Evidence check

6 April 2020

Cardiopulmonary resuscitation (CPR)

Rapid review questions
What is the evidence that cardiopulmonary resuscitation is aerosol generating?
What is the current advice for CPR in patients with suspected or confirmed COVID-19?

In brief
- There are case reports of transmission of different infectious diseases as a result of cardiopulmonary resuscitation (CPR) - guidance from the Clinical Excellence Commission is for the use of resuscitation devices, such as masks to reduce risk
- CPR has been described as a potential aerosol generating procedure in multiple publications, however a systematic review saw non-significant results for increased risk of transmission for chest compressions
- Resuscitation Council UK, American Heart Association, Department of Health, Australian College for Emergency Medicine, Australian and New Zealand Committee on Resuscitation and the International liaison committee on resuscitation recommend that full aerosol generating procedure PPE be worn during CPR with known or suspected COVID-19
- Chest compressions, assisted ventilation, and advanced airway manoeuvres are all considered potentially aerosol-generating procedures requiring appropriate PPE, whereas defibrillation can be performed wearing droplet precautions, if the patient's mouth and nose are covered
- Resuscitation Council UK recommends if the rhythm is shockable to use a defibrillator prior to chest compressions. Compression-only resuscitation is recommended by multiple sources.

Background
The potential risk for COVID-19 transmission via resuscitation care has led to the development of guidelines by some organisations. A BMJ opinion piece has stated healthcare staff in one region have been told not to start chest compressions unless they are wearing full PPE. (1) Little evidence exists on the risks of viral transmission through aerosol and droplet generation from interventions that form part of a resuscitation attempt. Cardiovascular disease is a risk factor for COVID-19 pneumonia; acute cardiac injury is commonly observed in severe cases and is strongly associated with mortality; (2) survival after cardiac arrest is likely to be low. (3) This review aims to summarise the risk of transmission of disease through CPR, and guidance available for CPR relevant to COVID-19.

Methods (Appendix 1)
Google and PubMed were searched on 6 April 2020. Only the latest version of guidelines are included.

Results (Tables 1and 2)
Local protocols have been developed, generally based on Australian resuscitation council guidance.
Table one: CPR and aerosol generating procedures

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<thead>
<tr>
<th>Source title</th>
<th>Advice</th>
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<tr>
<td>Peer reviewed literature</td>
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| Nosocomial transmission of emerging viruses via aerosol-generating medical procedures (4) | • Aerosol-generating medical procedures (AGMPs) are increasingly being recognized as important sources for nosocomial transmission of emerging viruses.  
• Healthcare workers are considered to be at risk for nosocomial virus transmission from both small and large droplet aerosols  
• AGPs include bronchoscopy, CPR, BiPAP, CPAP, HFOV, tracheal intubation, manual ventilation, surgery, sputum induction, nebuliser treatment, suctioning, laser plume  
• Coronaviruses (e.g. SARS, MERS) cause respiratory disease in humans and transmit via aerosols, but it is unknown whether small-droplet or large-droplet aerosols are the modes of transmission. | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6832307/?!po=12.5000 |
| Aerosol Generating Procedures and Risk of Transmission of Acute Respiratory Infections to Healthcare Workers: A Systematic Review (5) | • During the severe acute respiratory syndrome (SARS) outbreaks, many frontline HCWs had a significantly increased risk of contracting disease  
• Although clinical guidelines and protective measures for the management of patients with acute respiratory diseases exist, the magnitude of the risk of acquiring an infectious disease through some patient care procedures is not clearly understood  
• Procedures reported to present an increased risk of transmission included tracheal intubation, non-invasive ventilation, tracheotomy and manual ventilation before intubation  
• Other intubation associated procedures, endotracheal aspiration, suction of body fluids, bronchoscopy, nebulizer treatment, administration of O2, high flow O2, manipulation of O2 mask or BiPAP mask, defibrillation, chest compressions, insertion of nasogastric tube, and collection of sputum were not significant. | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3338532/?report=reader |
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<thead>
<tr>
<th>Title</th>
<th>Summary</th>
<th>Reference</th>
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| Hospital management of adults with severe acute respiratory syndrome (SARS) if SARS re-emerges—updated 10 February 2004 (6) | Procedures that might promote the generation of aerosols (non-exhaustive list):  
- Use of high flow oxygen (>6 L/min)  
- Use of nebulisers  
- Chest physiotherapy  
- Continuous positive airways pressure (CPAP)  
- Non-invasive ventilation (NIV)  
- Bronchoscopy  
- Tracheal intubation  
- Suctioning  
<p>| Transmission of Infectious Diseases through Mouth-to-Mouth Ventilation: Evidence-Based or Emotion-Based Medicine? (7) | Virtually any disease transmissible by secretions or blood may be acquired during basic CPR. Only reports of isolated incidents have been published of tuberculosis, Neisseria meningitidis, Herpes simplex, Helicobacter pylori, Shigella sonnei and Salmonella infantis. | <a href="http://www.scielo.br/scielo.php?pid=S0066-782X2000000100008&amp;script=sci_arttext">http://www.scielo.br/scielo.php?pid=S0066-782X2000000100008&amp;script=sci_arttext</a> |
| Transmission of Panton-Valentine Leukocidin–Producing Staphylococcus aureus to a Physician during Resuscitation of a Child (8) | We report the first case of transmission of Panton-Valentine leukocidin–producing Staphylococcus aureus to a physician during the resuscitation of an infant with fatal pneumonia. | <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7107817/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7107817/</a> |
| Possible SARS Coronavirus Transmission during Cardiopulmonary Resuscitation (9) | Case report - This report describes the apparent transmission of SARS-CoV from a patient to healthcare workers during an attempted resuscitation. The healthcare worker was wearing PPE. | <a href="https://pubmed.ncbi.nlm.nih.gov/15030699/">https://pubmed.ncbi.nlm.nih.gov/15030699/</a> |
| Healthcare Worker Infected With Middle East Respiratory Syndrome During Cardiopulmonary Resuscitation in Korea, 2015 (10) | Case report - The healthcare worker was infected while performing cardiopulmonary resuscitation (CPR) for a MERS patient in an isolation room. | <a href="https://pubmed.ncbi.nlm.nih.gov/29129042/">https://pubmed.ncbi.nlm.nih.gov/29129042/</a> |</p>
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<th>Grey literature</th>
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<tr>
<td>WHO - Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations</td>
<td>In the context of COVID-19, airborne transmission may be possible in specific circumstances and settings in which procedures or support treatments that generate aerosols are performed; i.e., endotracheal intubation, bronchoscopy, open suctioning, administration of nebulized treatment, manual ventilation before intubation, turning the patient to the prone position, disconnecting the patient from the ventilator, non-invasive positive-pressure ventilation, tracheostomy, and cardiopulmonary resuscitation.</td>
<td><a href="https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations">https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations</a></td>
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<td>Infection prevention and control of epidemic- and pandemic-prone acute respiratory infections in healthcare</td>
<td>The evidence suggests that performing or being exposed to endotracheal intubation, either by itself or combined with other procedures (e.g. cardiopulmonary resuscitation or bronchoscopy), is consistently associated with increased risk of transmission (Conditional recommendation, very low to low quality of evidence)</td>
<td><a href="https://apps.who.int/iris/bitstream/handle/10665/112656/9789241507134_eng.pdf?sequence=1">https://apps.who.int/iris/bitstream/handle/10665/112656/9789241507134_eng.pdf?sequence=1</a></td>
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<td>NHS National services Scotland</td>
<td>Cardiopulmonary resuscitation (CPR) is not currently stated on WHO list of AGPs (2014). Nevertheless, CPR can include a number of different procedures, namely intubation, manual ventilation, open suctioning, chest compression and defibrillation. Some of these procedures are identified AGPs. Therefore, CPR involving procedures listed as AGPs should be managed as such (i.e. a potential source of infectious aerosols).</td>
<td><a href="https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2893/documents/1_tbp-lr-agp-v1.pdf">https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2893/documents/1_tbp-lr-agp-v1.pdf</a></td>
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Table two: CPR guidelines for COVID-19

<table>
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<th>Organisation</th>
<th>Title</th>
<th>Advice</th>
<th>Source link</th>
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<tr>
<td>Resuscitation Council UK</td>
<td>Advanced life support for COVID-19 patients</td>
<td>Flow chart including PPE recommendations. When decision to initiate CPR is made, level 3 PPE is recommended which includes: Disposable gloves, Disposable gown, Filtering face piece (FFP3) respirator, Disposable eye protection. If shockable to use a defibrillator followed by chest compressions, or if not shockable chest compressions. Defibrillator is classified level 2 PPE (Disposable gloves, Disposable apron, Fluid resistant surgical mask, Disposable eye protection)</td>
<td><a href="https://www.resus.org.uk/media/statements/resuscitation-council-uk-statements-on-covid-19-coronavirus-cpr-and-resuscitation/covid-healthcare-resources/">https://www.resus.org.uk/media/statements/resuscitation-council-uk-statements-on-covid-19-coronavirus-cpr-and-resuscitation/covid-healthcare-resources/</a></td>
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| Resuscitation Council UK      | Resuscitation of COVID-19 patients in hospital | 1. Recognise cardiac arrest, do not put face near patients mouth  
2. Defibrillate shockable rhythms if possible  
3. Full aerosol generating procedure PPE for anyone in room, compression only CPR  
4. Airway interventions much be carried out by experience personnel  
5. Identify and treat any reversal causes before stopping CPR  
6. Dispose of or clean all equipment that was used during CPR  
7. Remove PPE  
8. Post resuscitation debrief  
Infographics with key points are also available | https://www.resus.org.uk/media/statements/resuscitation-council-uk-statements-on-covid-19-coronavirus-cpr-and-resuscitation/covid-healthcare-resources/                                                                 |
| American Heart Association    |                                             | When caring for patients with known or suspected COVID-19:  
- Aerosol-generating procedures e.g. CPR should be performed in Airborne Infection Isolation Rooms (AIIRs) and personnel should use respiratory protection  
- Patients with known or suspected COVID-19 should be cared for in a single-person room with the door closed  
- Hand Hygiene  
- PPE  
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| Australian government department of health | Information for paramedics and ambulance first responders | Airborne precautions should be used routinely for all persons in the vehicle during high-risk AGPs including:

- Hand hygiene before donning a gown, eye protection, a P2/N95 respirator and gloves
- Having the driver don a P2/N95 respirator and protective eyewear
- After the AGP, removing gloves (perform hand hygiene), eye protection and gown (perform hand hygiene) and P2/N95 respirator (perform hand hygiene)
- Not touching the front of any item of PPE during removal
- Disposing of used PPE in a clinical waste bag
- Cleaning ambulance equipment and surfaces with disinfectant wipes by a person wearing clean PPE

If officers don’t have sufficient time to adequately apply full airborne precautions, they are advised to ensure their own safety including:

- Use of a surgical mask and eye protection as a minimum precaution, or a (fit-checked) P2/N95 respirator and eye protection if available;
- At completion of the episode of care, removal of gloves (perform hand hygiene), removal of eyewear, gown and mask (perform hand hygiene again); | 42A98A49A50C05173C77EF6 |

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<table>
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<tr>
<th>Australian College for Emergency Medicine</th>
<th>Adult Cardiac Arrest Management</th>
<th>Recommended:</th>
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<td>- Health care workers should only perform resuscitative interventions when they are protected by appropriate personal protective equipment (PPE).</td>
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<tr>
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<td></td>
<td>- Health care workers must not perform resuscitative interventions if they are not adequately protected by appropriate PPE.</td>
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<td>- Therefore, modifications to the traditional approach to cardiac arrest are needed.</td>
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Individual modifications to cardiac arrest management are provided, some high level points include:

- Ideally, all resuscitation should be performed by healthcare workers in PPE suitable for aerosol generating procedures (may not be the case for first responder who should be wearing at least a surgical mask, eye protection and gloves)
- Defibrillation is not considered an aerosol-generating procedure and can be performed by responders wearing droplet precautions, as long as the patient’s mouth and nose are covered.
- Chest compressions, assisted ventilation, and advanced airway manoeuvres are all considered potentially aerosol-generating procedures, and should only be performed by responders in airborne PPE
- Until endotracheal intubation has occurred, compression-only CPR is recommended.

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<th>Australian and New Zealand Resuscitation during the</th>
<th>The underlying principles for CPR remain the same</th>
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<tr>
<td></td>
<td>- Any resuscitation is better than no attempt</td>
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<td>- COVID-19 has changed the risk to rescuers</td>
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https://resus.org.au/
| Committee on Resuscitation | COVID-19 pandemic | • Healthcare workers should be provided with appropriate PPE to perform their roles  
• Many sudden cardiac arrests occur in the presence of family members and many will be unrelated to COVID-19  
• For lay rescuers who are unable or unwilling to do rescue breathing, compression only CPR is acceptable  
• After any attempts at resuscitation, please adhere to current advice about hand washing, cleaning and decontamination |
| --- | --- | --- |
| International liaison committee on resuscitation | COVID-19 infection risk to rescuers from patients in cardiac arrest | • Suggested that chest compressions and cardiopulmonary resuscitation have the potential to generate aerosols (weak recommendation, very low certainty evidence).  
• Suggested that in the current COVID-19 pandemic lay rescuers consider compression-only resuscitation and public-access defibrillation (good practice statement).  
• Suggested that in the current COVID-19 pandemic, lay rescuers who are willing, trained and able to do so, may wish to deliver rescue breaths to children in addition to chest compressions (good practice statement).  
• Suggested 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).  
• Suggested it may be reasonable for healthcare providers to consider defibrillation before donning aerosol generating personal protective equipment in situations where the provider assesses the benefits may exceed the risks (good practice statement) |
| Medical Journal of Australia | Consensus statement: Safe Airway Society principles of airway | Compression only cardiopulmonary resuscitation is advocated until the airway has been secured with a viral filter in place. |

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| management and tracheal intubation specific to the COVID-19 adult patient group | management-and-tracheal |
References


Appendix one


Google: COVID-19 AND CPR , CPR AND Aerosol Generating