

Safety Recommendations for Evaluation and Surgery of the Head and Neck During the COVID-19 Pandemic

Babak Givi, MD; Bradley A. Schiff, MD; Steven B. Chinn, MD, MPH; Daniel Clayburgh, MD, PhD; N. Gopalakrishna Iyer, MBBS, PhD; Scharukh Jalisi, MD; Michael G. Moore, MD; Cherie-Ann Nathan, MD; Lisa A. Orloff, MD; James P. O'Neill, MD, MBA; Noah Parker, MD; Chad Zender, MD; Luc G. T. Morris, MD, MSc; Louise Davies, MD, MS

Author Audio Interview

IMPORTANCE The rapidly expanding novel coronavirus disease 2019 (COVID-19) pandemic, caused by severe acute respiratory syndrome coronavirus 2, has challenged the medical community to an unprecedented degree. Physicians and health care workers are at added risk of exposure and infection during the course of patient care. Because of the rapid spread of this disease through respiratory droplets, health care workers who come in close contact with the upper aerodigestive tract during diagnostic and therapeutic procedures, such as otolaryngologists–head and neck surgeons, are particularly at risk. A set of safety recommendations was created based on a review of the literature and communications with physicians with firsthand knowledge of safety procedures during the COVID-19 pandemic.

OBSERVATIONS A high number of health care workers were infected during the first phase of the pandemic in the city of Wuhan, China. Subsequently, by adopting strict safety precautions, other regions were able to achieve high levels of safety for health care workers without jeopardizing the care of patients. The most common procedures related to the examination and treatment of upper aerodigestive tract diseases were reviewed. Each category was reviewed based on the potential risk imposed to health care workers. Specific recommendations were made based on the literature, when available, or consensus best practices. Specific safety recommendations were made for performing tracheostomy in patients with COVID-19.

CONCLUSIONS AND RELEVANCE Preserving a highly skilled health care workforce is a top priority for any community and health care system. Based on the experience of health care systems in Asia and Europe, by following strict safety guidelines, the risk of exposure and infection of health care workers could be greatly reduced while providing high levels of care. The provided recommendations, which may evolve over time, could be used as broad guidance for all health care workers who are involved in the care of patients with COVID-19.

JAMA Otolaryngol Head Neck Surg. doi:10.1001/jamaoto.2020.0780
Published online March 31, 2020.

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Babak Givi, MD, Department of Otolaryngology–Head and Neck Surgery, NYU Langone Health, 160 E 34th St, 7th Floor, New York, NY 10016 (babak.givi@nyulangone.org).

The coronavirus disease 2019 (COVID-19) pandemic has put unprecedented challenges on the medical community. Physicians and other health care workers who perform and participate in examinations and procedures within the head and neck region and airway are at particularly high risk of exposure and infection from aerosol and droplet contamination. Specific data on the risk of infection in otolaryngologists–head and neck surgeons are not available. However, one of the earliest reports from Wuhan, China, where severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first identified, found 40 health care workers among the first consecutive 138 patients hospitalized.¹ During the severe acute respiratory syndrome (SARS) outbreak of 2003 in Canada, 51% of the 438 cases were health care workers, and 3 died from SARS-related causes.² While the figures are worrying, other data suggest that through the use of careful hygiene, health care workers can stay safe. A case report of early COVID-19 experience from Singapore³ revealed that none of the 41 health care workers who took care of a

patient with severe pneumonia before their diagnosis of COVID-19 became infected themselves or developed symptoms. These health care workers had been present during intubation and extubation of the patient; they were present for at least 10 minutes at a distance of less than 2 m from the patient, with 85% wearing a surgical mask and the remainder wearing N95 masks.

The preservation of this highly skilled, limited workforce should be a top priority of health care officials and policy makers. At the time of this writing, to our knowledge, no unified, widely agreed-on protocols exist on how to perform a routine examination of the head and neck; office-based rigid and flexible endoscopy of the nose, sinuses, and larynx; tracheostomy; and other common operations. Some health authorities and societies have developed separate guidelines.⁴

This article was prepared in consultation with otolaryngologists–head and neck surgeons and other health care workers in the US, Asia, and Europe, applying existing guidance from the infection control specialty to physicians potentially at risk from exposure to the

head and neck of infected patients. As the available information evolves, we expect to modify these guidelines. We expect that each health authority or organization will make specific decisions appropriate to their community. These recommendations have been developed to give broad guidance to practitioners. Per the US Centers for Medicare & Medicaid Services, the following factors should be considered when determining whether a planned examination or surgical procedure should proceed: current and projected COVID-19 cases in the facility and region; supply of personal protective equipment (PPE), beds, ventilators, and staff in the facility and system; health and age of the patients, especially given the risks of SARS-CoV-2 infection during recovery; and urgency of the procedure.⁵ Here, we highlight common procedures that should be considered and provide a framework on which to base decisions using the best available evidence. As this is a highly fluid situation, it is likely that these recommendations will change based on emerging evidence, the infection burden, availability of the health care workforce, and medical infrastructure.

General Considerations

General Care of Otolaryngologic Patients

Head and neck examinations are considered high risk in patients with suspected or confirmed COVID-19; therefore, we recommend the following guidelines. Depending on the current circumstances of the local setting, such as the rate of community spread and case doubling time, routine, nonurgent appointments should be postponed to limit the chance of SARS-CoV-2 infection of patients or health care workers during their visit to the facility. This may include postponing appointments for patients with benign disease (eg, benign salivary or thyroid tumors, hyperparathyroidism) or patients undergoing routine surveillance visits after treatment for head and neck cancer. In all instances, patients should be queried by telephone about any new or concerning signs or symptoms that may suggest disease recurrence and/or pending issues, such as severe dysphagia or airway compromise, as well as current symptoms suggestive of COVID-19. Patients thought to be at risk for significant negative outcomes without evaluation should be offered an in-person clinic visit. Those with symptoms suggesting possible COVID-19 should be directed to the appropriate self-care or triage mechanism. The use of telephone, video, or telemedicine visits should be considered to maintain relationships with patients and to support assessments that can be made without an in-person physical examination. Only patients who need a thorough head and neck examination should be seen in person.

Use of Powered Air-Purifying Respirators vs N95 Masks

In the literature, conflicting practices can be seen regarding the use of N95 masks and tight-fitting goggles or the use of powered air-purifying respirators (PAPRs).^{6,7} PAPRs reduce the risk of exposure more than N95 masks, but how much more they reduce the risk depends on the airflow setting. The assigned protection factor range is 25 to 1000 for PAPRs and 10 for N95 masks.⁸ The most common concern about using PAPRs is their effect on the sterile field during surgery, as they do not filter the discharged air, but there are few data on the infection risk compared with other methods or in combination with the use of a mask. Nearly as important, they are also

cumbersome to use. They can limit visibility if they fog up, make using a headlight impossible, and, if the hooded type is used, render the use of a stethoscope impossible. Donning and doffing are opportunities for self-exposure. However, ill-fitting N95 masks also increase the risk of exposure and thus carry their own disadvantages. Decisions about which protection to use may depend on the settings, risks, and logistics.⁹ Practicing the planned tasks in the use of PAPRs if they are to be used is important.

The Otolaryngology–Head and Neck Physical Examination and Associated Procedures

General Examination

Head and neck examination that will include the mucous membranes should be performed by maintaining the suggested level of precaution (Table). The examination preferably should be performed in a separate room away from other patients, and only the necessary personnel should be present. The examination should be performed by the most experienced person present and might be a more focused assessment, based on the judgment of the examining physician. Proper doffing and disposal of PPE are of utmost importance.

Endoscopic Examinations of the Mucosa of the Head and Neck

Endoscopic examinations of the nose, sinuses, oropharynx, hypopharynx, and larynx are among the most common head and neck diagnostic procedures and are routinely performed by a wide variety of practitioners and trainees. They are considered aerosol-generating procedures.¹⁰ Moreover, the nose and nasopharynx have been shown to be reservoirs for high concentrations of the SARS-CoV-2 virus,¹¹ and after manipulation, viral particles have been shown to be airborne for 3 hours or more.¹² Therefore, we recommend the same precautions be adopted for mucosal surface endoscopic examinations of the head and neck as for other aerosol-generating procedures.

Examinations should be limited to patients who have a clear indication and need. Again, the examination should be performed by the most experienced personnel available in an expedient fashion. Routine or lower-priority examinations should be deferred during the pandemic. Patients should be placed in private rooms with negative pressure, if available, and the use of PPE should follow the guidance of the Table.

Specific recommendations additionally include the following:

1. In awake patients, adequate topical preparation to make the examination more comfortable is important. However, use of sprays should be avoided. Carefully placed pledgets should be used to provide decongestion and anesthesia.
2. Topical anesthesia for any office-based intervention of the larynx under the guidance of a laryngoscope or strobolarngoscope is performed through application of a spray. This is considered high risk; therefore, office-based biopsy, injection, laser, or other procedures should be delayed if possible.
3. If a video screen is available to project the examination, it should be used to keep the patient's and health care worker's faces apart.
4. Disposable endoscopes may be considered.
5. After completion of the examination, the endoscope must be appropriately handled. The endoscope should not be removed from the examination room without a protective cover.

Table. Summary of Head and Neck Examination and Procedure Recommendations^a

Risk and definition	Patient wears	Clinician/staff wear
Nonprocedure encounters in non-immune-compromised patients		
High risk to clinician: any examination in: <ul style="list-style-type: none"> • Patients with active SARS-CoV-2 infection • Patients with influenzalike symptoms • Patients under evaluation for SARS-CoV-2 infection 	Surgical mask	<ul style="list-style-type: none"> • Single-use N95 mask • Goggles or face shield • Gown • Gloves
Moderate risk to clinician: examination of ear, nose, mouth, or throat in asymptomatic patients	Nothing ^b	<ul style="list-style-type: none"> • Surgical mask with face shield to allow for reuse of mask • Gloves
Low risk to clinician: other examination in asymptomatic patients	Nothing ^b	<ul style="list-style-type: none"> • Mask optional • Gloves
Aerosol-generating interventional procedures		
Procedures including but not limited to the following: Intubation, extubation, office-based nasal and laryngeal endoscopy, bronchoscopy, gastrointestinal endoscopy, drainage of peritonsillar abscess, placement of nasal packing, foreign body management in the nose or airway, tracheostomy, tracheostomy care, powered instrumentation in mucosal head and neck surgery, possibly laparoscopic surgery		
High risk to clinician: consider delaying or discussing the following: <ul style="list-style-type: none"> • Patients with active SARS-CoV-2 infection • Patients with influenzalike symptoms • Patients under evaluation for SARS-CoV-2 infection 	Surgical mask	<ul style="list-style-type: none"> • PAPR or single-use N95 mask and goggles or face shield • Gown • Double gloves
Low risk to clinician: <ul style="list-style-type: none"> • Patients who are asymptomatic and untested or SARS-CoV-2 negative in 48 h preceding surgery • If possible, test patients within 48 h of procedure 	Nothing ^b	<ul style="list-style-type: none"> • N95 mask and eye protection (may be appropriate to reuse; must use face shield to allow reuse) • If unavailable, surgical mask with goggles or face shield • Gown • Double gloves
Non-aerosol-generating interventional procedures		
Soft tissue surgery exposes blood, which can have a viral count, but unless the blood is aerosolized by the use of energy devices, it would be expected to be lower risk. Suctioning away smoke and aerosolized tissue is recommended. To our knowledge, the infectiousness of aerosolized blood with SARS-CoV-2 is not yet known.		
High risk to clinician: consider delaying or discussing in: <ul style="list-style-type: none"> • Patients with active SARS-CoV-2 infection • Patients with influenzalike symptoms • Patients under evaluation for SARS-CoV-2 infection 	Surgical mask	<ul style="list-style-type: none"> • Single-use N95 mask • Goggles or face shield • Gown • Gloves
Low risk to clinician: patients who are asymptomatic or SARS-CoV-2 negative in last 48 h	Nothing ^b	<ul style="list-style-type: none"> • Surgical mask • Goggles or face shield • Gown • Gloves

Abbreviations: PAPR, powered air-purifying respirator; SARS, severe acute respiratory syndrome; SARS-CoV-2, SARS coronavirus 2.

^a Adapted and updated with permission from Stanford Health Care. Recommendations are subject to change as more data become available.

^b If the patient is immune compromised (receiving active chemotherapy,

radiotherapy, or immunotherapy; <1 y after solid organ transplant; receiving chronic immunosuppression therapy; pregnant), both the patient and clinician should wear a surgical mask unless the patient is high risk. Clinicians and staff should wear a face shield over a surgical mask to allow reuse of the mask.

Commonly Performed Otolaryngology Procedures

Procedures Commonly Performed Outside the Operating Room

These inpatient, emergency department, and outpatient otolaryngology procedures should be handled differently during the pandemic. Adequate education of health care workers is essential. The following are examples of procedures that in this setting are considered high risk:

- Routine suctioning of patients with a tracheotomy.
- Nasal packing placement, removal, or manipulation.
- Drainage of peritonsillar abscesses. Consider avoiding through the use of antibiotic management or needle drainage instead of open drainage.
- Attempted foreign body removal. Deferring may not be possible. If the location is such that it will be particularly challenging to access in an awake patient or if the individual is particularly intolerant of manipulation, performing the removal under general anesthesia may be necessary.

Operative Procedures—General Considerations

A number of head and neck, otolaryngologic, and oral surgery procedures are high risk owing to exposure of airway and mucosal

surfaces and the possibility of generating aerosols. During the pandemic, based on the guidelines of national and state authorities, all elective procedures that can be safely postponed should be delayed. If an operative procedure involving the mucosa of the head and neck is planned, the following considerations are recommended.

COVID-19 Status

If possible, determine the COVID-19 status of the patient beforehand. If a patient tests positive, a careful assessment of risk to the patient and health care workers should be performed by a multidisciplinary team before the operation is recommended. Operating on mucosal surfaces in a patient who is actively infected generates a great risk for the entire operating room and recovery units and may compromise the patient's ability to recover from the infection.

Operating Room Setting

High-risk operations or operations in patients with known COVID-19 should be performed in a designated operating room with negative pressures.¹³ Unprotected health care personnel should not be allowed in a room where an aerosol-generating procedure is being or has been conducted. If a patient is known or suspected to have COVID-19, appropriate PPE must be worn by all.

High-Risk Procedures

Considering the high viral titers in nasal mucosal, oral, pharyngeal, and pulmonary secretions, any operation that involves these surfaces is high risk to the entire operating room personnel. To our knowledge, bloodborne transmission has not been documented, but aerosolization of blood through the use of energy devices used for control of bleeding and in dissection has been documented.¹⁴ These procedures should be considered higher risk. This includes the use of powered devices (eg, drills, microdebriders, saws) or ultrasonic shears, such as the Harmonic scalpel (Ethicon) or Thunderbeat scalpel (Olympus).

If a high-risk operation is indicated during the pandemic in a SARS-CoV-2–negative patient or a patient without symptoms or contact, appropriate PPE for all operating room staff is strongly recommended. Observed levels of community disease will not reflect the full prevalence.

Intubation and Extubation

In all operations, coordination with the anesthesia team is critical. It is advisable that during intubation, all nonessential staff leave the room and only return after the airway is secured. Additionally, all nonessential staff should be out of the room during extubation. Anybody who is present should maintain appropriate PPE. In some centers, an interval equivalent to known air exchange times for that operating room is practiced before other personnel are allowed to enter. Jet ventilation procedures pose a particularly high risk and should be performed only under absolute necessity and with appropriate PPE, preferably in a negative-pressure room.

Patient Transport

Adequate protection during the transfer of SARS-CoV-2–positive patients or patients of unknown infection status after a high-risk procedure is critical. Clear protocols should be established with the nursing staff, recovery unit personnel, anesthesia department, and infection control personnel. Nonintubated patients could be transferred while wearing a surgical mask (not an N95 mask) if tolerated. If oxygen is required, it can be administered by face mask over the surgical mask. Intubated patients should be transported with an intensive care unit ventilator (dry circuit, filter in place) and not with a bag-valve mask, which breaks the closed circuit. Appropriate PPE should be maintained by all health care workers participating in the transfer.

Operative Procedures—Specific Procedures and Scenarios**Endoscopic Sinonasal and Skull Base Surgery**

Endoscopic nasal operations, including sinus surgery and transphenoidal pituitary surgery, are very high-risk procedures. In general, these procedures should be postponed in patients with COVID-19 or those who cannot be tested. In negative patients, PPE for all operating room staff is recommended as per the Table.¹⁵

Thyroidectomy and Neck Procedures

Procedures that do not expose mucosal surfaces are lower risk, with the caveat that the use of energy devices can result in aerosolization of the virus from the bloodstream or other gastrointestinal secretions. Patients with COVID-19 are likely to have the virus in their bloodstream and feces, based on the experience with SARS, which is also caused by a coronavirus.^{16,17}

Ear Surgery

It is not known if the respiratory mucosa lining the middle ear and mastoid air cell system is involved in COVID-19. But because the rest of the airway is involved, it appears likely that the lining of the eustachian tube, middle ear, and mastoid air cell system are all contaminated.^{18,19} Drilling through the mastoid creates droplets and aerosols in significant clouds that, if the virus is present, could risk infecting everyone in the operating room environment. As contaminated mists harbor viable virus for several hours, especially in enclosed spaces, caution is warranted. Mastoidectomy therefore is considered a high-risk procedure. Ideally, any patient undergoing any ear surgery should be tested for COVID-19 preoperatively. If a patient is positive, surgery should be delayed until the patient has cleared the disease.

Management of Facial Trauma

Management of trauma patients should be led by the trauma management team. Physicians who are called to assess trauma patients or perform specific procedures in areas of high community spread should be equipped with adequate PPE based on the trauma center policies. After following the trauma triage protocol, if assessment and treatment of facial trauma is needed, our recommendation is to treat patients of unknown COVID-19 status as COVID-19 positive. Lacerations that involve mucosal surfaces should be treated as high risk. For injuries that require operative intervention (for example, reduction of fractures), the infection status of the patient should be confirmed first and then definitive treatment initiated if at all possible. In areas with significant shortage of medical capacity and personnel, nonoperative approaches should be considered as much as medically acceptable.

Tracheostomy

Performing tracheostomy on patients with suspected or confirmed COVID-19 imposes unique challenges on not only otolaryngologists–head and neck surgeons but the entire health care team.²⁰ In nonemergency situations, all cases should be reviewed by a multidisciplinary team, and the risks vs benefits of the procedure for the patient and the entire health care team should be carefully assessed. Additionally, a detailed postprocedure care plan should be established to ascertain the protection of other patients and health care workers. The accompanying article by Tay et al⁶ outlines many of these considerations. In general, most tracheostomy procedures should be avoided or delayed (even beyond 14 days) because of the high infectious risks of the procedure and subsequent care until such time as the acute phase of infection has passed, when the likelihood of recovery is high, and when ventilator weaning has become the primary goal of care. Avoiding early tracheostomy in patients with COVID-19 is suggested because of the higher viral load that may be present at this time. In addition, early tracheostomy was not found to be associated with improved mortality or reduced length of intensive care unit stay in a randomized clinical trial of patients on mechanical ventilation.²¹

We suggest the following additional guidelines:

1. Select the patients carefully. If the tracheostomy is assessed as difficult because of anatomy, history, comorbidities, or other factors, consider postponing the procedure.
2. Consideration may be given to percutaneous dilatational tracheostomy if the patient's anatomy and proceduralist expertise

- allow it to be done safely with minimal or no bronchoscopy, endotracheal suctioning, and disruption of the ventilator circuit.
3. Provide adequate sedation including paralysis to eliminate the risk of coughing during the procedure. Ventilation should be paused (apnea) at end-expiration when the trachea is entered and any time the ventilation circuit is disconnected.
 4. Choose a nonfenestrated, cuffed, tracheostomy tube on the smaller side to make the tracheostomy hole smaller overall (Shiley size 6 for both men and women is adequate). Keep the cuff inflated to limit the spread of virus through the upper airway.
 5. Perform tracheostomy suctioning using a closed suction system with a viral filter.
 6. Use a heat moisture exchanger device instead of tracheostomy collar during weaning to prevent virus spread or reinfection of patients.
 7. Avoid changing the tracheostomy tube until viral load is as low as possible.

Conclusions

We acknowledge that these challenging times require extraordinary efforts. Maintaining the health and strength of our clinical workforce is critical to avoiding collapse of our health care system. However, the experience of our colleagues in Singapore and Hong Kong in protecting their health care workers is quite reassuring.²² By following carefully planned routines and procedures, we will be able to provide excellent care and help protect the safety and health of our colleagues.

ARTICLE INFORMATION

Accepted for Publication: March 24, 2020.

Published Online: March 31, 2020.
doi:10.1001/jamaoto.2020.0780

Author Affiliations: Department of Otolaryngology, NYU Langone Health, New York, New York (Givi); Department of Otolaryngology, Montefiore Medical Center, New York, New York (Schiff); Department of Otolaryngology, University of Michigan, Ann Arbor (Chinn); Department of Otolaryngology, Oregon Health & Science University, Portland (Clayburgh); Department of Head and Neck Surgery, Singapore General Hospital and National Cancer Centre, Singapore (Iyer); Department of Otolaryngology, Beth Israel Deaconess Medical Center, Boston, Massachusetts (Jalisi); Department of Otolaryngology, Indiana University School of Medicine, Indianapolis (Moore, Parker); Department of Otolaryngology, Louisiana State University, Shreveport (Nathan); Department of Otolaryngology, Stanford University, Palo Alto, California (Orloff); Department of Otolaryngology, Beaumont Hospital, Royal College of Surgeons in Ireland, Dublin, Ireland (O'Neill); Department of Otolaryngology, University of Cincinnati, Cincinnati, Ohio (Zender); Head and Neck Service, Memorial Sloan Kettering Cancer Center, New York, New York (Morris); Department of Veterans Affairs, White River Junction, Vermont (Davies).

Conflict of Interest Disclosures: Dr Morris reported receiving grants from Illumina, Inc. and AstraZeneca outside the submitted work. No other disclosures were reported.

Additional Contributions: We thank our physician, nursing, advanced practice provider, respiratory therapy, administrative, and environmental services colleagues for their extraordinary professionalism and dedication. We gratefully acknowledge the expertise provided by colleagues around the world, including Dr Hui Chen (Department of Otolaryngology-Head and Neck Surgery, Eye and ENT Hospital, Fudan University, Shanghai, China), Dr Filippo Marchi (Department of Otorhinolaryngology-Head and Neck Surgery, Ospedale Policlinico San Martino, University of Genoa, Genoa, Italy), Dr Giacomo Sollini (Department of Otorhinolaryngology-Head and Neck Surgery, Ospedale Bellaria, Bologna, Italy), Dr Nevill Shine (Department of Otolaryngology-Head and Neck Surgery, Royal College of Surgeons in Ireland, Dublin, Ireland), Dr Jason Y.K. Chan (Department of Otorhinolaryngology-Head and

Neck Surgery, Chinese University of Hong Kong), Dr Woei Shyang Loh (Department of Otolaryngology-Head and Neck Surgery, National University Hospital, Singapore), and Drs Mini Kamboj, Richard Wong, and Robert Lee (Memorial Sloan Kettering Cancer Center, New York, New York).

REFERENCES

1. Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China [published online February 7, 2020]. *JAMA*. doi:10.1001/jama.2020.1585
2. Moore D, Gamage B, Bryce E, Copes R, Yassi A; BC Interdisciplinary Respiratory Protection Study Group. Protecting health care workers from SARS and other respiratory pathogens: organizational and individual factors that affect adherence to infection control guidelines. *Am J Infect Control*. 2005;33(2):88-96. doi:10.1016/j.ajic.2004.11.003
3. Ng K, Poon BH, Kiat Puar TH, et al. COVID-19 and the risk to health care workers: a case report. *Ann Intern Med*. 2020. doi:10.7326/L20-0175
4. ENT UK. Guidance for ENT during the COVID-19 pandemic. Accessed March 23, 2020. <https://www.entuk.org/guidance-ent-during-covid-19-pandemic>
5. Siddiqui S. CMS adult elective surgery and procedures recommendations [version 3.15.20]. Accessed March 23, 2020. <https://www.cms.gov/files/document/31820-cms-adult-elective-surgery-and-procedures-recommendations.pdf>
6. Tay JK, Khoo ML-C, Loh WS. Surgical considerations for tracheostomy during the COVID-19 pandemic: lessons learned from the severe acute respiratory syndrome outbreak [published online March 31, 2020]. *JAMA Otolaryngol Head Neck Surg*. doi:10.1001/jamaoto.2020.0764
7. Roberts V. To PAPR or not to PAPR? *Can J Respir Ther*. 2014;50(3):87-90.
8. Institute of Medicine. *The Use and Effectiveness of Powered Air Purifying Respirators in Health Care: Workshop Summary*. National Academies Press; 2015.
9. Wax RS, Christian MD. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients [published online February 12, 2020]. *Can J Anaesth*. doi:10.1007/s12630-020-01591-x
10. US Centers for Disease Control and Prevention. Interim infection prevention and control recommendations for patients with suspected or confirmed coronavirus disease (COVID-19) in healthcare settings. Accessed March 23, 2020. <https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html>
11. Zou L, Ruan F, Huang M, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. *N Engl J Med*. 2020;382(12):1177-1179. doi:10.1056/NEJMc2001737
12. van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1 [published online March 17, 2020]. *N Engl J Med*. doi:10.1056/NEJMc2004973
13. American College of Surgeons. COVID-19: guidance for triage of non-emergent surgical procedures. Accessed March 23, 2020. <https://www.facs.org/covid-19/clinical-guidance/triage>
14. Zheng MH, Boni L, Fingerhut A. Minimally invasive surgery and the novel coronavirus outbreak: lessons learned in China and Italy [published online March 15, 2020]. *Ann Surg*. Accessed March 23, 2020. <https://journals.lww.com/annalsurgery/Documents/Minimally%20invasive%20surgery%20and%20the%20novel%20coronavirus%20outbreak%20-%20lessons%20learned%20in%20China%20and%20Italy.pdf>
15. Patel ZM, Hwang PH, Nayak JV, et al. [Statement from Stanford University School of Medicine Departments of Otolaryngology-Head and Neck Surgery and Neurosurgery]. Accessed March 23, 2020. <https://www.docdroid.net/AyUBOji/covid-19-information.pdf>
16. Isakbaeva ET, Khetsuriani N, Beard RS, et al; SARS Investigation Group. SARS-associated coronavirus transmission, United States. *Emerg Infect Dis*. 2004;10(2):225-231. doi:10.3201/eid1002.030734
17. Ding Y, He L, Zhang Q, et al. Organ distribution of severe acute respiratory syndrome (SARS) associated coronavirus (SARS-CoV) in SARS patients: implications for pathogenesis and virus transmission pathways. *J Pathol*. 2004;203(2):622-630. doi:10.1002/path.1560
18. Pitkäranta A, Virolainen A, Jero J, Arruda E, Hayden FG. Detection of rhinovirus, respiratory syncytial virus, and coronavirus infections in acute otitis media by reverse transcriptase polymerase

chain reaction. *Pediatrics*. 1998;102(2, pt 1):291-295. doi:10.1542/peds.102.2.291

19. Heikkinen T, Thint M, Chonmaitree T. Prevalence of various respiratory viruses in the middle ear during acute otitis media. *N Engl J Med*. 1999;340(4):260-264. doi:10.1056/NEJM199901283400402

20. Murthy S, Gomersall CD, Fowler RA. Care for critically ill patients with COVID-19 [published

online March 11, 2020]. *JAMA*. doi:10.1001/jama.2020.3633

21. Young D, Harrison DA, Cuthbertson BH, Rowan K; TracMan Collaborators. Effect of early vs late tracheostomy placement on survival in patients receiving mechanical ventilation: the TracMan randomized trial. *JAMA*. 2013;309(20):2121-2129. doi:10.1001/jama.2013.5154

22. Gawande A. Keeping the coronavirus from infecting health-care workers: what Singapore's and Hong Kong's success is teaching us about the pandemic. *The New Yorker*. March 21, 2020. Accessed March 23, 2020. <https://www.newyorker.com/news/news-desk/keeping-the-coronavirus-from-infecting-health-care-workers>