup>3</sup> ROSC guidelines include optimizing ventilation and oxygenation based on the patient's physiologic needs, management of hypotension with I.V. fluids or vasopressors, and a 12-lead ECG for diagnosis of ST-segment elevation myocardial infarction. Targeted temperature management (TTM) should be initiated promptly if the patient remains unresponsive, maintaining a core temperature range of 32-36° C (89.6-96.8° F) for a minimum of 24 h.<sup>3</sup>

A debriefing session should be conducted for the team to discuss the resuscitation effort and identify strategies that could be implemented in the future. Debriefing provides an educational and quality improvement opportunity and allows for the processing of emotions associated with the event.<sup>7</sup>

## Special situations

### *Patient arrests in the prone position*

Limited evidence suggests that providing CPR in the prone position is better than no CPR at all. If the patient in the prone position has an advanced airway, manual compressions can be started with the patient in the prone position and continued until they are transitioned to the supine position. Prone CPR should be done with the hands centered over the T7/T10 vertebral bodies while the care team safely transitions the patient to the supine position. If using anterior/posterior positioned defibrillator pads, the posterior defibrillator pad should be applied to the patient's back prior to turning. Once positioned supine, CPR should re-

sume immediately. All tubes, circuits, and access lines should be confirmed as being intact and functioning properly after the patient is placed supine.<sup>1</sup>

### *In-hospital cardiac arrest of pregnant patients with suspected or confirmed COVID-19*

Patients who are pregnant and symptomatic with COVID-19 are at an increased risk for severe illness requiring ICU admission and mechanical ventilation.<sup>1</sup> A multidisciplinary team should be assembled including obstetric, neonatal, emergency, anesthesiology, intensive care, and cardiac arrest services.<sup>1</sup> HCWs should be wearing AGP-appropriate PPE.<sup>1</sup> AGPs include but are not limited to chest compressions, ventilation, intubation, defibrillation, and any break in airway circuit continuity.

Maternal interventions include ventilation with a BVM and 100% O<sub>2</sub> with a HEPA filter attached to the exhalation port of the airway device using a two-handed technique to obtain a tight mask seal and avoid excessive ventilation. I.V.s should be inserted above the diaphragm. Discontinue I.V. magnesium if infusing and administer calcium chloride or calcium gluconate. Endotracheal intubation should be an early priority. Endotracheal intubation or supraglottic airway insertion should be performed by the most experienced person present as the patient who is pregnant may be more apt to present with a difficult airway. Waveform capnography should be used to confirm and monitor ETT placement and CPR quality. Once an advanced airway is in place, give 1 breath every 6 seconds (10 breaths/min) with continuous chest compressions.<sup>1</sup>

Obstetric interventions include relieving aortocaval compression with continuous left lateral uterine displacement, detaching fetal monitors, and preparing for perimortem cesarean delivery within 5 minutes of cardiac arrest if maternal ROSC is not obtained.<sup>1</sup>

## Strategies for pediatric patients

### Pediatric BLS

The rescuer, wearing AGP-appropriate PPE, should verify scene safety, check for responsiveness, shout for help, and activate the emergency response system via a mobile device, if appropriate. Simultaneously scan for breathing and check for a pulse, taking no longer than 10 seconds. Pediatric cardiac arrests are often related to respiratory causes, so ventilation takes a high priority. In the patient with suspected or confirmed COVID-19, ventilation increases the risk of transmission.<sup>1</sup>

**If the patient is breathing and has a pulse:** monitor until emergency responders arrive.

**If the patient has a pulse but is not breathing, or agonal or gasping respirations are noted:** the provider should perform rescue breathing 1 breath every 2-3 seconds (20-30 breaths/min) with 100% O<sub>2</sub> and BVM with a HEPA filter attached to the exhalation port of the airway device using a two-handed technique to obtain a tight mask seal, if needed.

**If the patient is apneic and pulseless or heart rate is less than 60 beats/minute with signs of poor perfusion**

If the arrest is witnessed, activate the emergency response system if not done so already and retrieve the AED. If the arrest is not witnessed, the provider, in PPE, should start CPR pushing hard (1/3 of the anteroposterior diameter of the chest), pushing fast (100-120/min), allowing for complete chest recoil, changing compressors every 2 minutes, and minimizing interruptions. Ventilations should be performed with a 100% O<sub>2</sub> and a BVM with a HEPA filter attached to the exhalation port of the airway device using a two-handed mask technique to obtain a tight seal, if needed. For a single rescuer, perform CPR cycles of 30 compressions and 2 breaths, and activate emergency responders after 2 minutes of CPR if still alone. When a second rescuer arrives, perform cy-

cles of 15 compressions to 2 breaths. Use the AED and follow the prompts until advanced providers arrive.

### Pediatric advanced life support

AGPs include but are not limited to chest compressions, ventilation, advanced airway insertion, ETT instillation of medications, defibrillation, and any interruptions in the circuit continuity after the airway is secured. Advanced providers should wear appropriate PPE for AGPs and excuse persons not wearing appropriate PPE from the scene. CPR and BVM ventilation with 100% O<sub>2</sub> and a HEPA filter attached to the exhalation port of the airway device using a two-handed technique to obtain a tight mask seal continues with reassessment at 2-minute intervals.<sup>1</sup>

In VF/pVT, deliver an unsynchronized shock 2 J/kg, continue CPR for 2 minutes, and obtain I.V./I.O. access. If VF/pVT continues, deliver an unsynchronized shock at 4 J/kg, resuming CPR for 2 minutes; administer epinephrine 0.01 mg/kg I.V./I.O. every 3-5 minutes (maximum dose 1 mg). Providers should consider inserting an advanced airway (ETT or supraglottic airway) with continuous waveform capnography to confirm and monitor placement as well as CPR quality. Airway procedures should be performed by the most experienced HCW present, attired in PPE appropriate for AGPs.<sup>1</sup> All ventilation should use 100% O<sub>2</sub> and a HEPA filter attached to the exhalation port of the airway device. If unable to obtain I.V. or I.O. access, epinephrine may be administered via the ETT at a dose of 0.1 mg/kg. It is important to remember that instillation of medications into the ETT may cause aerosolization of respiratory droplets.<sup>1</sup> After intubation, perform continuous chest compressions and ventilations at 1 breath every 2-3 seconds (20-30 breaths/min). If VF/pVT persists, an unsynchronized

shock of 4 J/kg is delivered. CPR is continued for 2 minutes and I.V./I.O. amiodarone 5 mg/kg or lidocaine 1 mg/kg is administered. The patient is evaluated for reversible causes of cardiac arrest.

If rhythm analysis reveals PEA or asystole, continue CPR with reassessment at 2-minute intervals with epinephrine 0.01 mg/kg every 3-5 min administered I.V./I.O. (maximum dose 1 mg). Placement of an advanced airway (ETT or supraglottic airway) should be considered with continuous waveform capnography to confirm and monitor ETT placement. Airway interventions (ETT or supraglottic airway) should be performed by the most experienced person present, attired in PPE appropriate for AGPs.<sup>1</sup> After intubation, chest compressions are continuous and ventilations with 100% O<sub>2</sub> and a HEPA filter attached to the exhalation port of the airway device are 1 breath every 2-3 seconds (20-30 breaths/min). CPR continues with reassessment every 2 minutes. As PEA or asystole persists, providers evaluate the patient for reversible causes.<sup>1</sup>

Postarrest care of the pediatric patient with suspected or confirmed COVID-19 who achieves ROSC should be conducted based on the 2020 AHA Guidelines for Pediatric Advanced Life Support with providers wearing appropriate PPE.<sup>4</sup> ROSC guidelines include optimizing ventilation and oxygenation based on the patient's physiologic needs, management of hypotension with I.V. fluids or vasopressors, continuous electroencephalogram monitoring, and treatment for seizures as needed. TTM should be initiated promptly if the patient remains unresponsive, maintaining a core temperature range of 32-34° C (89.6-93.2° F) for 48 hours followed by TTM at 36-37.5° C (96.8-99.5° F) for 3-5 days.<sup>4</sup>

A debriefing session should be held to allow the team to discuss the resuscitation effort and identify

strategies that could be implemented in future resuscitative efforts. Debriefing provides an educational and quality improvement opportunity and allows the processing of emotions associated with the event.<sup>7</sup>

### Strategies for neonates

Newborns are usually not a source of COVID-19, even if the mother tests positive for COVID-19. For mothers with suspected or confirmed COVID-19 infection, HCWs should wear PPE appropriate for AGPs as the mother's respiratory secretions may be a source of viral transmission to the newborn and the HCW team.<sup>1</sup> Mothers can be encouraged to wear a surgical mask during delivery.

It is unlikely that the initial steps of neonatal resuscitation, drying, tactile stimulation, wrapping, and monitor application will generate aerosols. Suctioning of the airway after delivery should not be performed routinely for clear or meconium-stained amniotic fluid because suctioning is a suspected AGP and is not indicated for uncomplicated deliveries, regardless of COVID-19 status.<sup>1</sup> Endotracheal instillation of medications is a suspected AGP, especially if the

endotracheal tube is uncuffed. The preferred route of medication administration during neonatal resuscitation is a low-lying umbilical venous catheter regardless of COVID-19 status. When resuscitating newborns with apnea; bradycardia; or ineffective breathing such as gasping, positive pressure ventilation remains the main resuscitative strategy. Chest compressions occur later in the resuscitative effort.

If the neonate is stable and the mother with suspected or confirmed COVID-19 is masked, delay cord clamping and allow skin-to-skin contact. Until confirmed to be COVID-19-negative, mothers with suspected or confirmed COVID-19 must wear a mask and practice hand and breast hygiene when providing newborn care such as feeding. Closed incubators should be used for those neonates requiring neonatal intensive care; however, they do not protect against aerosolized particles.<sup>1</sup>

With the ongoing COVID-19 pandemic and emergence of new variants, healthcare professionals can utilize this latest evidence-based guidance to improve outcomes of adult and pediatric patients. ■

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