The following information resources have been selected by the National Health Library and Knowledge Service Evidence Virtual Team in response to your question. The resources are listed in our estimated order of relevance to practicing healthcare professionals confronted with this scenario in an Irish context. In respect of the evolving global situation and rapidly changing evidence base, it is advised to use hyperlinked sources in this document to ensure that the information you are disseminating to the public or applying in clinical practice is the most current, valid and accurate. For further information on the methodology used in the compilation of this document—including a complete list of sources consulted—please see our National Health Library and Knowledge Service Summary of Evidence Protocol.

YOUR QUESTION

What guidance is available for healthcare workers on the provision of CPR for patients with suspected or confirmed COVID-19 in hospital settings, focusing primarily on the evidence relating to CPR as an aerosol generating procedure? Settings of relevance include hospitals, community assessment hubs and intermediate care facilities?

IN A NUTSHELL

There is international consensus on CPR as an aerosol-generating procedure[1,2,3,4,5,6,7,8,9,10,11,12,13,14]. Although some guidelines mention the lack of strong evidence[5], they operate on the principle that "absence of evidence is not evidence of absence" and focus on the risks and benefits to HCWs and patients. Earlier discussion on the benefits to the patient of CPR have been underpinned by the findings in Girotra et al[23] and should be considered. Donning PPE before commencing compressions, reducing the number of personnel in the room, early intubation, using a HEPA filter—these are common themes in the guidance. Additional guideline recommendations include: using a negative pressure room[10], applying compression only, and automating the process wherever possible[11] . Useful charts and infographics are available to summarise key considerations at point of care[2,4].

The international literature acknowledges CPR as an aerosol generating procedure and a range of protective measures available for healthcare staff are discussed. Guidelines and resuscitation strategies are important[30-34] including ensuring awareness of the strategies among staff [25] and practice simulations[30]. PPE is vital[16,21,22,27,30,34,36].
Shao discusses the fact that PPE can loosen or slip during CPR, so the person doing compressions should change more often[21]. Authors also discuss other protective devices including the use of mechanical compression devices[16,17,21,

[22, 35]; drapes or protective covers[16, , 20, 22]; Seger et al [17] describe personal containment devices. Endotracheal intubation is discussed by Scapigliati[18]. Ludwin[19] also discuss resuscitation in the prone position. Jost et al [36] discuss out of hospital cardiac arrest resuscitation and using hand over belly technique, full PPE, and mechanical devices.

IRISH AND INTERNATIONAL GUIDANCE

What does the Health Protection Surveillance Centre (Ireland) & HSE say? [Recently Updated] **HPSC (26 May 2020) Use of PPE to support Infection Prevention and Control Practice when performing aerosol generating procedures on confirmed or clinically suspected COVID-19 cases in a pandemic situation**[1]

HPSC guidance states that all staff working in an area where aerosol generating procedures are being performed must wear appropriate PPE. The minimum number of staff required must be present. The guidance includes a table of aerosol generating procedures which have been associated with increased risk of transmission of respiratory infection. CPR [pre-intubation due to manual ventilation] has a consistently recognised, AGP-related increased risk of pathogen transmission, and PPE is recommended. Recommended PPE include: hand hygiene; FFP2 respirator mask; eye protection; gloves; and long-sleeved gown.

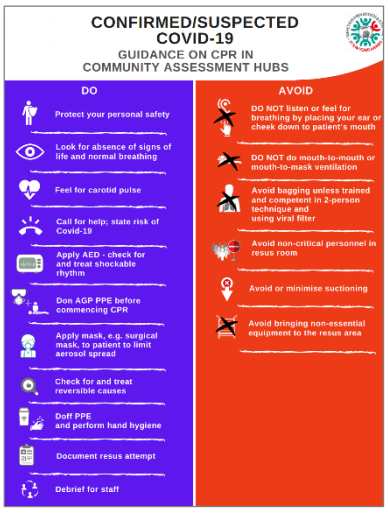
HSE Deteriorating Patient Improvement Programme (9 April 2020) CPR Guidance for Confirmed or Suspected COVID-19 in Community Assessment Hubs[2]

This guidance has been developed by the HSE Deteriorating Patient Improvement Programme; steps are set out as follows:

— recognise cardiopulmonary arrest
— use AED check if shockable rhythm present
— cardiopulmonary resuscitation (CPR): chest compressions and airway management

- reversible causes
- equipment
- doffing PPE
- documentation and debriefing

Accompanying infographics are also available.



European Resuscitation Council (24 April 2020) COVID-19 Guidelines[3]

Section 3 ["Advanced Life Support in Adults"] addresses both in-hospital cardiac arrest and out-of-hospital cardiac arrest.

In-Hospital Cardiac Arrest

4. Personal Protective Equipment (PPE) must be available to protect staff during resuscitation attempts. It is acknowledged that this may cause a brief delay to starting chest compressions, but the safety of staff is paramount.
5. Chest compressions have the potential to generate aerosols and airway interventions are aerosol-generating procedures. Healthcare staff should therefore put on airborne-precaution personal protective equipment before starting chest compressions and/or airway interventions; as a minimum a FFP3 mask [FFP2 or N95 if FFP3 not available], eye and face protection, long-sleeved gown and gloves before initiating these procedures.
6. Ensure that there is a viral filter between the self-inflating bag and airway to filter exhaled breaths.
7. Applying defibrillator pads and delivering a shock from an AED/defibrillator is unlikely to be an aerosol-generating procedure and may be undertaken with the healthcare provider wearing a fluid-resistant surgical mask, eye protection, short-sleeved apron and gloves.

Out-of-Hospital Cardiac Arrest

Most of the principles described for the management of in-hospital cardiac arrest in adults with confirmed or suspected COVID-19 also apply to out-of-hospital cardiac arrest. In the context of COVID-19, early recognition of cardiac arrest by the dispatcher will enable emergency medical services staff to put on airborne-precaution PPE as soon as possible.

Interim Guidance for Basic and Advanced Life Support in Adults, Children, and Neonates With Suspected or Confirmed COVID-19: From the Emergency Cardiovascular Care Committee and Get With the Guidelines® Resuscitation Adult and Pediatric Task Forces of the American Heart Association in Collaboration With the American Academy of Pediatrics, American Association for Respiratory Care, American College of Emergency Physicians, the Society of Critical Care Anesthesiologists, and American Society of Anesthesiologists; Supporting Organizations: American Association of Critical Care Nurses and National EMS Physicians[4]

Released on April 9, this statement applies to all adult, paediatric and neonatal resuscitations in patients with suspected or confirmed COVID-19 infection; it is based on expert opinion and should be adapted locally. Among the general principles for resuscitation in suspected and confirmed COVID-19 patients is the statement to prioritize oxygenation and ventilation strategies with lower aerosolization risk: "Although the procedure of intubation carries a high risk of aerosolization, if the patient is intubated with a cuffed endotracheal tube and connected to a ventilator with a high-efficiency particulate air (HEPA) filter in the path of exhaled gas and an inline suction catheter, the resulting closed circuit carries a lower risk of aerosolization than any other form of positive-pressure ventilation."

Strategies suggested to prioritise oxygenation and ventilation with lower aerosolization risk are:

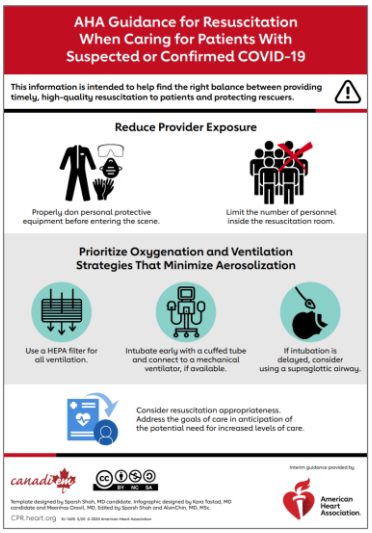
- Attach a HEPA filter securely to the manual or mechanical ventilation device in the path of exhaled gas before administering any breaths.
- After healthcare providers assess the rhythm and defibrillate any ventricular arrhythmias, patients in cardiac arrest should be intubated with a cuffed tube at the earliest feasible opportunity. Connect the endotracheal tube to a ventilator with a HEPA filter when available.

Minimize the possibility of failed intubation attempts by the following:

— Assign the provider and approach with the best chance of first-pass success to intubate.
— Pause chest compressions to intubate.
— Video laryngoscopy may reduce intubator exposure to aerosolized particles and should be considered when available.
— Before intubation in neonates, use a bag-mask device or T-piece with a HEPA filter and a tight seal; or, for adults, consider passive oxygenation with a non-rebreathing face mask covered by a surgical mask.
— If intubation is delayed, consider manual ventilation with a supraglottic airway or bag-mask device with a HEPA filter.
— Once on a closed circuit, minimize disconnections to reduce aerosolization.

The guidance also addresses aerosolization within situation- and setting-specific considerations:
— out-of-hospital cardiac arrest [OHCA]
— in-hospital cardiac arrest [IHCA]
— maternal and neonatal considerations

The AHA (7 May 2020) have also created a COVID-19 Healthcare Provider Infographic.



International Liaison Committee on Resuscitation (10 April 2020) COVID-19 infection risk to rescuers from patients in cardiac arrest[5]

Having completed public consultation, the ILCOR have released:

Treatment Recommendations

— We suggest that chest compressions and cardiopulmonary resuscitation have the potential to generate aerosols [weak recommendation, very low certainty evidence].
— We suggest that in the current COVID-19 pandemic lay rescuers consider chest compressions and public access defibrillation [good practice statement].
— We suggest that in the current COVID-19 pandemic, lay rescuers who are willing, trained and able to do so, consider providing rescue breaths to infants and children in addition to chest compressions [good practice statement].
— We suggest that in the current COVID-19 pandemic, healthcare professionals should use personal protective equipment for aerosol generating procedures during resuscitation [weak recommendation, very low certainty evidence].
— We suggest it may be reasonable for healthcare providers to consider defibrillation before donning personal protective equipment for aerosol generating procedures in situations where the provider assesses the benefits may exceed the risks [good practice statement].

A related article from the ILCOR, **Perkins et al (June 2020) International Liaison Committee on Resuscitation: COVID-19 consensus on science, treatment recommendations and task force insights**, reiterates the treatment recommendations listed above.

Resuscitation Council UK (28 April 2020) Statement on PHE PPE Guidance[6]
In the absence of high-quality evidence to state that anything less than AGP PPE is sufficient for healthcare professional safety, Resuscitation Council UK maintains its belief that AGP PPE provides the safest level of protection when administering chest compressions, CPR and advanced airway procedures in known or suspected COVID-19 patients. "For this reason, we welcome the fact that PHE's guidance of 24 April now aligns with that of RCUK, inasmuch as it allows Trusts to opt for AGP levels of PPE if they consider this appropriate to best ensure HCP safety."

Resuscitation Council UK (6 April 2020) Statement on COVID-19 in relation to CPR and resuscitation in healthcare settings[7]
11 points are listed under Section 2: GUIDANCE ON CPR IN PATIENTS WITH A COVID-19 ILLNESS OR A CONFIRMED CASE OF COVID-19 IN ACUTE HOSPITAL SETTINGS. This encompasses PPE and IPC considerations; early identification

of patients at risk of acute deterioration or cardiac arrest; airway interventions and use of equipment; and post-resuscitation debrief.

A related document from the RCUK is also available: **Resuscitation Council UK (15 April 2020) Statement on COVID – 19 in relation to non-acute hospital settings**[8]

Cook et al (April 2020) 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[9]
These consensus guidelines list cardiopulmonary resuscitation [before tracheal intubation] as an aerosol- generating procedure. The guidelines cite the UK Resuscitation Council statement on the management of cardiac arrest in patients with COVID-19: "Airway procedures undertaken during management of cardiac arrest are likely to expose the rescuer to a risk of viral transmission. The minimum PPE requirements to assess a patient, start chest compressions and establish monitoring of the cardiac arrest rhythm are an FFP3 facemask, eye protection, plastic apron, and gloves."

Alhazzani et al (March 2020) Surviving Sepsis Campaign: guidelines on the management of critically ill adults with Coronavirus Disease 2019 (COVID-19)[10]
Aerosol-generating procedures in the ICU include cardiopulmonary resuscitation.
Recommendation 1. For healthcare workers performing aerosol-generating procedures on patients with COVID- 19 in the ICU, we recommend using fitted respirator masks [N95 respirators, FFP2, or equivalent], as opposed to surgical/medical masks, in addition to other personal protective equipment.
Recommendation 2. We recommend performing aerosol-generating procedures on ICU patients with COVID-19 in a negative pressure room.

Faculty of Intensive Care Medicine, Intensive Care Society, Association of Anaesthetists and Royal College of Anaesthetists (17 March 2020) Critical care preparation and management in the COVID-19 pandemic[11]
Cardiac Arrest
— Appropriate PPE must be worn as with aerosol-generating procedures. Facemask ventilation should be avoided where possible.

— Compression-only CPR is advised until airway-experienced personnel are available.
— An automated chest compression device may be used.
— Early intubation by an experienced operator is advised.

What do WHO, ECDC and CDC say?

As CPR is an aerosol-generating procedure, the guidance from these organisations is as follows:

— **WHO (19 March 2020) Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected**[12] [Section 3.2]
— **[Recently Updated] ECDC (13 May 2020) Infection prevention and control and preparedness for COVID-19 in healthcare settings**[13] [Aerosol generating procedures sections include CPR as an AGP]
— **[Recently updated] CDC (19 June 2020) Interim Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) in Healthcare Settings**[14]

POINT-OF-CARE TOOLS
What does UpToDate say?
Coronavirus disease 2019 (COVID-19): Critical care and airway management issues[15]
Interventions
In the event of a cardiac arrest, cardiopulmonary resuscitation should proceed with all members of the team wearing appropriate PPE. Practicing a test run of a COVID-19 patient cardiac arrest is prudent. Bag-mask ventilation should be avoided if feasible and the ventilator may be used instead to deliver a respiratory rate of 10 bpm. Guidance for advanced cardiac life support and CPR in patients who are prone and cannot be returned to the supine position is provided separately.

INTERNATIONAL LITERATURE

What does the international literature say?

[Recently Published] **Chahar and Marciniak (June 2020) Cardiopulmonary resuscitation in COVID-19 patients**[16]
COVID-19 is extremely transmissible. Cardiopulmonary resuscitation (CPR) is associated with multiple aerosol-generating procedures including chest compression, positive pressure ventilation, and airway manipulation. Healthcare providers who perform CPR are at high risk of contracting COVID-19. CPR in patients with suspected or proven COVID-19 must be performed without compromising the safety of healthcare providers.
Deteriorating patients should be preferentially transferred to negative-pressure rooms to minimize risk of exposure to providers during CPR. Mechanical compression devices for CPR should be kept in units housing patients with COVID-19.
Caregivers assigned to a resuscitation team should have a bag with personal protective equipment (PPE) immediately available, with contents verified prior to start of shift.
In the event of cardiac arrest, all providers should don appropriate PPE before entering the room, even if this delays care. The number of caregivers should be minimized, and only caregivers with assigned roles should enter the room. Extra caregivers should be outside the room with a team member donned in PPE to help with medications and equipment if needed by the team.

CPR and COVID-19: Additional Considerations
Compression-only [hands-only] CPR should be administered by the first available provider in appropriate PPE. A barrier device, cloth or mask may be placed on the patient's mouth to minimize aerosol generation.
For shockable rhythms [ventricular tachycardia, ventricular fibrillation], defibrillator pads should be placed and shock applied as soon as a defibrillator is available. In the absence of reliable intravenous access, we recommend early intraosseous line placement. A mechanical compression device [LUCAS device, AutoPulse] should be used as soon as available.
Passive oxygenation should be provided by a non-rebreathing mask covered by a surgical mask.

[Recently Published] **Seger et al (11 June 2020) A Novel Negative Pressure Isolation Device for Aerosol Transmissible COVID-19**[17]

The COVID-19 pandemic creates a need to protect healthcare workers from patients undergoing aerosol-generating procedures which may transmit the SARS CoV-2 virus. Existing personal containment devices (PCDs) may protect healthcare workers from respiratory droplets but not from potentially dangerous respiratory-generated aerosols. We describe a new PCD and its aerosol containment capabilities. The device ships flat and folds into a chamber. With its torso drape and protective arm sleeves mounted, it provides contact, droplet, and aerosol isolation during intubation and cardiopulmonary resuscitation. Significantly improved ergonomics, single-use workflow, and ease of removal distinguish this device from previously published designs.

[Recently Published] **Scapigliati et al (June 2020) [Letter] How to ventilate during CPR in time of COVID-19?**[18]

While for occasional rescuers [lay people], chest compression-only (CCO) CPR can be recommended as an alternative to the compressions-ventilations technique, reasonable suggestions for healthcare professionals are lacking. So far, the focus of safety for personnel with a duty to respond has been placed on high-level personal protection equipment rather than on a method to minimize dispersion of exhaled gases from the patient. Endotracheal intubation (ETI) is still considered the best way to isolate airways provided that it is performed by a high-skilled operator, possibly with a video laryngoscope aid.

Recently, American interim guidance for basic and advanced life support has been published suggesting questionable approaches to obtain oxygenation of the patient in cardiac arrest prior to ETI. It is unlikely that both ventilation with a tight seal bag-mask device or passive oxygenation with an oxygen high flow facial mask can effectively constrain exhalation and limit rescuers' exposition to patient-generated droplets during CPR.

In order to stimulate discussion on this crucial aspect of CPR, we propose a feasible modification of ventilation through a supraglottic airway [i-gel®, Intersurgical]. I-gel is a device widely used among professional rescuers on account of its easy insertion and effectiveness in providing ventilation during CPR.

We tested the modified procedure on an ALS mannequin with a ventilation feedback system [Man Advanced®, Ambu]. After i-gel insertion and before any ventilation attempt to check for proper positioning, we applied a large square-shaped sheet of adhesive transparent drape from one [cheek] to the opposite, wrapping in the external portion of the i-gel. A second similar sheet was applied from the forehead to the chin, over the first one: Figure 1 a and b. After checking for good drape seal on the mannequin's face, we perforated the drape onto the i-gel connector and attached a HEPA filter before a self-inflating bag: Figure 1 c and d. Proper device positioning was then checked through chest rising. To detect any minor inspiratory leak around the drape perimeter, we attached the device to a ventilator [Servo-air®, Getinge] setting a tidal volume of 600 ml with a rate of 10 breaths per minute and a PEEP of 5 cmH20 to allow circuit washout. The circuit was able to provide exactly the set tidal volume with no obvious inspiratory leak evidence as measured by the mannequin's feedback system. To confirm this result, we are planning to test the system on a more realistic model.

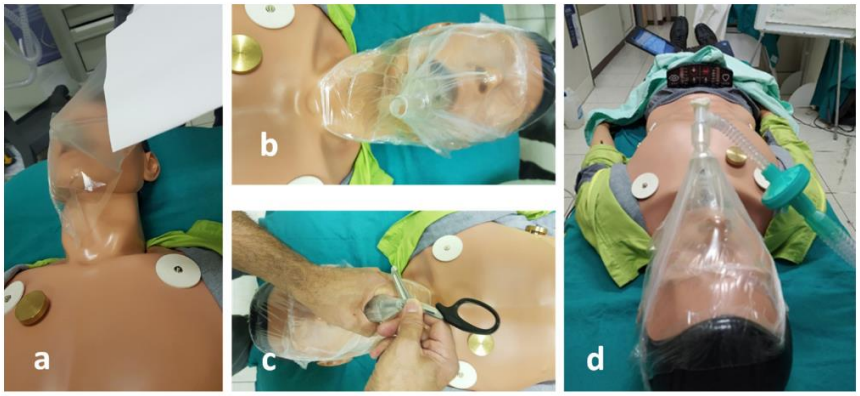


Fig. 1 – Application of drapes and connection to circuit: (a) first drape; (b) second drape; (c) perforation of drapes; (c) connection.

If a complete seal is confirmed, this easy and low-cost adjunct could allow professional rescuers to provide effective ventilation during CPR trough a supraglottic device with no exposition to the patient's directly exhaled gases.

[Recently Published] **Ludwin et al (June 2020) [Letter] Cardiopulmonary Resuscitation in the prone position: a good option for patients with COVID-19**[19]

The authors discuss resuscitation of a patient with COVID-19 in the prone position. CPR including chest compressions are challenging when the

patient is in the prone position. Issues arising from turning the patient from the prone to the supine position before starting CPR include multiple risks such as displacement or disconnection of tubes and/or lines. The authors conclude that CPR in the prone position is effective in patients who are positioned prone.

[Recently Published] **Lim et al (May 2020) [Letter] Resuscitation during the COVID-19 pandemic: Lessons learnt from high-fidelity simulation**[20]
The authors discuss simulation sessions which were held in Sengkang General Hospital, Singapore. Table 1 (below) includes recommendations for resuscitation in acute and community hospital settings reducing aerolization and exposure.

Table 1 – Summary of our recommendations between acute and community hospitals.

	Acute care hospital	Community hospital
Set up	Isolation, negative pressure room	Cohorted ward with 4–6 beds
Physical barriers to reduce aerosolization and exposure	Placement of a non-porous sheet (e.g. plastic drape) or a wet gauze over the patient's mouth and nose	Waterproof shields/partitions to cordon off the resuscitation area and evacuate ambulant patients within the same area Placement of a non-porous sheet (e.g. plastic drape) or a wet gauze over the patient's mouth and nose
Limit staff present	Maximum of 5 HCW to minimize exposure; dedicated staff (with PPE) outside the room to render immediate assistance	
Donning & doffing of PPE	Buddy system or supervisor	
First responder	PPE including N95 (leave resus scene once CB team arrives)	PPE including PAPR
Second responder	PPE including PAPR	
Code blue team	Full PPE including PAPR	
CPR	Compression-only CPR till code blue team arrives	CPR including face mask or SAD ventilation till code blue team arrives
Intubation	Early intubation by experienced personnel using videolaryngoscope	
Equipment	Attachment of a HEPA filter to the resuscitation ventilator bag; capnography to confirm tracheal tube placement; use 2nd generation SAD if required	
Patient transfer	Clamp tracheal tube prior to disconnection; dedicated transport ventilator with appropriate filters attached	
Communication	Concise, closed-loop communication, especially via intercom	

CB, code blue; HCW, healthcare worker; HEPA, high efficiency particulate air; PAPR, powered air-purifying respiratory; PPE, personal protective equipment; SAD, supraglottic airway device

[Recently Published] **Shao et al (May 2020) [Letter] Cardiopulmonary resuscitation of inpatients with severe COVID-19 pneumonia: The Wuhan experience**[21]
In our opinion, medical personnel should wear high-level personal protection equipment including N95 masks, gowns, gloves, goggles, visors and a powered air-purifying respirator at the beginning of each work shift and during CPR. In our experience, the PPE can loosen and the mask can slip during chest compression. Clothing should therefore be loose fitting to prevent tearing during CPR, and rescuers should switch if their mask is slipping. In addition, chest compressions in PPE cause more rapid fatigue. The person doing compressions should change more often to limit fatigue,

damage to PPE, and slipping of the face mask. The use of a positive pressure respirator hood could be helpful. In addition, a mechanical chest compression device can be used to free rescuers and maintain chest compression quality.

[Recently Published] **Singh et al (May 2020) Indian resuscitation council (IRC) suggested guidelines for comprehensive cardiopulmonary life support (CCLS) for suspected or confirmed coronavirus disease (COVID-19) patient**[22]

Once the suspected or confirmed patient is admitted to the healthcare facility, it is important to identify the patients—based on history, examination and required investigations—who are at risk of acute deterioration. Patients with low oxygen saturation, hypotension, altered sensorium, etc., appear to be at increased risk of cardiopulmonary events. This would help the physician to be better prepared to deal with cardiac arrest in an effective manner. Early recognition and correction of hypoxemia, hypotension, electrolyte and acid–base abnormalities in these vulnerable patients will reduce the incidence of cardiac arrest.

Pulse/Rhythm and Breath Check

Check carotid pulse or check cardiac monitor for the rhythm and look for breathing if the patient is not on ventilator. Do not listen and feel for breathing. This should be performed within 5–10 s. If oxygen is being administered via nasal cannula to the patient, then consider putting a triple layer surgical mask on the patient's face which will help in containing the aerosol spill into the environment. If pulse or perfusing rhythm is present along with normal breathing, then assess further for patient being non-responsive and manage accordingly. It is advisable to check for oxygen saturation using pulse oximeter during this assessment as respiratory complications are common in COVID-19 patients. Appropriate ventilatory support preferably with definitive airway is necessary in patients who present with abnormal breathing but with a definite pulse. Use viral filters over face mask or over endotracheal tube. Early use of closed circuit and ventilator is desirable to avoid aerosolisation. In case of absence of breath and pulse or perfusing rhythm, then chest compression along with ventilatory support to be started. Early definitive airway and the use of a closed circuit with filter and ventilator is desirable. Until the definitive airway has been secured, face needs to be covered by transparent plastic sheet before initiating chest compressions. Use of mechanical chest compression devices should be preferred, if available. The ventilatory parameters should

be adjusted either by increasing the airway pressure alarm limit in volume control ventilation or by using pressure control ventilation support along with increasing the oxygen to 100% when a patient on ventilatory support develops a cardiac arrest. In such cases, the chest compression rate of 120 compressions/min to a depth of 5–6 cm should continue. High quality chest compressions must be given during CPR. Patients in prone position should be made supine before initiating CPR.

[Recently Published] **Girotra et al (April 2020) [Preprint] Survival After In-Hospital Cardiac Arrest In Critically Ill Patients: Implications For The COVID-19 Pandemic?**[23]
This study concluded that in a cohort of critically ill patients on mechanical ventilation, survival outcomes following in-hospital resuscitation were not uniformly poor. These data may help guide discussions between patients, providers and hospital leaders in determining appropriate use of resuscitation for patients with COVID-19.

[Recently Published] **Kinney & Slama (27 May 2020) Rapid outdoor non-compression intubation (RONCI) of cardiac arrests to mitigate COVID-19 exposure to emergency department staff**[24]
With the emergence of the COVID-19 pandemic, the ethical and moral obligations regarding cardiac arrest care are evolving. While cardiopulmonary resuscitation is the gold standard, only 7.6% of out-of-hospital cardiac arrest (OHCA) patients who receive CPR survive to hospital discharge. Also, CPR, intubation and resuscitation of the critically ill expose health care professionals to significant infection risk. This has prompted many to question the standard resuscitation of COVID-19 infected cardiac arrest patients, so modification of current resuscitation practices is being explored on many different levels. We present a case of an outdoor non-compression intubation of a patient in cardiac arrest to minimize COVID-19 exposure to staff while still providing standard advanced cardiac life support (ACLS).

[Recently Published] **Wenlock et al (19 May 2020) Low-fidelity simulation of medical emergency and cardiac arrest responses in a suspected COVID-19 patient - an interim report**[25]
A survey was completed by 56 medical and nursing staff. The majority of respondents (87.5%, n=49) reported knowing where to find local Trust guidelines, and the majority had reviewed updated guidance on PPE, aerosol-

generating procedures (AGPs) and adult life support (91%, 84% and 91% respectively). In addition, 80% (n=45) of participants were aware that chest compressions are an AGP as per local Trust guidelines.

[Recently Published] **Sorbello M, Di Giacinto I, Falcetta S, Greif R. (June 2020) [Letter] Ventilation and airway management during Cardiopulmonary Resuscitation in COVID-19 era**[26]
Fast tracheal intubation using video laryngoscope and bougie in one attempt is recommended. In case of failure use of second generation SADs has been claimed to lower aerosol spread, provided that a leak-free seal has been ensured.
Solutions with facial or all-body plastic covers have been suggested to reduce aerosolization during airway management including modifications of SAD but these might be dangerous. Positioning the barrier would delay chest compressions and CPR.
In respect of the lack of evidence and considering the risk that use of similar devices may generate a false sense of security among HCPs, we strongly recommend to adhere to well elaborated guidelines and to use certified airborne-level PPE during CPR and airway management.

[Recently Published] **Ruetzler K, Smereka J, Ludwin K, Drozd A, Szarpak L. (May 2020) [Letter] Respiratory protection among healthcare workers during cardiopulmonary resuscitation in COVID-19 patients**[27]
As recommended by the CDC for aerosol-generating procedures, medical personnel should be equipped with full personal protective equipment for AGPs. Currently, there are conflicting reports on protection against the infection while wearing N95 respirators. They undoubtedly protect more than cloth masks or medical masks. However, to additionally protect the rescuer during CPR procedures, use of face shields covering the entire face is also recommended, apart from using fitted N95 respirators — preferably equipped with FFP3 class filters. Then the risk of face contamination, including the mucosa, is much lower. The above is particularly vital in case of inadequate fitting of N95 respirators due to improper placement or the inability to fit due to facial hair.
In summary, medical personnel should use full personal protective equipment for aerosol-generating procedures when performing COVID-19 CPR in suspected/confirmed patients. Limiting protection strictly to the use of an N95 respirator as a respiratory protection device is a mistake that may result in an increased risk of infection among medical personnel.

Griffin et al (June 2020) Hospital Preparedness for COVID-19: A Practical Guide from a Critical Care Perspective[28]

Staff from an American hospital describe the approach they have used to increase preparedness.

Cardiac Arrests

Given the highly infective nature of the novel coronavirus, approaches to resuscitation have evolved. As such, institutional cardiac arrest policies were instituted limiting the number of responders to cardiac arrests outside the ICU. Mechanical compression devices were rapidly introduced to further reduce the number of medical and nursing staff responding to an arrest. Medical ICU nurses, who respond to every cardiac arrest in our institution, carried a COVID-19 backpack to every cardiac arrest; these contain high-risk PPE [welders style face shields, N95 masks, impermeable gowns] due to the aerosolizing nature of CPR. Resuscitations in the ICU continue to be conducted in a standard fashion with attempts to minimize aerosolization by leaving the patient on the ventilator, or if absolutely necessary, using a bag valve mask with a high-efficiency particulate air (HEPA) filter attached to the expiratory port.

Song et al (April 2020) Recommendations on cardiopulmonary resuscitation strategy and procedure for novel coronavirus pneumonia[29]

This document features:

- Section 2: Prediction, prevention, and early warning of cardiac arresting patients with novel coronavirus pneumonia.
- Section 3: Cardiopulmonary resuscitation strategy for cardiac arrest in novel coronavirus pneumonia.
- 3.1 Cardiopulmonary resuscitation strategy for out-of-hospital cardiac arrest [OHCA].
- 3.2 Cardiopulmonary resuscitation strategy during vehicle transportation.
- 3.3 Cardiopulmonary resuscitation strategy for in-hospital cardiac arrest.
- Algorithm for warning and cardiopulmonary resuscitation for cardiac arrest in patients with novel coronavirus pneumonia.

Liew et al (May 2020) Preparing for COVID-19: early experience from an intensive care unit in Singapore[30]

This letter outlines critical care issues and solutions for COVID-19, which includes their recommendations for resuscitation and code blue responses:

Principles

1. Provide clear guidelines on personal protective equipment and use of powered air-purifying respirators in ISO wards and normal wards during resuscitation.
2. Provide inter-professional simulation of resuscitation scenarios for suspected or confirmed cases.

Solutions

— Simulation practice with personal protective equipment and use of powered air-purifying respirators will help identify gaps in the wards and prepare ISO teams for such scenarios.
— Simulation with limited team members per scenario: eg 4 members per team to allow acclimatization of HCW to perform resuscitation in smaller teams.
— Checklists for preparation of drugs and pre-prepared trolleys for equipment, intubation, line setting and other procedures to minimize staff movement and enhance efficiency.
— Creative ways to improve communications during resuscitation, such as utilization of a printed 'CALL AIRWAY TEAM' card for difficult intubations, using a communication whiteboard in the patient room and using walkie-talkies to relay messages to staff outside the room for equipment and help.

Kearsley (April 2020) Consensus guidelines for managing the airway in patients with COVID-19[31]

This letter discusses the spread of online information about the use of an 'aerosol box' for intubation and recommends caution when evaluating new airway management techniques.

Wax et al (February 2020) Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients[32]

Intubation of critically ill patients with SARS-CoV was associated with episodes of healthcare worker transmission. The reasons for this are likely

multifactorial, including high-level viral shedding due to severity of patient illness, procedures associated with resuscitation or intubation that may generate aerosols, and healthcare worker use of PPE: high-risk patient + high-risk procedure = higher level of precautions.
Patients infected with 2019-nCoV should be monitored for early signs of respiratory deterioration and intubated electively rather than emergently. If possible, patients isolated with 2019-nCoV should be monitored in a critical care area with airborne isolation and continuous physiologic monitoring.
During the SARS outbreak, the concept of "Protected Code Blue" was created to distinguish usual resuscitation from those requiring special procedures and precautions. More information about PCB http://sars.medtau.org/simulatedprotectedcodeblue.pps and https://emergencymedicinecases.com/biohazard-preparedness-protected-code-blue/.
Once designated as requiring 2019-nCoV isolation:

- Resuscitation should take place in an airborne isolation room if possible, as it is an AGP.
- The resuscitation team must be wearing appropriate airborne/droplet/contact PPE.
- Given the greater risk of infection during a dynamic resuscitation use of powered air purifying respirators (PAPRs) by specially trained resuscitation teams should be strongly considered. Although PAPRs have a higher protective factor compared with N95 respirators, there is no definitive evidence that PAPRs reduce the likelihood of viral transmission in the setting of potential airborne spread. Nonetheless PAPRs may be more comfortable to wear for prolonged resuscitations, eliminate concerns of unexpected poor N95 respirator fit, and are less likely to be dislodged when managing an agitated patient. PAPRs with hoods covering the entire head and neck may provide additional protection against contamination.
- Initial resuscitation efforts by first responders wearing usual airborne/droplet/contact PPE to an acute crisis should focus on measures that are most likely to help the patient and have low risk for viral transmission.
- A list of specific low and high risk resuscitation interventions is provided in the full text of the article.
- Once the PCB team has donned PPE and been checked by an infection control coach, they can enter the room. Team size should be minimal to avoid unnecessary viral exposure—typically four people with designated roles.

— Consider use of a specialized cart containing modular packs of equipment, with PCB team members bringing in the necessary defibrillator and packs rather than an entire resuscitation cart.
— Following resuscitation, team members can exit when appropriate and should remove PPE under careful supervision of an infection control coach using a checklist to avoid self-contamination.

Ling et al (April 2020) COVID-19: A critical care perspective informed by lessons learnt from other viral epidemics[33]

Cardiopulmonary Resuscitation

The increased transmission of SARS-CoV to HCW previously reported during cardiopulmonary resuscitation (CPR) was likely due to virus aerosolisation during BVM ventilation. Preventive measures may include using apnoeic oxygenation during CPR, or careful two-person BVM ventilation to allow an effective face seal by two handed mask holding with inline bacterial/viral filter, and early intubation when indicated. The use of mechanical CPR devices to replace HCW CPR may reduce the risk of facemask leakage for the HCW and decreases their own minute ventilation, thus potentially reducing the risk of disease transmission. For patients already receiving mechanical ventilation in ICU, the ventilator may be set to volume control, with a large negative pressure trigger and high-pressure alarm setting to avoid a need for disconnection and change to manual BVM ventilation.

Szerlip et al (March 2020) Considerations for Cardiac Catheterization Laboratory Procedures During the COVID-19 Pandemic Perspectives from the Society for Cardiovascular Angiography and Interventions Emerging Leader Mentorship (SCAI ELM) Members and Graduates[34]

The authors recommend using appropriate PPE, disinfection and cleaning of all surfaces and if CPR is required in the cardiac catheterization lab consider using automated CPR devices for chest compression to minimize personnel exposure.

Driggin et al (May 2020) Cardiovascular Considerations for Patients, Health Care Workers, and Health Systems During the Coronavirus Disease 2019 (COVID-19) Pandemic[35]

In the event of a cardiac arrest, efforts at cardiopulmonary resuscitation causing aerosolized pathogens could result in the wide dissemination of virus particles to clinicians, health care workers, and other patients. One measure which may help protect health care workers in the setting of

cardiac arrest and chest compressions is the use of external mechanical compression devices to minimize direct contact with infected patients. Another important consideration for the catheterization laboratory is appropriate post-intervention cleaning of all equipment potentially contaminated with SARS-CoV2. The necessary downtime required for cleaning may seriously impact the availability of catheterization laboratory-based treatments for other patients. As such, many hospitals are minimizing or cancelling elective procedures during the growth phase of the outbreak. Another consideration is the fact that catheterization laboratories and operating rooms are typically configured with positive pressure ventilation, and there have been reports of centers in China converting such facilities to negative pressure isolation in the setting of COVID-19. Guidance and recommendations in this space will be forthcoming from interventional communities, including the ACC and SCAI.

OUT-OF-HOSPITAL CARDIAC ARREST ARTICLES

[Recently Published] **Jost D, Derkenne C, Kedzierewicz R, et al. (June 2020) The Need to Adapt the Rescue Chain for Out-of-Hospital Cardiac Arrest during the COVID-19 Pandemic: Experience from the Paris Fire Brigade Basic Life Support and Advanced Life Support Teams**[36]

A report of the Paris fire brigade prehospital system's adaption to out-of-hospital cardiac arrest during COVID-19. Methods included:

- Used hand-over-belly technique which kept bystander away from the patient's airway.
- BLS teams fully equipped with PPE, masks, gloves, overshoes.
- Used mechanical CC device instead of manual CCs which limited teams' viral exposure.
- Physician performed orotracheal intubation wearing a hooded suit and ski mask and using video laryngoscopy.

[Recently Published] Yang et al (June 2020) Taipei Azalea - Supraglottic airways (SGA) preassembled with high-efficiency particulate air (HEPA) filters to simplify prehospital airway management for patients with out-of-hospital cardiac arrests (OHCA) during Coronavirus Disease 2019 (COVID-19) pandemic[37]

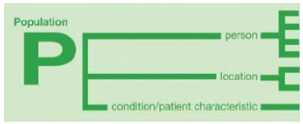
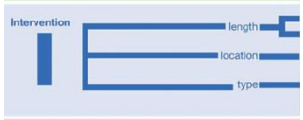
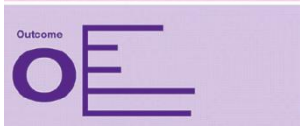
We recommend the attachment of high-efficiency particulate air (HEPA) filters to SGA for infection control as it has been proven to be effective against SARS transmission in 2003 outbreak. Although the second-generation SGA usually provides adequate seal, when the airway is secured and cardiopulmonary resuscitation (CPR) is resumed, aerosols could be easily expelled through the opening of SGA and put emergency medical technicians (EMTs) near the patient at risk, as usually some time consumption occurs until the filter is attached. To minimize this period of unfiltered air exchange, we proposed a preassembled SGA and HEPA filter set for rapid, easy, and safer airway management.

[Recently Published] Sayre MR, Barnard LM, Counts CR, et al. Prevalence of COVID-19 in Out-of-Hospital Cardiac Arrest: Implications for Bystander CPR[38]

A cohort study of out-of-hospital cardiac arrests (OHCA) attended by EMS January 1-April 15 2020, Seattle and Kings County, WA. Total of 1,067, of which 478 were EMS treated. COVID-19 laboratory confirmed in 23.
"Our results have implications when considering the balance of risks and benefits of changes in OHCA resuscitation guidelines for bystander CPR. The balance depends on risk of COVID-19 transmission from infected patients and the disease's prevalence among all OHCAs. Experts question whether chest compressions are a high-risk aerosolizing procedure, especially given bystander CPR is typically provided for only a few minutes. Less than 5% of 121 exposed healthcare workers without personal protective equipment (PPE) developed symptomatic COVID-19 following intensive care for an infected patient".
The authors conclude that current findings support telecommunicators and bystanders maintaining the most efficient approach that prioritizes rapid identification of cardiac arrest and immediately proceeds to chest compressions and use of a defibrillator. Delaying bystander CPR to implement PPE should only be considered when the prevalence of COVID-19 is substantially increased.

Produced by the members of the National Health Library and Knowledge Service Evidence Team†. Current as at 26 JUNE 2020.This evidence summary collates the best available evidence at the time of writing and **does not replace clinical judgement or guidance**. Emerging literature or subsequent developments in respect of COVID-19 may require amendment to the information or sources listed in the document. Although all reasonable care has been taken in the compilation of content, the National Health Library and Knowledge Service Evidence Team makes no representations or warranties expressed or implied as to the accuracy or suitability of the information or sources listed in the document. This evidence summary is the property of the National Health Library and Knowledge Service and subsequent re-use or distribution in whole or in part should include acknowledgement of the service.

The following PICO(T) was used as a basis for the evidence summary:

	HEALTHCARE WORKERS IN THE HOSPITAL SETTING WORKING WITH PATIENTS WITH CONFIRMED OR SUSPECTED COVID-19
	PROVISION OF CPR TO PATIENTS
	NO CPR OR LIMITED CPR (E.G CHEST COMPRESSIONS AND AED USE ONLY)
	TRANSMISSION OF COVID-19 TO HCWS THROUGH THE PROVISION OF CPR

The following search strategy was used:

EMTREE: RESUSCITATION/

MESH: CARDIOPULMONARY RESUSCITATION

KEYWORD: CPR OR RESUSCITATION OR RESUS OR CARDIO-PULMONARY RESUSCITATION OR CARDIOPULMONARY RESUSCITATION OR CHEST COMPRESSIONS OR AUTOMATED EXTERNAL DEFRIBRILLATOR OR CARDIAC ARREST OR ADVANCED CARDIAC LIFE SUPPORT OR CARDIO PULMONARY RESUSCITATION OR RESUSCITATE OR CARDIOVASCULAR

† Anne Madden, Assistant Librarian, St. Vincent's University Hospital, Dublin [Author]; Margaret Morgan, Librarian, Midland Regional Hospital, Mullingar [Author]; Maura Flynn, Librarian, Midland Regional Hospital, Tullamore [Author]; Brendan Leen, Area Librarian, HSE South [Editor]

[1] Health Protection Surveillance Centre Ireland (March 2020) Use of PPE to support Infection Prevention and Control Practice when performing aerosol generating procedures on confirmed or clinically suspected COVID-19 cases in a pandemic situation. Guidance V 2, 23.3.2020. https://www.hpsc.ie/a-z/respiratory/coronavirus/novelcoronavirus/guidance/infectionpreventionandcontrolguidance/aerosolgeneratingprocedures/ [Accessed 26th June /2020].

[2] Health Service Executive Deteriorating Patient Improvement Programme (2020). CPR guidance for confirmed or suspected COVID-19 in community assessment hubs. https://www.hpsc.ie/a-z/respiratory/coronavirus/novelcoronavirus/guidance/primarycareguidance/communityassessmenthubs/ [Accessed 26th June /2020].

[3] European Resuscitation Council, COVID-19 Guidelines, Edition 1. 24th April 2020. https://www.erc.edu/COVID [Accessed 26th June /2020].

[4] Edelson DP et al Interim Guidance for Basic and Advanced Life Support in Adults, Children, and Neonates With Suspected or Confirmed COVID-19: From the Emergency Cardiovascular Care Committee and Get With the Guidelines®-Resuscitation Adult and Pediatric Task Forces of the American Heart Association in Collaboration with the American Academy of Pediatrics, American Association for Respiratory Care, American College of Emergency Physicians, The Society of Critical Care Anesthesiologists, and American Society of Anesthesiologists: Supporting Organizations: American Association of Critical Care Nurses and National EMS Physicians [published online ahead of print, 2020 Apr 9]. *Circulation*. 2020;10.1161/CIRCULATIONAHA.120.047463. doi:10.1161/CIRCULATIONAHA.120.047463 https://pubmed.ncbi.nlm.nih.gov/32270695 [Accessed 26th June /2020].

[5] *International Liaison Committee on Resuscitation.* COVID-19 infection risk to rescuers from patients in cardiac arrest. *Consensus on Science with Treatment Recommendations [Internet] Brussels, Belgium: International Liaison Committee on Resuscitation (ILCOR), 10 April 2020.* https://costr.ilcor.org/document/COVID-19-infection-risk-to-rescuers-from-patients-in-cardiac-arrest [Accessed 26th June /2020].

[6] Resuscitation Council UK (28 April 2020) Statement on PHE PPE Guidance https://www.resus.org.uk/media/statements/resuscitation-council-uk-statements-on-COVID-19-coronavirus-cpr-and-resuscitation/statement-on-phe-ppe-guidance/ [Accessed 26th June /2020].

[7] Resuscitation Council UK Statement on COVID-19 in relation to CPR and resuscitation in healthcare settings 6 April 2020. https://www.resus.org.uk/media/statements/resuscitation-council-uk-statements-on-COVID-19-coronavirus-cpr-and-resuscitation/COVID-healthcare/ [Accessed 26th June /2020].

[8] Resuscitation Council UK (15 April 2020) Statement on COVID – 19 in relation to non-acute hospital settings. https://www.resus.org.uk/media/statements/resuscitation-council-uk-statements-on-COVID-19-coronavirus-cpr-and-resuscitation/in-hospital-settings/COVID-19-cpr-and-resuscitation-in-non-acute-hospital-settings/ [Accessed 26th June /2020].

[9] 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 [published online ahead of print, 2020 Mar 27]. *Anaesthesia*. 2020;10.1111/anae.15054. doi:10.1111/anae.15054 https://pubmed.ncbi.nlm.nih.gov/32221970 [Accessed 26th June /2020].

[10] Alhazzani W, Møller MH, Arabi YM, et al Surviving Sepsis Campaign: guidelines on the management of critically ill adults with Coronavirus Disease 2019 (COVID-19) [published online ahead of print, 2020 Mar 28]. *Intensive Care Med*. 2020;1–34. doi:10.1007/s00134-020-06022-5 https://pubmed.ncbi.nlm.nih.gov/32222812/ [Accessed 26th June /2020].

[11] The Faculty of Intensive Care Medicine, Intensive Care Society, Association of Anaesthetists and Royal College of Anaesthetists - Critical care preparation and management in the COVID-19 pandemic. (2020). https://icmanaesthesiaCOVID-19.org/critical-care-preparation-and-management-in-the-COVID-19-pandemic [Accessed 26th June /2020].

[12] WHO. 19 March 2020. Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected. https://www.who.int/publications-detail/infection-prevention-and-control-during-health-care-when-novel-coronavirus-(ncov)-infection-is-suspected-20200125 [Accessed 26th June /2020].

[13] European Centre for Disease Prevention and Control (13 May 2020. Infection prevention and control and preparedness for COVID-19 in healthcare settings third update https://www.ecdc.europa.eu/en/publications-data/infection-prevention-and-control-and-preparedness-COVID-19-healthcare-settings [Accessed 26th June /2020].

[14] Centres for Disease Control and Prevention. Interim Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) in Healthcare Settings. https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Finfection-control%2Fcontrol-recommendations.html [Accessed 26th June /2020].

[15] UpToDate. Coronavirus disease 2019 (COVID-19): Critical care and airway management issues. https://www.uptodate.com/contents/coronavirus-disease-2019-COVID-19-critical-care-and-airway-management-

issues?search=COVID19%20cpr&source=search_result&selectedTitle=5~150&usage_type=default&display_rank=5 [Accessed 26th June /2020].
[16] Chahar P, Marciniak D. Cardiopulmonary resuscitation in COVID-19 patients [published online ahead of print, 2020 Jun 11]. *Cleve Clin J Med*. 2020;10.3949/ccjm.87a.ccc040. doi:10.3949/ccjm.87a.ccc040 https://pubmed.ncbi.nlm.nih.gov/32493738/ [Accessed 26th June /2020].
[17] Seger CD, Wang L, Dong X, et al. A Novel Negative Pressure Isolation Device for Aerosol Transmissible COVID-19 [published online ahead of print, 2020 Jun 11]. Anesth Analg. 2020;10.1213/ANE.0000000000005052. doi:10.1213/ANE.0000000000005052 https://pubmed.ncbi.nlm.nih.gov/32541251/ [Accessed 26th June /2020].
[18] Scapigliati A, Gullì A, Semeraro F, et al. How to ventilate during CPR in time of COVID-19?. *Resuscitation*. 2020;151:148-149. doi:10.1016/j.resuscitation.2020.04.036 https://pubmed.ncbi.nlm.nih.gov/32371025/ [Accessed 26th June /2020].
[19] Ludwin K, Szarpak L, Ruetzler K, et al.[Letter] Cardiopulmonary Resuscitation in the prone position: a good option for patients with COVID-19 [published online ahead of print, 2020 Jun 8]. Anesth Analg. 2020;10.1213/ANE.0000000000005049. doi:10.1213/ANE.0000000000005049 https://pubmed.ncbi.nlm.nih.gov/32516166/ [Accessed 26th June /2020].
[20] Lim WY, Wong P, Teo LM, Ho VK.[Letter] Resuscitation during the COVID-19 pandemic: Lessons learnt from high-fidelity simulation [published online ahead of print, 2020 May 22]. Resuscitation. 2020;152:89-90. doi:10.1016/j.resuscitation.2020.05.024 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7242194/ [Accessed 26th June /2020].
[21] Shao F, Sun P, Tang Z. Cardiopulmonary resuscitation of inpatients with severe COVID-19 pneumonia: The Wuhan experience [published online ahead of print, 2020 May 11]. Resuscitation. 2020;152:95-96. doi:10.1016/j.resuscitation.2020.05.009 [Letter] https://pubmed.ncbi.nlm.nih.gov/32437782/ [Accessed 26th June /2020].
[22] Singh et al (May 2020) Indian resuscitation council (IRC) suggested guidelines for comprehensive cardiopulmonary life support (CCLS) for suspected or confirmed coronavirus disease (COVID-19) patient." Indian Journal of Anaesthesia 64.14 (2020): 91. http://www.ijaweb.org/article.asp?issn=0019-5049;year=2020;volume=64;issue=14;spage=91;epage=96;aulast=Singh [Accessed 26th June /2020].
[23] Girotra S, Tang Y, Chan P, Nallamothu BK. Survival After In-Hospital Cardiac Arrest In Critically Ill Patients: Implications For The COVID-19 Pandemic?. Preprint. *medRxiv*. 2020;2020.04.11.20060749. Published 2020 Apr 17. doi:10.1101/2020.04.11.20060749 https://pubmed.ncbi.nlm.nih.gov/32511438/ [Accessed 26th June /2020].
[24] Kinney B, Slama R. Rapid outdoor non-compression intubation (RONCI) of cardiac arrests to mitigate COVID-19 exposure to emergency department staff [published online ahead of print, 2020 May 27]. *Am J Emerg Med*. 2020;S0735-6757(20)30437-X. doi:10.1016/j.ajem.2020.05.080 https://pubmed.ncbi.nlm.nih.gov/32507572/ [Accessed 26th June /2020].
[25] Wenlock RD, Arnold A, Patel H, Kirtchuk D. Low-fidelity simulation of medical emergency and cardiac arrest responses in a suspected COVID-19 patient - an interim report [published online ahead of print, 2020 May 19]. *Clin Med (Lond)*. 2020;clinmed.2020-0142. doi:10.7861/clinmed.2020-0142 https://pubmed.ncbi.nlm.nih.gov/32430344/ [Accessed 26th June /2020].
[26] Sorbello M, Di Giacinto I, Falcetta S, Greif R. Ventilation and airway management during Cardiopulmonary Resuscitation in COVID-19 era [published online ahead of print, 2020 Jun 3]. Resuscitation. 2020;S0300-9572(20)30225-2. doi:10.1016/j.resuscitation.2020.05.043 https://pubmed.ncbi.nlm.nih.gov/32504767/ [Accessed 26th June /2020].
[27] Ruetzler K, Smereka J, Ludwin K, Drozd A, Szarpak L. Respiratory protection among healthcare workers during cardiopulmonary resuscitation in COVID-19 patients [published online ahead of print, 2020 May 11]. Am J Emerg Med. 2020;S0735-6757(20)30354-5. doi:10.1016/j.ajem.2020.05.014 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7211648/ [Accessed 26th June /2020].
[28] Griffin KM, Karas MG, Ivascu NS, Lief L. Hospital Preparedness for COVID-19: A Practical Guide from a Critical Care Perspective [published online ahead of print, 2020 Apr 16]. *Am J Respir Crit Care Med*. 2020;10.1164/rccm.202004-1037CP. doi:10.1164/rccm.202004-1037CP https://pubmed.ncbi.nlm.nih.gov/32298146 [Accessed 26th June /2020].
[29] Song W, Liu Y, Ouyang Y, et al Recommendations on cardiopulmonary resuscitation strategy and procedure for novel coronavirus pneumonia [published online ahead of print, 2020 Apr 7]. *Resuscitation*. 2020;S0300-9572(20)30137-4. doi:10.1016/j.resuscitation.2020.03.023. https://pubmed.ncbi.nlm.nih.gov/32276002/ [Accessed 26th June /2020].
[30] Liew MF, Siow WT, MacLaren G, See KC. Preparing for COVID-19: early experience from an intensive care unit in Singapore. *Crit Care*. 2020;24(1):83. Published 2020 Mar 9. doi:10.1186/s13054-020-2814-x http://www.ncbi.nlm.nih.gov/pubmed/?term=32151274 [Accessed 26th June /2020].
[31] Kearsley R. Consensus guidelines for managing the airway in patients with COVID-19 [published online ahead of print, 2020 Apr 20]. *Anaesthesia*. 2020;10.1111/anae.15081. doi:10.1111/anae.15081 https://pubmed.ncbi.nlm.nih.gov/32311772/ [Accessed 26th June /2020].
[32] Wax and Christian (12 February 2020) Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients. Canadian Journal of Anaesthesia. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7091420/ [Accessed 26th June /2020].

[33] Ling et al COVID-19: A critical care perspective informed by lessons learnt from other viral epidemics. 20 February 2020. Anaesthesia, Critical Care & Pain Medicine. https://www.ncbi.nlm.nih.gov/pubmed/?term=32088344 [Accessed 26th June /2020].
[34] Szerlip et al (2020) Considerations for Cardiac Catheterization Laboratory Procedures During the COVID-19 Pandemic Perspectives from the Society for Cardiovascular Angiography and Interventions Emerging Leader Mentorship (SCAI ELM) Members and Graduates. Catheter & Cardiovascular Interventions. https://www.ncbi.nlm.nih.gov/pubmed/?term=32212409 [Accessed 26th June /2020].
[35] Driggin et al (2020) Cardiovascular Considerations for Patients, Health Care Workers, and Health Systems During the Coronavirus Disease 2019 (COVID-19) Pandemic. Journal of the American College of Cardiology. https://www.ncbi.nlm.nih.gov/pubmed/?term=32201335 [Accessed 26th June /2020].
[36] Jost D, Derkenne C, Kedzierewicz R, et al. The Need to Adapt the Rescue Chain for Out-of-Hospital Cardiac Arrest during the COVID-19 Pandemic: Experience from the Paris Fire Brigade Basic Life Support and Advanced Life Support Teams [published online ahead of print, 2020 Jun 12]. Resuscitation. 2020;S0300-9572(20)30241-0. doi:10.1016/j.resuscitation.2020.06.005 https://pubmed.ncbi.nlm.nih.gov/32540262/[Accessed 26th June /2020].
[37] Yang WS, Hou SW, Lee BC, et al. Taipei Azalea - Supraglottic airways (SGA) preassembled with high-efficiency particulate air (HEPA) filters to simplify prehospital airway management for patients with out-of-hospital cardiac arrests (OHCA) during Coronavirus Disease 2019 (COVID-19) pandemic. *Resuscitation*. 2020;151:3-5. doi:10.1016/j.resuscitation.2020.03.021 https://pubmed.ncbi.nlm.nih.gov/32283118/ [Accessed 26th June /2020].
[38] Sayre MR, Barnard LM, Counts CR, et al. Prevalence of COVID-19 in Out-of-Hospital Cardiac Arrest: Implications for Bystander CPR [published online ahead of print, 2020 Jun 4]. Circulation. 2020;10.1161/CIRCULATIONAHA.120.048951. doi:10.1161/CIRCULATIONAHA.120.048951 https://pubmed.ncbi.nlm.nih.gov/32496811/ [Accessed 26th June /2020].