

Peri-procedure Attire in the Age of COVID-19

Uday Jain, B.S.E.E., M.D., Ph.D., FASA

Peri-procedure attire is primarily designed to protect the patient and the provider from infecting each other.

Protecting the provider not only supports a healthy workforce, but also prevents the provider from becoming a vector in disease propagation.

Prior to COVID-19, the focus of most perioperative infection control was protecting the patient from developing surgical site infection (SSI). Since arrival of the COVID-19 pandemic, the focus has shifted toward protecting the provider from contracting COVID-19. This is critically important because healthcare providers are on the front lines of caring for exponentially increasing numbers of patients. Every physician, nurse, or allied healthcare personnel who becomes ill not only deprives patients of a skilled clinician, but also becomes a vector, and potentially a patient, in the burgeoning pandemic. The following discussion is primarily about protection from COVID-19. Protecting the patient from developing SSI is also briefly discussed.

Airborne, Droplet and Contact Isolation

Respiratory droplets from coughing or sneezing are a primary mechanism of transmission of microorganisms including SARS-CoV-2 virus that causes COVID-19 disease. Airway manipulation such as suctioning and extubation generates large amounts of droplets and aerosol. Transmission also occurs via personal contact and fomites. Isolation should be a part of universal precautions with all patients.

It is important to emphasize that droplets, not aerosol, appear to be the primary route of transmission with COVID-19. A patient with active COVID-19 who is breathing quietly is far less likely to infect others than a patient who is coughing. Although the route of transmission is the respiratory tract, touching the eyes readily transmits viruses

to the nasal cavity via the lacrimal ducts. Similarly, touching mucous membranes should be avoided. The best bet is to just not touch your face at all.

Hand Sanitization

The “gel in, gel out” mantra has been drilled into all of us as a routine procedure to prevent nosocomial infection. That hasn’t changed, but the level of paranoia is appropriately increasing because of the risk COVID-19 poses to healthcare providers. PPE contaminated with COVID-19 from the provider’s hands may not prove very helpful. Hand sanitizing should be performed before putting on PPE and after removing it.

Hand sanitizer with 60-95% alcohol or washing with soap and water for at least 20 seconds should be utilized. As a lipid encapsulated RNA virus, COVID-19 is readily destroyed by alcohol and soap.

As always, visibly soiled hands should be cleaned with soap and water before using alcohol-based hand sanitizer.

Scrub Suits

Providers should wear scrub suits made of tightly woven cotton-polyester fabric that is less porous than cotton fabric. Scrubs should cover legs. To reduce shedding of microorganisms, the scrubs should be cuffed and tucked. Scrubs often have pathogenic bacteria on them.¹ Although there is no evidence of reduced SSI with choice of scrubs, colony-forming unit (CFU) bacterial count can be reduced. Non-scrub clothing (e.g., bras, undershirts) should be covered by the scrub suit.²

Reusable versus disposable textiles have similar cost, protection, and comfort. Reusable scrubs are preferable because they provide environmental benefits.³

Personal Protective Equipment (PPE)

PPE guidelines⁴ ANSI/AAMI PB70:2012 are published by The American National Standards Institute (ANSI) and The Association for the Advancement of Medical Instrumentation (AAMI). Anesthesia Patient Safety Foundation (APSF) recommends that anesthesia providers should utilize PPE for all patients during airway and other high-risk procedures. ASA and other organizations have recommended “all anesthesia professionals should utilize PPE appropriate for aerosol-generating procedures for all patients when working near the airway.”⁵

PPE include gown, respirator, eye protection, head, face and shoe covers and gloves⁶ (Figure 1). They provide barrier



Uday Jain, B.S.E.E., M.D., Ph.D., FASA, is Staff Anesthesiologist, San Mateo Medical Center, San Mateo, California.

protection for broken skin and mucous membranes, e.g., eyes, nose and mouth. Sterile PPE are not essential except when performing invasive procedures. PPEs are in short supply, are expensive, and should be used judiciously.

Gloves and gowns reduce SSI. Scrub suits, masks, head and face coverings reduce bacterial counts but there is no evidence that they reduce SSI.²

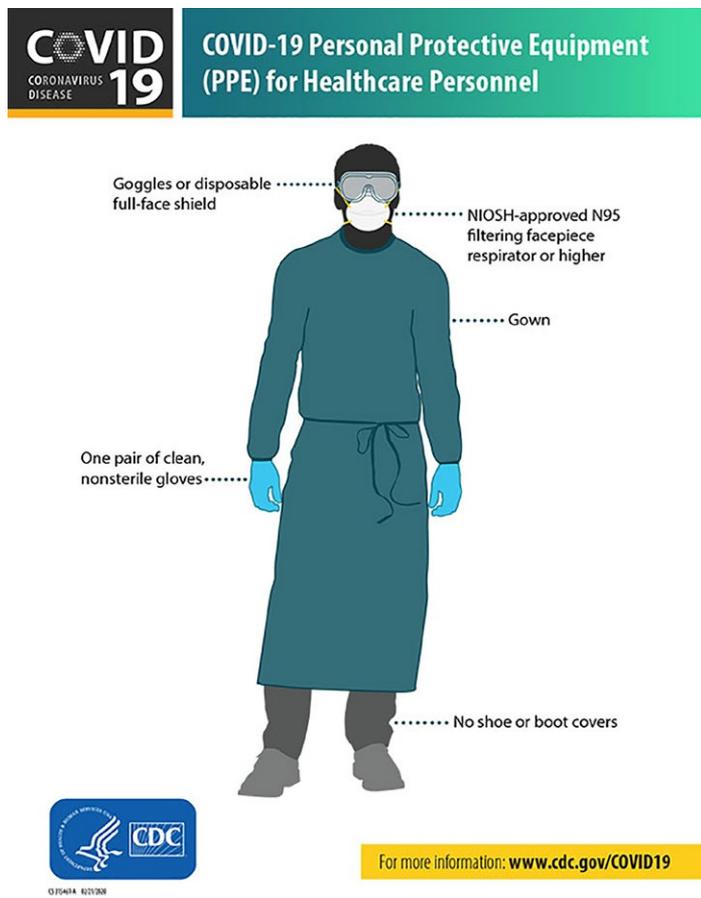


Figure 1: PPE recommended by CDC. Courtesy of CDC.

Gowns

ANSI/AAMI PB70:2012⁴ documents the testing standards for medical gowns. There are four protection levels of gowns. Level 1 gowns only provide splash protection. Level 2 gowns provide splash protection and some resistance to fluid under pressure. Most surgical gowns are level 3, intended to provide protection against fluids under moderate pressure. The highest protection is provided by level 4 gowns, which provide protection against fluids and pathogens. Surgical gowns do not provide protection at the back of the gown, presumably because the surgeon is facing the patient. Isolation gowns differ by applying the standard to both the front and back of the gown.

Prior to COVID-19, the usual hospital recommendation was to utilize isolation gowns with moderate to high barrier protection (Level 3 or 4) if there is medium to high risk of contamination and a large critical zone. In the age of COVID-19, level 4 gowns are preferred.

Head, Face and Shoe Covers

Microorganisms in the hair are difficult to clean. In a contaminated environment, the head and any facial hair should be completely covered. This is typically done with a skull cap or bouffant cap and, if necessary, a beard cover.² Fabric caps and beard covers will not block all virus containing particles. Also, they have not been shown to reduce SSI. Centers for Disease Control and Prevention (CDC) does not recommend shoe covers. Interestingly, the APSF does recommend shoe covers.

Mask/Respirator

Surgical masks are typically worn to protect patients from contamination by the health care provider. Although they are ubiquitous, they have not been proven to reduce SSI. The patient should use a surgical face mask, preferably with a face/eye shield. This partially blocks splashes and droplets, but not aerosol or airborne particles. The mask has leakage around the edges, reducing its effectiveness.

Providers should use a respirator such as N95 particulate filtering facepiece respirator (FFR). (N – not resistant to oil, 95 – captures 95% of particles > 0.3 microns, respirator – filters air). It does not protect against gas or vapor.

There is a shortage of respirators. Extend the use of N95 respirator for several different patients by wearing without removing and covering it with a fresh mask/face shield per patient. Extended use and limited reuse are recommended.⁸⁻⁹

Continued on page 22

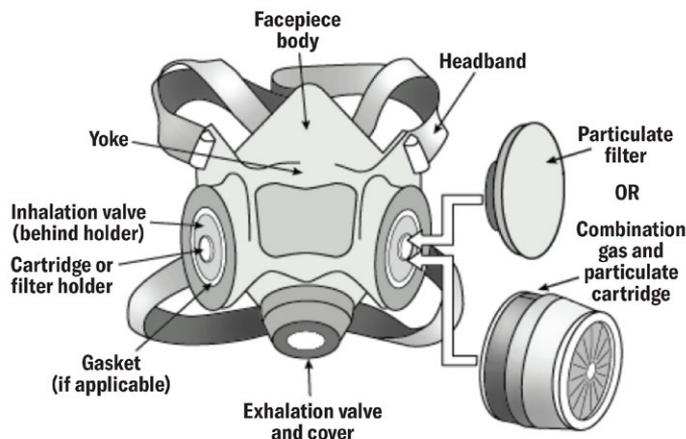


Figure 2: Elastomeric half-facepiece respirator (EHFR). Courtesy of National Academy of Sciences.

Downloaded from <http://pubs.asahq.org/monitor/article-pdf/46/04/20.pdf> by guest on 07 December 2021

N95 respirators manufactured for utilization in construction and manufacturing, but not having FDA approval, may also be used if necessary.

Elastomeric half-facepiece respirator (EHFR) is a tight-fitting respirator made of synthetic or natural rubber¹⁰ (Figure 2). Elastomeric indicates it is rubber-like. Half-facepiece indicates it covers nose and mouth. It can be reused after cleaning and disinfection.

Powered air-purifying respirator (PAPR) (Figure 3) utilizes high-efficiency particulate air (HEPA) P-100 filter (P – oil proof, 100 – captures 99.97% of particles > 0.3 microns).¹⁰ It has a battery-powered air blower. It is loose fitting and hooded or helmeted. No fit testing is necessary. It also protects eyes, face and head. Mask, goggles or cap are not required but may be utilized. PAPR mitigates COVID-19 transmission. PAPR is especially useful if provider breathing is labored, or provider has excess facial hair, or provider requires eyeglasses or surgical telescopes. PAPR is expensive and in short supply. It is reusable after cleaning and disinfection. In settings such as the operating room (O.R.), a PAPR that also covers the back of the head and neck may be preferable to the one that does not.



Figure 3: Powered air-purifying respirator (PAPR).
Photo courtesy of 3M®.

Assigned Protection Factor (APF) is the aerosol concentration outside divided by inside the respirator. For N95 respirator, APF is 10. For EHFR respirator, APF is 10. For PAPR respirator, APF is 25-1000.

Controlled Air Purifying Respirators (CAPR®) are smaller units. CAPR units provide similar protection to PAPR units. However, they do not need the air pump and tubing shown in Figure 3. Instead, CAPR systems include the air ventilation and high efficiency filtration in the headpiece.

It is important to note that PAPR/CAPR systems are not necessary for full protection. A properly seated N95 mask, face shield, and hair/beard cover is adequate, as specified in the standard operating procedures of the Nebraska Biocontainment Unit.



Figure 4: Disposable face shield
Photo courtesy of Sanford News.

Eye Protection

PAPR or tight-fitting goggles should be utilized. Alternatively, a disposable face shield that covers the front and sides of the face may be utilized (Figure 4). Eyeglasses and contact lenses are not adequate, as they may still readily permit contaminated droplets reaching the eyes. Tight-fitting goggles may not work well with eyeglasses or surgical telescopes.

Gloves

Gloves reduce SSI². Avoid nail polish and jewelry on hands.⁷ The CDC does not recommend extended length gloves or routine double gloves.

Gloves are made of polymers of latex or nitrile, rated for thickness, puncture resistance and tensile strength. Natural latex gloves provide better protection against bacteria and viruses but pose a risk of allergic reaction. Nitrile is a synthetic

rubber that is stronger than latex or vinyl. Nitrile gloves present no risk of allergic reaction to latex and are more resistant to needle sticks and abrasions. Bulk nonsterile disposable patient examination gloves are usually made of nitrile.

Vinyl (polyvinyl chloride) gloves are less durable and prone to punctures and tears. Neoprene (polychloroprene) gloves are also used in medical application.



It is important to note that PAPR/CAPR systems are not necessary for full protection. A properly seated N95 mask, face shield, and hair/beard cover is adequate, as specified in the standard operating procedures of the Nebraska Biocontainment Unit.

Donning and Doffing PPE

Donning and doffing PPE is where the “rubber hits the road.” It must be performed exactly right each time to avoid self-contamination. Rather than provide details here, the reader should refer to either institutional guidelines, ASA guidelines found on the ASA’s website, or the standard operating procedures of the Nebraska Biocontainment Unit (NBU).^{11,12} For nearly two decades the NBU has handled the nastiest infection in the world. Although the NBU adopted even more aggressive PPE during for patients with Ebola, they are using the N95 and face shield during the COVID outbreak.

The most important aspect of donning and doffing is performing it exactly to protocol every time. Donning is somewhat less risky, as presumably everything that the health care provider touches is clean and not infectious. However, donning must be done exactly right in anticipation of doffing. The doffing process is where the health care work is at greatest risk of exposure to infectious agents. It should always be done with supervision. It should always be performed exactly as specified in the standard operating procedures. No short cuts! No changing the order of steps! No rush to get out of the PPE! When the PPE is applied exactly per protocol, worn exactly per protocol, and then removed exactly per protocol, then the risk to the health provider can be reduced to nearly zero.

The SOP is the key to PPE!^{11,12} Develop it, adopt it, and then follow it to the letter every time.

References:

1. Wiener-Well Y, Galuty M, Rudensky B, Schlesinger Y, Attias D, Yinnon AM. Nursing and physician attire as possible source of nosocomial infections. *Am J Infect Control*. 2016;39(7):555-559.
2. Salassa TE, Swiontkowski MF. Surgical attire and the operating room: role in infection prevention. *J Bone Joint Surg Am*. 2014; 96(17):1485-1492.
3. Overcash M. A comparison of reusable and disposable perioperative textiles: sustainability state-of-the-art 2012. *Anesth Analg*. 2012; 114(5):1055-1066.
4. ANSI/AAMI PB70:2012. AAMI website. <https://my.aami.org/store/detail.aspx?id=PB70-PDF>. Last accessed March 30, 2020.
5. Update: The use of personal protective equipment by anesthesia professionals during the COVID-19 pandemic [news release]. Schaumburg, IL: American Society of Anesthesiologists; } March 22, 2020. <https://www.asahq.org/about-asa/newsroom/news-releases/2020/03/update-the-use-of-personal-protective-equipment-by-anesthesia-professionals-during-the-covid-19-pandemic>. Last accessed March 30, 2020.
6. Coronavirus (COVID-19). Centers for Disease Control and Prevention website. <https://www.cdc.gov/coronavirus/2019-ncov/index.html>. Last accessed March 30, 2020.
7. Loison G, Troughton R, Raymond F, et al. Compliance with clothing regulations and traffic flow in the operating room: a multi-centre study of staff discipline during surgical procedures. *J Hosp Infect*. 2017;96(3):281-285.
8. The National Institute for Occupational Safety and Health (NIOSH): Pandemic Planning. Centers for Disease Control and Prevention website. <https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextxuse.html>. Last accessed March 30, 2020.
9. Coronavirus (COVID-19) update: FDA and CDC take action to increase access to respirators, including N95s, for health care personnel [news release]. Silver Spring, MD: U.S. Food & Drug Administration; March 2, 2020. <https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-and-cdc-take-action-increase-access-respirators-including-n95s>. Last accessed March 30, 2020.
10. Radonovich L. Elastomeric and powered-air purifying respirators in U.S. Healthcare. <https://www.cdc.gov/niosh/npptl/pdfs/Elastomeric-PAPR-Healthcare-508.pdf>. September 5, 2017. Last accessed March 30, 2020.
11. Donning High Level Personal Protective Equipment (PPE) https://www.nebraskamed.com/sites/default/files/documents/biocontainment/Donning_High_Level_PPE.pdf. Last accessed March 30, 2020.
12. Nebraska Biocontainment Unit – Doffing High Level Personal Protective Equipment (PPE) https://www.nebraskamed.com/sites/default/files/documents/biocontainment/Doffing_High_Level_PPE.pdf. Last accessed March 30, 2020