

COVID-19 cardiopulmonary resuscitation: Guidelines and modifications

Pankaj Kundra, Stalin Vinayagam

Department of Anaesthesiology and Critical Care, JIPMER, Puducherry, India

Abstract

International societies like the International Liaison Committee on Resuscitation (ILCOR), American Heart Association (AHA), and UK Resuscitation Council have suggested modified guidelines for resuscitation during coronavirus disease (COVID-19) pandemic. Though there is consensus in most of the recommendations there are also disparities. Considering the rapidly evolving COVID-19 pandemic and our better understanding of the spread of the disease, there is an urgent need to suggest modifications to the existing guidelines. These modifications should allay the fear of health care workers regarding their safety and reluctance to provide cardiopulmonary resuscitation (CPR) but should also address the serious concerns where an opportunity is lost to revive patients who may not be COVID positive as suspected.

Keywords: COVID-19, cardiopulmonary resuscitation

Cardiopulmonary resuscitation (CPR) in suspected or confirmed COVID-19 patients needs a modified approach as compared to the conventional approach. CPR in COVID-19 patient carries added risk to health care workers (HCWs) as it involves aerosol-generating procedures, requires many rescuers to work in close proximity, and increases the chance of breach in personal protection due to high-stress event. The biggest challenge is to ensure the best possible chance of survival for COVID-19 patients without compromising the safety of the rescuer. According to the World Health Organization (WHO), globally more than 22,000 HCWs were infected with COVID-19 at their workplace, which ranges between 4% and 13% of the total infected patients in various countries.^[1] In India, around 548 HCWs were infected with COVID-19 which amounts to 1% of total infected cases.^[2] The safety of HCW during CPR should be given paramount importance as this can have

a significant impact on the already overwhelmed health care system.

Many international societies like the International Liaison Committee on Resuscitation (ILCOR), American Heart Association (AHA), and UK Resuscitation Council have come with interim updates and modified guidelines for resuscitation during COVID-19 pandemic.^[3-5] Though there is consensus in most of the recommendations, there are also differences in specific areas of consideration among the societies. Moreover, it may not be feasible to follow all these recommendations in resource constraint situations. The ILCOR has conducted a systematic review and released its consensus on science, treatment recommendations, and task force insights for the resuscitation of COVID-19 patients.^[6,7] Consequently, the European Resuscitation Council (ERC) has released its COVID-19 guidelines with certain changes in current guidelines to be considered during the resuscitation of COVID-19 patients.^[8]

Address for correspondence: Dr. Pankaj Kundra,
Dean Academics, Office of the Dean,
JIPMER, Puducherry - 605 006, India.
E-mail: p_kundra@hotmail.com

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Kundra P, Vinayagam S. COVID-19 cardiopulmonary resuscitation: Guidelines and modifications. *J Anaesthesiol Clin Pharmacol* 2020;36:S39-44.

Submitted: 15-May-2020 **Accepted:** 17-May-2020 **Published:** 24-Jul-2020

Access this article online	
Quick Response Code:	Website: www.joacp.org
	DOI: 10.4103/joacp.JOACP_257_20

Recommended Changes in Cardiopulmonary Resuscitation (CPR) for COVID-19 Patients by European Resuscitation Council

Chest compressions and CPR have the potential to generate aerosols and HCWs should use Personal protection equipment (PPE) before attempting CPR (weak recommendation, very low certainty evidence).^[9]

Adult basic life support (BLS) by lay rescuers:^[10]

- Perform hands-only CPR.
- Place a cloth/towel over the person's mouth and nose before performing chest compressions.
- Use automated external defibrillator (AED), if available.
- After CPR, wash hands thoroughly with soap or disinfect hand with alcohol-based hand-gel.

Adult BLS by health care professional (both in-and out-of-hospital)^[10]

- Should have prior training in the use of PPE
- Consider compression-only CPR if bag-mask ventilation is difficult
- Use a high-efficiency particulate air (HEPA) filter or bacterial/viral filter during bag-mask ventilation
- Use two hands to hold the mask and the person doing compressions can squeeze the bag when they pause after 30 compressions
- Defibrillation is not an aerosol-generating procedure and can be undertaken after wearing a surgical mask, eye protection, apron, and gloves.

Adult advanced cardiac life support (ACLS)^[11]

- In high-risk patients, take appropriate steps to prevent cardiac arrest and consider proactively moving the patient to a negative pressure room, if available.
- Consider "Do-not-attempt CPR (DNACPR)" in patients with poor prognosis.
- Restrict the number of staff in the room.
- Clearly communicate COVID-19 status to any new providers
- If shockable rhythm, consider three attempts of shocks before wearing PPE and starting chest compression.
- Place an oxygen mask and supplement oxygen, if not done already.
- Pause chest compression during intubation and consider video laryngoscopy, if available.
- If supraglottic airway (SGA) is inserted, the compression ventilation ratio should be 30:2.
- In already intubated, do not disconnect the ventilator circuit while starting CPR.

- Consider a mechanical compression device, if there is a need for prolonged CPR.
- Patient in the prone position: If un-intubated, turn immediately to supine before attempting CPR. If intubated, start CPR in the prone position itself.
- Ensure the safe removal of PPE.

Chain of survival

The 2015 AHA guidelines have recommended a separate chain of survival for in-hospital cardiac arrest which consists of five chains of events that must occur in rapid succession to maximize the chances of survival.^[12] Resuscitation in COVID-19 patients needs significant changes in each of these links for a safe and positive outcome. As each link is critical and interdependent, rescuers should address these modifications while attempting resuscitation in COVID-19 patients [Figure 1].

Surveillance and Prevention

Decision-making

Mortality for critically ill COVID-19 patients is high and increases with age, comorbidities, and severity of illness.^[13] AHA recommends considering these factors while determining the appropriateness of starting resuscitation in-order to balance the success against the risk.^[3] Many other societies have also recommended to actively look for DNACPR consideration in patients with poor prognosis.^[4] Indian council of medical research policy document leaves the final decision regarding DNACPR with the treating physician, which should be taken in consultation with the patient/surrogate, empowered with the required information.^[14]

On the other hand, it has been observed that many HCWs are now hesitant to perform CPR with the fear of the patient being COVID-19-positive. There is no data available, but there is growing apprehension that we might lose many patients who otherwise had other comorbidities and could have been saved with effective and timely CPR. Authors are of opinion that COVID-19 positivity alone should not be a criterion to consider DNACPR unless it is complicated by irreversible multi-organ failure. The benefit of CPR should be given to all possible COVID-19 patients by attempting resuscitation after taking all safety precautions and the patient should be declared dead only once the CPR has been attempted.

CPR location

In-Hospital CPR: AHA has recommended shifting the high-risk COVID-19 patients proactively to a negative pressure isolation room before attempting CPR.^[3] However, not all centers will have a dedicated negative pressure room and it may not be always feasible to shift an unstable patient to an isolation room. Nevertheless, CPR can be performed after

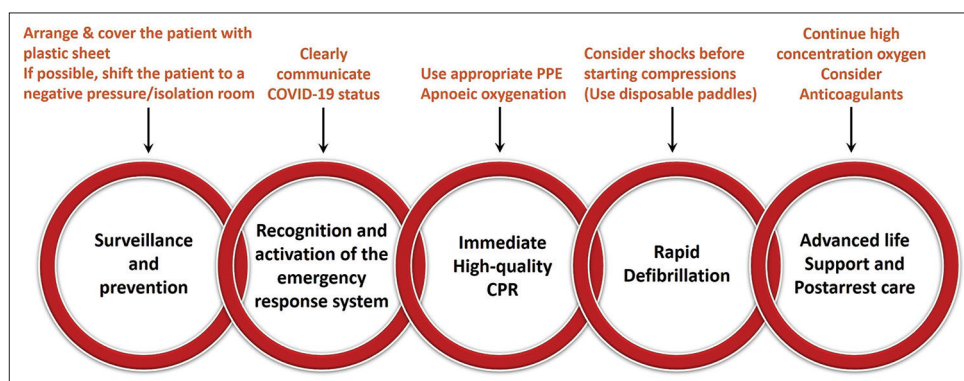


Figure 1: Modified chain of survival for the resuscitation of coronavirus disease (COVID-19) patients

taking standard safety precautions in the ICU/ward itself, if the patient is completely covered with a transparent plastic sheet [Figure 2a].

Immediate High-Quality CPR

Chest compression

All committees unanimously recommended the use of full PPE before attempting chest compression in COVID-19 positive patients.^[3-5] But, not all the centers will have a sufficient supply of full PPEs to be used during this emergency situation. It was also noted that CPR with PPE requires considerable physical effort and may compromise the quality of chest compression.^[15] Authors therefore suggest:

- **Barrier protection:** The use of transparent plastic sheets to cover the patient fully before attempting chest compression to prevent the aerosol released into the environment [Figure 2a]. Hence, the rescuer can wear standard safety devices like a 3-ply mask (seal the leaks around by adhesive tape), face shield, apron, and gloves [Figure 2b]
- **Rescuer rotation CPR:** If chest compression is started after donning full PPE, then one should consider the more frequent rotation of rescuer that is, after every two to three cycles or 1 min to avoid poor quality compressions due to fatigue by a single rescuer.

Airway

The use of supraglottic airway during the course of resuscitation in COVID-19 patients is not recommended as it increases the chance of aerosol generation. Even if SGA is used, the ventilation rate should be reduced to two breaths for every 30 compressions as compared to 10 breaths/min in non-COVID patients.^[11] Difficult airway society (DAS) has suggested that insertion of second-generation SGA should take priority over face mask ventilation as it improves the seal and minimizes aerosol generation.^[16] Thus, whenever difficulty in mask ventilation and delay in intubation is anticipated, one should consider a second-generation SGA along with high-efficiency particulate air (HEPA) filter to



Figure 2: (a) COVID-19 patient covered with a transparent plastic sheet during cardiopulmonary resuscitation. (b) Three-ply surgical mask with the complete seal of leaks on all sides using an adhesive tape

maintain ventilation. Covering the patient with a transparent plastic sheet will also help to prevent aerosol spread in case of a leak around the SGA.

Breathing (apneic oxygenation)

Cardiac arrest in severe COVID-19 patients can be due to respiratory failure secondary to acute respiratory distress syndrome (ARDS), myocardial injury, ventricular arrhythmias, shock, and drugs.^[17-20] Among all, hypoxemia is the most common cause and these patients are likely to present with non-shockable rhythm during cardiac arrest. Many studies have shown that the demand for oxygen is very high in these patients and those who received a high concentration of oxygen responded well.^[21] Hence, the authors suggest the use of supplemental oxygen throughout the course of resuscitation to improve the overall survival outcome. This can be achieved by placing an oxygen mask over the patient's surgical mask, if not done already. One can also consider nasal oxygen (5 L/min) through a nasal cannula (apneic oxygenation) as there is no current evidence that this technique will generate viral aerosols.^[16] Apneic oxygenation has been shown to increase the safe apnea period.^[22] With the evidence growing

Table 1: COVID-19 CPR: Recommendations and modifications

Specific area of consideration	Name of the committee/council	Recommendations	Suggested modifications
Decision-making	Resuscitation Council UK	Look for “Do Not Attempt Cardiopulmonary Resuscitation” orders before attempting CPR.	<i>Universal CPR:</i> Every suspected or confirmed COVID-19 patient deserves CPR and it should be attempted after taking all safety precautions.
	AHA	Determine whether it’s appropriate to start CPR using risk factors to assess the prospect of recovery.	
In-hospital CPR location	Resuscitation Council UK	High-risk patients should be shifted to ICU	<i>Plastic barrier:</i> Cover the patient with a transparent plastic sheet to prevent aerosol spread, CPR can be performed where ever the arrest occurs.
	AHA	Should be performed in airborne infection isolation room	
Personal protection	Resuscitation Council UK	Level 3 PPE must be worn by all members of the resuscitation team before entering the room. No chest compressions or airway procedure should be done without level 3 PPE.	Consider starting CPR with <i>standard safety precautions</i> after covering the patient completely with a transparent plastic sheet.
Chest compression	Resuscitation Council UK	To ensure high-quality CPR, rotation of the rescuer should be done after every five cycles or 2 min.	<i>Rescuer rotation CPR:</i> Consider rotation of rescuer after every three cycles or 1 min to avoid rescuer fatigue and ineffective cardiac compressions.
Oxygenation	Resuscitation Council UK	Oxygen supplementation only if readily available.	<i>Oxygen supplementation</i> should be provided as soon as possible during CPR. <i>Apneic oxygenation:</i> Nasal oxygen at the rate of 5 L/min should be considered.
	AHA	Avoid high-flow nasal oxygen	
Ventilation	Resuscitation Council UK	When two hands are used for mask ventilation, rescuer performing chest compression should deliver breaths during the pause.	During mask ventilation with two hands, consider connecting the mask to ventilator with filter, as soon as possible. <i>NIV + barrier:</i> Can be considered if the patient is covered with transparent plastic sheet
	AHA	Avoid NIV	
Advanced Airway management	Resuscitation Council UK	Must be carried out by experienced individuals	<i>Video laryngoscopy</i> should be the first choice, if available. Consider COVID intubation/extubation box, if available. Make sure it doesn’t interfere with chest compression.
	AHA	Endotracheal intubation by rapid sequence intubation is the preferred technique. Consider video laryngoscopy, if available.	
Defibrillation	Resuscitation Council UK	Consider defibrillation (up to 3 shocks) before donning and starting chest compressions, if benefit exceeds the risks.	<i>Disposable Paddles Defibrillation (DPD):</i> Consider disposable paddles for hands-free defibrillation and continuous monitoring.
Treatment of reversible cause	AHA	Look for 5Hs and 5Ts	<i>Thrombolysis:</i> After hypoxemia, actively look for thrombosis and consider thrombolysis as early as possible.
Out of the Hospital CPR	AHA	EMS person should follow full precautions including the use of PPE Lay-rescuer should perform hands-only CPR Place a cloth/towel over the patient’s mouth	Consider basic precautions (3-ply mask, gloves, face shield, and apron). <i>CareGiver CPR:</i> Encourage and instruct/supervise the patient’s “caregiver” to start CPR after wearing a face mask, if he/she is already in close contact with the patient.
Transport by ambulance	AHA	Don’t allow family and friends to ride along HEPA filter is mandatory Open rear windows and activate HVAC (heating, ventilation, and air conditioning) system Turn on rear vent exhaust fans	Consider covering the patient with transparent plastic sheet One person can be allowed with face mask, if he/she is already in close contact with patient (caregiver).
Mechanical chest compression device	Resuscitation Council UK	Recommended only if it facilitates transport or treatment	Can be considered if prolonged resuscitation is needed.
	AHA	Recommended in settings with protocols and expertise for the use.	
ECMO	AHA	Insufficient data to support E-CPR in COVID 19 patients.	Can be considered if facility and expertise is available

CPR: Cardiopulmonary resuscitation, PPE=personal protection equipment, AHA=American Heart Association, NIV=noninvasive ventilation, HEPA=high-efficiency particulate air, HVAC=heating, ventilation, and air conditioning

in favor of apneic oxygenation, resuscitation guidelines in the future are likely to recommend continuous apneic oxygenation instead of intermittent ventilation while the chest compressions are kept uninterrupted for in-hospital CPR.

Defibrillation

The ILCOR systematic review didn’t find any evidence that defibrillation leads to aerosol generation and suggested that

it may be reasonable for HCWs to consider defibrillation before donning full PPE.^[7] The resuscitation council UK also recommends considering defibrillation (maximum of three shocks) before donning PPE and starting CPR.^[4]

Disposable Paddle Hand-Free Defibrillation (DPD)

We strongly recommend the use of disposable paddles for hands-free defibrillation with continuous rhythm monitoring. Disposable paddles should be placed on a bare chest before covering the patient with a transparent plastic sheet and similarly, the defibrillator can also be covered with a transparent plastic sheet to avoid contamination.

Post-Arrest Care

Early Thrombolysis and Anticoagulants

An autopsy study by Wichmann et al. revealed that 58% of COVID-19 patients had deep vein thrombosis and one-third of patients had a massive pulmonary embolism.^[23] They have also suggested that patients with COVID-19-induced coagulopathy may benefit from anticoagulant treatment. Hence in COVID-19 patients, during resuscitation as well as after achieving the return of spontaneous circulation (ROSC) rescuers should have strong suspicion for pulmonary thrombosis and should consider thrombolysis as early as possible.

Out of Hospital Cardiac Arrest

Most guidelines for out of the hospital cardiac arrest have recommended the use of full PPE by health care professionals before attempting CPR in suspected COVID-19 patient.^[3] But in developing countries, a full PPE may not be available in the out of the hospital set-up. In such situations, one should take as many precautions as possible before attempting CPR which includes wearing 3-ply mask with complete seal [Figure 2b], face shield, gloves, face shield, and a plastic apron.

Care-Giver resuscitation

The immediate caregiver (who may have been already exposed) should be encouraged to start CPR after wearing a face mask. If telecommunication facility is available, Care-Giver CPR can be done under the guidance of the HCW who instructs and simulates the steps of CPR. Before starting CPR, one should make sure that the patient's face is covered with a towel/mask. Similarly, after completing resuscitation, one should perform proper hand hygiene by washing hands with soap or disinfect with alcohol-based hand-gel.

Transport

AHA has recommended that family members and other contacts should not ride along with a COVID-19 patient in the same vehicle.^[3] Moreover, if ROSC is not achieved in the field, consider not transferring the patient to the hospital to avoid additional contact of prehospital and hospital staff to patients. Authors suggest that one family member with a face mask can be allowed to travel in the same ambulance, if he/she is already in close contact with the patient.

Training and Education

COVID-19 pandemic is going to stay for a significant period of time and to adapt to this unprecedented situation it is necessary to bring changes in the CPR training programs. Teaching programs must include "Mock drills" even for the already certified CPR instructors or trained personnel for specific interventions for COVID-19 patients focusing on infection prevention. We strongly recommend that specific differences in COVID-19 CPR should focus on skill-based simulation learning.

Conclusion

The changes in guidelines for COVID-19 patients recommended by various international committees are dynamic and based only on expert opinion. These guidelines are likely to change as and when we get more data and it is necessary to adapt locally based on resource availability. Similarly, the modifications mentioned above in Table 1 are only suggestions which can be considered in developing nations, particularly in a resource constraint situation. Health care centers are free to decide on the allocation of resources for the provision of CPR in COVID-19 patients based on their values and preferences.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. World Health Organization. Coronavirus disease 2019 (COVID-19) situation report - 82. Geneva, Switzerland: World Health Organization; 2020. [cited 2020 May 15]. Available from: <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200411-sitrep-82-covid-19.pdf>.
2. 548 doctors, nurses, paramedics infected with Covid-19 across India: Report - India news - Hindustan Times [Internet]. [cited 2020 May 15]. Available from: <https://www.hindustantimes.com/india-news/548-docs-nurses-paramedics-infected-with-covid-19-across-india-report/story-o2pM3w2adM4g3PXI6TBlkN.html>.

3. Edelson DP, Sasson C, Chan PS, Atkins DL, Aziz K, Becker LB, *et al.* Interim Guidance for Basic and Advanced Life Support in Adults, Children, and Neonates With Suspected or Confirmed COVID-19. *Circulation* 2020. Available from: <https://doi.org/10.1161/CIRCULATIONAHA.120.047463>. [Last cited on 2020 May 10].
4. Resuscitation Council UK Statements on COVID-19 (Coronavirus), CPR and Resuscitation [Internet]. [cited 2020 May 15]. Available from: <https://www.resus.org.uk/media/statements/resuscitation-council-uk-statements-on-covid-19-coronavirus-cpr-and-resuscitation/>.
5. ILCOR practical guidance for implementation – COVID 19. [Internet]. [cited 2020 May 15]. Available from: <https://www.ilcor.org/covid-19>.
6. Perkins GD, Morley PT, Nolan JP, Soar J, Berg K, Olasveengen T, *et al.* International Liaison Committee on Resuscitation: COVID-19 consensus on science, treatment recommendations and task force insights. *Resuscitation* 2020;151:145-7.
7. Couper K, Taylor-Phillips S, Grove A, Freeman K, Osokogu O, Court R, *et al.* COVID-19 in cardiac arrest and infection risk to rescuers: A systematic review. *Resuscitation* 2020;151:59-66.
8. European Resuscitation Council COVID-19 Guidelines. [cited 2020 May 15]. Available from: <https://erc.edu/covid>.
9. Nolan JP European Resuscitation Council COVID-19 Guidelines: Section 1. Introduction. [cited 2020 May 15]. Available from: <https://erc.edu/covid>.
10. Olasveengen T, Castrén M, Handley A, Kuzovlev A, Monsieurs KG, Perkins G, *et al.* European Resuscitation Council COVID-19 Guidelines: Section 2. Basic Life Support in Adults. [cited 2020 May 15]. Available from: <https://erc.edu/covid>.
11. Soar J, Lott C, Böttiger BW, Carli P, Couper K, Deakin CD, *et al.* European Resuscitation Council COVID-19 Guidelines: Section 3. Adult advanced life support. [cited 2020 May 15] Available from: <https://erc.edu/covid>.
12. Hazinski MF, Nolan JP, Aickin R, Bhanji F, Billi JE, Callaway CW, *et al.* Part 1: Executive summary: 2015 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. *Circulation* 2015;132:S2-39.
13. Centers for Disease Control and Prevention. Severe outcomes among patients with coronavirus disease 2019 (COVID-19) - United States, February 12-March 16, 2020. *MMWR Morb Mortal Wkly Rep* 2020;69:343-6.
14. Mathur R. ICMR Consensus Guidelines on 'Do Not Attempt Resuscitation'. *Indian J Med Res* 2020;151:303-10.
15. Shao F, Xu S, Ma X, Xu Z, Lyu J, Ng M, *et al.* In-hospital cardiac arrest outcomes among patients with COVID-19 pneumonia in Wuhan, China. *Resuscitation* 2020;151:18-23.
16. Cook TM, El-Boghdadly K, McGuire B, McNarry AF, Patel A, Higgs A. Consensus guidelines for managing the airway in patients with COVID-19: Guidelines from the Difficult Airway Society, the Association of Anaesthetists the Intensive Care Society, the Faculty of Intensive Care Medicine and the Royal College of Anaesthetists. *Anaesthesia* 2020;75:785-99.
17. Bhatraju PK, Ghassemieh BJ, Nichols M, Kim R, Jerome KR, Nalla AK, *et al.* Covid-19 in critically ill patients in the Seattle Region — Case series. *New Eng J Med* 2020. doi: 10.1056/NEJMoa2004500.
18. Guo T, Fan Y, Chen M, Wu X, Zhang L, He T, *et al.* Cardiovascular implications of fatal outcomes of patients with coronavirus disease 2019 (COVID-19). *JAMA Cardiol* 2020. doi: 10.1001/jamacardio.2020.1017.
19. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, *et al.* Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395:497-506.
20. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, *et al.* Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. *JAMA* 2020;323:1061-9.
21. Geng S, Mei Q, Zhu C, Yang T, Yang Y, Fang X, *et al.* High flow nasal cannula is a good treatment option for COVID-19. *Heart Lung* 2020;S0147-9563(20)30113-8. doi: 10.1016/j.hrtlng.2020.03.018.
22. Myatra SN, Shah A, Kundra P, Patwa A, Ramkumar V, Divatia JV, *et al.* All India Difficult Airway Association 2016 guidelines for the management of unanticipated difficult tracheal intubation in adults. *Indian J Anaesth* 2016;60:885-98.
23. Wichmann D, Sperhake J-P, Lütgehetmann M, Steurer S, Edler C, Heinemann A, *et al.* Autopsy findings and venous thromboembolism in patients with COVID-19: A prospective cohort study. *Ann Intern Med* [Internet]. 2020. Available from: <https://annals.org/aim/fullarticle/2765934/autopsy-findings-venous-thromboembolism-patients-covid-19-prospective-cohort-study>. [Last cited on 2020 May 14].