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

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ILCOR staff

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Conflict of Interest Declaration

The ILCOR Continuous Evidence Evaluation process is guided by a rigorous ILCOR Conflict of Interest policy. The following Task Force members and other authors were recused from the discussion as they declared a conflict of interest: none applicable.

The following Task Force members and other authors declared an intellectual conflict of interest and this was acknowledged and managed by the Task Force Chairs and Conflict of Interest committees: none applicable.

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

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Methodological Preamble and Link to Published Systematic Review

The continuous evidence evaluation process for the production of Consensus on Science with Treatment Recommendations (CoSTR) started with a systematic review (CRD42020175594) conducted by Warwick Evidence at the University of Warwick with involvement of clinical content experts. Evidence for adult and pediatric literature was sought and considered by the ILCOR COVID-19 task and finish group.

Systematic Review

NOT YET PUBLISHED

PICOST

This review encompassed three review questions.

Research question one

The PEOST (Population, Exposure, Outcome, Study Designs and Timeframe)

Population: Individuals in any setting

Exposure: Delivery of:

1) Chest compressions

2) Defibrillation

3) CPR (all CPR-interventions that include chest compressions)

Outcomes: Generation of aerosols (critical outcome).

Study Designs: Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies, case reports/series, cadaver studies) are eligible for inclusion. Unpublished studies (e.g., conference abstracts, trial protocols) are excluded.

Timeframe: All years and all languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded. Literature search completed March 24 2020.

Research question two

The PEOST (Population, Exposure, Outcome, Study Designs and Timeframe)

Population: Individuals in any setting wearing any/ no personal protective equipment

Exposure: Delivery of:

1) Chest compressions

2) Defibrillation

3) CPR (all CPR-interventions that include chest compressions)

Outcomes: Transmission of infection (critical outcome).

Study Designs: Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies, case reports/ series) are eligible for inclusion. Unpublished studies (e.g., conference abstracts, trial protocols) are excluded.

Timeframe: All years and all languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded. Literature search completed March 24 2020.

Research question three

The PICOST (Population, Intervention, Comparator, Outcome, Study Designs and Timeframe)

Population: Individuals delivering chest compressions and/or defibrillation and/ or CPR in any setting

Intervention: **Wearing of personal protective equipment**

Comparison: **Wearing any alternative system of personal protective equipment or no personal protective equipment**

Outcomes: Infection with the same organism as patient (critical-9); PPE effectiveness (critical- 7); Quality of CPR (important -5)

Study Designs: Randomized controlled trials (RCTs) and non-randomized studies (non-randomized controlled trials, interrupted time series, controlled before-and-after studies, cohort studies, cadaver studies, simulation studies) are eligible for inclusion. Unpublished studies (e.g., conference abstracts, trial protocols) are excluded.

Timeframe: All years and all languages were included as long as there was an English abstract; unpublished studies (e.g., conference abstracts, trial protocols) were excluded. Literature search completed March 24 2020.

PROSPERO Registration CRD42017080475

In most cases bias was assessed per comparison rather than per outcome, since there were no meaningful differences in bias across outcomes. In cases where differences in risk of bias existed between outcomes this was noted.

Consensus on Science

Across all research questions and outcomes, heterogeneity in study design, exposures and outcomes precluded meta-analysis.

Research question one

For the critical outcome of aerosol generation, we identified evidence from two case reports (Chalumeau 2005 e29-30, Nam 2017 e2017052) involving performance of airway manoeuvres (suctioning/ tracheal intubation), that reported the generation of aerosols based on the transmission of infection. Neither case reported delivery of defibrillation. Overall evidence certainty was rated as very low due to serious risk of bias and serious indirectness.

Research question two

For the critical outcome of transmission of infection, we included two retrospective cohort studies comprising 656 healthcare workers (one with 624 and one with 32 participants),(Loeb 2004 251, Raboud 2010 e10717) one case-control study comprising 477 healthcare workers,(Liu 2009 52-59), and five case-reports(Chalumeau 2005 e29-30, Christian 2004 287-93, Kim 2015 1681-3, Knapp 2016 48-51, Nam 2017 e2017052)

Of the three observational studies, two did not report a statistically significant association between CPR-related activities and infection.(Loeb 2004 251; Raboud 2010 e10717) A case-control study (Liu 2009 52-59) 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), but the analysis did not adjust for other key potential contacts and there was a significant correlation between chest compressions and tracheal intubation.

Two case reports described transmission of an airborne bacterial infection in cases where CPR was delivered (including ventilation) and PPE was not worn.(Chalumeau 2005 e29-30, Knapp 2016 48-51) In three cases, transmission of an airborne viral infection was described, all of which described healthcare workers wearing PPE.(Christian 2004 287-93, Kim 2015 1681-3, Nam 2017 e2017052) In one case report, a nurse wearing personal protective equipment who delivered only chest compressions developed infective symptoms following a cardiac arrest, although it is unclear whether the nurse was also present in the room during tracheal intubation and bag-mask ventilation. Delivery of defibrillation was not described in any of the three case reports. Overall evidence certainty was rated as very low due to serious risk of bias and serious indirectness.

Research question three

For the critical outcome of Infection with the same organism as the patient, we found no evidence.

For the critical outcome of PPE effectiveness, we found evidence from one manikin randomized controlled trial enrolling 30 healthcare providers.(Shin 2017 e8308) The study reported differences in the adequacy of protection provided by different mask types during delivery of chest compressions (cup-type 44.9% ± 42.8 v fold-type 93.2% ± 21.7 v valve-type 59.5% ± 41.7, p<0.001), and evidence of reduced protection from a pre-chest compression baseline assessment. Evidence certainty was rated as low, downgraded for serious risk of bias and serious indirectness.

For the important outcome of CPR quality, we included evidence from three randomized controlled manikin trials enrolling 104 participants.(Schumacher 2013 33-8, Shin 2017 e8308, Watson 2008 333-8) The outcome of treatment time was reported in two studies.(Schumacher 2013 33-8, Watson 2008 333-8) In a study of paediatric cardiac arrest, paramedic time to complete four key tasks, including tracheal intubation and intraosseous access, was longer when paramedics wore personal protective equipment (no PPE 261 ± 12 seconds v full face mask 275 ± 9 v hood 286 ± 13, p=0.001).(Schumacher 2013 33-8) In a study of 58 firefighters that compared the effect of wearing different types of gown along with gloves, eye protection and an N95 mask found that not wearing a gown reduced time to first compression (no gown 39 seconds (95% CI 34–43) v standard gown 71 seconds (95% CI 66–77, p < 0.01); v modified gown 59 seconds (95% CI 54–63), p < 0.001). The outcome of chest compression quality was reported in one study enrolling 30 participants which found no difference in chest compression quality between mask types.(Shin 2017 e8308) Evidence certainty was rated as very low, downgraded for very serious risk of bias and serious indirectness.

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 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 and Evidence to Decision Framework Highlights

- This topic was prioritized by ILCOR based on ongoing international clinical uncertainty regarding the optimum approach regarding the initiation of chest compressions and defibrillation in known or suspected COVID-19 patients.
- This CoSTR complements other guidelines which describe the personal protective equipment that should be worn for aerosol generating procedures. https://apps.who.int/iris/bitstream/handle/10665/331498/WHO-2019-nCoV-IPCPPE_use-2020.2-eng.pdf (https://apps.who.int/iris/bitstream/handle/10665/331498/WHO-2019-nCoV-IPCPPE_use-2020.2-eng.pdf) ; https://www.sccm.org/getattachment/Disaster/SSC-COVID19-Critical-Care-Guidelines.pdf?lang=en-US (https://www.sccm.org/getattachment/Disaster/SSC-COVID19-Critical-Care-Guidelines.pdf?lang=en-US)
- In the context of chest compressions, aerosol generation is plausible as chest compressions do generate passive ventilation associated with small tidal volumes.(Deakin 2007 436-443) It also has parallels with chest physiotherapy techniques which are associated with aerosol generation, although in that context the intent is often to induce coughing and aerosol generation.(Simonds 2010 131-172) Furthermore, the person performing chest compressions is in physical contact with the patient and in close proximity to the airway.
- We did not identify evidence that defibrillation generates aerosols. If it occurs the duration of an aerosol generating process would be brief. Furthermore, the use of adhesive pads means that defibrillation can be delivered without direct contact between the defibrillator operator and patient.
- We acknowledge the risks 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. We further note the indirectness of evidence as no included studies reported data on COVID-19 which may have a different transmissibility risk to other infections.
- 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)
- In making recommendations, there is a need to carefully balance the benefit of early treatment with chest compressions and defibrillation (prior to donning personal protective equipment) with the

potential harm to the rescuer, their colleagues and the wider community if the rescuer were to be infected with COVID-19.

- In suggesting that lay rescuers consider compression only CPR and public access defibrillation, the writing group noted that the majority of out of hospital cardiac arrests occur in the home where those providing resuscitation are likely to have been in contact with the person requiring resuscitation; that accessibility to personal protective equipment for aerosol generating procedures is likely to be limited; there may be significant harm from delaying potentially lifesaving treatment if resuscitation is deferred until arrival of personnel with suitable personal protective equipment.
- In suggesting that lay rescuers who are willing, trained and able to do so, may wish to consider rescue breaths in addition to chest compressions, the writing group considered that 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.
- In suggesting that healthcare professionals should use personal protective equipment for aerosol generating procedures we considered that 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.
- Given the potential for defibrillation within the first few minutes of cardiac arrest to achieve a sustained return of spontaneous circulation and the very low likelihood of defibrillation generating an aerosol, we suggest healthcare providers consider the risks versus benefits of attempting defibrillation prior to donning personal protective equipment for aerosol generating procedures.
- The time taken for a team to don personal protective equipment may be up to 5-minutes, although individuals may don equipment in around one-minute(Abrahamson 2006 R3, Watson 2008 333-8). However, once donned we identified evidence that there is a risk of mask slippage during chest compression delivery rendering the protective equipment less effective.
- The practical implementation of these recommendations will require healthcare systems to consider availability of PPE, training needs of their workforce and infrastructure / resources to provide on-going care for patients resuscitated from cardiac arrest.

Knowledge Gaps

No identified study assessed the potential for aerosol generation through delivery of chest compressions and/or defibrillation without associated airway manoeuvres.

Attachments

Evidence-to-Decision Table: COVID-19 infection risk to rescuers from patients in cardiac arrest (assets/images/photos/2020-03-30-EtD-table-uploaded.pdf)

GRADE Table: COVID-19 infection risk to rescuers from patients in cardiac arrest (assets/images/photos/GRADE-TABLE-300320.pdf)

References

Abrahamson SD, Canzian S and Brunet F. Using simulation for training and to change protocol during the outbreak of severe acute respiratory syndrome. *Critical Care (London, England)*. 2006;10:R3.

Chalumeau M, Bidet P, Lina G, Mokhtari M, Andre MC, Gendrel D, Bingen E and Raymond J. Transmission of Panton-Valentine leukocidin-producing Staphylococcus aureus to a physician during resuscitation of a child. *Clinical Infectious Diseases*. 2005;41:e29-30.

Chan PS, Krumholz HM, Nichol G and Nallamothu BK. Delayed Time to Defibrillation after In-Hospital Cardiac Arrest. *New England Journal of Medicine*. 2008;358:9-17.

Christian MD, Loutfy M, McDonald LC, Martinez KF, Ofner M, Wong T, Wallington T, Gold WL, Mederski B, Green K, Low DE and Team SI. Possible SARS coronavirus transmission during cardiopulmonary resuscitation. *Emerg Infect Dis*. 2004;10:287-93.

Deakin CD, Cheung S, Petley GW and Clewlow F. Assessment of the quality of cardiopulmonary resuscitation following modification of a standard telephone-directed protocol. *Resuscitation*. 2007;72:436-443.

Gräsner J-T, Wnent J, Herlitz J, Perkins GD, Lefering R, Tjelmeland I, Koster RW, Masterson S, Rossell-Ortiz F, Maurer H, Böttiger BW, Moertl M, Mols P, Alihodžić H, Hadžibegović I, Ioannides M, Truhlář A, Wissenberg M, Salo A, Escutnaire J, Nikolaou N, Nagy E, Jonsson BS, Wright P, Semeraro F, Clarens C, Beesems S, Cebula G, Correia VH, Cimpoesu D, Raffay V, Trenkler S, Markota A, Strömsöe A, Burkart R, Booth S and Bossaert L. Survival after out-of-hospital cardiac arrest in Europe - Results of the EuReCa TWO study. *Resuscitation*. 2020;148:218-226.

Hawkes C, Booth S, Ji C, Brace-McDonnell SJ, Whittington A, Mapstone J, Cooke MW, Deakin CD, Gale CP, Fothergill R, Nolan JP, Rees N, Soar J, Siriwardena AN, Brown TP and Perkins GD. Epidemiology and outcomes from out-of-hospital cardiac arrests in England. *Resuscitation*. 2017;110:133-140.

Kim WY, Choi W, Park SW, Wang EB, Lee WJ, Jee Y, Lim KS, Lee HJ, Kim SM, Lee SO, Choi SH, Kim YS, Woo JH and Kim SH. Nosocomial transmission of severe fever with thrombocytopenia syndrome in Korea. *Clinical Infectious Diseases*. 2015;60:1681-3.

Knapp J, Weigand MA and Popp E. Transmission of tuberculosis during cardiopulmonary resuscitation. Focus on breathing system filters. [German]. *Notfall und Rettungsmedizin*. 2016;19:48-51.

Liu W, Tang F, Fang LQ, De Vlas SJ, Ma HJ, Zhou JP, Looman CWN, Richardus JH and Cao WC. Risk factors for SARS infection among hospital healthcare workers in Beijing: A case control study. *Tropical Medicine and International Health*. 2009;14:52-59.

Loeb M, McGeer A, Henry B, Ofner M, Rose D, Hlywka T, Levie J, McQueen J, Smith S, Moss L, Smith A, Green K and Walter SD. SARS among critical care nurses, Toronto. *Emerging infectious diseases*. 2004;10:251-5.

Nam HS, Yeon MY, Park JW, Hong JY and Son JW. Healthcare worker infected with Middle East Respiratory Syndrome during cardiopulmonary resuscitation in Korea, 2015. *Epidemiol Health*. 2017;39:e2017052.

Nikolaou N, Dainty KN, Couper K, Morley P, Tijssen J, Vaillancourt C, Olasveegen T, Mancini MB, Travers A, Løfgren B, Nishiyama C, Stanton D, Ristagno G, Considine J, Castren M, Smyth M, Kudenchuk P, Escalante R, Gazmuri R, Brooks S, Chung SP, Hatanaka T, Perkins G, Maconachie I, Aickin R, Caen AD, Atkins D, Bingham R, Couto TB, Guerguerian A-M, Meaney P, Nadkarni V, Ng K-C, Nuthall G, Ong Y-KG, Reis A,

Schexnayder S, Shimizu N and Voorde PVd. A systematic review and meta-analysis of the effect of dispatcher-assisted CPR on outcomes from sudden cardiac arrest in adults and children. *Resuscitation*. 2019;138:82-105.

Raboud J, Shigayeva A, McGeer A, Bontovics E, Chapman M, Gravel D, Henry B, Lapinsky S, Loeb M, McDonald LC, Ofner M, Paton S, Reynolds D, Scales D, Shen S, Simor A, Stewart T, Vearncombe M, Zoutman D and Green K. Risk factors for SARS transmission from patients requiring intubation: a multicentre investigation in Toronto, Canada. *PLoS One*. 2010;5:e10717.

Schumacher J, Gray SA, Michel S, Alcock R and Brinker A. Respiratory protection during simulated emergency pediatric life support: a randomized, controlled, crossover study. *Prehospital & Disaster Medicine*. 2013;28:33-8.

Shin H, Oh J, Lim TH, Kang H, Song Y and Lee S. Comparing the protective performances of 3 types of N95 filtering facepiece respirators during chest compressions: A randomized simulation study. *Medicine*. 2017;96:e8308.

Simonds AK, Hanak A, Chatwin M, Morrell M, Hall A, Parker KH, Siggers JH and Dickinson RJ. Evaluation of droplet dispersion during non-invasive ventilation, oxygen therapy, nebuliser treatment and chest physiotherapy in clinical practice: implications for management of pandemic influenza and other airborne infections. *Health Technol Assess*. 2010;14:131-172.

Watson L, Sault W, Gwyn R and Verbeek PR. The "delay effect" of donning a gown during cardiopulmonary resuscitation in a simulation model. *CJEM Canadian Journal of Emergency Medical Care*. 2008;10:333-8.

First Aid (/document/?category=first-aid)

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COVID-19

Discussion

GUEST

Ken Spearpoint (301 posts) 2020.03.30 14:55:14 (modified: 2020.03.31 04:54:33)

Thank you for the rapid publication of this review. I have conducted an extensive search of the literature independent of this important work. I could only one paper that mentions defibrillation in the context of being a potential AGP, and it indicated as you have done that there is no reliable evidence that defibrillation is an AGP's, but it is important to safety to note that there is no evidence that defibrillation is NOT an AGP. In the absence of evidence we have to rely on professional opinion. When we defibrillate people, arms can flail and air is usually expelled very rapidly from the patient's mouth and nose as a result of the widespread muscular contraction that occurs in the chest, lungs and heart as a result of electrical energy passing through the person's chest wall. It isn't difficult to work out, that if a person infected with the Covid-19 virus, receives an electric shock from a defibrillator, at that moment, millions of viral particles will be forcefully expelled into the air from the mouth and the nose. There is very strong evidence specific to corona virus particles, that theses particles may remain present in the air for up to three hours.