Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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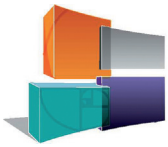

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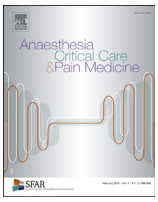

Letter to the Editor

Minimising COVID-19 exposure during tracheal intubation by using a transparent plastic box: A randomised prospective simulation study

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Personal protective equipment (PPE) was crucial for patient management in the context of this COVID-19 pandemic. As the availability of this equipment is lacking in many healthcare settings, new devices could be of a particular interest. Facing the high proportion of asymptomatic patients and the lack of data regarding the risk of transmission during tracheal intubation and extubation, implementing physical barriers to minimise the risk of healthcare workers exposure is urgent. To date, several expert recommendations and consensus have been published [1]. It is crucial that these new physical barriers do not impede tracheal intubation. Several devices fitted as an aerosol square box were tested during a simulated-cough tracheal intubation [2,3]. As no study has ever evaluated outcome and feasibility of intubation with droplets protection box, we compared tracheal intubation with and without a box using a mannequin-based simulated airway.

A cross-over trial was conducted at the department of Anaesthesia and Critical Care Medicine of the Henri Mondor University Hospital (Créteil, France) between April 25 and May 4, 2020. Included participants were anaesthesiology consultants, fellows, residents in anaesthesiology and intensive care medicine, and certified registered nurse anaesthetists. All participants were trained to tracheal intubation with the Macintosh laryngoscope but strictly naive to the use of the box.

An airway simulator mannequin (LAERDAL, AirMan™) was used to perform an airway management simulation in two scenarios. In scenario 1, the operator, dressed in standard PPE (gown, gloves, face mask, eye shield) stood at the head of an airway mannequin and performed the airway procedure, whereas in scenario 2, an additional DROPP-BOX was covering the mannequin's head. Each participant was invited to perform the two sequential procedures in a random order using direct laryngoscope (Macintosh™ blade, size 4). After performing each scenario, the participant was invited to answer a survey to evaluate the quality of the airway access and view through the box (Cormack-Lehane grading), as well as the ease for tracheal intubation on a scale from 0 (impossible) to 100 (very easy). The procedure was controlled and timed by an independent investigator.

The box designed in our study had a different shape than previous aerosol boxes, with a 30° rounded angulation in order to improve the visibility of the mannequin's head and to optimise the position of the operator during tracheal intubation. With this setting, the operator's head and line of vision for laryngoscopy were in a more optimal position without crossing the angle of the box. The box included two circular holes through which the clinician can introduce his/her hands to perform the airway procedure. Moreover, this design allowed the incorporation of waterproof protective oversleeves, in which the physician would introduce his/her gloved hands (Fig. 1).

The primary endpoint was the duration of the intubation, defined as the elapsed time between the moment when the operator was positioned at the head of the mannequin and the moment when effective bag mask ventilation through the tracheal tube was confirmed. Failed intubation was defined as the absence of successful tracheal tube placement or as oesophageal intubation.

Secondary endpoints included the quality of the laryngeal view using the Cormack-Lehane grade from 1 (full view of glottis) to 4 (neither the glottis nor the epiglottis can be seen), and the ease of tracheal intubation using a scale from 0 (impossible) to 100 (very easy).

First, we measured that the duration of conventional tracheal intubation was 50 seconds with this mannequin when performed by 10 expert physicians. Based upon this estimation, we hypothesised that the use of the box did not increase tracheal the duration of the intubation more than 25% compared to reference time. In accordance to a crossover study design, we calculated that 47 intubations in each group would be sufficient to prove our hypothesis with a 90% power at a two-sided significance test level of 0.05.

Data were expressed as median and interquartile range for quantitative variables. Data regarding tracheal intubation in scenario 1 and 2 were compared using a paired *t*-test or a Wilcoxon matched-pairs signed rank test, as appropriate. Statistics were performed using SPSS (Statistical Package for Social Science, IBM SPSS Statistics, USA). A P-value < 0.05 was considered statistically significant.

Forty-seven volunteers (17 senior anaesthesiology consultants, 4 fellows, 18 nurse anaesthetists, and 8 residents) were enrolled in the study.

Each participant performed tracheal intubation in both scenarios, with a total of 94 tracheal intubations. The median duration of tracheal intubation was higher in the box group (53 s

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Fig. 1. Incorporation of waterproof protective oversleeves in which the physician would introduce his/her gloved hands.

Table 1
Primary and secondary endpoints for intubation assessment.

Primary and secondary endpoints	Box group (n = 47)	Conventional group (n = 47)	*P*
Duration of intubation (s)	53 [45–61]	48 [44–54]	0.007
Intubation ease	80 [80–90]	90 [80–100]	0.004
Cormack-Lehane grade	1 [1]	1 [1]	0.75

Score of laryngeal view quality (Cormack-Lehane grading score) from 1 (full view of glottis) to 4 (neither the glottis nor the epiglottis can be seen), and the ease of tracheal intubation using a scale from 0 (impossible) to 100 (very easy). Data are reported as median and interquartile range or mean.

[45–61] *vs.* 48 s [44–54] in the conventional group, $P = 0.007$; mean difference 5 s, CI 95% [1 s; 9 s]). No tracheal intubation failure was observed. The Cormack-Lehane grading score was 1 or 2 and was not different between the two groups ($P = 0.75$). The overall appreciation of tracheal intubation ease was higher in the conventional group: 80 [80–90] in the box group, 90 [80–100] in the conventional group, $P = 0.004$ (Table 1).

Our study shows that using an easy-to-build and low-cost box slightly influences the duration of tracheal intubation in a mannequin scenario. It was also demonstrated that tracheal intubation was feasible with this device, with high levels of intubation quality and ease. Most of the participants were comfortable with the use of the box and only minor difficulties limiting the physicians' range of motion were reported.

It has been previously reported that droplets can be found on uncovered skin of participants after simulations of management of patients in respiratory distress [4]. This may strengthen the usefulness of our box, limiting dissemination of droplets, including in extreme emergency situations and in a teaching hospital.

In addition to being user-friendly, the DROPP-BOX is easily washable and reusable [5]. Herein, it could be included as an additional protection device into a bundle of barrier enclosure care to minimise healthcare workers exposure to virus transmission with aerosol droplets.

The increased duration of intubation, although not clinically relevant on a manikin study, may interfere with tracheal intubation in real situation. A randomised controlled study including patients is required to evaluate its translation to airway management prior to recommending its usefulness in clinical practice.

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Disclosure of interest

The authors declare that they have no competing interest.

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