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SPECIAL REPORT

# Interim Guidance for Emergency Medical Services Management of Out-of-Hospital Cardiac Arrest During the COVID-19 Pandemic

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The novel coronavirus disease 2019 (COVID-19) has caused immense adverse health consequences around the world. The pandemic's potential impact upon out-of-hospital cardiac arrest (OHCA) resuscitation and related training are substantial. Given the public health implications of OHCA, resuscitation in the COVID-19 era must strive to correctly balance the best practices achieved by the links in the chain of survival with the added risks of COVID-19. Importantly, changes that are implemented to address COVID-specific risks are likely to affect resuscitation care for all patients with OHCA given the challenges of accurate and timely assessment of COVID infection in the prehospital setting. Preliminary reports indicate that OHCA care and outcome have been adversely impacted in communities with low and high COVID-19 prevalence.[1–3] Some of the mortality toll may be attributable directly to COVID-19 infection among patients with OHCA. However, an important contributor appears to be adverse impacts of the pandemic on circumstances and care for OHCA patients without COVID-19, highlighting the far-reaching challenges to resuscitation as systems and society navigate the pandemic.

Resuscitation strategies should be informed by rigorous research, acknowledging that there are significant gaps in knowledge involving COVID-19 and OHCA. As a consequence, advisories from many groups, including the World Health Organization,[4] Heart and Stroke Foundation of Canada,[5] Public Health Scotland,[6] the New Emerging Respiratory Virus Threats Advisory Group,[7] the American Heart Association,[8] and the European Resuscitation Council,[9] have offered thoughtful, but differing guidance, highlighting the need for ongoing, evidence-based updates. This interim guidance builds on those published by the American Heart Association in April 2020, providing additional insights about public response and Emergency Medical Services (EMS) care of patients with OHCA.[8] This guidance applies to adults and children unless otherwise noted.

**Key Words:** coronavirus ■ emergency medical services ■ guideline ■ mortality ■ out-of-hospital cardiac arrest

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## KEY POINTS

- Quickly recognizing sudden cardiac arrest, alerting Emergency Medical Services via 9-1-1, initiating chest compressions (and rescue ventilations in children), and defibrillating when available, remain the cornerstones of out-of-hospital cardiac arrest care during the coronavirus disease 2019 (COVID-19) pandemic.
- Resuscitation must balance the proven public health benefits of programmatic best practices with new risks of COVID-19. The prevalence of COVID-19 among patients with out-of-hospital cardiac arrest in most communities is low, perhaps 5%, and is likely more common in residential than public settings.
- Severe acute respiratory syndrome coronavirus transmission risk appears to be low with hands-only cardiopulmonary resuscitation or public access defibrillation. Thus, 9-1-1 telecommunicators and lay rescuers should prioritize chest compressions and defibrillation even when facemasks are not immediately available (revised recommendation).
- For professional rescuers, transmission risk for aerosol-generating procedures can be mitigated using personal protective equipment. We recommend use of high-efficiency particulate absorbing filters to reduce aerosolization in combination with a bag-valve mask with a tight mask-face seal, a supraglottic airway, or an endotracheal tube with an inflated cuff (revised recommendation).
- When caring for infants and children in cardiac arrest, even in areas with a high prevalence of COVID-19, treatment priorities, including high-quality cardiopulmonary resuscitation and appropriate ventilatory support, should not be altered by concerns about severe acute respiratory syndrome coronavirus transmission (revised recommendation).
- The COVID-19 pandemic has revealed inequalities in COVID-19 disease prevalence and burden, as well as access to emergency care. Geographic standards of Emergency Medical Services care should seek to understand these disparities and promote strategies that can support optimal outcomes for all individuals served.

## A FRAMEWORK FOR THE CHAIN OF SURVIVAL IN THE COVID-19 ERA

The links in the chain of survival provide the foundation for how to address the added complexity of the COVID-19 pandemic. For example, layperson cardiopulmonary resuscitation (CPR) derives from a large evidence base, indicating a number needed to treat of 25 to 50 to save a life—a powerful and lifesaving intervention.[10] COVID-19 introduces a new risk for the rescuers caring for an patient with OHCA who is infected with the severe acute respiratory syndrome coronavirus (SARS-CoV-2) virus. Consequently, a rescuer's risk would depend on (1) the prevalence of COVID-19 among the OHCA population, (2) the risk of transmission related to resuscitation, and (3) the potential for morbidity and mortality if transmission occurs. The prevalence of COVID-19 among OHCA depends on a community's epidemiology, and evidence to date suggests that the prevalence is modest—perhaps 5% or less among OHCA in many communities, although the additional high-quality investigation is needed.[11]

Investigation continues to evaluate the risk of transmission with CPR, understanding that risk may depend on the duration and nature of exposure. Whether hands-only CPR or defibrillation confer added transmission risk is uncertain, although other care, especially involving the airway and ventilation, has been associated with an increased risk with other coronavirus infections.

The observed case fatality from COVID-19 infection is 1% to 2% and depends on various demographic and clinical characteristics.[12] Moreover, risks and benefits must be considered for different rescuer groups. The lay rescuer often knows the victim, has already had substantial exposure, is likely to provide hands-only CPR, and will provide cardiac arrest care for a handful of minutes. In contrast, EMS providers are meeting the patient for the first time, have ready access to personal protective equipment (PPE), often provide extended resuscitation attempts, and use a range of treatments associated with aerosolization. This framework should inform if and how the links in the chain may be changed, appreciating that well-intended change itself can produce unexpected or unintended consequences that can adversely affect patients and rescuers.

### Activation of the Emergency Response System

Rapid recognition of cardiac arrest and prompt activation of the emergency response system remain the initial and critically important actions for neurologically intact survival. All 911 EMS calls should continue standard acquisition of caller address/location information followed by determination of possible cardiac arrest. If OHCA is suspected, the closest available responder(s) should be activated immediately.[13,14]

### High-Quality (Layperson) CPR

If cardiac arrest is suspected, telecommunicators should prioritize CPR coaching for the bystander to deliver hands-only CPR for an adult patient, with the addition of rescue breathing (if willing and able) for infants and children. Telecommunicator-CPR can substantially increase the provision of lay rescuer CPR and improve a system's survival.[15–17]

There is no evidence available about the consequences of the methods by which telecommunicators integrate questions about COVID-19 in suspected OHCA. Systematic questioning about COVID-19 may delay or prevent lay rescuer care for all OHCA victims by adding questions, potentially causing anxiety and fear for the rescuer, or by adding additional tasks such as applying a mask to the victim, without strong evidence that such actions lower risk for the rescuer. Conversely, each minute that CPR is delayed has been associated with measurable decline in the likelihood of survival.[18,19] Consequently, telecommunicator programs should consider the local prevalence of COVID-19 among OHCA. If evidence supports a low prevalence, defined by the US Centers for Disease Control as 0% to 5% COVID-19 viral reverse transcriptase-polymerase chain reaction laboratory test 7-day percent positivity,[20] telecommunicators and rescuers should prioritize chest compressions before considering additional questioning about COVID-19.[11]

Whether telecommunicator strategies should allocate additional questions based on the location of the arrest is also uncertain. Although evidence is preliminary, those with OHCA and COVID-19 may be disproportionately distributed in residential and nursing facilities given presumed prodromal COVID-19 illness.[11] Thus, additional questions about COVID-19 could be reserved for residential settings and deferred in public locations. Again, this type of stratification may delay or prevent early layperson care without evidence that added complexity results in additional rescuer safety. Finally, smartphone applications can crowdsource lay rescuer responses to nearby suspected OHCA. Whether there is any COVID-19 risk to rescuers responding to this activation is uncertain at the time of dispatch, although there are reports that a few systems suspended these programs during the COVID-19 pandemic.[3] No firm recommendation can be made at this time to suspend or continue these programs when disease prevalence is moderate or high.

## Early (Layperson) Defibrillation

Early defibrillation is an essential, lifesaving intervention for OHCA patients with ventricular fibrillation/pulseless ventricular tachycardia.[21,22] Public access defibrillation by laypersons is an effective strategy that leverages the beneficial survival effects of early defibrillation.[23] The risk of COVID-19 transmission to the lay rescuer related to automated external defibrillator application and shock is unknown, although there is indirect evidence to help inform transmission risk.

Defibrillation is unique among cardiac arrest interventions in requiring minimal patient contact. Apart from placing adhesive electrodes, rescuers can deliver therapy without patient contact. Defibrillation itself causes momentary tonic skeletal muscle contraction, a mechanism that alone is not likely to cause exhaled aerosol. Defibrillation in the health care setting was not associated with risk of SARS-CoV transmission, although the sample size was small and precluded the ability to rule out clinically important risk.[24] Given the strong evidence supporting early defibrillation balanced against the likely negligible COVID-19 risk to the rescuer, albeit based on limited or indirect evidence, strategies to implement and achieve public access defibrillation should not be altered by COVID-19 in most communities.

## Advanced Resuscitation Interventions

### *EMS Diagnosis of COVID-19*

Early and accurate diagnosis in the field setting could potentially inform care as well as rescuer PPE decisions. However, accurate diagnosis of COVID-19 based on history and clinical presentation alone is challenging. To date, evidence among all emergency patients indicates that there are no absolute signs EMS or hospital-based emergency professionals can use to accurately identify COVID-19.[25–27] With regard to diagnosis among patients with OHCA, a single retrospective investigation compared COVID-19 clinical classification based on collective review of EMS documentation and death certificates to a gold-standard test using reverse transcriptase-polymerase chain reaction swabs.[11] Clinical classification produced a sensitivity of 70% (14/20), specificity of 88% (69/78), positive predictive value of 61% (14/23), and negative predictive value of 92% (69/75). As this preliminary report suggests, real-time clinical classification among patients with OHCA is not sufficiently accurate to determine COVID-19 status, guide PPE decisions, or indicate COVID-19 specific care. Use of personal protective equipment against aerosol, droplet, and contact modes of viral transmission is warranted for any OHCA patient with a recent positive test for COVID-19.

### *Personal Protective Equipment*

Professional rescuers encounter distinct circumstances compared with lay rescuers. Professional rescuers typically have lead time and information about the nature of illness, are trained and equipped for proper use of PPE, provide more prolonged resuscitation, and deliver treatment associated with an elevated risk of aerosolization. Even with lead time, accurate and timely assessment of COVID-19 risk is often not feasible. As such, guidelines have consistently recommended a full compendium of PPE to include the combination of N95 respirator mask, eye shield, gown, and gloves (abbreviated as MEGG) for all patients with OHCA during the COVID-19 era. Evidence on the topic is limited. A simulation experience suggested that full PPE may not assure complete protection during high-quality chest compressions.[28] However, field experience from a large metropolitan system indicated a very low infectious risk for EMS providers routinely using full PPE for high-risk cases including OHCA.[29] To achieve timely and effective PPE application, a new resuscitative team choreography may be required to smoothly integrate infection control procedures. Thus, professional responders should practice efficiently donning PPE against droplet, aerosol, and contact methods of transmission. Factoring studies previously mentioned in this guidance, initial chest compressions and defibrillation could be provided without gowns but with masks, eye protection, and gloves, while the remainder of arriving responders don the full PPE complement.

### *Professional Rescuer CPR*

COVID-19 does not change evidence-based best-practice goals for CPR performance to include metrics related to compression depth, release, rate, and interruption. Although each event has a range of circumstances, these metrics should continue to be the goal during the COVID-19 era. Thus, EMS programs must train new approaches that modify resuscitation choreography. For example, strategies that stage additional rescuers outside the immediate resuscitation area to reduce potential rescuer exposure may produce delays or interruptions in CPR and thus require training to reduce this risk. Although mechanical compression devices can reduce EMS-OHCA hands-on patient contact, there is no evidence to date that compares the risk of infection transmission of COVID-19 (or any pathogen) between manual versus mechanical chest compression. Manual chest compressions remain a standard of care for OHCA.[30] Moreover, EMS systems contemplating pandemic-related implementation of mechanical CPR devices must consider the significant training to achieve operational expertise as well as the ongoing requirement to remain proficient with manual CPR. Without such a commitment, care will suffer, and patient lives will be lost for unproven rescuer benefit. Careful review of measures of chest compression fraction, rates of chest compressions per minute, and causes of pauses in chest compressions is valuable for EMS leaders that choose to implement mechanical chest compressions for their system.[31]

### *Airway Management*

All positive-pressure ventilation or invasive airway procedures are considered aerosol-generating procedures and potentially confer added risk of COVID-19 transmission in an infectious patient. EMS professionals should wear an N95 equivalent or higher-level respirator when performing these procedures. High-efficiency particulate absorbing-type viral filters should be added to all exhalation ports to provide additional protection.[8] Thus, the current guidelines continue to recommend bag-valve-mask with a tight mask-face seal, a supraglottic airway, or endotracheal intubation with an inflated cuff in combination with a high-efficiency particulate absorbing filter to reduce aerosolization.[8] Care should be taken to ensure that early airway strategies to minimize aerosolization do not preempt emphasis on high-quality chest compressions and rapid defibrillation. Ultimately, the optimal strategy must balance patient outcome and provider safety while incorporating provider experience and proficiency and the established practice.[32,33] A change in practice motivated solely by COVID-19 risk may result in a paradoxical increase in exposure due to inexperience with procedures and prolonged airway interventions, in turn imperiling high-quality CPR.

## Postcardiac Arrest Care

Prehospital advanced life support and immediate postarrest care goals are not fundamentally altered by COVID-19, although appropriate infection control measures started by EMS are expected to be continued in the emergency department and beyond in the in-hospital setting. Limited evidence from in-hospital settings indicates that COVID-19 related arrests occur in the setting of multiorgan failure.[34] Hypoxia and respiratory failure are often a prominent component of advanced illness.[35] Currently, this understanding does not support specific protocolized change in advanced treatment. When COVID-19 is suspected, EMS should alert emergency department personnel of this suspicion as part of the notice that a pericardiac arrest patient will be arriving shortly. Raising awareness in the receiving hospital's staff about the suspected or confirmed COVID-19 status of the inbound patient may help to expedite infection control preparation at the hospital. The primary focus of the EMS to hospital communication should remain on the patient's present clinical status and if specific services such as urgent cardiac catheterization appear indicated.

### *Termination of Resuscitation*

Among adult OHCA, there are validated termination of resuscitation algorithms that strive to balance lifesaving efforts with futility and unnecessary prolongation of resuscitation. Such guidelines provide the framework to consider field termination and continue to be relevant during the COVID-19 era.[36,37] Recent evidence also supports the potential survival advantage of prehospital field resuscitation over early hospital transport.[38] Taken together, resuscitation attempts that deliver full efforts in the field and are responsibly terminated when deemed futile, provide a logical approach to improve outcomes while limiting unnecessary risk through transport of patients, including those with COVID-19, to the hospital setting.

## Survivorship and Recovery

Survivorship and recovery after OHCA are increasingly recognized as important priorities for optimizing the quality of life for patients, families, and their caregivers.[39] Important issues to address for healthy survivorship include emotional (fear, anger, self-doubt), psychological (anxiety, posttraumatic stress), and existential (What if? What now?) domains. Moreover, OHCA experience does not affect just the patient and their family but also impacts the lay rescuers and professionals involved in the chain of survival.[39] Debriefings and psychosocial support may be useful to improve EMS system performance and individual EMS professional wellness.[40,41] The pandemic has highlighted the complexity of survivorship and the need to incorporate long-term recovery and wellness for patient and responders.

### Pediatric Cardiac Arrest

Studies to date have found that children have less severe COVID-19 illness and COVID-19-related deaths are rare.[42] Therefore, if willing and able, lay rescuers should perform chest compressions, consider mouth-to-mouth ventilation, and use public access defibrillation if available.[9] For EMS professionals caring for infants and children in cardiac arrest, even in areas with a high prevalence of COVID-19, treatment should not be altered by concerns about COVID-19 transmission.

## ADDITIONAL AREAS OF IMPORTANCE

### Disparity and COVID-19

Racial and ethnic minority populations have been disproportionately affected by COVID-19-related morbidity and mortality.[43–46] For example, deaths in US communities that experienced the first wave of COVID-19 indicated that ≈25% occurred among the Black population, although the Black population constitutes only 13% of the US population. In New York City, minority race was substantially more common among patients with OHCA during COVID-19 compared with nonpandemic control periods.[47] The reasons for this disproportionate OHCA burden among racial and ethnic minorities are complex and likely involve a greater prevalence of COVID-19 infection but are also likely attributable to enduring social determinants of health and other cultural influences that more generally impede health and health care access.

### Matching Response to Risk

In any demanding situation that stresses the health care system, there may be a need to consider whether normal standards of care should be altered to sustain some measure of operations and health care delivery. In the prehospital circumstance, the volume or type of patients, the capacity of the workforce, or the availability of supplies and treatment resources (eg, PPE) can individually or collectively affect the ability to deliver a standard of care, even for patients with OHCA. During most periods, EMS systems deliver conventional standards of care aimed at achieving optimal outcomes for each patient. In contingency standards of clinical care, some alteration(s) in some aspect(s) of the EMS system's response will occur, although generally with the intent to maintain optimal outcomes for each patient. In crisis standards of clinical care, resources cannot meet the needs of the system despite contingency efforts and often invoke temporary alterations in the clinical care, understanding that these changes will help preserve some measure of system response but may produce worse individual patient outcomes.[48]

In a pandemic, ethical principles can guide changes in the standard of care for EMS systems. Prior experience, for example, from 2009 to 2010 avian influenza A (H1N1) pandemic can be used to inform current decisions.[49,50] In each instance, the balance of risk and benefit to the individual patient, the health care provider, and the system must be considered. Prehospital stakeholders and EMS leaders should carefully evaluate the aim to achieve risk-matched guidance with respect to OHCA standards of clinical care. For example, PPE may be extended by reuse strategies as part of contingency standard of care. This strategy may be prioritized for care of most conditions but might be avoided for resuscitation given the heightened risk associated with aerosol-generating procedures. When considering crisis standards, such decisions may be more consistent and effective if they derive from a vetted and prescriptive plan that includes meaningful and robust triggers. Effective implementation involves participation by multiple stakeholders responsible for not just clinical care but also public health and safety with a plan for ongoing assessment and return to contingent and conventional standards as soon as possible.[48]

### Training and Education

There is no comprehensive assessment of the impact of COVID-19 on layperson and emergency responder CPR and resuscitation training, although undoubtedly training and education has been markedly reduced during the pandemic. Many training and certification groups have extended certification. Ultimately, however, education and skills practice are important and necessary to achieve and maintain proficiency. One notable report with encouraging results to build upon is from the World Restart a Heart Initiative.[51] Additional staff training relevant to COVID-19 infection control safety is evident in a survey regarding in-hospital pediatric resuscitation team practices.[52] While this pandemic brings challenges to engage in traditional in-person training, these same circumstances can serve to spur innovation in CPR education and training. New approaches can potentially increase access and promote hands-on skills through strategies of distance learning that harness technology. COVID-19 may ultimately and paradoxically accelerate CPR training and produce a larger and more skilled group of lay and professional responders.

## UNANSWERED QUESTIONS

The COVID-19 pandemic remains a dynamic event in which there are many remaining questions which may impact implementation of safe and effective resuscitation practices. Examples include the following:

- What is the transmission risk (in $R_0$ and relative risk formats) from COVID-19-related OHCA from patient to rescuer and how does that risk vary with specific rescuer or type of care?
- How effective is PPE and is it reliably reproducible among differing EMS systems? Does effectiveness depend on the type of care being provided?
- How accurate is clinical field diagnosis of COVID-19 by EMS professionals overall and among OHCA? Can this knowledge be used to improve care or provider safety?
- What are rates of neurologically intact survival from COVID-19 related OHCA? What are the pathophysiology, optimal clinical response, and rates of death for COVID-19-related OHCA and do answers to these questions inform special treatment strategies?
- Are there different rules for medical futility determination in termination of resuscitation for suspected or confirmed COVID-19 related OHCA? Do those rules apply to pediatric COVID-19 related OHCA?
- What is the balance of risk and benefit of current efforts to mitigate COVID-19 related to the public health burden of OHCA? What is the right balance between impeding time-sensitive clinical care for the patient versus rescuer safety during the pandemic?
- Will apparent adverse impacts involving resuscitation health services during COVID-19 pandemic improve once the pandemic is better managed?
- How should EMS systems optimally meet survivorship needs of lay rescuers and EMS professionals performing, or withholding, resuscitative efforts for patients with OHCA during this pandemic?
- Will concerns of risk of infectious diseases such as COVID-19 discourage future generations from pursuing careers in EMS, the fire service, and law enforcement?
- What impacts will effective SARS-CoV-2 vaccines confer upon EMS professionals and the resuscitative practices and capabilities within EMS systems?
- How will the pandemic impact both initial and continuing CPR and resuscitation education for laypersons and EMS professionals? What methods can overcome the current challenges posed by the pandemic?

## CONCLUSIONS

At this time, strategies for layperson and EMS should avoid implementing major modifications to evidenced-based resuscitation practices due to the COVID-19 global pandemic. A significant shift away from evidence-based resuscitation practices could lead to a decrease in OHCA survival. Adapting resuscitation processes for the possibility of COVID-19 should be implemented in parallel with standard resuscitation activities. Emerging infectious diseases constitute ongoing challenges for EMS systems. Optimal infection control in the EMS environment should be a lasting responsibility shared by all EMS professionals.

## ARTICLE INFORMATION

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