EDITORIAL

COVID-19 and Risks Posed to Personnel During Endotracheal Intubation

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Health care personnel who care for critically ill patients with suspected or confirmed novel coronavirus disease 2019 (COVID-19) routinely participate in procedures, such as endotracheal intubation, that may create infectious aerosols. Among persons infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes COVID-19, approximately 8% will require endotracheal intubation and mechanical ventilation.[1]

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Aerosol-generating procedures have been described as "…procedures performed on patients [that] are more likely to generate higher concentrations of infectious respiratory aerosols than coughing, sneezing, talking, or breathing."[2] Health Protection Scotland defines aerosol-generating procedures "as medical and patient care procedures that result in the production of airborne particles (aerosols) that create the potential for airborne transmission of infections that may otherwise only be transmissible by the droplet route."[3] Although there is no generally accepted and comprehensive list of aerosol-generating procedures performed during clinical care, examples include open suctioning of airways, sputum induction, manual ventilation, endotracheal intubation and extubation, noninvasive ventilation, bronchoscopy, and tracheotomy.[4] There is great interest in understanding the hazards posed by the range of potentially hazardous aerosol-generating procedures for the transmission of COVID-19 and other infectious diseases.

Among the aerosol-generating procedures, performing endotracheal intubation is especially hazardous. The proceduralist performing endotracheal intubation is close to the patient's airway before, during, and after the procedure. The proceduralist is also likely to be present for the associated interventions that create respiratory aerosols, such as manual (bag) ventilation. A systematic literature review and meta-analysis that evaluated transmission of SARS coronavirus 1 (SARS-CoV-1) to health care personnel in association with exposure to aerosol-generating procedures found a significantly increased odds ratio of 6.6.[5] This review also found an absolute risk increase of between 10% (cohort studies) and 15% (case-control studies) for transmission of SARS-CoV-1–associated infection to health care personnel performing intubation.[5] In addition, several other types of aerosol-generating procedures were also associated with increased risk for SARS-CoV-1, including tracheotomy, noninvasive ventilation, and manual ventilation prior to intubation.[5] However, tracheal intubation was the procedure most consistently associated with transmission across the studies reviewed. Given that high viral loads of SARS-CoV-2 are found in sputum and upper respiratory secretions of patients with COVID-19, endotracheal intubation should also be viewed as a high-risk procedure for exposure to and transmission of SARS-CoV-2.[6]

In this issue of *JAMA*, Feldman et al[7] reported the results of 2 simulations of endotracheal intubation using a fluorescent marker to visualize deposition of simulated exhaled respiratory secretions and material from the body surfaces of adult and pediatric manikins onto health care personnel performing or assisting in endotracheal intubation procedures. Personnel wore N95 respirators, eye protection, isolation gowns, and gloves. After the procedures, the investigators found fluorescent markers on the uncovered facial skin, hair, and shoes of the health care personnel performing the intubations. The authors concluded that the ensemble of personal protective equipment (PPE) used in the simulation may not fully prevent exposure of personnel performing endotracheal intubation in emergency department settings, although they acknowledged uncertainty about how generalizable the manikin studies are to intubations in actual patients.

Several groups have developed guidance specific to protecting health care personnel involved in performing intubation procedures.[6,8,9] In all cases, the guidance includes a comprehensive set of interventions, including elimination or substitution (eg, avoiding elective intubations of patients with COVID-19), engineering controls (eg, using intubation boxes as barriers to droplet spray, using antiviral filters between the face mask and the manual ventilation device, and performing procedures in airborne infection isolation rooms), administrative controls (eg, only essential personnel present during the procedures, and cleaning and disinfection of the room after the procedure), and use of PPE. Thus, the use of PPE is important, but it is only 1 part of the protective interventions that should be implemented to protect personnel who perform intubations. Published recommendations specifically focused on intubation include a UK consensus statement[6] that notes the following about PPE: "General principles are that it should be simple to remove after use without contaminating the user and complex systems should be avoided. It should cover the whole upper body. It should be disposable whenever possible.…Airborne precaution PPE is the minimal appropriate for all airway management of patients with known COVID-19 or those being managed as if they are infected."

An Australian consensus statement recommends that at a minimum PPE should include "Impervious gown, theatre hat, N95 mask, face shield and eye protection, consider double gloves."[8] The Chinese Society of Anesthesiology Task Force on Airway Management recommends "…fit-tested N95 masks, hair cover, protective coverall, gown, gloves, face shields and goggles, shoe covers. If available, medical protective head hood or powered air purifying respirator should be used. Goggles and glasses need to be prepared for anti-fog."[9] Recommendations from the US Centers for Disease Control and Prevention[10] and the World Health Organization[11] cover a wide range of aerosol-generating

procedures as opposed to being targeted specifically to endotracheal intubation. The PPE recommendations from the 2 organizations are similar, stating that those involved in aerosol-generating procedures wear an N95 or higher level respirator, eye protection, gloves, and a gown. This ensemble protects the surfaces where SARS-CoV-2 initiates infection (eyes, upper and lower respiratory tract) from the direct effects of droplet sprays and small particle aerosols.

As suggested in the study by Feldman et al,[7] droplet sprays and aerosols can be deposited on uncovered sites such as skin on the face and neck; however, SARS-CoV-2 is not able to initiate infection at those sites. Infective material may be deposited into the susceptible tissues of the eyes, nose, or mouth via mechanisms such as hand transfer (ie, self-inoculation). This underscores the importance of maintaining consistent adherence to hand hygiene, including after removal of PPE. As part of standard precautions, any procedure that can be expected to generate splashes or sprays of infectious material should be performed using appropriate barriers to protect the operator (eg, a face shield that provides reliable protection from splashes from either side and below). Loose-fitting powered air-purifying respirators provide both high-level respiratory protection,[12] as well as extensive facial and hair covering, and could be an effective and convenient alternative.

In addition, powered air-purifying respirators do not require fit testing and can be repeatedly disinfected and redonned.[13] Any time skin or clothes become perceptibly contaminated with blood or body secretions during a procedure, the skin and hair should be cleaned with soap and water and clothes changed as soon as is feasible. Health care personnel should not wear soiled scrubs home from work.

COVID-19 has only been recognized as a disease for a few months, and much work is still needed to improve and refine protective efforts. Improved rapid identification of patients with COVID-19[14] could help to ensure that protective precautions are used whenever needed and PPE is appropriately conserved during supply-chain shortages. Improved engineering controls providing barrier protection against droplet sprays and protection against small airborne particles generated during intubation procedures would be especially valuable. Identifying biomarkers of protective immunity to SARS-CoV-2 acquired in response to natural infection, or in the future, vaccination, might enable the administrative control of assigning individuals at lower risk for infection acquisition to selectively perform procedures associated with higher risks of exposure, such as intubation of patients with COVID-19.

Fundamental research is needed to better inform PPE recommendations. For example, it would be useful to know how long SARS-CoV-2 can remain infective on surfaces such as the skin, hair, and clothing, and the potential for contact transmission from those sites to guide recommendations for barrier protection. A better understanding of the duration of infectivity and level of risk posed by airborne SARS-CoV-2 would help to guide recommendations for respiratory protection. Much can be done to protect health care personnel performing endotracheal intubations from procedure-related transmission of COVID-19. Individuals who perform this life-saving procedure must be able to do it as safely as possible.

ARTICLE INFORMATION

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