The Medical Journal of Australia – **Pre-print – 26 June 2020**

Efficacy of an enclosure to reduce aerosol exposure during simulated intubation

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Abstract:

Enclosures have been proposed as engineering controls to reduce droplet contamination during airway procedures. To investigate whether an enclosure would reduce aerosol exposure during laryngoscopy, we performed 90 simulated intubations on a resuscitation manikin. Saline was nebulised into the tracheostomy port of the manikin, and aerosol levels measured at the proceduralist's respirator. Median (range) change in aerosol count measured during intubation was greatly reduced when the enclosure was used 23ml-1 (-81 - 231) compared to 125 (-53 - 24,020), $p < 0.001$. An enclosure may reduce the chance of high level aerosol exposure occurring during intubation.

Introduction

Personal Protective Equipment (PPE) provided incomplete protection against the SARS 1 coronavirus.(1) In the safety hierarchy, engineering controls are considered more effective than PPE at reducing the risk of exposure to occupational hazards.(2) Enclosures have been proposed as protective controls during airway procedures.(3, 4) While they appear to effectively prevent droplet contamination, their ability to protect specifically against aerosols has not been quantitatively assessed. To investigate whether an enclosure would reduce aerosol exposure, we constructed a tent for intubation by covering a frame with a 1200mm x 1400mm clear plastic drape. We then used this tent during simulated intubations on a resuscitation manikin (Laerdal Medical, Stavanger, Norway).

Methods

Each author performed 30 intubations, via direct laryngoscopy, half conventionally and half with the manikin's head and upper torso covered by the tent (N=90). The method for each intubation was randomized. Intubations were performed under the laminar flow vent in an operating theatre measured to have 29 air changes per hour. Nebulized saline was piped into the tracheostomy port of the manikin, commencing immediately before laryngoscopy and ceasing when the endotracheal tube was inserted. We measured aerosol levels from the outside of the operator's respirator using the real time measurement mode of an AccuFIT9000™ (AccuTec-IHS Tulsa, Oklahoma). This device measures respirable particles in the range of 0.02 to 1µm. Readings were recorded on video and values for each one second interval later transcribed by a blinded observer. We waited until the ambient aerosol count was consistently less than 200 ml^{-1} before starting each test. Change in aerosol count during each procedure was calculated by averaging the values obtained during intubation and subtracting a three second averaged baseline level taken before intubation. The duration of intubation and change in average aerosol count from baseline were compared with a Mann-Whitney-U test.

Results

Median (IQR) change in aerosol counts during intubation was greatly reduced when the enclosure was used $23ml^{-1}$ (-19 - 98) compared to 125 (14 - 434), $p < 0.001$. In the conventional group, extreme values were seen when the operator moved their head closer to the manikin during intubation. The maximum value in this group was 100 times higher than when using the enclosure (Fig 1). Even if all values greater than $1000ml^{-1}$ are removed, the difference between groups is still statistically

significant p = 0.01. There was no difference in median (IQR) time to intubation 22s (20 - 25) compared with the conventional technique 21s (18 - 24), p = 0.18.

Discussion

Our data suggest that such an enclosure, which is readily improvised, may reduce the chance of high level aerosol exposure occurring during intubation. The protection provided was not complete and appropriate PPE should still be worn. Although we did not observe any of the difficulties that have been reported with a rigid enclosure,(5) the method is a departure from conventional practice and should be first attempted under controlled conditions.

References

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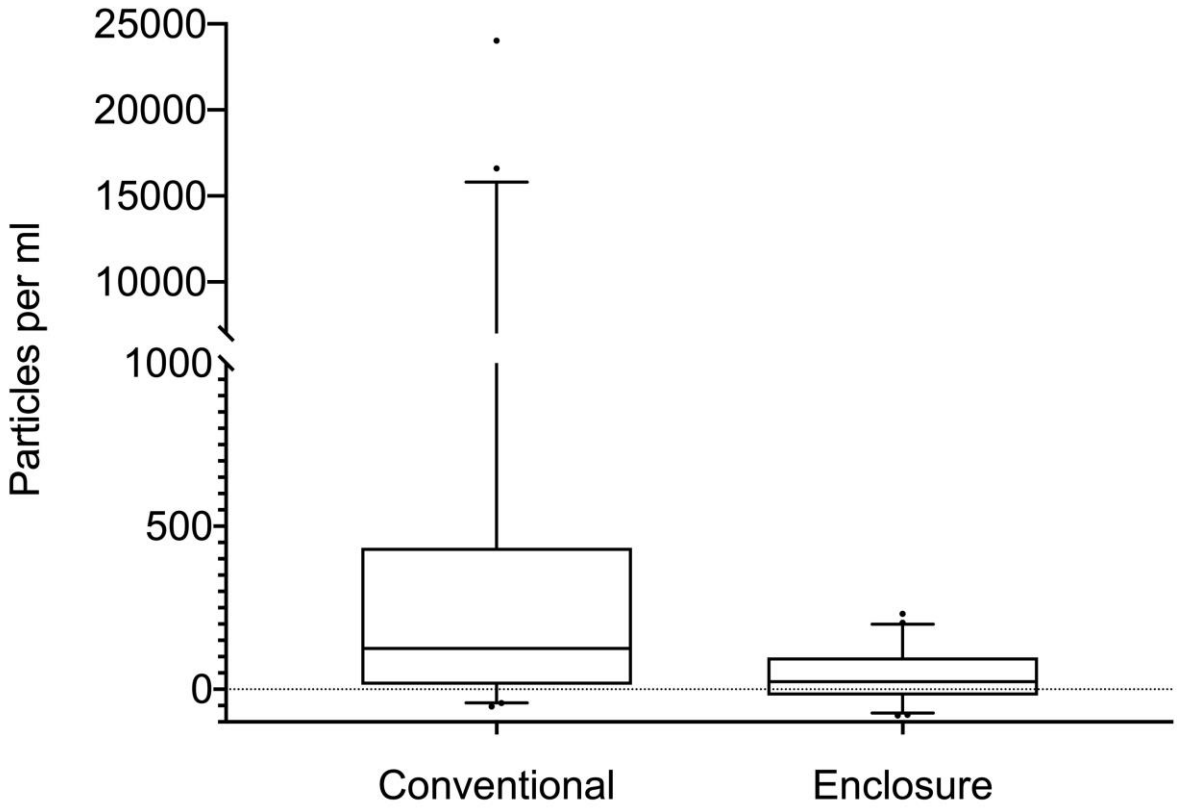

Rise in aerosol count at face level during intubation. Whiskers show the 5th and 95 centiles. The Y axis is broken because of the wide range in the conventional group.

Enclosure created with aluminium frame and clear plastic drape.