Precautions for Operating Room Team Members During the COVID-19 Pandemic

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BACKGROUND: The novel coronavirus SARS-CoV-2 (COVID-19) can infect healthcare workers. We developed an institutional algorithm to protect operating room team members during the COVID-19 pandemic and rationally conserve personal protective equipment (PPE).

STUDY DESIGN: An interventional platform (operating room, interventional suite, and endoscopy) PPE taskforce was convened by the hospital and medical school leadership and tasked with developing a common algorithm for PPE use, to be used throughout the interventional platform. In conjunction with our infectious disease experts, we developed our guidelines based on potential patterns of spread, risk of exposure, and conservation of PPE.

RESULTS: A decision tree algorithm describing our institutional guidelines for precautions for operating room team members was created. This algorithm is based on urgency of operation, anticipated viral burden at the surgical site, opportunity for a procedure to aerosolize virus, and likelihood a patient could be infected based on symptoms and testing.

CONCLUSIONS: Despite COVID-19 being a new threat, we have shown that by developing an easy-to-follow decision tree algorithm for the interventional platform teams, we can ensure optimal health care worker safety. (J Am Coll Surg 2020;230:1098−1101. © 2020 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

The novel corona virus SARS-CoV-2 (COVID-19) was identified in early December in Wuhan, China.[1] On January 20, 2020, the first case was reported in the US.[2] By March 9, the Centers for Disease Control and Prevention released special guidance for Santa Clara County, CA recommending cessation of elective surgical practices.[3] The Santa Clara County Public Health Department issued a shelter-in-place order on March 16, 2020 to improve social distancing and decrease the potential for spread of COVID-19.[4] This unprecedented pre-emptive public health intervention was one of the first such orders in the US, and was followed by a statewide shelter-in-place order on March 19, 2020.[5] At this time in our institution, we had between 5 and 10 hospitalized patients infected with COVID-19. In anticipation of the predicted surge of patients infected with COVID-19 and the need to rationally use personal protective equipment (PPE) while continuing to provide urgent and emergency surgical interventions, we developed institutional guidelines

for precautions for operating room team members during the COVID-19 pandemic. While the preponderance of evidence suggests that COVID-19 is droplet spread, some literature supports spread by aerosol.[6,7] In conjunction with our infectious disease experts, we developed our guidelines based on potential patterns of spread, risk of exposure, and conservation of PPE.

METHODS

An interventional platform (operating room, interventional suites, and endoscopy) PPE taskforce was convened by the hospital and medical school leadership and tasked with developing a common algorithm for PPE use, to be used throughout the interventional platform. This taskforce comprised members from each interventional stakeholder group. The goal was to have these guidelines created by the PPE taskforce, ratified by hospital leadership, and implemented across the interventional platform within 72 hours. Before beginning work on the algorithm, a set of guiding principles were agreed upon to ensure common vision throughout the process (Table 1).

We reviewed current data describing COVID-19 transmission in the hospital and nonhospital settings.[6-9] PPE taskforce members relied on existing published decision-making algorithms and assessments of operating room

Abbreviations and Acronyms	
AGP	= aerosol-generating procedure
CAPR	= controlled air purifying respirators
COVID-19	= novel coronavirus 2019
PPE	= personal protective equipment
PUI	= patient under investigation
RT-PCR	= reverse transcription-polymerase chain reaction
SARS	= severe acute respiratory syndrome

risk developed during outbreaks associated with severe acute respiratory syndrome (SARS) and Ebola virus disease.[10-12] The draft algorithm was then vetted by experts from infection control and infectious disease, and approved by hospital leadership to ensure accuracy and compliance with institutional best practice. Usability was assessed by feedback from healthcare providers in our institution. We reviewed our current and anticipated PPE on hand, developed predictive models for our current use rate and the implications of implementation of our guidelines to PPE days on hand.

RESULTS

A decision tree algorithm describing our institutional guidelines for precautions for operating room team members was created (Fig. 1). The underlying assumption was that every patient is potentially infected with COVID-19 until proven otherwise. This assumption is based on growing community spread of COVID-19, which placed the burden for ruling out infection on the healthcare team. Patients were initially triaged by acuity into urgent and emergency procedures. No guidance was provided for elective procedures, as these had been stopped in accordance with county order.[4] Rapid testing for COVID-19 virus was not possible for emergency procedures. We assumed all patients undergoing emergency procedures to be infected by COVID-19 until proven otherwise. The PPE requirement for the entire team managing emergency cases is to don a fitted N95 respirator mask in addition to droplet PPE (gown, gloves, eye protection).

Urgent cases were stratified into high- and low-risk procedures, depending on the anticipated viral burden at the surgical site and the likelihood that a procedure would aerosolize virus, classified as aerosol-generating procedures (AGP). All AGP of the aerodigestive tract (nasopharyngeal, oropharyngeal, tracheal, lung) were considered high risk given the known viral load in these areas and potential for aerosolization, consistent with previous experience with SARS.[1,13-15] COVID-19 virus RNA had been documented in the gastrointestinal tract.[16] Given the

potential for aerosolizing intraluminal contents during endoscopy, this was considered a high-risk AGP. Similarly, due to extended contact with potentially high levels of virus despite a lower risk of creating aerosol, open or laparoscopic surgery on the bowel in the presence of gross contamination was also considered a high-risk AGP.

Patients were stratified based on their risk of having active infection. For patients who screened positive for symptoms (fever, cough, sore throat), the surgeon would consider delaying the operation. If surgical delay would result in unacceptable risk, then any patient with positive symptoms would undergo urgent reverse-transcription polymerase chain reaction (RT-PCR) testing. If a patient's operation was unable to be delayed for testing, then the patient would be re-triaged into the emergency category and presumed COVID+. We decided to make RT-PCR testing of symptomatic patients mandatory given the availability of in-house testing at our institution, with the caveat of a 24-hour turn around. If a patient tested positive, operation would proceed after approval by surgical, anesthesia, and hospital leadership. For these COVID+ patients, all members of the operating room are required to don a fitted N95 respirator mask with droplet attire (gown, gloves, and eye protection). For symptomatic patients who test negative by RT-PCR, operating room team members would use standard surgical attire.

Bag mask ventilation and endotracheal intubation are deemed as AGP, with a high-risk for virus transmission, irrespective of the COVID-19 status of the patient. In the unlikely event that a patient is both asymptomatic and tests false-negative, we recommend donning fitted N95 respirators and face shields for intubation and extubation, at a minimum. The face shield will protect the N95 from droplet contamination and allow for safe reuse on multiple patients. This is an important part of our conservation strategy. Additionally, we stipulated that all

Table 1. Guiding Principles and Considerations for Creation of a Personal Protective Equipment Use Algorithm for Patients Undergoing Intervention

Consideration
Healthcare worker safety
Patient safety
Risk of procedure to transmit virus from infected patient to healthcare worker
Anticipated PPE stock, surge burn rate, and opportunity for resupply
Risk of patient having COVID-19
Institutional access to laboratory testing

COVID-19, novel coronavirus 2019; PPE, personal protective equipment.
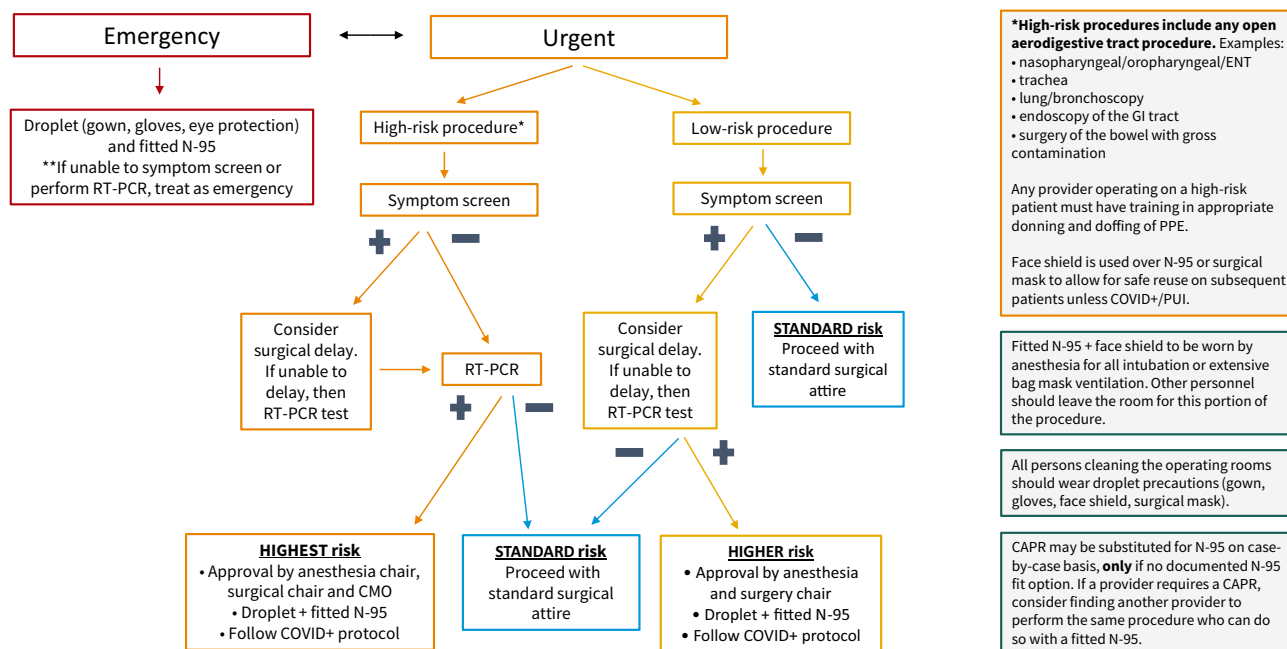
Figure 1. Algorithm describing institutional precautions for operating room team members (surgeons, nurses, technicians). CAPR, controlled air purifying respirator; CMO, chief medical officer; COVID, novel coronavirus 2019; GI, gastrointestinal; PPE, personal protective equipment; PUI, patient under investigation; RT-PCR, reverse transcription polymerase chain reaction.

providers not directly involved with intubation leave the operating room before intubation and extubation. To protect our cleaning staff at the conclusion of an operation, we stipulated droplet precautions for all cleaning personnel.

At the time these guidelines were created, we had few controlled air purifying respirators (CAPRs). To address this supply challenge, we stipulated that a CAPR could be substituted for an N95 on a case-by-case basis; a CAPR would be allowed only if the provider failed N95 fit test and no other provider fitted for N95 could provide a similar level of service. During the algorithm creation process, there was a nationwide critical shortage of N95 masks. In an attempt to conserve the N95 masks, we mandate face shields to be placed over the N95 mask. At the completion of the case, the face shield can be disinfected and the N95 mask can be re-used for non-COVID patients or patients under investigation (PUI). Finally, education and training on proper donning and doffing of PPE is crucial for healthcare worker safety. Improper doffing, in particular, can be a high-risk procedure for healthcare workers.[17,18] We instituted mandatory training on proper donning and doffing of PPE for all healthcare workers, in addition to a donning and doffing buddy system for healthcare providers when managing COVID or PUI patients.[17]

It is important to note that our patient risk-stratification algorithm is dependent on both symptomatology and the ability to perform RT-PCR to determine a patient's infection status, recognizing the false negative rate of the test and concern for asymptomatic transmission. Because access to rapid testing is variable, any institutions adopting these guidelines will need to adjust them to reflect local testing availability. Similarly, PPE availability, anticipated PPE use rates, and supply-chain disruptions may require modification of the algorithm.

CONCLUSIONS

The current COVID-19 pandemic has necessitated rapid development of novel hospital guidelines across a spectrum of clinical environments. Despite COVID-19 being a new threat, we have shown that by developing an easy-to-follow decision tree algorithm for the interventional platform teams, we can ensure optimal healthcare worker safety. This algorithm prioritizes patients based on disease severity, testing status, and symptomology while ensuring rational use of PPE in a resource-constrained setting. The algorithm has been shared with healthcare providers and stakeholders nationwide and is expected to be widely adopted.

REFERENCES

1. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497−506.
2. Holshue ML, DeBolt C, Lindquist S, et al. First case of 2019 novel coronavirus in the United States. N Engl J Med 2020; 382:929−936.
3. Centers for Disease Control and Prevention. CDC's recommendations for 30 day mitigation strategies for Santa Clara County, California, based on current situation with COVID-19 transmission and affected health care facilities. Centers for Disease Control and Prevention; 2020. Available at: https://www.cdc.gov/coronavirus/2019-ncov/downloads/Santa-Clara_Community_Mitigation.pdf. Accessed March 28, 2020.
4. Santa Clara County. Order of the Health Officer of the County of Santa Clara. March 16, 2020. Available at: https://www.sccgov.org/sites/phd/DiseaseInformation/novel-coronavirus/Pages/order-health-officer-031620.aspx. Accessed March 28, 2020.
5. Newsom G. Executive Order N-33-20. March 19, 2020. Executive Department of the State of California. Available at: https://covid19.ca.gov/img/Executive-Order-N-33-20.pdf. Accessed March 28, 2020.
6. van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. N Engl J Med 2020 Mar 17 [Epub ahead of print].
7. Guan W-j, Ni Z-y, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020 Feb 28 [Epub ahead of print].
8. Li Q, Guan X, Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus−infected pneumonia. N Engl J Med 2020;382:1199−1207.
9. Ong SWX, Tan YK, Chia PY, et al. Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient. JAMA 2020 Mar 4 [Epub ahead of print].
10. Tien HC, Chughtai T, Jogeklar A, et al. Elective and emergency surgery in patients with severe acute respiratory syndrome (SARS). Can J Surg 2005;48:71−74.
11. Wren SM, Kushner AL. Surgical protocol for possible or confirmed Ebola cases. American College of Surgeons, Oct 7, 2014. Available at: www.facs.org/ebola/surgical-protocol. Accessed March 28, 2020.
12. McAlister V. Surgery in patients with Ebola virus disease. Can J Surg 2014;57:364−365.
13. 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;382:1177−1179.
14. Lu R, Zhao X, Li J, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet 2020;395:565−574.
15. Caputo KM, Byrick R, Chapman MG, et al. Intubation of SARS patients: infection and perspectives of healthcare workers. Can J Anaesth 2006;53:122−129.
16. Wu Y, Guo C, Tang L, et al. Prolonged presence of SARS-CoV-2 viral RNA in faecal samples. Lancet Gastroenterol Hepatol 2020 Mar 19 [Epub ahead of print].
17. Andonian J, Kazi S, Therkorn J, et al. Effect of an intervention package and teamwork training to prevent healthcare personnel self-contamination during personal protective equipment doffing. Clin Infect Dis 2019;69[Suppl_3]:S248−S255.
18. Suen LKP, Guo YP, Tong DWK, et al. Self-contamination during doffing of personal protective equipment by healthcare workers to prevent Ebola transmission. Antimicrob Resist Infect Control 2018;7:157.