

SPECIAL REPORT

2021 Interim Guidance to Health Care Providers for Basic and Advanced Cardiac Life Support in Adults, Children, and Neonates With Suspected or Confirmed COVID-19

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In April 2020, the American Heart Association (AHA) Emergency Cardiovascular Care (ECC) Committee and Get With The Guidelines-Resuscitation Adult and Pediatric Task Forces published their Interim Guidance for Basic and Advanced Cardiac Life Support in Adults, Children, and Neonates With Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) at the start of the SARS-CoV-2 pandemic. In October 2020, the AHA published new cardiopulmonary resuscitation (CPR) guidelines with the latest evidence-based algorithms and recommendations for Basic Life Support, Advanced Cardiac Life Support, Pediatric Advanced Life Support, Neonatal Advanced Life Support, and Maternal Cardiac Arrest Resuscitation.¹

As the COVID-19 pandemic continues into 2021 and beyond, there is now a more accurate understanding of the transmissibility of SARS-CoV-2, a stabilizing of personal protective equipment (PPE) availability, and widespread vaccination of health care providers and some communities prompting the committee and task forces to update the initial interim guidance.² Both nationally and internationally, the prevalence of COVID-19 and variants, vaccination, and risk of transmission are variable, and individual systems and settings can utilize this guidance to match local risk. While the initial interim guidance was focused on the use of PPE, as well as early intubation and control of the airway to decrease potential transmission risk to

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medical personnel, the updated 2021 interim guidance now aligns with the 2020 AHA guidelines for CPR and ECC with the provision of appropriate PPE usage and aerosol control for suspected and confirmed COVID-19 patients in settings where vaccinations have been readily adopted.

International data early during the COVID-19 pandemic described worse survival outcomes for both out-of-hospital and in-hospital cardiac arrests compared with prior years.³⁻⁶ This worsening of outcomes may have been multifactorial; the severity of SARS-CoV-2–related cardiac arrest, the implementation of termination of resuscitation guidance, local crisis standards of care, or patient hesitancy to seek medical care contributing to delays in care.⁷ The provision of prompt chest compressions and defibrillation may also have been delayed due to the additional time required in donning PPE or securing the airway, and the PPE may have accelerated rescuer fatigue resulting in decreased CPR quality.^{8,9} Concerns that resuscitation from cardiac arrest due to COVID-19 may be futile may have led to earlier termination of resuscitative efforts, and overwhelmed Emergency Medical Services systems may have had insufficient resources to respond to increased number of calls for arrests in regions with high rates of COVID-19.^{3,10,11} Lastly, significant delays in presentation for medical care, such as a tripling of the time from onset of chest pain to presentation to emergency care, may have contributed to an increase in out-of-hospital cardiac arrests rates during the pandemic as compared with before the pandemic.¹²

With increased scientific knowledge, a more stable PPE supply chain, and vaccination of frontline health care providers and the general public, application of the best resuscitation science available must be once again assessed and prioritized. The following guidance should be applied to patients with suspected or confirmed COVID-19 infection (Figures 1 through 8). The standard 2020 CPR algorithms and recommendations for resuscitation should apply to those patients who are known to be COVID-19 negative.

REDUCE PROVIDER RISK

Rationale

Frontline health care providers are at significant risk for contracting respiratory illnesses due to frequent contact with symptomatic patients. Adequate PPE including N-95 masks or positive air pressure respirators, especially during aerosol generating procedures (AGPs), can reduce the risk of coronavirus transmission.¹⁶ Provider risk may vary based on individual (age/ethnicity/comorbidities/vaccination status) and system factors.

Health care organizations may need to consider redoubling efforts to maintain a sufficient supply of PPE for AGPs if vaccination of their staff is incomplete as only full vaccination of health care providers ensures an extremely low rate of infection.¹⁵ Even as immunity to SARS-CoV-2 is achieved with health care provider vaccination, it is reasonable for health care providers to continue taking appropriate precautions against COVID-19 and its variants since CPR includes AGPs and vaccination rates of health care providers remain below 100%.^{17,18} On the other hand, the risk to the patient by withholding or delaying the response for cardiac arrest is extremely high compared with the much lower risk that the resuscitation provider will contract COVID-19 and develop serious illness. This risk is particularly low in the vaccinated or unvaccinated provider who provides care while wearing appropriate PPE for AGPs.¹⁹ Although the effectiveness of available vaccines has been demonstrated against the wild-type SARS-CoV-2 and variants of concern, breakthrough infections, which are usually not life threatening, may still occur. Boosters addressing emerging variants of concern may be required.^{15,20}



REDUCE PROVIDER EXPOSURE AND PROVIDE TIMELY CARE

Rationale

The data regarding which procedures are aerosol generating are conflicting and continue to develop. Some components of CPR are suspected to be aerosol generating.²¹ SARS-CoV-2 is transmitted primarily by respiratory droplets and aerosols, with little transmission by fomites.²²⁻²⁴ Rapid initiation of chest compressions is critical for successful resuscitation and, in light of the low incidence of documented transmission to health care providers to date, is likely low risk to the compressor.²⁵⁻²⁷ In witnessed sudden arrests of patients with suspected or confirmed COVID-19, chest compressions should not be delayed. Chest compressions can be performed initially by a chest compressor with or without a surgical mask until relieved by responders with appropriate PPE for AGPs. Although data continue to develop, in light of the low incidence of documented transmission to health care providers to date, chest compressions should not be delayed for retrieval and application of a mask or face covering for either the patient or provider. Masks may be considered for providers once compressions have started and before the arrival of responders with appropriate PPE for AGPs.²⁸ Unless there are active efforts to maintain an open airway, it is typically occluded in the unconscious patient with minimal air movement during chest compressions.²⁹

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| <p>Reduce provider risk</p> <p>Healthcare providers can significantly reduce their risk of infection by receiving the vaccine and approved boosters (if applicable) against the SARS-CoV2 virus^{13, 14, 15}</p> |
| <p>Reduce provider exposure and provide timely care</p> <ul style="list-style-type: none"> • Rapidly provide chest compressions, without delay or interruption • Do not delay chest compressions for provider PPE or to place a face covering on the patient • Relieve initial resuscitation personnel with providers wearing appropriate PPE for AGPs as soon as possible • Don appropriate PPE for AGPs (N95 masks with eye protection or positive-airway pressure respirators, gloves and gowns) prior to confirmed AGPs including bag-mask ventilation, intubation and positive pressure ventilation • Limit unprotected rescuers from exposure of AGPs • Consider using mechanical CPR devices <i>if available and personnel are already trained</i> • Communicate COVID-19 status of the patient to any new providers and clearly communicate expectations of appropriate risk-matched PPE |
| <p>Specific additional resuscitation strategies</p> <p>Pediatric and adult cardiac arrest</p> <ul style="list-style-type: none"> • Defibrillate as soon as possible when indicated; do not delay defibrillation for application of masks or other PPE. • For agonal breathing, consider passive oxygenation until HEPA filtered ventilation can be provided • Securely attach a HEPA filter to any ventilation device • Ventilate with a bag-mask-HEPA filter with tight seal until a supraglottic or endotracheal airway is placed • Engage the intubator with the highest chance of first pass success • Consider use of video laryngoscopy, if available and personnel are already trained • Maximize chest compression fraction, pausing to intubate only if needed • Minimize endotracheal administration of medications to avoid aerosol generation • Minimize closed ventilation circuit disconnections • Commit to ethical and evidence-based termination of resuscitation policies <p>Out-of-hospital cardiac arrest</p> <ul style="list-style-type: none"> • For adults, prioritize chest compressions and defibrillate when indicated; compressors should apply their own masks if immediately available and retrieval does not delay treatment • For pediatrics, prioritize oxygenation and HEPA filtered ventilation with chest compressions; compressors should apply their own masks when available <p>Maternal and neonatal cardiac arrest</p> <ul style="list-style-type: none"> • Newborn babies are unlikely to be a source of SARS-CoV2 transmission • For newborns, bag-mask or T-piece / mask ventilation with appropriate risk-matched PPE is safe • Maternal respiratory secretions and fluids may be potential sources of SARS-CoV2 transmission for the neonatal team and newborn |

Figure 1. Summary of adjustments to cardiopulmonary resuscitation (CPR) algorithms in patients with suspected or confirmed coronavirus disease 2019 (COVID-19).^{13–15}

AGP indicates aerosol generating procedure; HEPA, high efficiency particulate air; PPE, personal protective equipment; and SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

The case definitions of suspected and confirmed COVID-19 have changed over time.³⁰ For communities and facilities with a higher prevalence of COVID-19 and lower immunization rates, the continuous use of an N-95 respirator and eye protection should be considered when the patient's COVID-19 status is unknown and resuscitation involves AGP interventions to which compressors and other personnel will be exposed. Provided there is sufficient PPE, additional compressors may be required due to increased fatigue or potential for N-95 respirator slippage resulting from

compressions.^{31–33} The application of mechanical compression devices can reduce the number of health care providers required for compressions; however, these devices may not be appropriate or available for morbidly obese adults, infants, children, and small adolescents or for all clinical scenarios.³⁴ Training and regular practice in the use and rapid application of mechanical compressions devices is required to minimize the early no-flow time and to ensure proper application and utilization of the device. Although the clinical use of mechanical devices has not demonstrated improvement in outcome

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| <p>Is masking of the patient during the initial compressions necessary?</p> | <p>Chest compressions without ventilation results in tidal volumes far less than that of normal breathing.^{47, 48, 49} In addition, the airway of cardiac arrest patients is typically initially obstructed by the tongue further reducing the risk of aerosol transmission.²⁹ Thus, in the unlikely event that an unmasked patient with suspected or confirmed COVID-19 suffers an unanticipated cardiac arrest, <i>do not delay compressions</i>. If within immediate reach, the concerned compressor may apply a surgical mask or layered cloth over the mouth and nose of the patient, but this should not delay initiation of chest compressions. The aerosol potential of agonal breathing requires further investigation.</p> |
| <p>Do first responders need to don masks for their safety?</p> | <p>There are no reports yet of chest compressions alone on COVID-19 positive patients resulting in transmission of the virus. It is reasonable for an unvaccinated first responder to don a mask immediately if within reach, but initiation of chest compressions should not be delayed. For completely vaccinated first responders, the risk of infection of COVID-19 from performing compressions without a mask for a short duration is likely negligible while providing an effective treatment for cardiac arrest. Ventilations, which are a priority in pediatric and neonatal arrests, are suspected to be an AGP and an N-95 wearing provider should replace an unmasked first responder as soon as possible.</p> |
| <p>Are 'intubation boxes' useful in controlling aerosolization?</p> | <p>Evidence regarding using a protective barrier enclosure around the patient's head and neck for intubations is still developing. Their use may be considered in scenarios where there is appropriate negative pressure applied and when the intubator is familiar with the technique.⁵⁰ In cardiac arrest resuscitations, logistical considerations affecting chest compressions and other critical care may limit the use of an intubation box. Unless there is intubator and institutional experience with use of an intubation box during resuscitations, there is insufficient evidence to support their use at this time.⁵¹</p> |
| <p>Do mechanical compression devices help during resuscitations?</p> | <p>For institutions that have systems in place, timely implementation of mechanical compression devices can reduce the number of personnel required for chest compressions and maintain quality compressions but are not superior to manual compressions in survival to discharge with intact neurologic function.^{35, 36}</p> |

Figure 2. Frequently asked questions.

AGP indicates aerosol generating procedure; and COVID-19, coronavirus disease 2019.

compared with manual CPR, it may reduce the number of additional staff who are needed to participate in the resuscitation event.^{35,36}

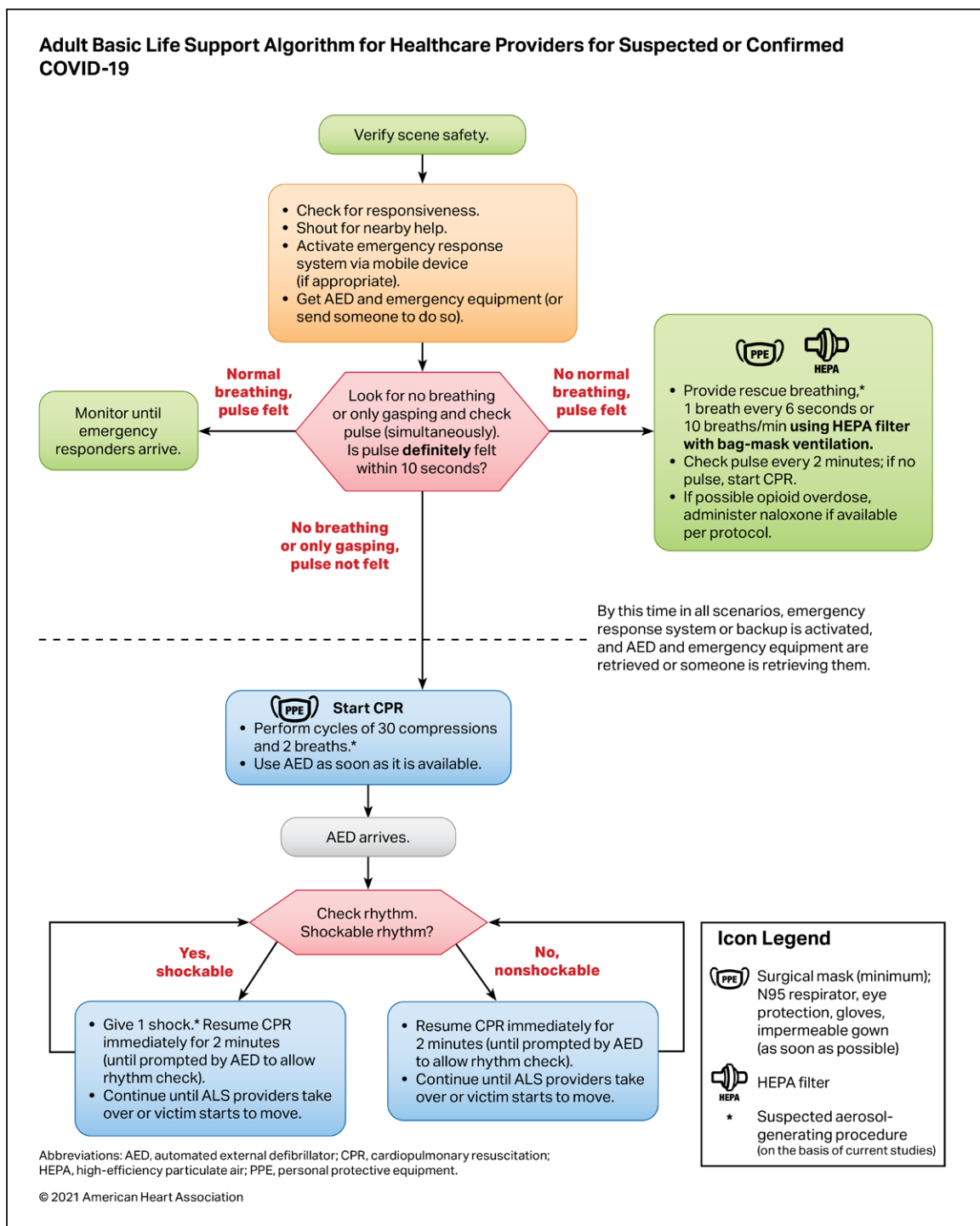
As not every resuscitation space has negative pressure ventilation, closing the door may help limit contamination of adjacent indoor spaces. In out-of-hospital cardiac arrest, taking measures to better ventilate a confined space such as opening windows or doors may reduce the local concentration of aerosols for health care providers if this does not risk contamination of other spaces in the adjacent vicinity. In addition, some health care organizations may have continued shortages in PPE

supply, low vaccination rates among staff, and personnel limitations; this guidance needs to be adapted to local protocols with consideration of current COVID-19 disease burden and resource availability.

Specific Additional Resuscitation Strategies

Rationale

It remains unclear whether defibrillation itself is an AGP; however, preliminary animal data suggest chest compressions following defibrillation may be aerosol generating.³⁷ On the other hand, case-control and retrospective cohort



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Figure 3. Adult basic life support algorithm for health care providers for suspected or confirmed coronavirus disease 2019 (COVID-19).

studies of other infectious agents spread by aerosolization indicate that the relative risk of transmission during defibrillation is minimal.³⁸ A surgical mask on a patient with COVID-19 may help deflect exhaled respiratory particles that can pass through some oxygen-delivering masks. However, mask availability should not delay or prevent time-sensitive lifesaving therapies like chest

compressions or defibrillation. When actively ventilating using bag-mask ventilation, a supraglottic airway, or an endotracheal tube, a high-efficiency particulate air (HEPA) filter on the ventilation exhaust port can capture aerosolized particles. Endotracheal intubation should be timed with having sufficient PPE-protected personnel to perform the procedure.

SITUATION- AND SETTING-SPECIFIC CONSIDERATIONS

Pediatric and Adult Cardiac Arrests

- In the witnessed sudden arrest, initiate chest compressions immediately and, if not already masked, the provider should don their mask without delaying or interrupting compressions. If immediately available, a face covering for the patient may be considered but should not delay or interrupt compressions.
- Ventilations that are prioritized in pediatric arrests are suspected to be aerosol generating. Upon arrival, providers wearing appropriate PPE for AGPs should excuse providers without risk-matched PPE.
- Defibrillate as soon as indicated. Masking of the unvaccinated provider and patient may reduce the uncertain transmission risk following defibrillation but should not prevent or delay defibrillation. Patient masks are not needed if providers are wearing appropriate PPE for AGPs.
- A HEPA filter should be securely attached to any manual or mechanical ventilation device along the exhalation port before all ventilation devices such as, but not limited to, bag-mask-valve, supraglottic airway devices, endotracheal tubes, and ventilator mechanical circuits. Alternatively, a low-dead space viral filter or a heat and moisture exchanging filter with >99.99% viral filtration efficiency may be placed between the ventilation device and the airway. The viral filter or the heat and moisture exchanging filter should remain attached to the airway when changing ventilation devices.
- Secure placement of a supraglottic airway with HEPA filters can help maximize chest compression fraction and control aerosol generation before endotracheal intubation.
- Agonal breathing has been observed during early phases of cardiac arrest and may be seen during resuscitation particularly during transient periods of restored spontaneous circulation. In such cases, consider passive oxygenation overlaid with a surgical facemask (if readily available) when a bag-mask device or an advanced airway with a HEPA filter is not being utilized.
- Before intubation, ventilate with a bag-mask-HEPA filter and a tight seal using practiced 2-person technique, ideally. The second team member can help provide extra support for additional procedures such as compressions once the airway is established.
- Assign the intubator with the highest chance of first pass success using the method the intubator is most comfortable with while protected with appropriate PPE for AGPs. Intubate with a cuffed endotracheal tube to minimize aerosolization of respiratory particles.

- Consider use of video laryngoscopy if available and if the operator is experienced with this technique as this may reduce direct exposure of the intubator to respiratory aerosols. Currently, there is no evidence of a difference in transmission risk using video versus direct laryngoscopy in the setting of providers wearing appropriate PPE for AGPs.
- As in any resuscitation, maximize the chest compression fraction, pausing only to facilitate intubation if needed. Minimizing noncompression time can require team-based instruction including pulse checks, advanced airway placement, and focused ultrasound evaluation coordinated with pulse checks and other necessary interruptions.
- Avoid endotracheal administration of medications; disconnections may be a source of aerosolization due to unfiltered exhalation.

Prearrest

Closely monitor for signs and symptoms of clinical deterioration to minimize the need for emergency intubations that put patients and providers at higher risk.

- Address advanced care directives and goals of care with all patients with suspected or confirmed COVID-19 (or proxy) on hospital arrival and with any subsequent significant change in clinical status.
- If the patient is at risk for cardiac arrest, consider proactively moving the patient to a negative-pressure room/unit, if available, to minimize risk of exposure to rescuers during a resuscitation.
- Close the door when possible to prevent airborne contamination of adjacent indoor space. Conversely, for out-of-hospital cardiac arrests, ventilating confined spaces by opening windows or doors may help disperse aerosolized particles if this does not risk exposure of others in the vicinity and not already in an outdoor setting.

Out-of-Hospital Cardiac Arrest

Guidance regarding Emergency Medical Services and lay rescuer is described in detail in other literature.^{39,40}

- For the out-of-hospital, public, cardiac arrest chest compressions should be immediately initiated. It is reasonable for the compressor to don a mask immediately, but initiation of chest compressions should not be delayed. Delays due to mask retrieval may increase the risk of death for the patient from delayed CPR while providing little benefit to the provider.
- If immediately available, placing a face covering on a known COVID-19 patient may reduce the uncertain risk of aerosol exposure from compressions following defibrillation but should not prevent or delay defibrillation or chest compressions and is unnecessary for providers in appropriate PPE for AGPs.

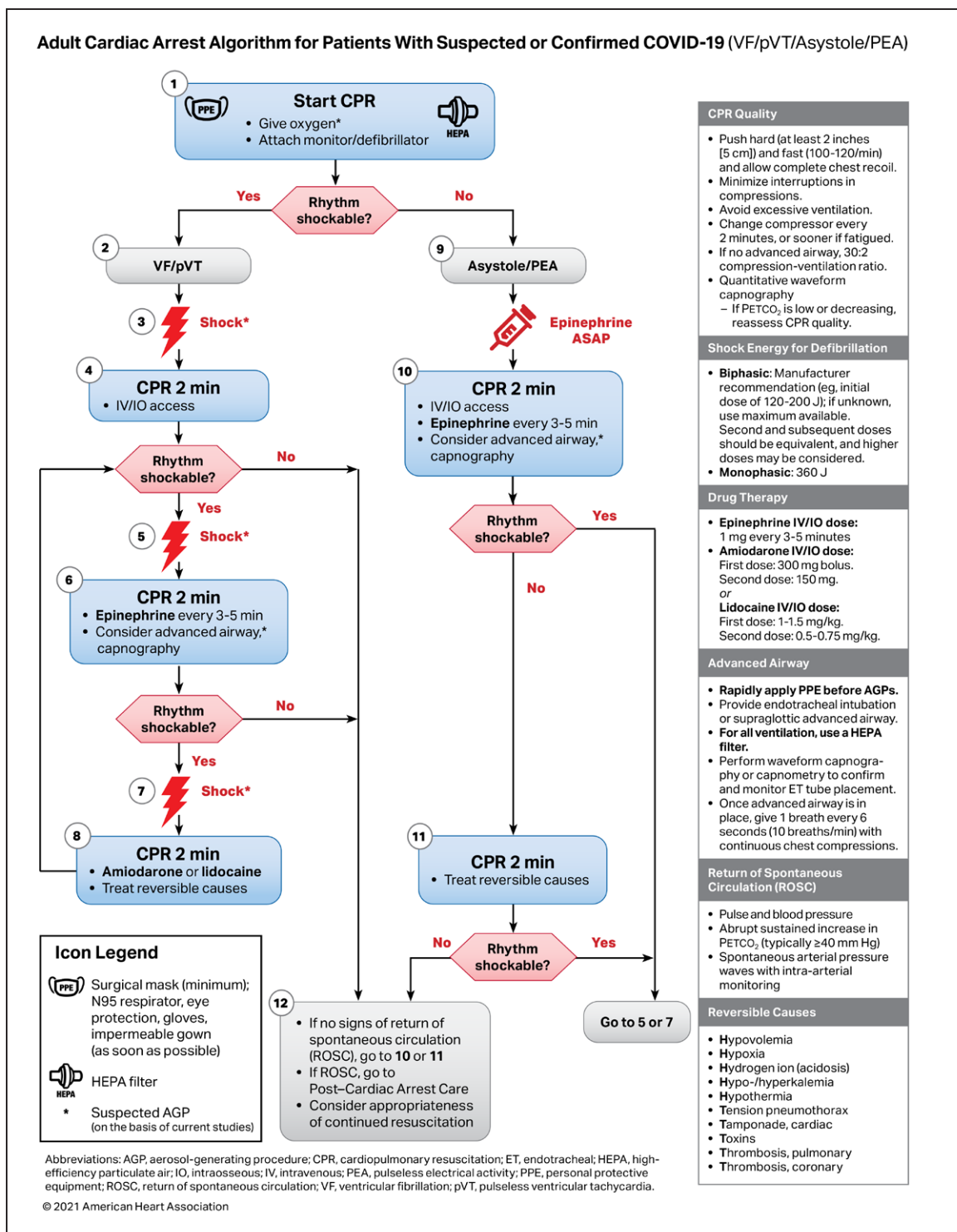


Figure 4. Adult cardiac arrest algorithm for patients with suspected or confirmed coronavirus disease 2019 (COVID-19; VF/pVT/asystole/PEA).

- Before or upon arrival, Emergency Medical Service providers should rapidly don appropriate PPE for AGPs without delay or interruption of chest compressions and excuse unprotected persons from the immediate scene of care as soon as possible.
- Pediatric arrests occur primarily from respiratory causes, and ventilation is a lifesaving priority. Since ventilation of suspected and confirmed COVID-19 pediatric arrests poses a transmission risk, HEPA-filtered ventilation and health care provider masking, when available, can reduce the risk of transmission

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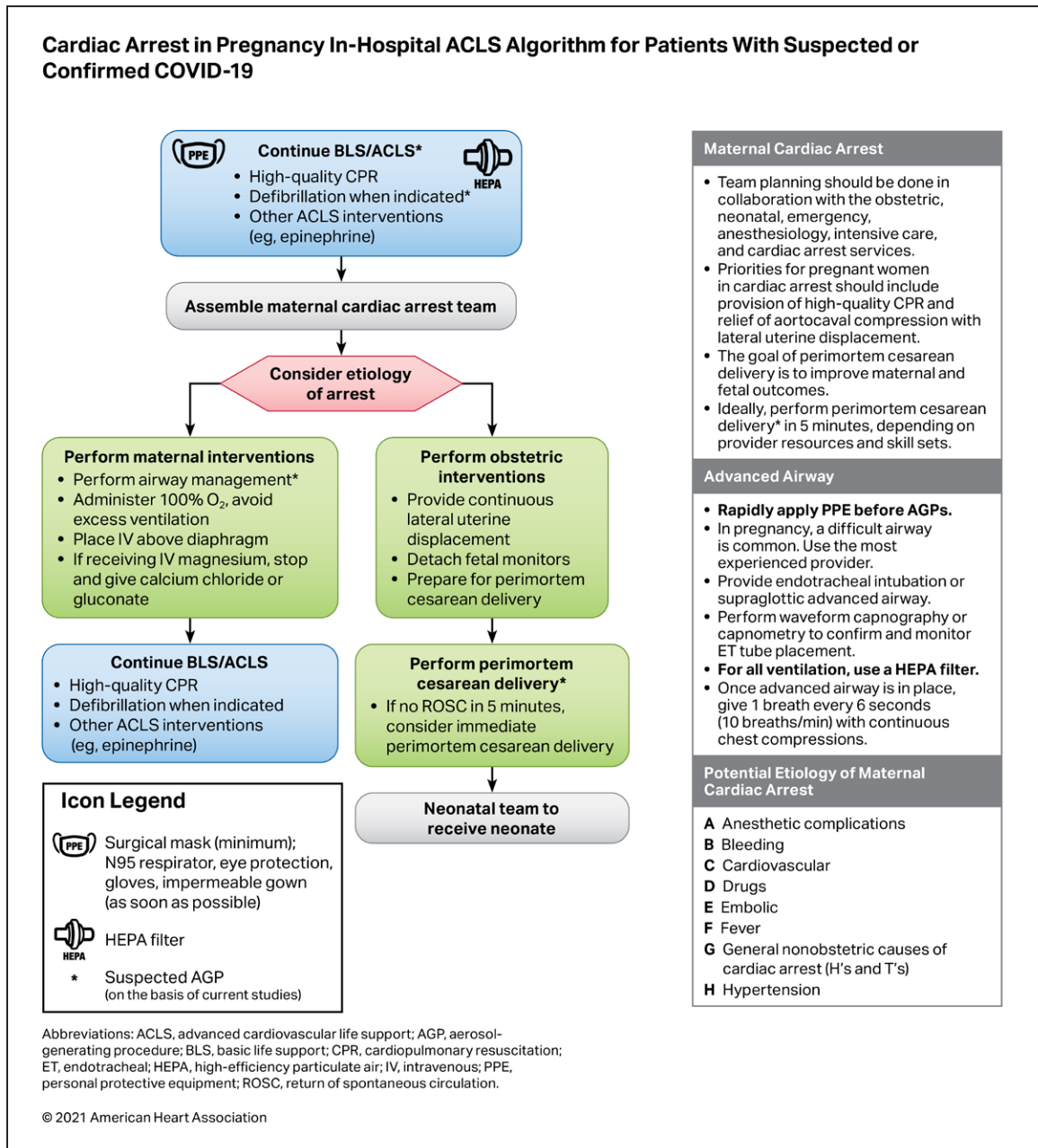


Figure 5. Cardiac arrest in pregnancy in-hospital Advanced Cardiac Life Support (ACLS) algorithm for patients with suspected or confirmed coronavirus disease 2019 (COVID-19).

during CPR until providers arrive wearing appropriate PPE for AGPs.

In-Hospital Cardiac Arrest

Crowd control for effective direction of resuscitation by the minimum number of people required is advised. Closing the door to the resuscitation area, when possible, may minimize airborne contamination of adjacent indoor space. Health care personnel should continue to wear appropriate PPE for clinical care including masks, eye protection, and gloves as recommended by the Centers for Disease Control and Prevention.⁴¹ The standard

2020 AHA guidelines for CPR and ECC should apply to those patients who are known to be COVID-19 negative.¹

Patients Who Are Intubated Before Arrest

Consider leaving the patient on a mechanical ventilator with a HEPA filter to maintain a closed circuit and to reduce aerosolization and adjust the ventilator settings to allow asynchronous ventilation with the following suggestions:

- Increase the FiO₂ to 1.0.
- Use either pressure or volume control ventilation and limit pressure or tidal volume to generate

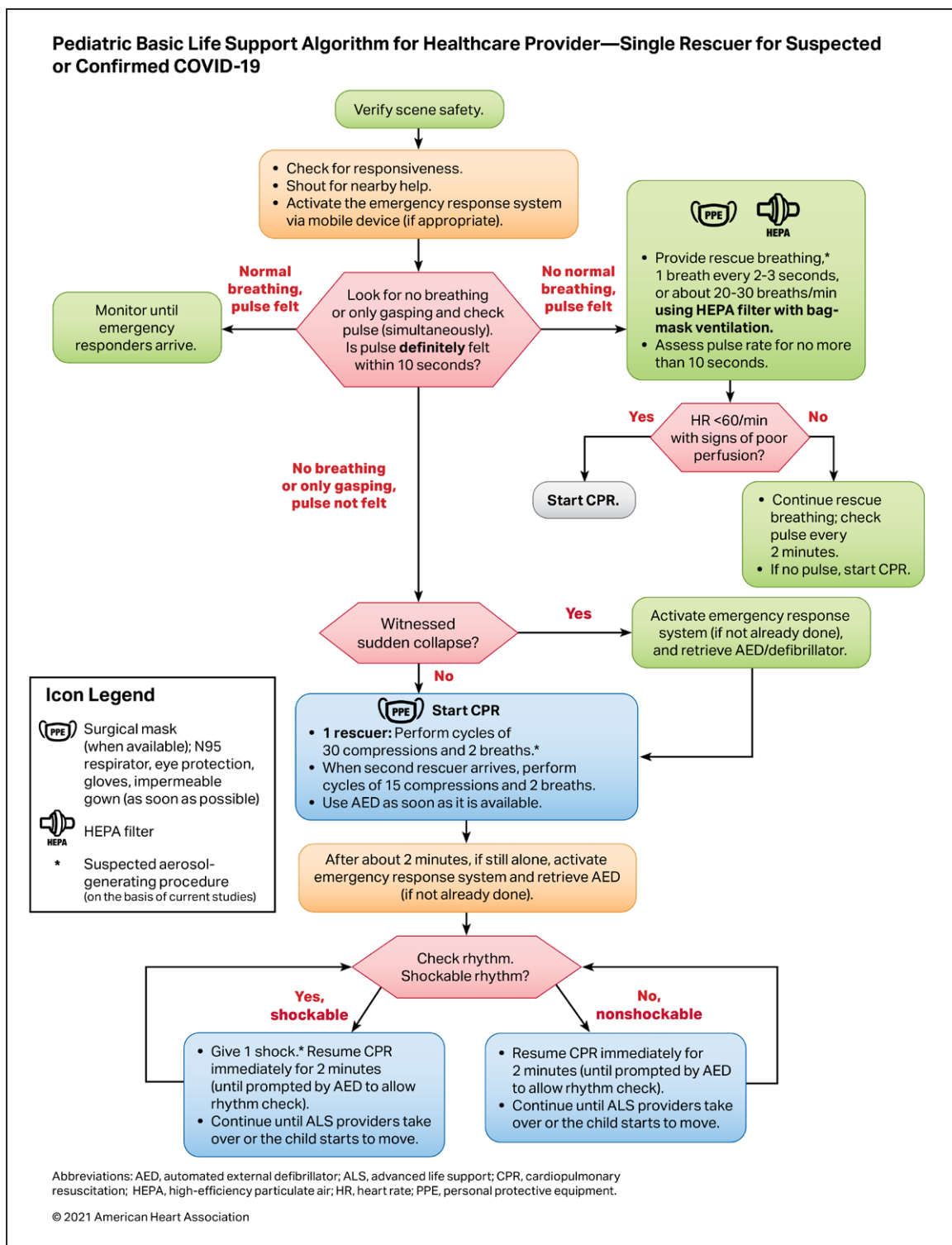


Figure 6. Pediatric basic life support algorithm for health care provider—single rescuer for suspected or confirmed coronavirus disease 2019 (COVID-19).

adequate chest rise (4–6 mL/kg ideal body weight is often targeted for adults and neonates, 5–8 mL/kg for children).

- Adjust the trigger settings to prevent the ventilator from auto-triggering with chest compressions and possibly prevent hyperventilation and air trapping.
- Adjust respiratory rate to 10 breaths/min for adults, 20 to 30 breaths/min for infants and children, and 30 breaths/min for neonates.
- Assess the need to adjust the positive end-expiratory pressure level to balance lung volumes and venous return.

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- Adjust ventilator settings to deliver full breaths with asynchronous chest compressions.
- Ensure endotracheal tube/tracheostomy and ventilator circuit continuity to prevent unplanned airway dislodgement or tubing disconnections.

If return of spontaneous circulation is achieved, set ventilator settings as appropriate to the patients' clinical condition and treat the underlying cause of cardiac arrest.

Patients Who Are in Prone Position at the Time of Arrest

Anticipation and preparation are important in rotating patients to a supine position. The limited evidence for providing CPR in the prone position suggests it may be better than not providing CPR. For patients in the prone position with an advanced airway, it may be reasonable to provide manual compressions in the prone position until a patient can be safely transitioned to a supine position with a trained team. If deemed necessary for optimal clinical care, such as assessing endotracheal tube patency and positioning, the following steps for transitioning a patient to a supine position are suggested:

- Provide compressions with hands centered over the T7/T10 vertebral bodies.
- Arrange for sufficient, trained, PPE-protected personnel to achieve safe supination on the first attempt.
- If already intubated, ensure ventilation and vascular tubing continuity and apply the posterior defibrillator pad to the patient's back before rotating.
- Immediately resume CPR supine once the patient has been rotated. Confirm tubing and access lines have not been dislodged and are in working order.

Postarrest Patients

Health care providers wearing appropriate PPE should continue to provide postcardiac arrest care per the 2020 AHA guidelines for CPR and ECC.^{42,43}

Appropriateness of Starting and Continuing Resuscitation

Address and follow the patient's goals of care and commit to ethical and evidence-based organizational policies to guide the determination of initiation and continuing resuscitative efforts. Follow the 2020 AHA guidelines for CPR and ECC for termination of resuscitation.⁴²

Unsuccessful Resuscitations With Suspected and Confirmed COVID-19

Inquire with the infection control officer or medical examiner if further postmortem testing is required for epidemiological or contact tracing purposes.⁴⁴

Maternal and Neonatal Considerations

Neonatal Resuscitation

Every newborn baby should have a skilled attendant prepared to resuscitate regardless of the COVID-19 status. The newborn baby is unlikely to be a source of COVID-19 transmission even when mothers have confirmed COVID-19, but maternal respiratory secretions and fluids may be a potential source of SARS-CoV-2 transmission for the neonatal team and newborn.⁴⁵ When appropriate, mothers can be encouraged to wear a surgical mask during the delivery. For suspected or confirmed COVID-19–infected mothers, health care providers should don appropriate PPE for AGPs to decrease the risk of transmission to themselves and the baby.

- Initial steps: routine neonatal care and the initial steps of neonatal resuscitation are unlikely to be aerosol generating; they include drying, tactile stimulation, placement into a plastic bag or wrap, assessment of heart rate, and placement of pulse oximetry and electrocardiographic leads.
- Suction: suction of the airway after delivery should not be performed routinely for clear or meconium-stained amniotic fluid. Suctioning is a suspected AGP and is not indicated for uncomplicated deliveries, regardless of the COVID-19 status.
- Endotracheal medications: endotracheal instillation of medications such as surfactant or epinephrine is suspected to be an aerosol generating procedure, especially via an uncuffed tube. Intravenous delivery of epinephrine via a low-lying umbilical venous catheter is the preferred route of administration during neonatal resuscitation, regardless of the COVID-19 status.
- Positive pressure ventilation remains the main resuscitation strategy for newborns for apnea, ineffective breathing (gaspings), and bradycardia. Chest compressions occur later in the resuscitation algorithm.
- Delayed cord clamping and skin-to-skin contact may be practiced in the setting of a suspected or confirmed COVID-19–positive mother in stable neonates provided the mother is appropriately masked.
- Until confirmed to be COVID-19 negative, suspected or confirmed COVID-19–positive mothers should practice hand and breast hygiene and wear a mask during care and feeding.
- Closed incubators: closed incubator transfer and care (with appropriate distancing) should be used for neonatal intensive care patients when possible, but incubators do not protect against aerosolized particles.

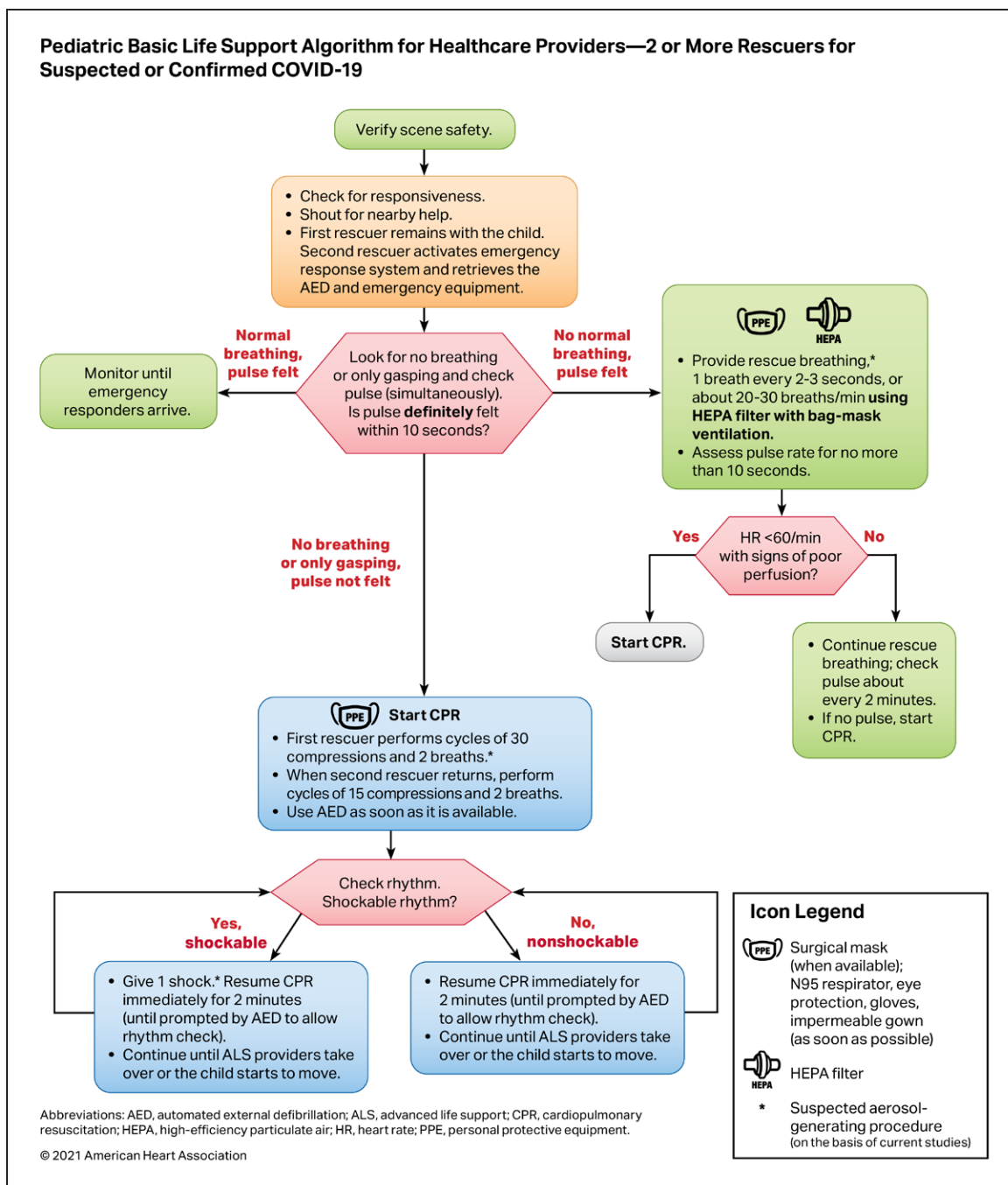


Figure 7. Pediatric basic life support algorithm for health care providers—2 or more rescuers for suspected or confirmed coronavirus disease 2019 (COVID-19).

Maternal Cardiac Arrest

Symptomatic pregnant patients with COVID-19 are at increased risk of more severe illness compared with nonpregnant peers. Although the absolute risk for severe COVID-19 is low, data indicate an increased risk of ICU admission, need for mechanical ventilation and ventilatory support, and death in pregnant women with symptomatic COVID-19 infection.⁴⁶

- Preparation for perimortem cesarean delivery, to occur by 5 minutes of advanced cardiac life support

without return of spontaneous circulation, should be initiated early to allow the obstetric and neonatal teams to apply appropriate PPE for AGPs before they enter the resuscitation area.

- Oxygenation with intubation should be prioritized earlier in pregnant women with symptomatic COVID-19 who experience cardiac arrest. Provide chest compressions with concurrent left lateral uterine displacement when the uterine fundus is at the level of the umbilicus or greater.

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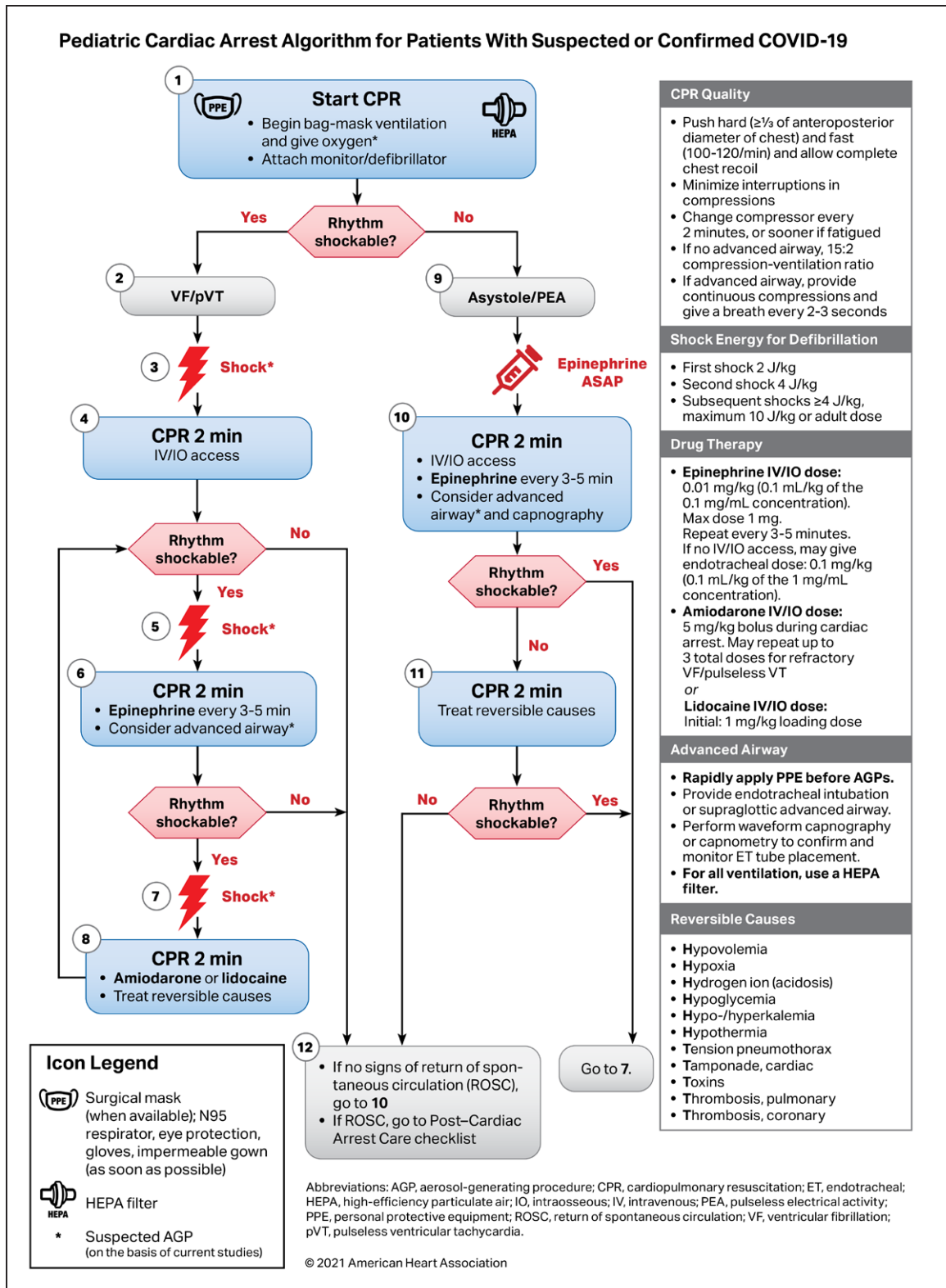


Figure 8. Pediatric cardiac arrest algorithm for patients with suspected or confirmed coronavirus disease 2019 (COVID-19).

ARTICLE INFORMATION

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