Is giving chest compressions, considered an aerosol generating procedure (AGP)?

HIS Evidence were asked to examine and give advice on the reason for the conflicting guidance on this topic from Public Health England and the Resuscitation Council (UK). This is to support the work of the work of the Scottish Government Clinical Cell. A rapid search of the relevant evidence sources from the McMaster University Health Forum COVID-19 resource list was undertaken and the findings summarised in this report.

**HIS Evidence Conclusion:**

The evidence on whether chest compression is an AGP is currently inconclusive. Some variation in advice given between different organisations is due to whether they are referring to chest compression as a component of Cardiopulmonary resuscitation (CPR), or CPR in its entirety. The latter is commonly regarded as an AGP. Some organisations, on the basis of biological plausibility and a precautionary approach, advise that chest compressions should be considered as aerosol generating until more robust evidence to support or refute this position becomes available. This will however delay commencement of chest compressions when responders are not already wearing Personal Protective Equipment (PPE) suitable for AGPs.

**Public Health England advice**

Public Health England (PHE) guidance on personal protective equipment (PPE), last updated on 27th April, states in section 8.1 that “Chest compressions and defibrillation (as part of resuscitation) are not considered aerosol generating procedures; first responders (any setting) can therefore commence chest compressions and defibrillation without the need for AGP PPE while awaiting the arrival of other clinicians to undertake airway manoeuvres.”

This statement is based upon the findings of a literature review conducted by Health Protection Scotland in 2019. The Health Protection Scotland (HPS) review takes as it main source guidelines.
prepared by the World Health Organisation in 2014. These guidelines are in turn informed by the findings of a systematic review by Tran et al(2012). This review (based on 10 observational studies) investigated transmission of SARS from patient to healthcare workers in intensive care or other healthcare settings during the 2002-3 SARS outbreak. Tran et al present a hierarchy of likely risk of transmission from various procedures. They report no evidence of a statistically significant increase in risk with chest compressions, but note the extremely limited volume and quality of the available studies and suggest that the review should be used for academic purposes and not clinical decision making. HPS note that Cardiopulmonary resuscitation (CPR) is not included on the WHO 2014 list of aerosol generating procedures and do not cite any additional evidence to refute or support this position in their review. They do however note that CPR can include a number of different procedures, namely intubation, manual ventilation, open suctioning, chest compression and defibrillation and some of these are identified AGPs. Therefore, they write that CPR involving procedures listed as AGPs, should be managed as such (i.e. a potential source of infectious aerosols).

**Resuscitation Council (UK) advice**

In early April, advice was issued by the Resuscitation Council (UK) that individuals should “not deliver chest compression or ventilation unless wearing level 3 PPE (FFP3 mask, eye /face protection, fluid-resistant long-sleeved gown, gloves). These are considered an aerosol generating procedure which requires level 3 PPE for all those in the immediate vicinity of the resuscitation attempt”.

The Resuscitation Council (UK) lists five supporting sources of evidence for this advice. These will now be discussed in turn:

a) **International Liaison Committee on Resuscitation (ILCOR)**: This group identified the need to examine the evidence on this issue and a systematic review was instigated. This was primarily undertaken by academics at Warwick University in the UK, who included the co-chair of ILCOR and the chair of the adult advanced life support ILCOR task group. There were three research questions. These considered firstly whether chest compressions, defibrillation and all CPR interventions (which includes chest compressions) generate aerosols; secondly, whether these procedures can transmit infection to individuals; and thirdly what is the impact of personal protective equipment on transmission. For question 1, only two case reports were identified, relating to suctioning and tracheal intubation, and the overall evidence certainty was rated by the group as very low due to serious risk of bias and serious indirectness. Regarding transmission of infection, two relevant retrospective cohort studies, undertaken in 2004 (n=624) and 2010 (n=32), one case-control study from 2009 (n=477), and five case-reports (published between 2004 and 2017) were identified. The cohort studies, two did not find a statistically significant association between CPR-related activities and infection (Loeb 2004; Raboud 2010). The case-control study (Liu 2009) reported an association between chest compression delivery and SARS infection in healthcare workers (adjusted odds ratio 4.52, 95% confidence intervals 1.08-18.81). However, the analysis did not adjust for other key potential contacts during which infection could be transmitted, and there was a significant correlation between chest compressions and tracheal intubation.
In considering this evidence, the group acknowledged the risk of confounding as none of the identified studies were able to separate risks related to individual components of a resuscitation attempt (compressions, ventilations, defibrillation), from the resuscitation attempt as a whole. They also noted the indirectness of evidence as no included studies reported data on COVID-19, which may have a different transmissibility risk to other infections.

They went on to conclude that there is no direct evidence that chest compressions and defibrillation either are, or are not, aerosol generating procedures. However, this absence of evidence they said should not be interpreted as providing evidence that these procedures are not aerosol generating. From a physiological perspective, the generation of aerosols by chest compressions is clinically plausible, because changes in thoracic pressure during chest compressions generate airflow, and small exhaled tidal volumes. For policy makers, there is a need to balance the known risk of treatment delays if PPE is donned before chest compressions and defibrillation are delivered, against the unknown, but potential, risk of COVID-19 transmission to rescuers. This risk may also extend beyond the rescuer, with additional risk of onward transmission to other healthcare workers, patients, and the wider community. They made two recommendations as follows:

“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, healthcare professionals should use personal protective equipment for aerosol generating procedures during resuscitation (weak recommendation, very low certainty evidence)”

The review authors also noted the urgent need for research to identify and quantify aerosol generation associated with chest compressions and defibrillation and indicate that this could be undertaken using observations in clinical settings, or cadaver or animal models.

b) World Health Organisation (WHO) 2020 advice:

This guidance lists CPR as an aerosol generating procedure, citing the Tran et al (2012) review, coming to a different conclusion from the WHO 2014 report (used by HPS) which is based upon the same underlying systematic review findings.

c) Centers for Disease Control and Prevention (CDC):

CDC states there is neither expert consensus, nor sufficient supporting data, to create a definitive and comprehensive list of AGPs for healthcare settings. They then go on to list a number of procedures which are ‘often considered AGPs’ and this includes cardiopulmonary resuscitation. They do not mention chest compression individually. Only one reference is cited and this is the Tran et al 2012 review.

d) Australian and New Zealand Intensive Care Society (ANZICS):

States that cardiopulmonary resuscitation is an AGP but does not discuss chest compressions separately. No detail is given of methods used to prepare the guidance or included studies. The Tran et al (2012) review is listed in their references.
d)  **Department of Defense COVID-19 Practice Management Guide**

States that cardiopulmonary resuscitation is an aerosol generating procedure but does not discuss chest compressions separately. No detail is given of methods used to prepare the guidance or included studies. The Tran et al.(2012) review is listed in their references.

e)  **Resuscitation Journal**

This is a description of the study conducted for the International Liaison Committee described above and therefore does not constitute additional evidence.

To summarise this supporting evidence for the UK Resuscitation Council position, most of it is based upon the same source evidence used by Public Health England, namely the Tran et al 2012 review. Sometimes the terms CPR and chest compression are used interchangeably and this can lead to mixed messaging. There is one new piece of evidence taken into account by the Resuscitation Council, a rapid systematic review. While it fails to find primary studies which support or refute the claim that chest compression is an AGP, the review authors advise, based upon physiological plausibility and the precautionary principle, that it should be considered as such, and PPE worn.

**What is the current advice from other organisations?**

The view taken amongst other national and international organisations varies, but again this partly due to use of differing terminology, CPR versus chest compressions alone. No additional evidence to that considered by Public Health England or the Resuscitation Council is identified by any other groups. A few examples of advice from other organisations is given in the table below:

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Publication</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Government Department of Health.</td>
<td>Interim recommendations for the use of personal protective equipment (PPE) during hospital care of people with Coronavirus disease (COVID-19)</td>
<td>States that CPR is an AGP, based on taking precautionary principle approach, but does not mention chest compression separately.</td>
</tr>
<tr>
<td>Health Protection Surveillance Centre, Ireland</td>
<td>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.</td>
<td>Notes that no significant evidence of chest compressions being an AGP, but suggests that a precautionary approach would be to consider is as such.</td>
</tr>
<tr>
<td>Public Health Ontario</td>
<td>Frequently asked questions.</td>
<td>States that performing a chest compression is not an AGP.</td>
</tr>
</tbody>
</table>
Additional evidence identified

Two rapid reviews examining this question were identified. One was conducted by the Norwegian Institute of Public Health and the other by the New South Wales government in Australia. The rapid reviews draw more or less the same conclusions, namely that, CPR in its entirety, has been described as a potential aerosol generating procedure in multiple publications, however the one identified systematic review found statistically non-significant results for increased risk of transmission for chest compressions.

The Centre for Evidence Based Medicine in Oxford, have “What counts as an aerosol generating procedure (AGP) and how consistent and evidence-based is current guidance?” on their list of COVID-19 questions for which they are currently reviewing evidence. No date is given currently for publication of their findings.

One new study by Ott et al. (2020), available as a pre-print, was identified. Given that it has not been subjected to the full journal peer review process, it should not be used for clinical decision making, but it is noted for interest. This study examined aerosol-spread during chest compressions in a cadaver model. The authors applied nebulised detergents into human cadavers and detected aerosol spread during chest compressions. Use of a surgical mask deflected the spread.
References


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Ott, M; Milazzo, A; Liebau, S; Jaki, C; Schilling, T; Krohn, A; Heymer, J. Aerosol-spread during chest compressions in a cadaver model. Available from: https://doi.org/10.1101/2020.03.31.20049197


This report has been prepared in line with the HIS Evidence rapid response process. It has not been peer reviewed, and does not constitute recommendations. It should be considered alongside existing guidance applicable to NHS Scotland.