

# COVID-19 Pandemic: What Every Otolaryngologist–Head and Neck Surgeon Needs to Know for Safe Airway Management

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## Abstract

The novel coronavirus disease 2019 (COVID-19) pandemic has unfolded with remarkable speed, posing unprecedented challenges for health care systems and society. Otolaryngologists have a special role in responding to this crisis by virtue of expertise in airway management. Against the backdrop of nations struggling to contain the virus's spread and to manage hospital strain, otolaryngologists must partner with anesthesiologists and front-line health care teams to provide expert services in high-risk situations while reducing transmission. Airway management and airway endoscopy, whether awake or sedated, expose operators to infectious aerosols, posing risks to staff. This commentary provides background on the outbreak, highlights critical considerations around mitigating infectious aerosol contact, and outlines best practices for airway-related clinical decision making during the COVID-19 pandemic. What otolaryngologists need to know and what actions are required are considered alongside the implications of increasing demand for tracheostomy. Approaches to managing the airway are presented, emphasizing safety of patients and the health care team.

## Keywords

COVID-19, coronavirus disease, airway management, difficult airway, intubation, tracheostomy, infection, patient safety, quality improvement

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As specialists in airway management, otolaryngologists require in-depth understanding of the 2019 novel coronavirus (COVID-19, 2019-nCoV, or SARS-CoV-2) to minimize personal exposure and iatrogenic transmission. The outbreak in Wuhan, China, was declared a public health emergency on January 30, 2020, and a pandemic on March 11, 2021. COVID-19 is caused by SARS-CoV-2, an RNA virus closely related to coronaviruses responsible for Middle East respiratory syndrome coronavirus (MERS) and severe acute respiratory syndrome

(SARS) outbreaks. Transmission occurs via respiratory droplets, with diagnosis confirmed by reverse transcription–polymerase chain reaction (RT-PCR) or antibody assays. Otolaryngologists can draw important insights from prior outbreaks and experience to date.<sup>1</sup>

## COVID-19 in Context

Most SARS and MERS cases involved nosocomial transmission in hospitals via aerosol-generating procedures.<sup>2</sup> Whereas even routine examination of nasal passages or oropharynx necessitates great care, risks are magnified with endoscopy and airway procedures. Many carriers are asymptomatic, and undocumented infections accelerate the dissemination of COVID-19.<sup>3</sup> Airway maneuvers performed in patients who may be infected with COVID-19 have high risk of transmission via inhalation or mucosal contact with infected respiratory secretions. This risk is maximal during intubation, tracheostomy, or open airway procedures, where the exposure will occur in close proximity, often involving positive-pressure ventilation. Understanding how to mitigate these risks is critical.

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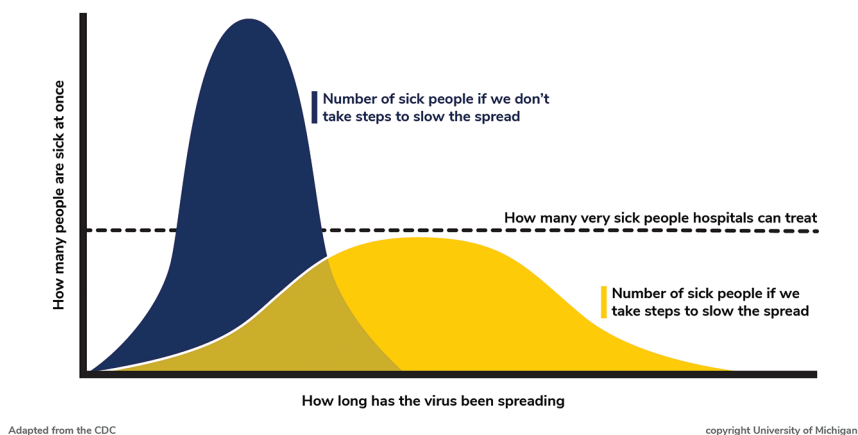
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**Figure 1.** Flattening the curve.

#### Case Study: Infectious Aerosols

Aerosol-generating procedures were implicated as a leading cause of infection during the SARS outbreak in 2003. Many healthcare workers were infected while caring for these patients in medical wards. In one instance, a jet ventilation procedure in a patient presenting with respiratory infection resulted in a super-spreading event linked to 138 patients, many of whom were healthcare workers subsequently hospitalized after exposure. This incidence was attributed to jet ventilation compounded by overcrowding of beds and poor ventilation. Super-spreading events of SARS were documented in hospitals in mainland of China, Hong Kong, Canada, and other countries. Procedures with highest risk of SARS transmission were tracheotomy, non-invasive ventilation, endotracheal intubation, and bag-mask ventilation prior to intubation. Jet ventilation, nasal cannula, and non-invasive ventilation can disperse exhaled respiratory droplets for a radius of roughly 1 meter, with this radius increasing with higher inspiratory pressures.<sup>6</sup>

**Figure 2.** Case study from severe acute respiratory syndrome outbreak.

#### Comparisons to SARS and MERS Outbreaks

Whereas awareness around social distancing and hygiene has achieved wide penetration, there is less awareness of steps to minimize infectious aerosol production and exposure, which will also be critical to “flattening the curve” (**Figure 1**). Since the first SARS and MERS outbreaks, advances in public health infrastructure and molecular diagnostics have enhanced transparency, communication, and public health response to COVID-19.<sup>4,5</sup> The accrued data on mitigating infectious aerosols represent decisive progress. Building on prior outbreaks and experience to date with COVID-19, this commentary provides practical advice to safely assess, secure, and manage the airway while ensuring safety of patients and the health care team.

### What Otolaryngologists Need to Know

#### Why Aerosols Matter

Aerosols are pervasive in clinical practice. Otolaryngologists are exposed to exhaled pathogens during routine physical examination and most procedures. While patients’ restful

breathing, coughing, and sneezing are potential sources of exposure, particular care is warranted in airway endoscopy and elective or emergent airway management. Aerosolized COVID-19 particles may remain airborne for up to 3 hours and may survive on surfaces for much longer.<sup>1</sup> Despite rapid proliferation of general guidelines for COVID-19 containment and mitigation, far fewer resources explicitly address the proven strategies for reduction and management of infectious aerosols. Awareness of best practices is imperative because infectious aerosols arising from airway procedures were a key etiologic factor in prior coronavirus outbreaks (**Figure 2**).<sup>6</sup>

#### What Airway Guidance Is Available

Guidelines addressing airway management with COVID-19 are limited. The British otolaryngology society released coronavirus recommendations for patients with tracheotomy,<sup>7</sup> paralleling recommendations from anesthesiology<sup>4</sup> and intensive care<sup>8</sup> on minimizing aerosol production and exposure. Recognizing concerns in endoscopy, the American Society for Gastrointestinal Endoscopy recommended personal protective equipment (PPE) use, endoscopy in negative-pressure rooms, and decontamination of endoscopes and rooms.<sup>9</sup> The American Academy of Otolaryngology–Head and Neck Surgery released COVID-19–related resources, including patient screening algorithms and postexposure risk classification. Postponing nonurgent surgery frees up capacity in the health system and avoids outpatients contracting illness or introducing undiagnosed carriers.

#### Airway Assessment and High-Risk Situations

Airway assessment includes identifying anatomical factors that may present difficulty in airway securement and risk for deterioration. Many pediatric airway and adult laryngology operations are performed with spontaneous, nonintubated ventilation without a closed circuit and employing lasers that may enhance viral spread through laser plume. Surgeons must consider whether such procedures can be safely postponed and, if not, whether a microlaryngoscopy tube coupled with intermittent extubation and apnea during

**Table 1.** Measures to Minimize Generation of Infectious Aerosols.

Principle	Practical Implementation
<b>Avoid elective airway surgery</b>	Limit procedures, especially airway procedures, to urgent cases.
<b>Optimize personnel</b>	Experienced individuals should perform procedures expeditiously with the fewest assistants possible.
<b>Close circuits when possible</b>	Tracheal intubation with cuffed tube (closed system) is preferred over supraglottic airway devices or facemasks (partially closed systems) or THRIVE/jet ventilation (open systems).
<b>Use rapid sequence induction</b>	Preoxygenation followed by rapid sequence induction minimizes bag-masking and associated high-risk exposures.
<b>Minimize bag-masking</b>	Laryngeal mask airway (LMA) is generally a preferable stop-gap measure to bag-masking when airway is not immediately secured.
<b>Avoid awake intubations</b>	Such procedures involve atomized analgesia that promotes coughing, with the endoscopist in close proximity to the airway.

Abbreviation: THRIVE, transnasal humidified rapid-insufflation ventilatory exchange.

**Table 2.** Proper Use of Personal Protective Equipment (PPE) to Avoid Exposure.

Principle	Practical Implementation
<b>Adhere to respiratory droplet precautions</b>	Protection from aerosol droplets requires eye protection, gown, gloves, mask; the health care team requires updated fit tested N95 mask or powered air-purifying respirator (PAPR) for procedures.
<b>Practice donning/doffing</b>	Clinicians should become proficient with safely donning and removing PPE prior to entering high-risk areas.
<b>Confirm visibility</b>	Ensure that line of vision is not obstructed or obscured. Some equipment may be incompatible with microscope; if alternative options are unavailable, procedure is done without a microscope.
<b>Maintain communication</b>	Be cognizant of impaired ability to speak and hear, which can impede safety and communication; minimize ambient noise.
<b>Assess fidelity</b>	Confirm adequate maneuverability and tactile sense to ensure adequate dexterity to accomplish the intended procedure.
<b>Perform safe endoscopy</b>	Standards are evolving; in addition to PPE worn by the clinician, patient should wear a loop mask (drop mask below the nose for transnasal scope) that captures droplets, should patient cough.
<b>Be alert to carriers</b>	Many cases of coronavirus disease 2019 (COVID-19) are undocumented, with patients who are asymptomatic or in prodromal state; clinicians should be alert to the possibility of any patient harboring COVID-19 infection.

non-laser tissue manipulation, or temporary tracheostomy for closed-circuit airway control are appropriate. Triage discussions and shared decision making with patients about whether or not to proceed are important responsibilities inherent in the surgeon-patient relationship. As jet ventilation and transnasal humidified rapid-insufflation ventilatory exchange (THRIVE) are important oxygenation and ventilation strategies, shared decision making and direct surgeon participation are essential in critical triage discussions as part of responsibilities inherent in the surgeon-patient relationship.

### Best Practices for Otolaryngologists

All airway surgery is aerosol generating,<sup>6</sup> and any patient may harbor infection. Airway management strategies to mitigate infectious risk (**Table 1**) include designating experienced providers, closing circuits, and minimizing bag-mask ventilation. Awake intubation should be avoided unless required. THRIVE, jet ventilation, or positive-

pressure ventilation without a cuffed tracheal tube are strongly discouraged. Any open circuitry airway procedure increases aerosol generation, as will rescue/maintenance bag-valve-mask ventilation. Proper use of protective equipment is imperative with N95 masks/powered air-purifying respirators (**Table 2**). We recommend staff rehearse donning/doffing PPE and check equipment provides adequate vision, hearing, and fidelity to safely conduct procedures. A number of measures may improve the safety of airway surgery (**Table 3**), and lessons can be taken from Hong Kong's experience, where swift implementation of current safety measures was informed by the SARS outbreak (**Table 4**).

### Special Consideration for Tracheostomy

The number of tracheostomies performed in critically ill patients will likely surge during the pandemic, to facilitate long-term ventilation or weaning from ventilation. Median

**Table 3.** Airway Surgery Pearls in the Time of COVID-19.

Consideration	Recommended Measures
<b>Indications</b>	The most common surgical indications in the near term may relate to patients receiving invasive ventilation for coronavirus disease 2019 (COVID-19) respiratory failure or weaning (surge in tracheostomy, managing laryngeal complications of intubation).
<b>Timing</b>	Viral shedding can exceed 20 days. When airway procedures cannot be postponed, the focus is on closed-circuit airway management, minimizing aerosol generation to maximally protect clinicians and staff.
<b>Location</b>	The decision to perform surgery in the intensive care unit vs in the operating room is multifaceted, involving infection control infrastructure, technical capabilities, and equipment; negative pressure is preferable.
<b>Patient factors</b>	Body habitus (obesity/obstructive sleep apnea), anticoagulation, morbidities, and ability to leave intensive care unit affect timing, location, and urgency of surgery; such factors may also affect decision for percutaneous or open technique.
<b>Surgeon, staff, and bystanders</b>	A small, experienced team that maximizes speed is preferred, thereby limiting duration of potential infectious exposure. Measures should be taken to avoid risk of transmission to nearby patients, staff, or equipment.
<b>Equipment</b>	Careful preparation for procedures also improves speed and safety, reducing risk of exposure; instrument trays need to be standardized, and suction, cautery, lighting, and positioning should all be optimized.

**Table 4.** Hong Kong Perspective: Approaches to Preventing Healthcare Worker Transmission of COVID-19.

Consideration	Practical Implementation
<b>Culture of learning</b>	<p>“Many of us in Hong Kong experienced SARS 17 years ago, where many health care workers were infected and quite a few died. As a result, many of our responses to COVID-19 were quite instantaneous, implementing measures aiming at 0% infection rates amongst healthcare workers.”</p> <p>—Anthony Y. B. Teoh, FRCSEd, MBChB</p>
<b>Rapid response team</b>	The daily situation of COVID-19 infections can change rapidly in the community and hospital. Hence, response teams should be set up in each unit for rapid dissemination of COVID-19–related information and communication of hospital strategic plans. The status of staff infection and the level of PPE stock should be made transparent.
<b>Staff monitoring</b>	Staff would be monitored for symptoms of COVID-19. All staff will have their body temperature measured daily when reporting to work. Alerts will be raised to any unusual clustering among staff.
<b>PPE “buddy” checks</b>	It is standard operating procedure in Hong Kong to observe another colleague gowning up and down to check for any breach in the protocol. The highest risk of infection is during gowning down, where viruses shed on the surface of PPE can be accidentally contaminate the health care worker and cause infection.
<b>Shoes and apparel</b>	Having a dedicated pair of shoes for inside the hospital has been implemented to decrease spread of infection. Similarly, keeping hospital attire within the hospital furthers decreases risk of community spread.
<b>Gowning sites/signs</b>	A dedicated physical space exists for putting on and removing gowns to minimize risk of transmission. These locations have prominent signs that provides clear instructions for proper sequence in donning PPE gear.
<b>Procedural sites</b>	Many procedures, such as endoscopy, are considered AGPs. Conducting AGPs in a dedicated location is performed to decrease risk to health care workers and for patients.
<b>Dedicated personnel</b>	A dedicated proceduralist, who does not engage otherwise in seeing patients, is assigned to perform endoscopy, thereby allowing for specialization in carrying out these procedures and reduced PPE usage.

duration of viral shedding is reported at 20 days but longer in the critically ill.<sup>10</sup> In patients at risk of failed primary extubation, cuffed tracheostomies allow better infection control than aerosol-generating extubations, involving continuous positive airway pressure/high-flow oxygen and urgent reintubation. Decreased sedation with tracheostomy also will reduce ventilator time, potentially reducing critical care resource strain. Surgeons must safely manage tracheostomized inpatients, particularly in isolated units with limited expertise in tracheostomy.

## Conclusions

Confirmed cases of COVID-19 continue to increase despite aggressive public health measures, with many patients requiring ventilatory support. Otolaryngologists, as experts in airway management, share a critical role in providing high-quality care, minimizing nosocomial spread from aerosol-generating procedures, and protecting themselves and others. We recommend preparation, planning, vigilance, and mindful application of lessons garnered from the SARS, MERS, and the current COVID-19 outbreak.

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## Author Contributions

**Karthik Balakrishnan**, design, drafting, interpretation, final approval, accountable; **Samuel Schechtman**, design, drafting, interpretation, final approval, accountable; **Norman D. Hogikyan**, interpretation, revising, final approval, accountable; **Anthony Y. B. Teoh**, substantial contributions to the design of the work, revising it critically for important intellectual content, final approval of the version to be published, agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; **Brendan McGrath**, interpretation, revising, final approval, accountable; **Michael J. Brenner**, conception, design, drafting, interpretation, final approval, accountable.

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