# Intubation speed by experts in a simulated model of cardiac arrest with continuous cardiopulmonary resuscitation (CPR)

## Authors:

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## Background:

Cardiac arrest is the common pathway leading to death in all people. The crude incidence of cardiac arrest is 100 events per 100 000 population1 with 98% of events occurring in adults[[1]](#footnote-1). Of these events, a cardiac cause is presumed in approximately 69%. Of cases with attempted resuscitation, 28% survived the event and 12% survived to hospital discharge or 30 days1. High quality, non-interrupted CPR and early defibrillation (when indicated) are the two best methods shown to increase survival. However, significant debate continues regarding the best form of airway management for a patient in cardiac arrest.3

There is weak evidence indicating intubation is the preferred method of oxygenation and ventilation during a cardiac arrest. It has shown to increase return of spontaneous circulation (ROSC) and improved neurological status on discharge, especially when performed by experienced users.4 The use of an advanced airway (ETT or LMA) during cardiac arrest has been shown to decrease interruptions to CPR5, and interruptions to CPR are associated with poor outcomes6.

Coronary perfusion drastically reduces with stopping CPR, and it takes a long time to increase to adequate perfusion after re-starting CPR7 Prehospital studies have shown that attempted tracheal intubation accounts for almost 25% of CPR interruptions, with some greater than three minutes and the median almost two minutes.8 The most recent European guidelines (2015) state that intubation should be attempted without stopping CPR, however if this will cause prolonged interruptions to CPR, they recommend to wait until ROSC to intubate.3 The fastest and most accurate way to intubate a patient undergoing continuous CPR has yet to be shown in an ideal setting using experts.

## Clinical Questions to be addressed:

The optimal oxygenation and ventilation for a patient undergoing CPR is still unknown. The most recent guidelines state that intubation should be attempted without ceasing CPR. Intubation is associated with many potentially dangerous sequelae, including oesophageal intubation, prolonged interruptions to CPR, damage to teeth or oral mucosa which may lead to tracheal or bronchial obstruction.

The aims of the project include:

1. To assess the speed at which highly skilled larryngoscopists can successfully intubate a simulated patient undergoing continuous CPR
2. To assess the rate at which highly skilled larryngoscopists can successfully intubate a simulated patient undergoing continuous CPR
3. To assess whether videolaryngoscopy or direct laryngoscopy assists in more successful or, faster intubation in a simulated patient undergoing continuous CPR
4. To assess the participants’ rating of task fidelity, and fidelity of the simulated patient.

## Study type:

A prospective, randomised, cross over trial.

## Funding:

This project will be funded by the Department of Anaesthesia and Pain Management, John Hunter Hospital, Hunter New England Area Health Service.

Equipment will also be provided in the form of a manikin and Auto-Pulse II (an automatic compression machine) by third parties, who will not have any contribution to data, access to data, or other ability to influence the study or study findings.

## Study setting:

John Hunter Hospital recovery unit, John Hunter Hospital, Lambton Heights, NSW 2300.

## Inclusion criteria:

## Participants must be advanced trainees in anaesthesia (minimum two years of anaesthetic training) or higher (FANZCA)

1. Participants must have experience in both direct and video assisted laryngoscopy

## Exclusion criteria

1. Not an advanced trainee in anaesthesia or FANZCA.
2. Has participated in the study previously (one attempt per candidate only)

## Method:

1. Participants will be recruited by volunteering. It will be promoted through an internal email to Anaesthetics staff members of the Hunter New England Area Health Service and at Departmental meetings
2. The participants will be initially randomised to either a traditional ‘direct’ laryngoscope with size four mac-blade, or a McGrath® videolaryngoscope with size four blade using a random binary number generator (0,1). The binary outcome will be concealed in individual opaque envelopes.
3. Participants will enter the room with a high fidelity manikin undergoing continuous compressions via a Lucas II mechanical compression device.
4. The participant will be asked to hold the mask and self-inflating bag and when ready, attempt intubation with the randomly allocated device.
5. All participants will be required to intubate the manikin with a size 7 endotracheal tube (ETT), and bougie whilst the manikin is receiving continuous compressions.
6. A study author will record the time taken to successfully intubate and attempts made.
7. The participants will then be asked to do steps 3-5 using the alternate laryngoscope.
8. The participants will be asked to complete a post-procedure questionnaire as described below.

The following items will be required for the above steps:

## Resources:

1. Intubating whole body resuscitation manikin
2. Continuous CPR machine (Model LUCAS-2)
3. Stop-watch
4. Mask & self-inflating bag
5. Size 7 ETT
6. Direct laryngoscope with size 4 mac blade
7. Video laryngoscope (McGrath) with size 4 mac blade
8. Gum-elastic bougie
9. 10ml syringe for cuff inflation

## Sample size and statistical analysis:

A sample size calculation was undertaken using pilot data from critical care paramedics. Assuming power 90%, alpha = 0.01, a mean difference (paired) = 4 seconds and a SD of the difference between groups of 5 seconds the sample size required was estimated to be n=24.

A more stringent power (90% vs 80%) and alpha (1% vs 5%) were selected to correct for unanticipated errors in any of the assumptions and to enable sub-group analysis (e.g. experience).

Null hypothesis:

H­­­0: There is no difference between direct and videolaryngoscopy for intubation speed and success by expert users in a simulated patient undergoing continuous CPR.

Alternate hypothesis

H1: There is a difference between direct and videolaryngoscopy for intubation speed and success by expert users in a simulated patient undergoing continuous CPR.

Significance level:

α = 0.01

Statistical method: paired t-test (two tailed).

Statistical methodology:

1. The participants two data points will be paired.
2. A learning effect will be tested for, to see if the crossover (alternate laryngoscope attempt) is helped by the first via ‘difference of two means’ testing.
3. Time, attempts and successful intubation will be assessed and compared between the two groups.

Questionnaires will be requested of all participants, with the following data points:

Data points will be:

1. Level of anaesthetic experience (staff specialist vs fellow vs advanced trainee)
2. Levels of task experience (times intubated during CPR 0, 1-5, >5
3. Which instrument participants are initially randomised to (videolaryngoscope vs direct laryngoscope)
4. Which laryngoscope the participant would usually prefer in this clinical scenario
5. Time taken to successful intubation (in tenths of seconds)
6. Attempts made to successful intubation
7. Fidelity of mannequin (Likert 1-5)
8. Fidelity of task (Likert 1-5)
9. Comfort level of participant and ease of task while intubating (for both instruments) (Likert 1-5)

Data points 1-4 will be collected via questioning prior to task initiation.

Data points 4-5 will be collected via observer with stop-watch, pen and paper to record information.

Data points 6-8 will be collected via questionnaire at the end of the task.

The data will be anonymised and confidentially stored. A confidentiality agreement between staff and 'assessors' will exist, this will help to protect both the study and anaesthetist. Participants will be asked to not discuss the contents of the study after completion. In the event an anaesthetist is unable to intubate the patient after two minutes, the continuous CPR will be ceased to allow easier intubation. This will be recorded as an anonymous data point. This data cannot be excluded as it is one of the end points of the study.

A data monitoring committee (DMC) is not needed.

No interim analyses or auditing will be conducted on the data.

## Expected outcomes:

## The authors expect a trend towards increased speed and accuracy with videolaryngoscopy.

## Participant timeline:

Participation will be voluntary and non-remunerated. Staff will have to attend during their non-clinical allocated time or during their personal time. The study should only take 10-15minutes to complete per participant.

## Potential Harms:

The study will simulate intubating a patient undergoing continuous CPR. This may cause some distress for participants, including in the following ways:

1. Physical harm:

- Participants are required to perform a very similar task on a day to day basis as an anaesthetist. This will not increase their risk of physical harm any more than their daily duties

1. Psychological harm:

The scenario may remind participant of a previously traumatic experience. This is unable to be predicted. Participants would be expected in a 'real-life' setting to perform intubation in this situation as the anaesthetist.

1. Economic Harm:

As previously stated, the participants will be asked to attend outside of clinical time (either academic and management time, or in their private time). The duration is expected to be approximately 15 minutes of volunteered time per candidate.

1. Reputational harm:

This exists if the anaesthetist exhibits either difficulty or inability to intubate the mannequin.

To minimised this:

- No active recording will take place (audio/video)

- Data will be anonymised and confidentially stored.

- Confidentiality agreement between staff and 'assessors' will exist, this will help to protect both the study and anaesthetist. Participants will be asked to not discuss the contents of the study after completion.

- In the event an anaesthetist is unable to intubate the patient after two minutes, the continuous CPR will be ceased to allow easier intubation. This will be recorded as an anonymous data point. This data cannot be excluded as it is one of the end points of the study.

## Ethics and Dissemination:

Ethics approval will be required. This will be sought from the Hunter New England Human Research Ethics Committee.

## Consent:

This is an opt-in study.

They will be given sufficient information prior to consenting and participating to decide whether they would or would not like to proceed.

Written consent will be mandatory for inclusion, and will be collected immediately prior to participation in the study by the study supervisor.

The study information sheets will be distributed via email in the initial recruitment material regarding the contents of the study. Participants will have the time between receiving the email until the time they choose to attend the practical component to consider whether they would like to proceed.

The authors have no conflicts of interest to declare.

## Reference List

1. Beck B, Bray J, Cameron P et al. (2018). Regional variation in the characteristics, incidence and outcomes of out-of-hospital cardiac arrest in Australia and New Zealand: Results from the Aus-ROC Epistry. *Resuscitation*. 126: 49-57.
2. Ambulance Victoria. (2018). Victorian Ambulance Cardiac Arrest Registry: 2016-2017 Annual Report. Ambulance Victoria, Doncater, Victoria.
3. Soar J, Nolan J, Bottiger B et al. (2015). European Resuscitation Council Guidelines for Resuscitation 2015 Section 3. Adult advanced life support. *Resuscitation*. 95: 100 – 147.
4. Benoit J, Gerecht R, Steuerwald M & McMullan J. (2015). Endotracheal intubation versus supraglottic airway placement in out-of-hospital cardiac arrest: A meta-analysis. *Resuscitation*. 93: 20 – 6.
5. Yeung K, Chilwan M, Field R et al. (2014). The impact of airway management on quality of cardiopulmonary resuscitation: an observational study in patients during cardiac arrest. *Resuscitation*. 85(7): 898-904.
6. Brouwer T, Walker R, Chapman F & Koster R. (2015). Association Between Chest Compression Interruptions and Clinical Outcomes of Ventricular Fibrillation Out-of-Hospital Cardiac Arrest. *Circulation*. 132(11): 1030-7.
7. Mader T, Coute R, Kellogg A & Jensen L. (2014). Restoring Coronary Perfusion Pressure before Defibrillation after Chest Compression Interruptions. *Open Journal of Emergency Medicine* 2: 29 – 35.
8. Wang H, Simeone S, Weaver M & Callaway C. (2009). Interruptions in Cardiopulmonary Resuscitation From Paramedic Endotracheal Intubation. *Annals of Emergency Medicine*. 54(5): 645 – 652.
1. [↑](#footnote-ref-1)