COVID-19 infection risk to rescuers from patients in cardiac arrest

Overarching research question: In individuals undertaking chest compressions/ defibrillation/ CPR (population), does the wearing of approved personal protective equipment for aerosol generating procedures (Intervention) compared with not wearing personal protective equipment or another system of personal protective equipment (Comparator) affect infection transmission risk from COVID-19 (population)?

Research question one
In individuals in any setting (population), is delivery of 1) chest compressions, 2) defibrillation or 3) cardiopulmonary resuscitation (exposures) associated with aerosol generation (outcome)?

Research question two
In individuals in any setting wearing any/ no personal protective equipment (population), is delivery of 1) chest compressions, 2) defibrillation or 3) cardiopulmonary resuscitation (exposures) associated with transmission of infection (outcome)?

Research question three
In individuals delivering chest compressions and/or defibrillation and/ or CPR in any setting (population), does wearing of personal protective equipment (intervention) compared with wearing any alternative system of personal protective equipment or no personal protective equipment (comparator) affect infection with the same organism as the patient, personal protective equipment effectiveness, or quality of CPR (outcomes)?

ASSESSMENT

Problem Is the problem a priority?		
JUDGEMENT	**RESEARCH EVIDENCE**	**ADDITIONAL CONSIDERATIONS**
○ No ○ Probably no ○ Probably yes ● Yes ○ Varies ○ Don't know	Internationally, as of 30th March 2020, COVID-19 pandemic has been confirmed in almost 750,000 individuals of which over 35,000 have died. The rate of infections and death toll continues to rise across the globe. Outside of the COVID-19 pandemic, each year over 1 million people sustain an out of hospital cardiac arrest around the world. CPR and defibrillation provide these people with the only chance of survival. (Iwami 2020 in press) There is good evidence that tracheal intubation and bag-mask ventilation are aerosol generating and may create risk to the unprotected rescuer. At present, the evidence surrounding the aerosol generating potential of chest compressions and defibrillation is uncertain. Given that these are the most time-critical interventions in cardiac arrest, the international resuscitation community has highlighted uncertainty as to the optimum approach in cardiac arrest patients with confirmed or suspected COVID-19. For healthcare professionals, one approach is to don personal protective equipment prior to any resuscitation attempt. This may reduce the risk of transmission to the rescuer, but will delay	

	treatment whilst the rescuer dons personal protective equipment. Cardiac arrest is a time-sensitive condition, where delays to treatment reduce the likelihood of a good patient outcome. An alternative approach is to commence chest compressions and defibrillation prior to or without donning personal protective equipment. On arrival of subsequent team members wearing personal protective equipment, the initial rescuer can depart whilst protected team members continue resuscitation including the commencement of ventilation if deferred. This approach minimises the delay to key treatments, but may expose rescuers to the risk of infection through aerosol generation. There is additional uncertainty for resuscitation by bystanders and in the context of dispatcher-assisted compression only CPR, and the advice that should be given to members of the public by the dispatcher. Cardiac arrests often occur in the home, and the rate of such events will likely increase due to isolation strategies being implemented by Governments across the world. As such, individuals that deliver dispatcher-assisted compression only CPR have likely already been exposed to the infection, and delivery of compression-only CPR may not cause additional exposure/ harm. During pediatric cardiac arrest, bystander rescuers are frequently those who routinely care for the child. In that case, the risk of the rescuer newly acquiring COVID-19 through provision of rescue breaths is greatly outweighed by improved outcome for children in asphyxial arrest who receive ventilations.	

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ○ Moderate ○ Large ○ Varies ● Don't know	From a patient perspective, the immediate initiation of chest compressions and defibrillation provides the highest likelihood of a good outcome. For children, who are more likely to sustain a cardiac arrest due to asphyxia, there is addition benefit from the provision of ventilation. Personal protective equipment (PPE) may reduce the risk of viral transmission during resuscitation. Reducing infection in laypersons and healthcare professionals decreases the risk of further propagating infection and which may preserve health system workforce capacity at a time of increased demand.	.

Undesirable Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Large ○ Moderate ○ Small ○ Trivial ○ Varies ● Don't know	Delaying or withholding chest compressions, defibrillation and in children ventilation leads to worse outcomes Some case reports and observational studies at high risk of bias suggested an association between cardiopulmonary resuscitation with aerosol generation and transmission of infection even in individuals wearing personal protective equipment. However, it was not possible in any study to isolate the potential aerosol generation and transmission during chest compressions and defibrillation with aerosol generation and transmission during cardiopulmonary resuscitation that incorporated airway manoeuvres. The donning of personal protective equipment, particularly by a resuscitation team is time-consuming, and delays treatment. Where personal protective equipment is worn, we identified that mask slippage during chest compression delivery may limit its effectiveness.	

Certainty of evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Very low ○ Low ○ Moderate ○ High ○ No included studies	Across all three research questions, evidence certainty in relation to critical outcomes was assessed as very low.	

Values

Is there important uncertainty about or variability in how much people value the main outcomes?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Important uncertainty or variability ○ Possibly important uncertainty or variability ○ Probably no important uncertainty or variability ○ No important uncertainty or variability	There is important uncertainty amongst the wider community as to the balance between optimising the likelihood of survival for an individual against the risk to an individual of being infected with COVID-19. Individual values may influence this decision- for example, a relative in the context of bystander CPR may be more willing	

Balance of effects

Does the balance between desirable and undesirable effects favor the intervention or the comparison?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention Favors the intervention ● Varies ○ Don't know	At present, the evidence does not demonstrate a definitive risk of aerosol generation associated with chest compression delivery and defibrillation. However, we did not identify any evidence that these key interventions do not generate aerosols. The risks versus benefit ratio may vary depending on the circumstances of the cardiac arrest and those providing resuscitation. Defibrillation within the first few minutes of cardiac arrest may achieve a sustained return of spontaneous circulation, with less risk than initiating chest compressions and ventilations for a patients in a non-shockable rhythm A risk benefit analysis may favour a layperson performing chest compressions on a witnessed cardiac arrest amongst a household member without PPE, more than a bystander performing compressions and ventilations on a stranger with an unwitnessed cardiac arrest. Healthcare professionals would have greater access to PPE, would likely be trained in its use, and may be able to don PPE before arriving at the patient's side, thus minimizing delays to commencing or continuing resuscitation.	

Resources required

How large are the resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large costs ○ Moderate costs○ Negligible costs and savings ○ Moderate savings ○ Large savings ● Varies ○ Don't know	The assumption is that all healthcare professionals will be required to don personal protective equipment at some stage during the care of the patient requiring resuscitation from cardiac arrest. This question relates to the timing of donning personal protective equipment, such that no additional resources are required. The question about rescuers in settings where personal protective equipment is not usually available is different. In these settings there are substantial potential logistic issues related to cost, distribution, training and availability of PPE resource for laypersons.	

Certainty of evidence of required resources

What is the certainty of the evidence of resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Very low ○ Low ○ Moderate ● High ○ No included studies	As stated above, for healthcare professionals there may be no additional resources are required. For laypersons, there would be likely substantial additional costs to provide and train large numbers of people in the use of aersol generating PPE. No studies were identified that specifically addressed resource requirements.	

Cost effectiveness

Does the cost-effectiveness of the intervention favor the intervention or the comparison?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ○ Varies ● No included studies	We did not identify any cost-effectiveness studies.	

Equity

What would be the impact on health equity?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ○ Probably reduced ○ Probably no impact ○ Probably increased ○ Increased ○ Varies ● Don't know	A delay in delivering chest compressions and defibrillation to individuals in cardiac arrest may disadvantage patients in cardiac arrest. However, it may provide benefits to the wider community by limiting potential infection transmission, particularly to healthcare professionals.	

Acceptability

Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know	The wearing of personal protective equipment by healthcare staff is accepted by stakeholders. For laypersons, the resuscitation provider to balance the benefits and risks.	

Feasibility

Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know	The use of PPE to protect healthcare professionals from COVID-19 is routine in many parts of the world. The provision of appropriate PPE and training in their use to large numbers of laypersons is unlikely to be feasible.	

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
PROBLEM	No	Probably no	Probably yes	**Yes**		Varies	Don't know
DESIRABLE EFFECTS	Trivial	Small	Moderate	Large		Varies	**Don't know**
UNDESIRABLE EFFECTS	Large	Moderate	Small	Trivial		Varies	**Don't know**
CERTAINTY OF EVIDENCE	**Very low**	Low	Moderate	High			No included studies
VALUES	**Important uncertainty or variability**	Possibly important uncertainty or variability	Probably no important uncertainty or variability	No important uncertainty or variability			
BALANCE OF EFFECTS	Favors the comparison	Probably favors the comparison	Does not favor either the intervention or the comparison	Probably favors the intervention	Favors the intervention	**Varies**	Don't know
RESOURCES REQUIRED	Large costs	Moderate costs	Negligible costs and savings	Moderate savings	Large savings	**Varies**	Don't know
CERTAINTY OF EVIDENCE OF REQUIRED RESOURCES	Very low	Low	Moderate	**High**			No included studies
COST EFFECTIVENESS	Favors the comparison	Probably favors the comparison	Does not favor either the intervention or the comparison	Probably favors the intervention	Favors the intervention	Varies	**No included studies**
EQUITY	Reduced	Probably reduced	Probably no impact	Probably increased	Increased	Varies	**Don't know**

	JUDGEMENT						
ACCEPTABILITY	No	Probably no	Probably yes	Yes		**Varies**	Don't know
FEASIBILITY	No	Probably no	Probably yes	Yes		**Varies**	Don't know

TYPE OF RECOMMENDATION

Strong recommendation against the intervention	Conditional recommendation against the intervention	Conditional recommendation for either the intervention or the comparison	Conditional recommendation for the intervention	Strong recommendation for the intervention
○	○	○	●	○

CONCLUSIONS

Recommendation

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 compression only resuscitation 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, may wish to deliver rescue breaths to 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 aerosol generating personal protective equipment in situations where the provider assesses the benefits may exceed the risks (good practice statement)

Justification

Subgroup considerations

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Implementation considerations

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Monitoring and evaluation

Research priorities

No identified study assessed the potential for aerosol generation through delivery of chest compressions and/or defibrillation without associated airway maneuvers. Such a study might be undertaken using a cadaver model of cardiac arrest and, if it can be undertaken safely, would examine the specific aerosol generation of the COVID-19 virus.