

CRITICAL CARE GUIDANCE FOR TRACHEOSTOMY CARE DURING THE COVID-19 PANDEMIC: A GLOBAL, MULTIDISCIPLINARY APPROACH

By Vinciya Pandian, PhD, MBA, MSN, APN, RN, ACNP-BC, Linda L. Morris, PhD, APN, CCNS, Martin B. Brodsky, PhD, ScM, CCC-SLP, James Lynch, MSc Nursing, Brian Walsh, PhD, RRT, Cynda Rushton, PhD, MSN, RN, Jane Phillips, PhD, RN, Alphonsa Rahman, DNP, APRN, CNS, Troy DeRose, MSN, CRNP, RNFA, CORLN, Leah Lambe, BSN, RN, CEN, Lionel Lami, RN, Sarah Pui Man Wu, MN, RN, Francisco Paredes Garza, RN, Simona Maiani, RN, Andrea Zavalis, RN, Kafilat Ajoke Okusanya, NRN, NRM, NRICN, BSc Nursing, Patrick A. Palmieri, DHSc, DPhil(Hon.), EdS, PGDip(Oxon), MBA, MSN, ACNP, RN, CPHRM, CPHQ, Brendan A. McGrath, MBChB, PhD, Paolo Pelosi, MD, Mary Lou Sole, PhD, CCNS, CNL, RN, Patricia Davidson, PhD, MEd, RN, and Michael J. Brenner, MD

Purpose Critical care nurses caring for patients with a tracheostomy are at high risk because of the predilection of SARS-CoV-2 for respiratory and mucosal surfaces. This review identifies patient-centered practices that ensure safety and reduce risk of infection transmission to health care workers during the coronavirus disease 2019 (COVID-19) pandemic.

Methods Consensus statements, guidelines, institutional recommendations, and scientific literature on COVID-19 and previous outbreaks were reviewed. A global interdisciplinary team analyzed and prioritized findings via electronic communications and video conferences to develop consensus recommendations.

Results Aerosol-generating procedures are commonly performed by nurses and other health care workers, most notably during suctioning, tracheostomy tube changes, and stoma care. Patient repositioning, readjusting circuits, administering nebulized medications, and patient transport also present risks. Standard personal protective equipment includes an N95/FFP3 mask with or without surgical masks, gloves, goggles, and gown when performing aerosol-generating procedures for patients with known or suspected COVID-19. Viral testing of bronchial aspirate via tracheostomy may inform care providers when determining the protective equipment required. The need for protocols to reduce risk of transmission of infection to nurses and other health care workers is evident.

Conclusion Critical care nurses and multidisciplinary teams often care for patients with a tracheostomy who are known or suspected to have COVID-19. Appropriate care of these patients relies on safeguarding the health care team. The practices described in this review may greatly reduce risk of infectious transmission. (*American Journal of Critical Care*. 2020;29:e1-e12)

The coronavirus disease 2019 (COVID-19) pandemic coincides with the culmination of the World Health Organization Nursing Now Campaign¹ and the bicentennial of Florence Nightingale's birth.²⁻⁵ The timing is significant because critical care nurses at the forefront of life-saving efforts are also at risk for infection with SARS-CoV-2 during tracheostomy care.^{6,7} High risks of

viral aerosolization attend both the tracheostomy procedure in patients receiving invasive mechanical ventilation and the subsequent tracheostomy management during weaning and after liberation from the ventilator.^{8,9} Therefore, it is important for nurses and other providers caring for patients to protect themselves from harm.¹⁰ In this article, we summarize current evidence on caring for patients with a tracheostomy, outlining state-of-the-art consensus guidance while also acknowledging the challenges inherent in providing such care in low-resource health systems.¹¹

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About the Authors

Vinciya Pandian is associate professor, Department of Nursing Faculty, and Outcomes After Critical Illness and Surgery (OACIS) Research Group, Johns Hopkins University, Baltimore, Maryland. **Linda L. Morris** is associate professor, Northwestern University Feinberg School of Medicine; Shirley Ryan AbilityLab, Chicago, Illinois. **Martin B. Brodsky** is associate professor, Department of Physical and Rehabilitation, Division of Critical Care and Pulmonary and OACIS Research Group, Johns Hopkins University. **James Lynch** is advanced critical care practitioner, Acute Intensive Care Unit, Manchester University National Health Services Foundation Trust, and National Tracheostomy Safety Project, Manchester, United Kingdom. **Brian Walsh** is professor, Department of Health Sciences, Liberty University, Lynchburg, Virginia. **Cynda Rushton** is professor, Johns Hopkins University Anne and George L. Bunting Berman Institute of Bioethics, Department of Nursing Faculty, Johns Hopkins School of Nursing, and Department of Pediatrics, Johns Hopkins School of Medicine; and adjunct professor, University of Technology of Sydney, Sydney, New South Wales, Australia. **Jane Phillips** is professor of Palliative Nursing, and director IMPACCT, University of Technology Sydney. **Alphonsa Rahman** is critical care clinical nurse specialist, The Johns Hopkins Hospital, Baltimore, Maryland. **Troy DeRose** is nurse practitioner, Thomas Jefferson University Hospital, Philadelphia, Pennsylvania. **Leah Lambe** is nursing clinical coordinator, Rapid Response Team, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania. **Lionel Lami**, University of Hospital of Toulouse, and University Cancer Institute of Toulouse Oncopole, Toulouse, France. **Sarah Pui Man Wu**, advance practice nurse, Department of Otolaryngology, Head and Neck Surgery, Chinese University of Hong Kong, Hong Kong. **Francisco Paredes Garza** is critical care nurse, Hospital Universitario La Paz, Madrid, Spain. **Simona Maiani** is head nurse, Anesthesiology and Intensive Care, San Martino Policlinico Hospital, and IRCCS for Oncology and Neurosciences, Genoa, Italy. **Andrea Zavalis** is critical care nurse, Enfermeira Intensivista, Manaus, Brazil. **Kafilat Ajoke Okusanya** is critical care nurse, Lagos University Teaching Hospital, Lagos, Nigeria. **Patrick A. Palmieri** is vice chancellor for research, Universidad Norbert Wiener; and director of Centro de Salud Basada en Evidencia de Sudamérica: A Joanna Briggs Affiliated Group, Lima, Perú. **Brendan A. McGrath** is anesthesiology consultant, University of Manchester, National Health Service Foundation Trust, National Tracheostomy Safety Project, Manchester, United Kingdom. **Paolo Pelosi** is with Anesthesiology and Intensive Care, San Martino Policlinico Hospital, IRCCS for Oncology and Neurosciences, University of Genoa, Genoa, Italy. **Mary Lou Sole** is dean of College of Nursing, Orlando Health Endowed Chair in Nursing, and University of Central Florida Pegasus Professor, University of Central Florida, Orlando, Florida. **Patricia Davidson** is professor and dean, Department of Nursing Faculty, Johns Hopkins University. **Michael J. Brenner** is associate professor, Department of Otolaryngology – Head & Neck Surgery, University of Michigan, Ann Arbor, Michigan; president, Global Tracheostomy Collaborative, Raleigh, North Carolina.

Corresponding author: Vinciya Pandian, PhD, MBA, MSN, RN, ACNP-BC, Johns Hopkins School of Nursing, 525 N Wolfe St, Baltimore, MD 21205. (email: vpandia1@jhu.edu.)

Methods

A search for relevant studies was conducted in the PubMed, CINAHL Plus, Embase, PsycINFO, and Scopus databases. Keywords included *coronavirus*, *COVID-19*, *SARS-CoV-2*, *SARS*, *MERS*, *tracheostomy*, *tracheotomy*, *nursing*, *ventilator*, and *critical care*. Studies were included if they assessed aerosol-generating procedures or tracheostomy and were published in English between January 1 and May 31, 2020, to coincide with the COVID-19 pandemic. The internet (Google and Google Scholar search engines) and gray literature were also searched for recent evidence and expert opinions in the forms of national and global guidance. Content experts in tracheostomy from various disciplines, including nursing, anesthesia and critical care, surgery, respiratory therapy, and speech-language pathology from different continents, were identified, with increased representation from nursing in the areas of critical care and otolaryngology. Contributors reviewed content and quality of the studies independently; discrepancies were adjudicated through iterative discussion via email, phone, and video conference until consensus was reached. Key concepts related to tracheostomy included timing and location for procedure, tracheostomy tube sizing and type, cuff management, humidification, tracheostomy tube and stoma care, suctioning, nebulization, positioning, tube changes, transportation, speech, rehabilitation, decannulation, resuscitation, and ethical considerations.

Transmission, Pathogenesis, and Clinical Course of COVID-19

The high infectivity of SARS-CoV-2 is evident in the global spread of infection.^{12,13} SARS-CoV-2 is primarily transmitted through droplets generated by speech, coughing, and sneezing but may be found in blood, feces, urine, and semen.¹³⁻¹⁶ The pathogenesis of severe COVID-19 involves several steps. SARS-CoV-2 enters the respiratory tract, causes respiratory cells to lyse, and infects nearby cells, initiating a cytokine storm. Activated neutrophils release interleukins (namely, interleukin-2, -7, and -10), leukotrienes, platelet-activating factors, oxidants, proteases, and tumor necrosis factor- α .¹⁷ These factors, in turn, increase alveolar-capillary membrane permeability, allowing fluid to leak into alveolar sacs and preventing gas exchange, resulting in hypoxemia and bilateral infiltrates (ie, interstitial pneumonitis). Patients

“Nurses and others assisting in the procedure should wear a fit-tested N95 mask, powered air-purifying respirator, or equivalent (filtering facepiece 3 [FFP3]) with or without a surgical mask and face shield.”

typically present with fever, shortness of breath, cough, and fatigue. When patients' illness progresses to acute respiratory distress syndrome, mechanical ventilation is required, sometimes necessitating tracheostomy, and some patients will experience ensuing progressive multiple organ dysfunction.¹⁷⁻²⁰

Considerations While Caring for a Patient With a Tracheostomy

Timing of a Tracheostomy

Patients critically ill with COVID-19 often require prolonged ventilatory support and are at risk of critical illness myopathy and neuropathy, requiring prolonged weaning and rehabilitation via tracheostomy.^{17-19,21,22} The timing of tracheostomy is controversial because the virus, even when inert and unable to grow in culture, may be amplified beyond 30 days (range, 8-37 days; median, 20 days; interquartile range, 17-24 days).^{22,23} Waiting until viral loads decrease may reduce risk to health care workers²⁴; however, such delays also present challenges. Prolonged deferral of tracheostomy when clinically indicated limits pulmonary hygiene, impedes efforts to decrease sedation, and may predispose to cognitive impairments or nosocomial complications, in addition to exacerbating the strain on intensive care unit bed capacity.²⁵ Prolonged intubation also interferes with normal voice and swallowing functions, as well as predisposing to laryngeal injuries, such as posterior glottis injury or subglottic stenosis.²⁶ Early in the pandemic, Takhar et al²⁷ observed that many patients positive for COVID-19 were extubated within 5 to 10 days after intubation. Building on this observation and integrating subsequent evidence, a multinational work group with expertise in nursing critical care, pulmonary, anesthesiology, intensive care medicine, otolaryngology, virology, and infectious disease partnered with medical ethicists and patient and family stakeholders. After evaluating clinical data and the timeline of SARS-CoV-2 viral load and immune response, this broad-based team arrived at a recommendation of 10 to 21 days postintubation for tracheostomy.²⁸

Setting Where Procedure Performed

Tracheostomy for patients requiring prolonged mechanical ventilation is performed in the operating

room or at the bedside in intensive care units. The safety risk of transmission while transporting patients positive for COVID-19 to operating rooms must be considered.^{29,30} Procedures are ideally performed by experienced specialists in negative-pressure rooms equipped with high-efficiency particulate air filter using time-out and checklists (Appendix).³¹⁻³⁷ For patients negative for COVID-19, considerations of acuity and presence of a difficult airway may influence location. Experience from the 2003 era of severe acute respiratory syndrome favored an open surgical technique out of concern for aerosolization during bronchoscopy; however, percutaneous techniques have progressed significantly, and there currently are no data indicating superior safety profile with open versus percutaneous techniques.^{28,38}

Preparing for a Tracheostomy

Regardless of the procedure technique or location, tracheostomy is a high-risk, aerosol-generating procedure; therefore, nurses and others assisting in the procedure should wear a fit-tested N95 mask, powered air-purifying respirator, or equivalent (filtering facepiece 3 [FFP3]) with or without a surgical mask and face shield.^{24,36,39,40} A trained health care professional should monitor donning and doffing for quality assurance.⁴¹ Meticulous collection of equipment (Appendix) is crucial to avoid multiple re-entries into procedure areas and unnecessary donning and doffing of personal protective equipment (PPE) (see Table).⁴² A dry run with the operating team before the procedure (using simulation centers,⁴³ if available) clarifies all team members' roles, responsibilities, and technique, with a senior operator performing the procedure to ensure efficiency and minimize exposure.^{24,44-47}

Size and Type of Initial Tracheostomy Tube

The size of the initial tracheostomy tube is chosen on the basis of several factors: the patient's airway anatomy, the need to facilitate early phonation, and the risk for development of granulation tissue. Selection of a tube of the appropriate size is particularly important during COVID-19 to create a smaller stoma to reduce aerosolization,⁴⁴ facilitate bronchial hygiene,²⁷ reduce tracheostomy tube changes, and minimize ventilator leak around the cuff. A computed tomographic

“ A closed suction-circuit system reduces expulsion of aerosolized viral particles from positive-pressure ventilation. ”

Table
Personal protective equipment and clinical considerations for tracheostomy care

Preprocedure	Intraprocedure	Postprocedure
Tracheostomy suctioning		
N95 mask or equivalent ± Surgical masks Gloves Goggles or face shield	Remove HME before suctioning (if present) Maintain closed suction system Replace viral filters every 8 h Create a closed suction system with T-piece and viral filters on both ends ^a	Doff PPE properly Perform hand hygiene Apply HME (if no inline suction)
Tracheostomy tube change		
Collect tube of same size and 1 size smaller N95 mask or equivalent ± Surgical masks Gloves Goggles or face shield	Remove HME (if present) Pause ventilator prior to cuff deflation and inserting a new tube Identify an extra person for backup in case of difficulty reinserting the tube ^a	Doff PPE properly Perform hand hygiene Apply HME (if no in-line suction)
Facilitation of speech		
N95 mask or equivalent ± Surgical masks Gloves Goggles or face shield Remove HME (if present)	Place surgical mask on patient's face if patient is receiving mechanical ventilation Deflate cuff if inflated Apply one-way speaking valve Maintain AAC devices on hand Consider the need for an interpreter Engage family/caregivers (use technology if visitation not permitted)	Doff PPE properly Perform hand hygiene
Transportation		
N95 mask or equivalent ± Surgical masks Gloves Goggles or face shield If cuffed, inflate cuff	Maintain closed-circuit system Place a surgical mask on face and tracheostomy of the patient	Deflate cuff if appropriate Doff PPE properly Perform hand hygiene
Decannulation		
Downsize and change to cuffless Capping trial N95 mask or equivalent ± Surgical masks Gloves Goggles or face shield Await PCR/antibody testing if COVID-19 positive	Place surgical mask on patient's face because coughing is anticipated	Pressure dressing Educate patient to place finger on the dressing when speaking and coughing Doff PPE properly Perform hand hygiene
Abbreviations: AAC, alternative and augmentative communication; COVID-19, coronavirus disease 2019; HME, heat moisture exchanger; PCR, polymerase chain reaction; PPE, personal protective equipment.		
^a Avoid cuff deflation if possible.		

scan of the neck or chest provides measurement distance from skin to cricoid cartilage, aiding tube selection. If distance from skin to cricoid cartilage is greater than 4 cm, an extended-length tracheostomy tube may decrease need for additional tracheostomy tube changes.⁴⁸ Ultrasound can also aid evaluation of anatomy and be useful during the

procedure.⁴⁹ Disposable inner-cannula tubes allow easier maintenance and decrease prolonged exposure to viral particles.²⁸

Tracheostomy Tube Cuff Management

Tracheostomy tube cuff pressures are typically maintained between 20 and 30 cm H₂O but may be

“ A surgical mask is placed on the face and over the tracheostomy tube to reduce the potential for viral spread via respiratory droplets. ”

slightly increased to obtain a better seal,^{28,50} bearing in mind that daily duties such as in-bed bathing and raising the head of the bed to 30° may alter pressures.⁵¹ Low pressure increases the risk of microaspiration of upper airway secretions, leading to ventilator-associated pneumonia as well as aerosol-generating ventilation leak. Risk of tracheal stenosis, tracheomalacia, or tracheal necrosis developing increases with higher cuff pressures.⁵² Therefore, cuff pressure should be checked at least once per shift. Using minimum occlusion volume or minimal leak techniques, which are often used in low-resource settings, is discouraged because of aerosol generation. If these techniques are used in the absence of a manometer, then the clinician should wear an N95 (FFP3) mask or equivalent, gloves, goggles, and a face shield, and the patient should wear a surgical mask.

Humidification

Because the tracheostomy bypasses the upper airway's humidification, the standard of care is to ensure humidification. In patients with COVID-19, certain humidification devices should be used with caution, however. To minimize risk of viral particles being sprayed, use of pressurized cooled or heated aerosols is discouraged.^{28,53} Humidification is best provided by either an active (heated) pass-over humidifier with a bacterial and viral filter on the exhaust limb or port or a heat and moisture exchanger (HME) with built-in filter, if available.⁵⁴⁻⁵⁷ Most HMEs are not equipped with filters to prevent transmission of viral particles. Therefore, when caring for patients with a tracheostomy, health care workers should be alerted to this common limitation and take precautions to minimize risk of viral exposure.⁵⁸ The patient's hydration status and need for enteral mucolytic agents should also be assessed to minimize risk of occlusion from tenacious secretions.

Tracheostomy Tube Care

Cleaning stomas, dressing changes, cleaning or changing the inner cannula, and changing tracheostomy ties may all expose nurses to aerosolized particles. Therefore, performing these procedures on the basis of patient need is preferable to performing them at routine, scheduled intervals.^{53,54} Secretions of patients infected with COVID-19 may be of high volume, however, thus contributing to stomal inflammation and overall viral load if not carefully monitored. Careful

assessment of the stoma site using an interdisciplinary care protocol, therefore, is imperative.⁵⁹ Patency of tracheostomy tubes is confirmed by passing inline suction through a closed circuit, ensuring that the suction catheter passes freely beyond the distal tip of the tracheostomy tube without sticking or blockage.

Tracheostomy Suctioning: Closed Versus Open Circuit

For patients receiving mechanical ventilatory support, a closed suction-circuit system (Figure 1A) reduces expulsion of aerosolized viral particles from positive-pressure ventilation.^{54,55,60} If the patient does not require mechanical ventilation, a T-piece using an HME with expiratory filter may be used to maintain a closed system (Figure 1B).^{61,62} Suctioning requirements are usually increased during the first 48 hours after tracheostomy.⁶³ Saline instillation is used sparingly or even avoided to prevent aerosolization and water-logging of the HME in the ventilator circuit.^{64,65} Nurses need to assess suctioning needs and communicate with physicians or advanced practice providers to ensure appropriate orders for safe treatment of patients.

Inhaled Medication Administration

Administering medications via nebulizer through tracheostomy collars generates even more aerosol than most other aerosol-generating procedures (Figure 2).⁶⁷⁻⁶⁹ Nebulized medication delivery is discouraged because it causes sideways leakage of exhaled air, and dispersion distance increases with lung injury. Dispersion distance is 45 cm in the normal lung, 54 cm in mild lung injury, and 80 cm in severe lung injury.⁷⁰ Vibrating mesh nebulizers that do not require disconnection of ventilator circuits are preferred for administering medications.⁷¹ Metered-dose inhalation is best administered via a spacer attached directly to the tracheostomy tube in patients not receiving mechanical ventilatory support or via ventilator circuit in those who are (Figure 2).^{66,71-81}

Managing the Tracheostomy During Proning

COVID-19 acute respiratory distress syndrome involves a vascular injury; disrupted vasoregulation may influence critical care strategy. Prone ventilation⁸² improves oxygenation and reduces lung atelectasis⁸³ but introduces unique new challenges.⁸⁴ Prone positioning is an effective intervention for acute respiratory

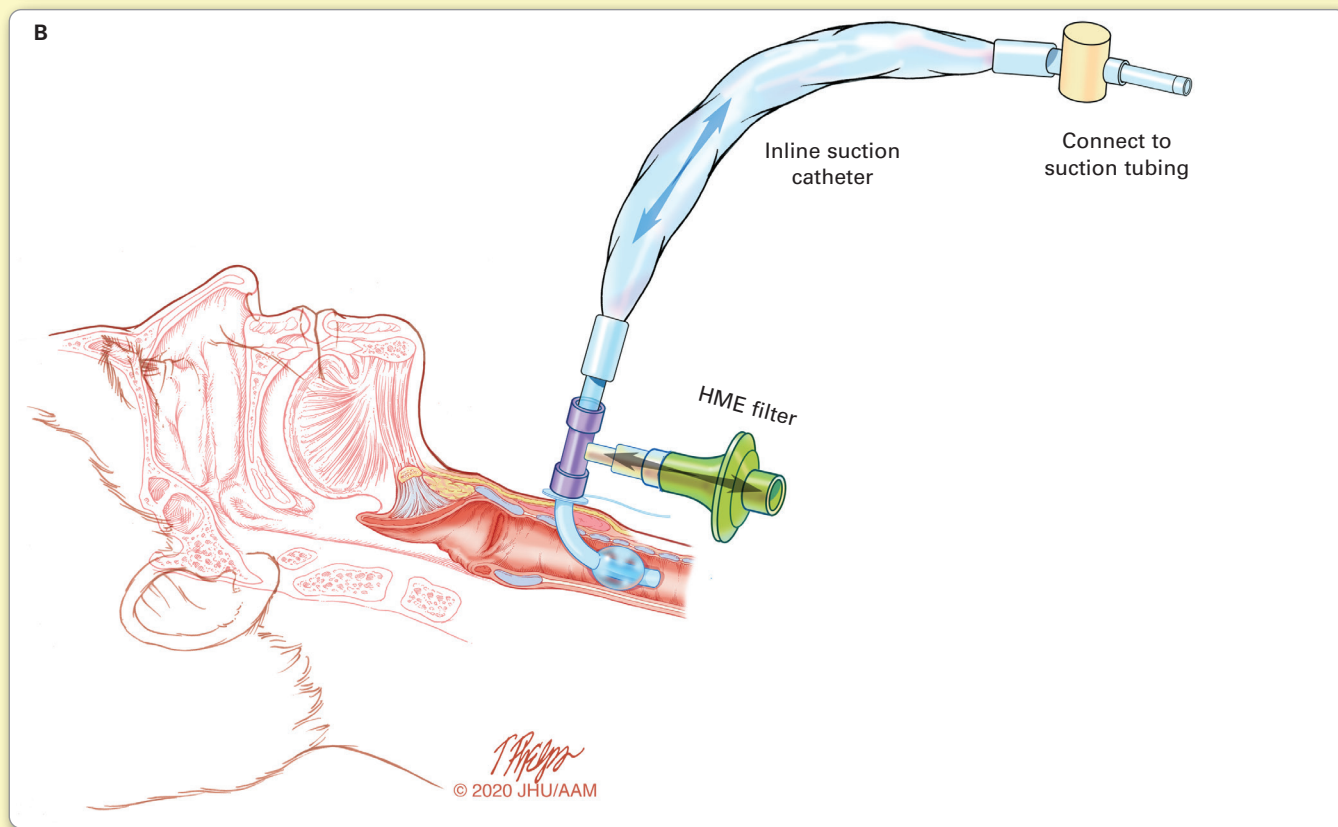
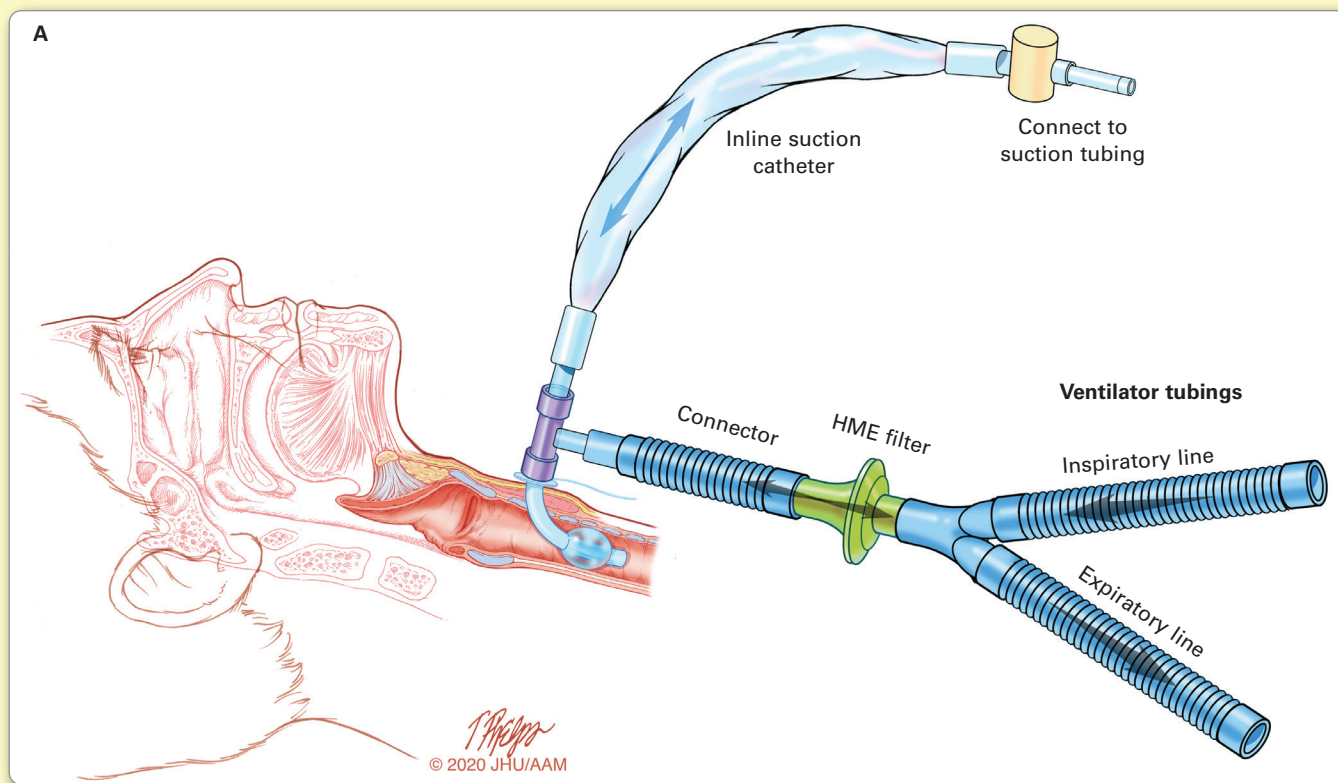
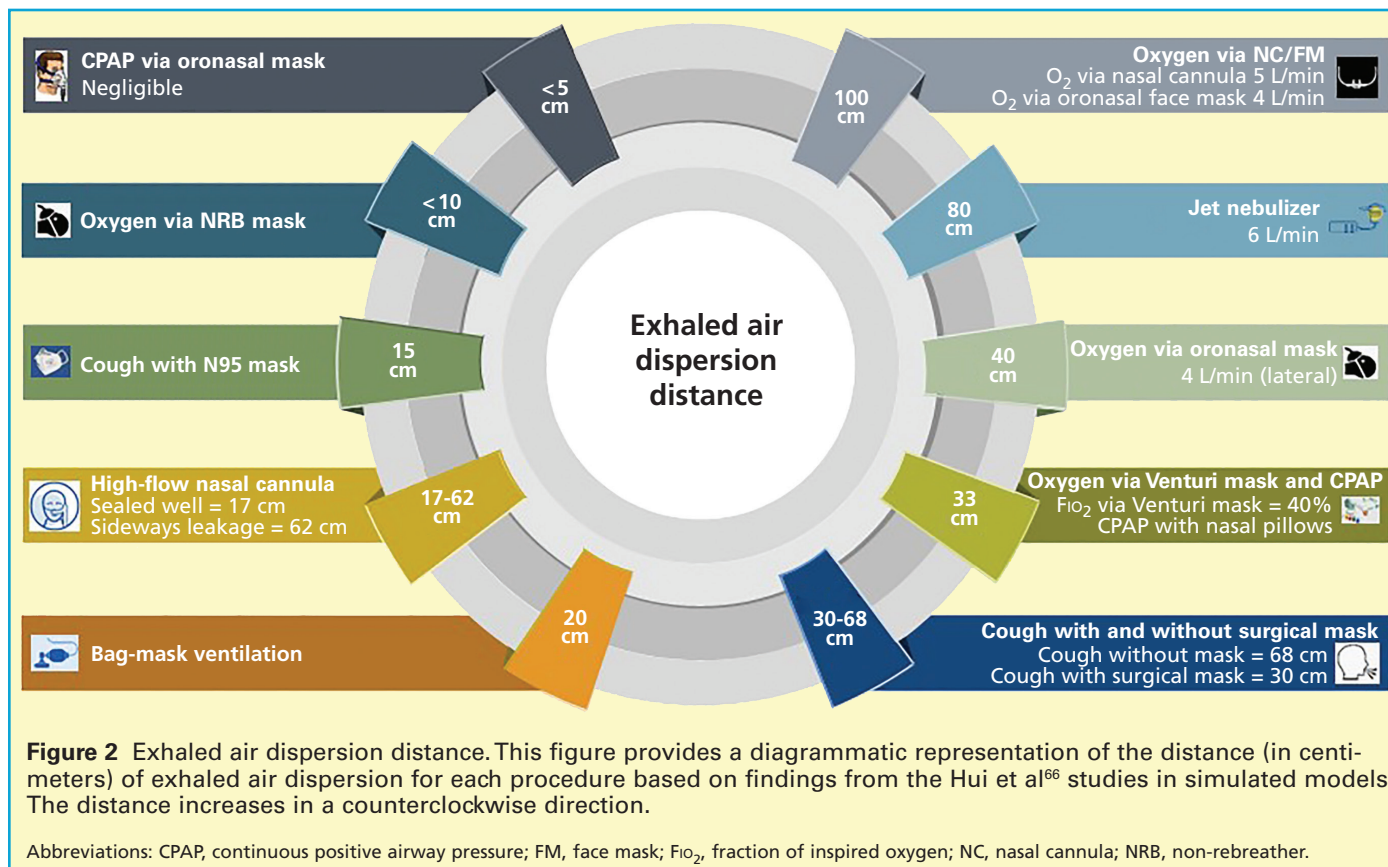


Figure 1 Suctioning of patients receiving mechanical ventilatory support. (A) This cross-sectional view displays the placement of the tracheostomy tube within the trachea and the attachments necessary to create a closed circuit when suctioning a patient who is receiving mechanical ventilatory support. A heat and moisture exchanger (HME) filter is recommended between the tracheostomy tube and the ventilator tubing. (B) This cross-sectional view displays the placement of the tracheostomy within the trachea and how an inline suction catheter with a sleeve and an HME filter could be used to imitate a closed-circuit system and minimize the aerosolization of viral particles.

Illustrations: Tim Phelps ©2020 JHU AAM, Department of Art as Applied to Medicine, The Johns Hopkins University School of Medicine.

“ Lack of PPE, rationing of ventilators, inability to isolate patients, and fear of contracting COVID-19 all may render nurses susceptible to moral distress or injury. ”



distress syndrome in COVID-19 during noninvasive⁸⁵ and invasive mechanical ventilation.⁸⁶ An increasing number of patients with acute respiratory distress syndrome related to COVID-19 required prone positioning, which posed a challenge to the nurses. A rehabilitation-based prone team has been suggested to assist with prone positioning of patients.⁸⁷ Prone position has been suggested for use in the early phase of severe hypoxemia in patients without a tracheostomy but has been necessary for patients with COVID-19 who have been admitted with a tracheostomy from a skilled-nursing facility or long-term acute care facility. In this case, particular attention has to be given to the those with a tracheostomy, because it is not easy to identify tracheostomy tube displacement. The patient's head should be aligned properly with padding around the tracheostomy tube, and extra tubing may be needed to ensure airway patency and access for suctioning. Suturing the tracheostomy tube may also need to be considered to decrease tracheostomy tube displacement. Thus,

specific challenges have to be considered and monitored when proning a patient with a tracheostomy.

Tracheostomy Tube Changes

The frequency of elective tracheostomy tube changes varies by institution.⁸⁸ Some centers perform weekly or biweekly tracheostomy changes in patients with resistant infections, to assist in decreasing bacterial or viral load. Others may perform less frequent changes to avoid risking loss of airway or airway injury. Institutions that practice tracheostomy tube changes more regularly may consider decreasing frequency to reduce nurses' exposure to aerosolized particles.⁵⁰ Waiting 29 days is suggested, on the basis of manufacturing guidelines, unless earlier change of the tube is clinically warranted.^{65,89} This standard may impede timely transition to skilled nursing homes and long-term acute care hospitals that expect the first tracheostomy tube change to be performed by health care providers in acute care hospitals. Communication with the receiving

institution is crucial for timely and safe transitioning, especially amid limited hospital-bed capacity.

Transporting Patients

The tracheostomy tube cuff should be inflated to maintain a closed system when transporting patients receiving mechanical ventilatory support with a tracheostomy within or between hospitals. For patients not receiving mechanical ventilatory support, an HME with viral filter may be placed on the tracheostomy tube, and a surgical mask is placed on the face and over the tracheostomy tube to reduce the potential for viral spread via respiratory droplets. Preplanning, collecting equipment, and effective communication ensure patient and staff safety.⁹⁰⁻⁹³

Speech and Augmentative Communication

Restoring ability to communicate greatly decreases anxiety and improves patient and family experience. Augmentative and alternative communication devices, smartphones, and tablets are first-line methods of communication for patients with COVID-19. Cuff deflation for insertion of an inline, one-way speaking valve in patients receiving mechanical ventilatory support results in aerosol generation; therefore, it is generally discouraged. If cuff deflation is necessary to perform cognitive assessments or to facilitate end-of-life discussions, transient cuff deflation may be considered.⁹⁴ During cuff deflation, the patient should wear a face mask to reduce the distances that aerosols can travel. Because patients not receiving mechanical ventilatory support have an open-circuit system, the cuff may be deflated to facilitate speech by either digital occlusion or a one-way speaking valve. Nevertheless, speech can generate aerosols. Nurses should wear surgical masks while communicating with patients with deflated cuffs and should maintain social distancing to minimize viral exposure.^{95,96}

Rehabilitation of Patients With COVID-19

Even after patients recover from COVID-19 critical illness, residual multisystem sequelae often persist. Rehabilitation aims to improve respiration, swallowing, mobility, cognition, emotional adjustment, and overall quality of life while reducing complications and disability.⁹⁷ During acute hospitalization, early respiratory rehabilitation is highly recommended. Strategies include noninvasive ventilation, frequent changes in position, and passive range of motion. It is important to gradually increase patients' anti-gravity position until an upright position can be maintained.⁹⁷ Staff protection with an N95 mask or equivalent with or without surgical masks, gloves,

and goggles or a face shield should continue en route to the rehabilitation environment until the patient is confirmed noninfectious.

Tracheostomy Decannulation

When the underlying reason for a tracheostomy tube has resolved, capping trials and decannulation should be approached conservatively in patients with COVID-19.²⁸ Often, lung injury is severe in COVID-19; therefore, the patient should be monitored in an outpatient setting with tracheostomy in situ until healing of lung injury is confirmed. Viral polymerase chain reaction assay or antibody testing may guide downsizing, capping, and decannulating of tracheostomy tubes.⁹⁸⁻¹⁰¹ When a patient is ready for downsizing and decannulation, appropriate PPE ensures protection from aerosolized particles (see Table).

Cardiopulmonary Resuscitation of Patients With a Tracheostomy

Data from Wuhan, China, on patients who experienced cardiac arrest (n = 136) showed that 87.5% of cardiac arrests had an underlying respiratory cause; for most (89.7%), the initial rhythm for cardiac arrest was asystole. Return of spontaneous circulation was achieved in 13.2% of patients (n = 18), with few alive at 30 days.¹⁰² The appropriateness of initiating and continuing cardiopulmonary resuscitation (CPR) should be considered early in patients' care, in line with patients' values and goals,^{103,104} and if the critical care team deems that CPR does not offer physiologic benefit, it may be withheld.¹⁰⁵

If a prone-positioned patient with a tracheostomy requires CPR, the prone position is maintained to prevent loss of airway.^{104,106-108} Conducting CPR in patients with COVID-19 is an intermediate-risk exposure event for clinicians.¹⁰⁵ The cause of acute deterioration in condition may be a readily reversible airway occlusion, such as a mucous plug or malposition of the tracheostomy tube in patients with a tracheostomy; therefore, an urgent assessment of mechanical airway obstruction is warranted. Nurses should provide CPR even when some personal risk is present^{103,105,109} but only after donning appropriate PPE to ensure safety.¹⁰⁴ A bag-mask valve should be used with a filter to decrease exposure during resuscitation.

Ethical Considerations

Few subjects are more fraught with fear than allocation of scarce resources amid a pandemic and duty to serve in instances that harbor risk for health care workers. The overarching principle of *primum non nocere*, "First, do no harm," must consider the

safety of patients and health care workers and societal needs. Opinions differ on how prevailing standards of care may be modified in the setting of a pandemic or other crisis; these issues have immediate relevance to care of patients with tracheostomy, whether in timing of the procedure or whether to perform CPR in a patient with progressive decline. Reconciling the benefits and countervailing risks of invasive care for patients and health care workers is an ongoing process.¹¹⁰ In the United Kingdom, clinicians were advised not to resuscitate patients with COVID-19 who had cardiac arrest in the hospital outside the emergency department, noting the poor prognosis and the aerosol-generating risk of CPR.¹¹¹ Nurses and clinicians should identify reversible causes of arrest, such as an occluded tracheostomy tube.

Lack of PPE, rationing of ventilators, inability to isolate patients, and fear of contracting COVID-19 all may render nurses susceptible to moral distress or injury. Inability to allow family to visit patients, particularly when communication is limited by restrictions on cuff deflation, also amplifies distress. The strain of bearing witness to critically ill patients is not new to intensive care unit nurses, but the suffering of patients with COVID-19, many of whom undergo tracheostomy, is increased during surges. These clinical realities are superimposed on providers' exhaustion from wearing PPE for prolonged periods, difficulty connecting with patients through protective gear, and fatigue from increased demands amid staff shortages.¹¹² Organizational efforts are needed to mitigate moral distress and foster resilience.

Considerations for Low-Resource Health Systems

Challenges in safely treating patients with tracheostomy in low-resource settings include staff training, inadequate PPE, insufficient functioning ventilators or repairs, lack of medical oxygen, short supply of suction devices, and reliance on nonsterile suction catheters that are washed and reused between patients.¹¹³⁻¹¹⁸ Despite these constraints, remarkable ingenuity by critical care nurses and hospitals allows most evidence-based recommendations presented herein to be tailored for implementation within local protocols,¹¹⁹ with notable caveats in conventional sterilization techniques, limited testing, and lack of isolation rooms.¹²⁰⁻¹²² Examples of ingenuity include gloves made from plastic materials melted in home-made heated molds, cutting 5-gallon water bottles into vented full-coverage face shields, and evidence-based substitution for infection control (eg, soaking used gloves in special available detergents).¹²³

Conclusion

Nurses have a critical role during the COVID-19 pandemic, especially when caring for patients with a tracheostomy. These guidelines address gaps in the literature and carefully ensure patient and staff safety. Aerosol generation and exposure risk can be minimized through use of closed systems, appropriate PPE, and other mindful practices. For low-resource countries, international recommendations, including protocols, may need to be adapted to the local context. Nurses and other health care team members need to care for themselves to optimize their physical and emotional health amidst a distressing and demanding environment. By working collaboratively to optimize care and by adhering to best practice in COVID-19 management, the dual goals of patient-centered care and health care worker safety can be ensured.

Appendix: Equipment Needed for Bedside Tracheostomy Procedure

Collect the following supplies:

- Sterile gowns^a
- Sterile gloves^a
- Bouffant caps
- N95 masks or equivalent
- Goggles or face shield
- Shoulder roll
- Free-flowing intravenous tubing and normal saline
- Central-catheter drape
- Sterile scissors
- Percutaneous tracheostomy kit or open tracheostomy tray for surgical technique
- Tracheostomy tubes (2 sizes)
- Cuff manometer
- 10-mL syringe
- Bronchoscope
- Curved hemostat
- Cricoid kit
- Sterile sutures
- Tracheal dilator
- Cricoid hook
- Electrocautery^b
- Medications per anesthesiologist

Ensure that the following supplies are available in the patient's room:

- 2 working suction setups with suction tubing and suction catheters
- 500-mL bottle of sterile water^a
- Infusion pump
- Manual resuscitation bag and mask
- Intubation supplies
- 4 × 4 gauze pads
- Limb restraints

^aLow-resource health systems should consider using equipment (eg, available gowns; boiled, distilled water) available in their settings.

^bPrecautions must be taken with use around oxygen (inflammable); a grounding pad is required for monopolar cautery.

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