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Developing a simulation programme to train airway management during the COVID-19 pandemic in a tertiary-level hospital

Heung Yan Wong , Craig Johnstone, Gunjeet Dua

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Anaesthesia, Guy's and St Thomas' NHS Foundation Trust, London, UK

Correspondence to

Dr Heung Yan Wong, Guy's and St Thomas' NHS Foundation Trust, London SE1 7EH, UK; heungyan.w@doctors.org.uk

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ABSTRACT

Tracheal intubation of a patient with COVID-19 is a high-risk procedure for not only the patient, but all healthcare workers involved, leading to an understandable degree of staff anxiety. We used simulation to help train airway managers to intubate patients with COVID-19. Based on action cards developed by our department, we designed a series of scenarios to simulate airway management during the COVID-19 pandemic. Teams were asked to perform a rapid sequence induction with tracheal intubation. We designed in situ scenarios with low-fidelity manikins that could be set up in operating theatres across multiple sites. Over a period of 4 weeks, 101 consultant anaesthetists, 58 anaesthetic trainees and 30 operating department practitioners received intubation training. These members made up the airway response team of our hospital. 30 emergency department doctors also received training in anticipation of further COVID-19 surges leading to the possibility of overwhelmed services. Simulation-based training was an invaluable tool for our hospital to rapidly upskill medical professionals during the first wave of the COVID-19 pandemic. We have used feedback and additional guidelines to improve our scenarios to retrain staff during subsequent waves.

INTRODUCTION

In March 2020, the COVID-19 pandemic was threatening to overwhelm our healthcare systems. In order to adapt to this burden, healthcare workers have had to rapidly mobilise and train staff to deal with unforeseen clinical scenarios. One of the main treatments for COVID-19 pneumonitis is invasive ventilation via tracheal intubation, and therefore airway management has been a key focus of training.

The WHO has advised that there is a high risk of airborne transmission of COVID-19 during aerosol-generating procedures such as tracheal intubation, suctioning and bag valve mask ventilation.¹⁻³ There has been a need to modify the way we perform rapid sequence inductions (RSIs) to minimise aerosolisation of respiratory particles. During the previous SARS-CoV-1 epidemic, healthcare workers made up 20% of all diagnosed cases.^{4,5} Understandably, there is therefore a high degree of staff anxiety around procedures that could potentially put themselves at risk of disease. In the UK, the most experienced airway manager is usually a senior anaesthetist. In order to ensure first pass success and minimise attempts at tracheal

intubation, the anaesthetic department of Guy's and St Thomas' National Health Service Foundation Trust took charge of developing guidelines, providing training and performing the vast majority of COVID-19 intubations in our hospital during the first wave of the pandemic.

Medical simulation training is an extremely useful resource that has been used to prepare healthcare workers for previous epidemics such as Middle East respiratory syndrome and Ebola.^{6,7} It allows for rapid upskilling of large numbers of healthcare staff. During high-risk procedures such as tracheal intubation, it also reduces the cognitive load of potentially stressed and fatigued members of staff.⁸ Specific to COVID-19, simulation allows airway managers to practise and make mistakes without risk of exposure to the disease itself. It also allows for feedback to participants and enables continuous evaluation of hospital systems and processes.

In mid-March 2020, we set up a series of simulation sessions to train a large number of doctors to intubate patients with COVID-19. This prepared them to go on to form our Mobile Emergency Rapid Intubation Teams (MERIT) which have, to date, intubated over 180 patients with COVID-19 since the start of the pandemic.

METHODS

Our aim was to develop a simulation programme which would train airway managers to perform tracheal intubation on patients with COVID-19. The scenarios were designed to be easy to set up in a clinical environment to allow in situ training in places such as operating theatres. The simulation session took place over approximately 1 hour, to minimise time spent away from clinical activities.

Development of simulation programme

In March 2020, a strategic team consisting of consultant anaesthetists with subspecialty experience in education, airway, governance and major incident leadership was formed and tasked with the production of consensus airway management guidelines and intubation action cards (online supplemental appendix 1) which were to be used to train and prepare anaesthetists for MERIT intubations. The guidelines and action cards were continuously modified and improved, reflecting the evolving nature of the pandemic, as various international guidelines on airway management were published.⁹



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Table 1 Equipment required for simulation training

Equipment categories	Equipment required
Plan A airway equipment	Endotracheal tube with subglottic port Tube tie Macintosh 3 and 4 direct laryngoscope 20 mL syringe (cuff inflation) Yankauer suction i-view video laryngoscope Airtraq video laryngoscope with attachable monitor Bougie Front of neck access kit: size 10 scalpel, size 6 endotracheal tube
Plan B airway equipment	I-gel Ambu aScope (slim) Aintree intubation catheter
Additional equipment	2× heat moisture exchange filter Tube clamp In-line suction catheter Anaesthetic machine/ventilator Monitoring including 3-lead ECG, oxygen saturations probe, non-invasive blood pressure
Personal protective equipment	FFP3 facemask Visor Long-sleeved gown Gloves
Simulation-specific equipment	Manikin with intubatable larynx Manikin to practise front of neck access

Faculty and participants

Consultant anaesthetists with experience in simulation-based education were recruited as trainers to deliver the simulation programme. The department's education and airway leads delivered an informal 'train the trainers' course to them, which was based on the intubation action cards. As the trainers were gradually redeployed to staff the MERIT rota, the responsibility of delivering the programme was later passed onto shielding anaesthetists who were unable to participate in frontline roles. They received a similar 'train the trainers' course.

The team members covering MERIT, including anaesthetic consultants, trainees and anaesthetic assistants, formed the initial participants of the programme. Later on, as the pandemic worsened, the strategic team anticipated that MERIT would struggle to cope with demand. As emergency department doctors are also frequently designated airway managers, MERIT training was rolled out in the emergency department.

It is important to note that all participants in MERIT training were fully competent in airway management prior to training and had ample experience in tracheal intubation. Our simulation training was focused on practising a process in order to increase first pass success and reduce aerosolisation of potentially infectious particles.

Equipment

A detailed list of equipment for MERIT training can be found in [table 1](#). Additionally, airway managers were familiarised with the i-view and Airtraq video laryngoscope as these were recommended by trust action cards as first-line laryngoscopy devices. Low-fidelity simulation was used to maximise the number of training sessions and the ability to do in situ training.¹⁰

Scenario design

Each scenario involved two facilitators, two doctors and two airway assistants. In the scenario, a patient had been transferred to theatre for intubation prior to intensive care unit (ICU)

admission. Participants had to prepare equipment and don personal protective equipment (PPE) in the anaesthetic room (designated as the 'cold' room) prior to entering theatre ('hot' room) and doff in a suitable area ('dirty room').

The teams were asked to perform an RSI with tracheal intubation of a manikin, and then to connect the patient to a ventilator (plan A, primary intubation). They were then asked to assume intubation had failed and to move onto plan B, secondary intubation. Following the scenario, participants were debriefed using the 'diamond' debriefing method.¹¹ They were asked for verbal feedback on the simulation session. A detailed run through of the simulation scenario can be found in online supplemental appendix 2. Additionally, a number of videos were produced which demonstrated the scenarios being taught.

In addition to the primary and secondary modes of intubation, participants were asked to refamiliarise themselves with emergency front of neck access in accordance with the Difficult Airway Society guidelines.¹² They were given the opportunity to practise a 'can't intubate, can't ventilate' scenario.

Organisation of training

In order to ensure that everyone was given the opportunity to attend MERIT simulation training, we arranged several in situ sessions in operating theatres, across multiple hospital sites, repeating daily and during various times of the day. We initially communicated time and location of training via email and instant messenger groups. Later on, our communications team emailed out a daily departmental newsletter, with a section detailing available training sessions for the following week. As elective operating was reduced due to the pandemic, more anaesthetic consultants were freed from clinical duties and were able to relieve their colleagues from operating lists to attend training.

RESULTS

MERIT simulation training started on 16 March 2020. Over a period of 4 weeks, 97% of the anaesthetists in the trust received MERIT intubation training. This consisted of 101 consultant anaesthetists and 58 anaesthetic trainees. Thirty operating department practitioners also received MERIT training. This was in addition to other simulation sessions set up by the anaesthetic department which included donning and doffing PPE, ICU upskilling and obstetric simulation. [Figure 1](#) shows a timeline of some of the training sessions that were set up over the months of March and April 2020. After extending training to the emergency department team, 30 of their senior doctors also took part in MERIT simulation.

We identified a number of active failures and latent hazards during our scenarios, summarised in [table 2](#). Technical difficulties included turning oxygen flows down and clamping the endotracheal tube before disconnection of the circuit. Non-technical difficulties were mainly centred around communication while wearing PPE. Participants found that 'active listening' and repeating instructions were useful in ensuring that communication was effective.

DISCUSSION

Under the threat of the impending pandemic, our department collaborated to deliver training to around 200 members of the team. The use of simulation helped alleviate some of the fears of the unknown and provided a safe space to ask questions and make mistakes.

Despite our success in setting up MERIT intubation training, we have also reflected on some difficulties faced and limitations

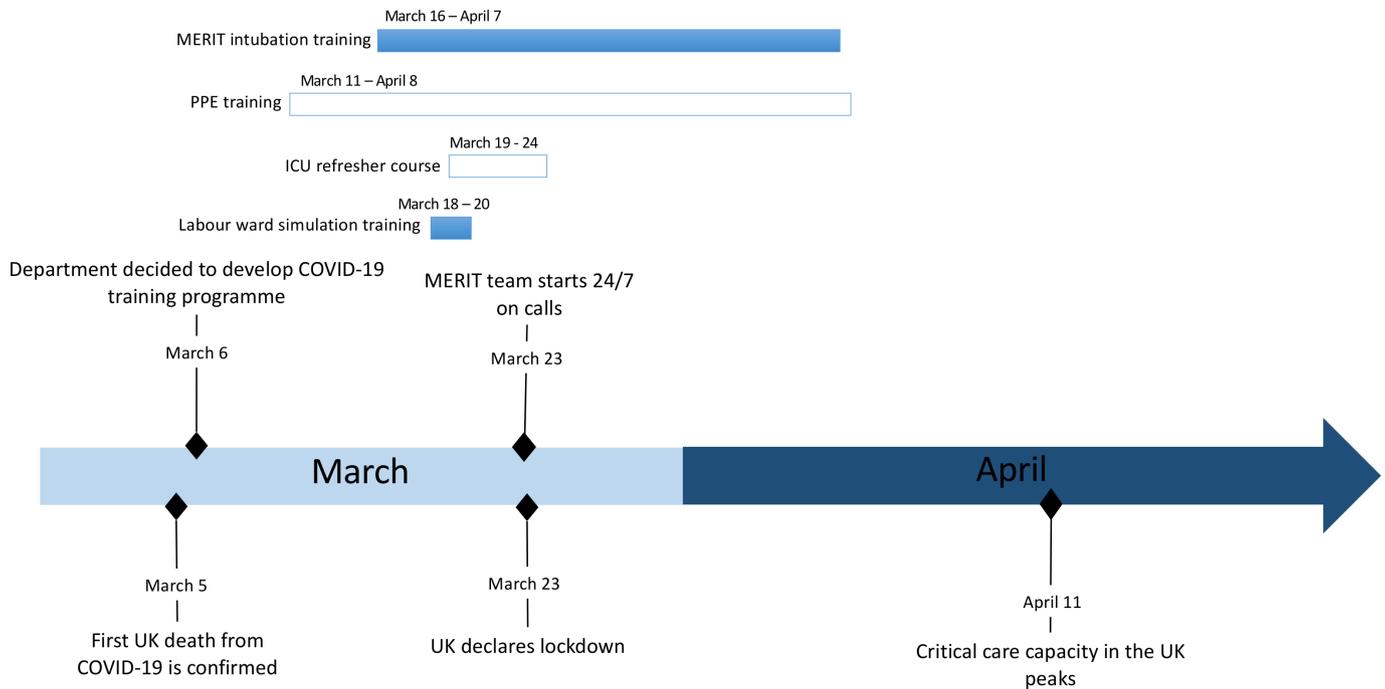


Figure 1 Timeline of training events during COVID-19 pandemic. ICU, intensive care unit; MERIT, Mobile Emergency Rapid Intubation Teams; PPE, personal protective equipment.

of our simulation programme. COVID-19 was an entirely new disease to us and a key issue we faced was that guidelines regarding airway management changed continuously. We were also given regular feedback from MERIT as clinical experience in COVID-19 intubations increased. Adapting our scenarios became a dynamic process throughout the 4 weeks of training. Second, we recognise that teaching a group of airway experts in relatively basic airway management may be difficult. We had to encourage each other to try and put aside our own ingrained behaviour to learn the MERIT method of intubation. We were continuously reminded that we were training a process, rather than a new skill.

We feel that our report on MERIT training adds to and expands on existing literature detailing use of simulation to deliver training for the COVID-19 pandemic. An earlier paper from March of this year depicts the use of simulation to drill various ICU scenarios, including tracheal intubation.¹³ A short report has recently been published depicting use of in situ simulation to train critical care staff.¹⁴ The authors look forward to further papers detailing the use of simulation for medical education during the pandemic.

CONCLUSION

This paper aims to share our experience of COVID-19 airway training with our counterparts across the world, to ensure that

Table 2 Summary of common pitfalls seen during COVID-19 intubation simulations

Active failures	Corrections made
Failure to ensure appropriate equipment has been brought into the room, therefore increasing interaction between 'cold' room and 'hot' room	Going through action cards to ensure adequate equipment available but not excessive
Forgetting to bring MERIT intubation action cards into 'hot' room	Ensuring action cards available for reference in 'hot' room
Failure to achieve a good seal during pre-oxygenation, increasing risk of aerosol generation due to high-flow oxygen	Two-hand technique for pre-oxygenation
Failure to turn the flow of oxygen down following pre-oxygenation and back on following intubation	Second anaesthetist to turn flow of oxygen on and off to reduce cognitive load of intubator
Not clamping the endotracheal tube in between disconnections, increasing risk of aerosol generation	Anaesthetic assistant to remind anaesthetist of use of clamp, verbal confirmation prior to circuit disconnection
Difficulty hearing other members of the team	Ensuring communication is loud and clear, use of active listening techniques
Failure to undergo adequate planning in 'cold' room, ensuring every member of anaesthetic team is aware of plan	Participants to go through intubation action cards and ensure all participants adequately briefed prior to entry into 'hot' room
Latent hazards	
Equipment list missing in-line suction as part of circuit	Change to action cards, attachment of in-line suction device reduces disconnections required for tracheal suction
ICU tube ties unavailable in theatres	ICU tube ties made available to MERIT team so endotracheal tubes did not need retying by ICU nursing staff
Doffing area in 'hot' room not clearly demarcated	Departments and teams asked to clearly demarcate doffing areas in 'hot' room to ensure teams were aware and did not risk contamination

ICU, intensive care unit; MERIT, Mobile Emergency Rapid Intubation Teams.

all healthcare workers are well equipped to face this unprecedented challenge. Following the first wave, we re-evaluated and reflected on lessons learnt and adapted training to prepare for future surges. We will continue to deliver high-quality medical education which enables staff to safely treat patients while maintaining personal protection.

Twitter Craig Johnstone @C_Johnstone1980

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ORCID iD

Heung Yan Wong <http://orcid.org/0000-0003-0009-1806>

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