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Contemporary Review

COVID-19 and the Otolaryngologist: Preliminary Evidence-Based Review

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The SARS-CoV-2 virus, which causes coronavirus disease 2019 (COVID-19), has rapidly swept across the world since its identification in December 2019. Otolaryngologists are at unique risk due to the close contact with mucus membranes of the upper respiratory tract and have been among the most affected healthcare workers in Wuhan, China. We present information on COVID-19 management relevant to otolaryngologists on the frontlines of this pandemic and provide preliminary guidance based on practices implemented in China and other countries and practical strategies deployed at Stanford University.

Key Words: COVID-19, SARS-CoV-2, clinical practice guidelines, evidence-based medicine, infectious disease.

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INTRODUCTION

The SARS-CoV-2 virus and the disease it causes, termed coronavirus disease 2019 (COVID-19), has rapidly swept across the world since its first known human manifestation on December 8, 2019.[1] Confirmed cases are present in over 160 countries and all 50 US states. Within the United States, community transmission became the dominant mode of transmission in March 2020.

During the early phase of the Wuhan outbreak, the highest rates of nosocomial spread were seen amongst otolaryngologists due to the high viral load in the upper respiratory tract and the close contact otolaryngologists have with patients' upper respiratory mucosa.[2–5] We have compiled information on COVID-19 management relevant to otolaryngologists who are on the frontlines with this new pandemic. This review provides preliminary guidance based on practices implemented in China and other countries, as well as practical strategies and policies developed at Stanford University, which is in Santa Clara County, California, one of the first regions in the United States to experience community transmission.

DEMOGRAPHICS AND PRESENTATION

There is a slight male predominance of 58.1% in the largest case series (n = 1099).[6] The symptoms of COVID-19 are similar to those seen in other respiratory infections and include fever (43%–98%), cough (68%–82%), fatigue (38%–44%), sore throat (13.9%–17.4%), dry cough (59.4%), and sputum production (28%–33%).[7] Other upper respiratory infection features such as nasal congestion (4.8%) and rhinorrhea (4%) are very uncommon.[6,8,9] Unlike SARS-CoV in 2002, which caused severe acute respiratory syndrome (SARS), the infectivity of this virus is exacerbated by a longer incubation period (5–7 days) of asymptomatic shedding resulting in a large number of carriers.[10–12]

Common laboratory findings include lymphocytopenia (35%–83%) and increased values of C-reactive protein (75%–93%), lactate dehydrogenase (27%–92%), and erythrocyte sedimentation rate (up to 85%).[6,13] The chest x-ray or chest computed tomography findings in COVID-19 infection are not specific, and official statements of the American College of Radiology and the Society of Thoracic Radiologists are that imaging should not be used to screen or diagnosis COVID-19.[14,15]

Diagnosis of SARS-CoV-2 is currently performed with polymerase chain reaction (PCR) testing for nucleic acid sequence homology in nasopharyngeal or throat swabs. Higher viral loads are seen in the nasopharynx, and this is the preferred site to sample.[3] Unfortunately, PCR testing may be negative early in the course and turn positive on repeat testing.[16] Serologic testing for COVID-19, which would detect antibodies that would indicate if a person had an immune response to SARS-CoV-2, is currently under development.[17–19]

Mortality is higher in the presence of coexisting conditions including hypertension and diabetes, as well as age >60 years. Although the overall mortality rate is estimated between 1.7% and 4.5%, this varies dramatically by age group, with a 0% reported mortality rate in

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children under age 9 years to 14.8% reported mortality rate in those over the age of 80 years.[20,21] Among patients, there have been reports of anosmia and dysgeusia from China, Italy, and Iran.[22,23] The duration and etiology of this finding is unknown, and more research will need to be conducted.

INFECTION CONTROL

The primary method of transmission is thought to occur from droplet spread, which is where large droplets carry virus particles. Owing to their weight, these droplets stay airborne for a few seconds and travel only a short distance before landing onto surfaces. However, under certain circumstances, such as during bag mask ventilation or bronchoscopy, the virus particles can become aerosolized or airborne, which increases the risk of spread. Airborne SARS-CoV-2 was shown to cause extensive environmental contamination in COVID-19 patients in negative-pressure rooms, with virus being detected on multiple surfaces including air exhaust vents.[24]

The survival time of SARS-CoV-2 varies considerably by surface type. In aerosol form, viable particles can remain after 3 hours, but the longest survival times are seen on plastic and stainless steel (up to 72 hours).[25] Transmission by elevator buttons and faucet taps is thought to have contributed to clusters of cases in Wenzhou, China.[26] These findings underscore the importance of surface cleanings with virucidal agents such as bleach, quaternary ammonium, and hydrogen peroxide.[27] Importantly, high level disinfection procedures should be followed for equipment like rigid and flexible endoscopes.

During the early phase of the outbreak, a 41% rate of nosocomial spread was observed, with healthcare workers accounting for 29% of patients.[7] As seen in the SARS outbreak, personal protective equipment (PPE) is known to be effective in reducing the risk of nosocomial infection.[28] Although recommendations have continued to change depending on resources, the Centers for Disease Control and Prevention (CDC) and the World Health Organization recommend healthcare workers wear a gown, gloves, goggles, and a medical mask, which should be protective against droplet-based transmission. Once supply chains are restored, the CDC recommends returning to N95 respirator use with both persons under investigation (PUI) for COVID-19 and known COVID-19 patients.[29,30] An aerosol-generating procedure, which includes noninvasive positive airway pressure, high-flow nasal canula (>6 LPM), nebulizer treatments, endotracheal intubation, bronchoscopy, and nasal endoscopy require use of an N95 mask. However, the Chinese Society of Anesthesiology, the National University Health System of Singapore, and Stanford guidelines recommend using powered air-purifying respirator (PAPR) hoods if available for procedures of the highest risk such as intubations.[31,32] As in the SARS outbreak, it is unknown if covering exposed areas of the head and hair reduces the risk of transmission,[33] though this strategy has been used in Wuhan.[34] Current CDC and Stanford guidelines recommend patients under investigation or with confirmed SARS-CoV-2 infection to wear a mask in healthcare facilities to reduce spread of viral particles.[29]

Research has shown that healthcare workers are at high risk of self-contamination when removing or doffing PPE; studies from the Ebola experience demonstrated that up to 79.2% of providers self-contaminated while removing respirators.[35,36] Considering that respiratory viruses were detected on 10.1% of used medical masks in a nonoutbreak context,[37] it is likely that masks and respirators used by otolaryngologists during the current outbreak have a significantly higher contamination rate. Furthermore, recommended doffing procedures for regular PPE differs significantly from those for operating room (OR) gowns,[38] which otolaryngologists are typically more accustomed to. Therefore, otolaryngologists must familiarize themselves with proper procedures and exhibit special caution when removing and/or reusing masks and respirators.[39] As such, our institution recommends doffing with a trained observer or assistant when possible to minimize self-contamination after high-risk procedures, which is consistent with Chinese recommendations.[31]

CONSIDERATIONS FOR OTOLARYNGOLOGISTS

Procedural Considerations

There is currently no formal guidance on the best method of reducing the risk of SARS-CoV-2 virus transmission during routine use of flexible fiberoptic laryngoscopy (FFL). Our institution has developed guidelines based on best available evidence including deferring all endoscopies unless considered necessary to reduce morbidity in the next 30 days (e.g., malignancy, airway risk). The provider should wear a gown, N95 mask, and face shield when performing FFL.[40] An otolaryngology group in Wuhan was able to avoid patient-to-physician infection in 4,148 cases of fever and 22 cases of confirmed COVID using changes to clinic and OR schedules and the following guidelines: 1) patients' nasal cavity and pharynx mucosal should be well anesthetized to reduce the cough and sneeze reflexes, 2) gel-type topical anesthetics rather than sprays should be used to minimize aerosol production, and 3) the smallest diameter scope to reduce the likelihood of coughing and sneezing should be used.[2] The position of the American Association for Bronchology and Interventional Pulmonology is that bronchoscopy has an extremely limited role in the diagnosis of COVID-19.[41]

Our department has decided to defer all elective procedures that may aerosolize tissue such as tonsillectomy, mastoid drilling, sinus surgery, and other airway procedures. When such a procedure is indicated, appropriate PPE must be worn. An idealized algorithm currently followed by our department (dependent on PPE availability) is shown in Figure 1. As COVID-19 testing becomes more widely available, we anticipate that testing of all preoperative patients will become more common and allow for a transition toward the algorithm shown in Figure 2, which would conserve PPE.

Intubation and Airway Manipulation

Clusters of nosocomial infections in Toronto were observed in healthcare workers administering respiratory

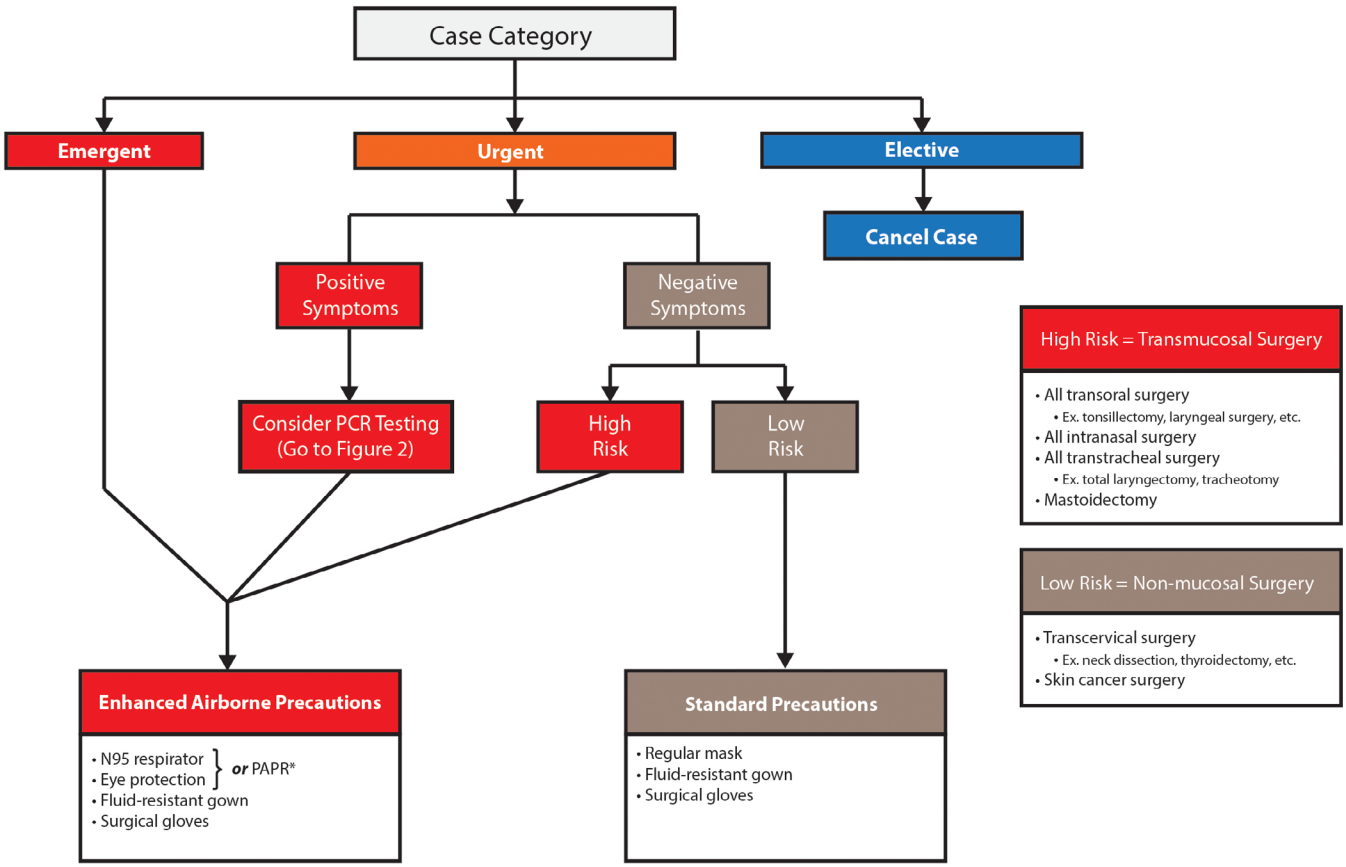

Fig. 1. Schematic for personal protective equipment (PPE) choice when COVID-19 polymerase chain reaction (PCR) status is unknown given sufficient PPE availability. *Powered air-purifying respirator (PAPR) should be considered in cases where significant nasal mucosa manipulation is anticipated. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

resuscitation during the SARS epidemic.[42] This has informed current policies at our institution. Our institution promotes early intubation to avoid emergent intubations, which would allow for more intubation planning and enough time to properly don PPE. Prior to intubation, patients may wear a nasal canula with ≤6 LPM flow rate covered by a medical mask. Nonrebreather masks are the only option for escalation prior to intubation given that high-flow nasal canula oxygen (>6 LPM), continuous positive airway pressure (CPAP), bilevel positive airway pressure (BiPAP), nebulizers, and bag-mask ventilation are aerosolizing procedures that must be avoided. Finally, as of March 9, 2020, all intubations for confirmed cases or PUI are supposed to be performed using PAPR gear per policy. However, as the number of cases increases and availability of PPE declines, adherence to this policy has not been optimal.

Our policies are distinct from the Italian experience, where noninvasive positive pressure ventilation delivered via a helmet device is being used to reduce intubations.[43] At institutions where a helmet type CPAP mask is available, this may be used as an alternative to other CPAP masks to reduce the risk of spread.[44] This style is not widely available in the United States. Several guidelines exist to direct the sequence of steps in the intubation of a PUI or confirmed COVID-19 patient.[45,46]

Role of Tracheostomy

Indications for tracheostomy in this population include emergent airway and prolonged mechanical ventilation. There are no published reports on tracheostomies performed in patients with COVID-19. In our experience so far, no patients had pathology that precluded successful endotracheal intubation and required surgical airway backup. Furthermore, critically ill patients have either recovered or died; it appears unlikely that COVID-19 would cause a need for prolonged ventilation necessitating tracheostomy. In one series of 52 critically ill COVID-19 patients in Wuhan, 22 were intubated, and only three were still alive and requiring ventilator support after 28 days, with the remainder either dying or recovering.[47] Early experience suggests that unlike in other lung diseases, such as bacterial pneumonia, patients with COVID-19 experience dry cough and produce relatively little mucus and secretions, which makes tracheostomy for pulmonary toilet less critical.[41,48]

If tracheostomy were to be required, data from the SARS experience in Hong Kong suggest that tracheostomy may be performed without transmission to surgeons and OR staff.[49] Key recommendations include minimizing opportunities for aerosolization including complete paralysis to avoid coughing, ventilation only with cuff inflation, stopping ventilation prior to entering the airway, avoiding

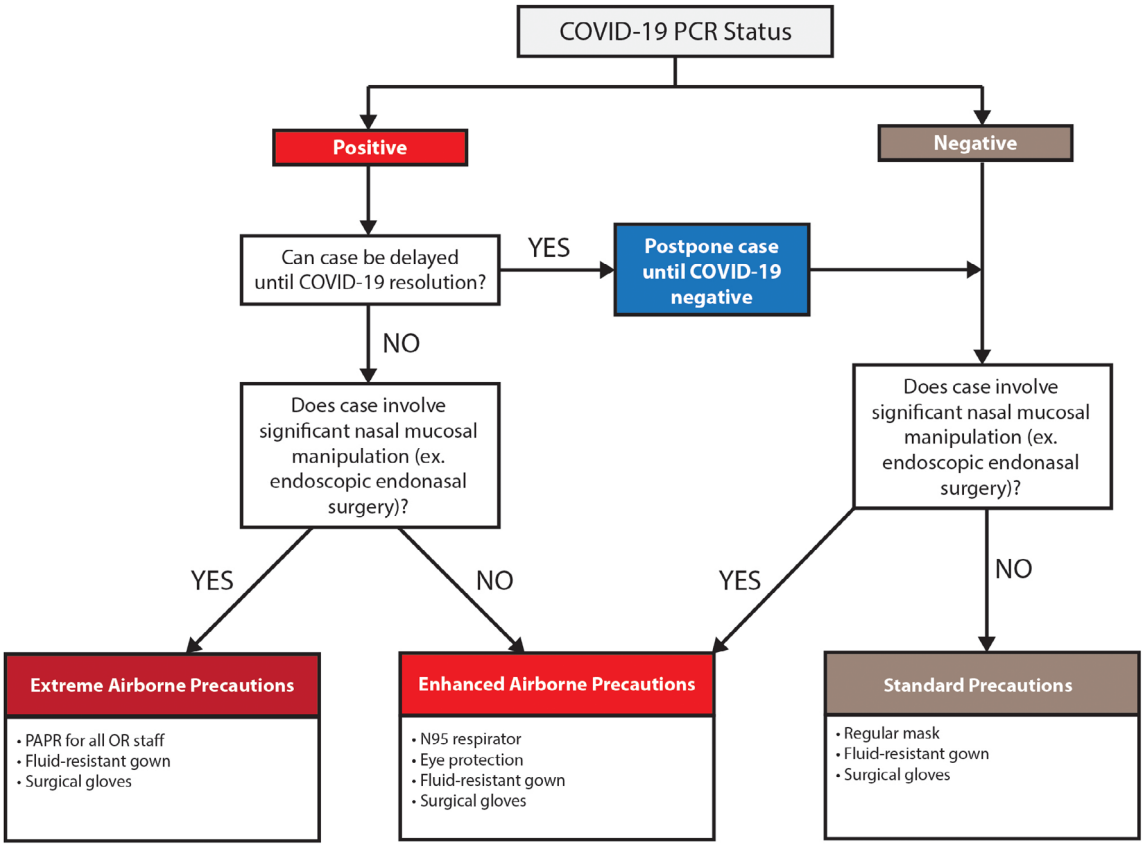

Fig. 2. Schematic for personal protective equipment choice when COVID-19 polymerase chain reaction (PCR) status is known by nasopharyngeal swab. OR = operating room; PAPR = powered air-purifying respirator. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

suctioning, and minimizing cautery. PPE worn by OR staff in Hong Kong were consistent with the enhanced airway precautions in Figure 1.

Posttracheostomy, the British Association of Otorhinolaryngology–Head and Neck Surgery has made the following recommendations to reduce risks of environmental contamination: keep the cuff inflated, use in-line suction, and delay tracheostomy tube change until COVID-19 has passed. Additionally, every effort should be made to avoid disconnecting the circuit.[50]

Endoscopic Sinus and Skull Base Surgery

The viral load of SARS-CoV-2 is higher in the nasal cavity than in the throat, regardless of whether the patient is symptomatic or asymptomatic.[3] As previously stated, once aerosolized, SARS-CoV-2 particles may stay in the air for at least 3 hours.[25] During endoscopic sinus and skull base surgery, there are many mechanisms for possible aerosolization of mucus and virus, including powered instrumentation such as debriders and drills, as well as use of saline irrigation either in the sinuses or to clean the endoscope. As any interaction of the airway mucus layer with high-speed flow causes aerosolization of mucus, even aerosolized spray of anesthetic into the nasal cavity may cause aerosolization of mucus.[51] Our team is aware of a firsthand account from a neurosurgeon serving in Wuhan who reported at least 14 providers developed SARS-CoV-2 after being involved in the care of patient who underwent endoscopic endonasal pituitary surgery.[52] This increased risk to endoscopic surgeons has been suggested in Iran and Italy as well, but there are no data currently to corroborate these communications. Appropriate PPE for aerosol exposure should be used during these types of surgeries as well as limiting use of anesthetic sprays in the clinic and instead applying anesthetic and decongestant via pledgets for nasal endoscopy, which itself should be limited to urgent encounters only. Recognizing the uniquely high risk of endoscopic endonasal surgery, our department now requires negative PCR testing within the 48 hours prior to surgery and has implemented the special considerations described in Figure 2.

Management of Special Patient Populations

Patients with existing tracheotomies. In tracheostomy patients who are connected to a closed ventilator circuit, standard droplet contact precautions, as would be

used for an endotracheally intubated patient on a ventilator, are appropriate. This closed system strategy has been used during the current outbreak in Hong Kong.[40] At our institution, use of tracheostomy collars is avoided whenever possible due to the aerosolization potential. Instead, use of a heat moisture exchanger (HME) is preferred.

Obstructive sleep apnea dependent noninvasive positive pressure. Many patients who have obstructive sleep apnea use CPAP or BiPAP devices overnight. Due to incomplete sealing, such as in nasal pillow masks, this increases the risk of airborne spread.[54] These patients should be placed on airborne precautions. Use of helmet type CPAP masks available in some regions will minimize this risk.

Pediatric patients. Many otolaryngologists see both adult and pediatric patients. A review of 72,314 patients from the Chinese Center for Disease Control and Prevention showed than fewer than 1% of cases were in children 10 years or younger.[21] With the exception of very young children (<12 months), pediatric patients appear to have relatively milder symptoms as compared to adults, with many of them potentially remaining asymptomatic (n = 2,143).[20] At Wuhan Children's Hospital, 15% of COVID-19–positive children were asymptomatic.[55] These statistics underscore their potential role in community transmission. It is important for otolaryngologists to be aware of the risk of spread from pediatric patients to healthcare workers and other patients. Separating patients in shared waiting areas and ensuring thorough cleaning of surfaces between patient encounters may help reduce spread. In addition to deferring nonurgent visits and switching to telehealth when feasible, our clinics now screen pediatric patients for symptoms outside of the clinic.

Patients with head and neck cancer. Based on a nationwide analysis in China, cancer patients were found to be at elevated risk for severe symptoms as a result of exposure to SARS-CoV-2.[56] Our department has developed a consensus for stratifying common head and neck cases by urgency (Table I). In addition, our tumor board reviews controversial cases for recommendations. Reviewing the risk mitigation strategies of radiation oncology departments in Wuhan, Taiwan, and Italy, several strategies emerge: 1) ruling out COVID-19 before proceeding with radiotherapy and 2) masks for patients to be worn while in medical facilities, and 3) developing new clinic workflows to segregate staff members to reduce the risk of transmission between staff, staggering patient appointment timings, and minimizing patient–staff contact time.[57–59] In Wuhan and Taiwan, these strategies have successfully prevented patients from developing COVID-19 while minimizing disruption to therapy.

TABLE I.
Stratification of Common Head and Neck Cases by Urgency.

Proceed with surgery; do not reschedule
HPV-negative HNC
Especially those with airway concerns
HPV+ HNC with significant disease burden or delay in diagnosis
HNC patients with complications of cancer treatment
HNC recurrent after radiation therapy failures
Thyroid
Anaplastic thyroid carcinoma; medullary thyroid carcinoma
PTC with suspicion for or identified metastases
Follicular lesions/neoplasms (>4 cm)
Recurrent PTC with active progression of disease
Parathyroidectomy with renal function declining
Skull base cancer requiring surgery
Salivary gland duct carcinoma
Skin cancer
Some melanoma and Merkel cell
Advanced-stage nonmelanomatous skin cancers (SCC)
BCC in critical areas (e.g., orbit)
Consider postponing >30 days
Low-risk PTC without metastasis
Some melanoma
Consider postponing 30–90 days; reassess once pandemic appears to be resolving
Goiter without airway/respiratory compromise
Routine benign thyroid nodules and thyroiditis
Revision PTC with stable or slow rate of progression
Parathyroidectomy with stable renal function
BCC where cosmetic impact/morbidity is likely low with further growth
Benign salivary lesions
Case-by-case basis
Rare histology with uncertain rates of progression
Diagnostic procedures such as direct laryngoscopy and biopsy
Stratify by degree of suspicion, risk of progression within 30 days

BCC = basal cell carcinoma; HNC = head and neck cancer; HPV = human papillomavirus; PTC = papillary thyroid carcinoma; SCC = squamous cell carcinoma.

Changes to Department Activities

Our department's principal objective during the COVID-19 pandemic has been to provide the highest quality of care to patients with urgent medical conditions while minimizing the risk to providers and conserve resources. The department's approach to operating room cases has been previously outlined. Broadly speaking, the two other areas that have undergone major changes are in outpatient visits and in residency program-related activities.

This strategy is consistent the American Academy of Otolaryngology–Head and Neck Surgery's recommendations published on March 20, 2019 to limit patient-care activities to individuals with urgent, time-sensitive conditions. Most clinics have reduced their visits by over 80%, though this varies by subspecialty. Our clinics have rapidly expanded the number of telehealth visits provided. Recognizing the unique age-dependent risk, all faculty over age 60 years have voluntarily agreed to recuse themselves from direct patient care contact. To reduce exposure and PPE usage, residents no longer staff the clinic.

With fewer cases and clinics, we have begun reducing the number of residents on service to reduce exposure and to preserve a pool of healthy physicians. Just prior to the California-wide shelter-in-place guidelines, resident

TABLE II.
Summary of Major Changes in Department Activities.

Summary of Changes
Faculty over the age 60 years have voluntarily recused themselves from direct patient contact, now exclusively utilizing a telehealth model
Surgery staffing changes
Single-surgeon surgery is performed by attending only
Procedures requiring assistant are done by attending and most senior fellows or residents available
No resident, student, or visiting observers
Substantial reduction of clinic visits and conversion to telehealth
Reducing number of residents on service
Residents no longer staff clinic to reduce risk of exposure
All department meetings and resident education sessions are conducted remotely

education sessions were being conducted through online meeting software, with residents segregated into their respective clinical teams. There have also been efforts to mitigate the educational consequences to this reduction in resident clinical activity. Stanford is participating in a novel initiative with all other otolaryngology programs in California termed Multi-Institutional Otolaryngology Residency Education–Collaborative Online Video Instruction and Discussion with didactic education for 2 hours every weekday. A summary of major changes in our department is provided in Table II.

CONCLUSION

As the COVID-19 pandemic promulgates throughout the United States, otolaryngologists will be faced with difficult questions on how to balance the safety of their patients, their families, and the community as a whole. Otolaryngologists have an important position as healthcare providers who may see patients with manifestations of COVID-19 and have significantly higher risk of infection due to the nature of the specialty. The practices and recommendations will evolve based on new data and the availability of testing and resources. This document should serve as a template for otolaryngologists to structure their practices in the face of the COVID-19 outbreak and to advocate for changes within their hospital systems.

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