

Title: Development of a Sterile PPE Donning and Doffing Procedure to Protect Surgical Teams from SARS-CoV-2 Exposure During the COVID-19 Pandemic

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Brief Title: COVID-19: Donning and Doffing of Sterile PPE

Introduction

At the time of this publication there have been 196 countries, territories, or areas with laboratory confirmed cases of Coronavirus Disease 2019 (COVID-19)¹. While the transmission of this novel coronavirus is not entirely understood, live virus has been found in samples obtained from bronchoalveolar lavage, sputum, nasal swabs, bronchial brush biopsies, pharyngeal swabs, feces, and blood². These potential numerous modes of transmission pose an unprecedented threat to healthcare workers all over the world.

Governmental and professional organizations have published guidelines on strategies to conserve personal protective equipment (PPE) during this pandemic, including the Food and Drug Administration and American College of Surgeons Committee on Trauma^{3,4}. The procedural steps for donning and doffing airborne-contact personal protective equipment (PPE) in a standard patient room or Emergency Department setting are well described^{5,6}, including for some extremely virulent microorganisms such as Ebola virus⁷. Despite these easily referenced resources, there is a lack of published guidelines regarding donning and doffing of *sterile* personal protective equipment (PPE) in an operating room environment. While many institutions have curtailed elective procedures in order to conserve resources and limit potential exposures, it is important to recognize that some patients with suspected or confirmed COVID-19 infection will still require emergent procedures and surgical care during this time. During this current pandemic, surgeons and all proceduralists, including scrub staff, should be provided with a standardized procedure in order to protect both themselves and their patients should the need arise for operative or procedural intervention.

Methods

An initial review of the guidelines from CDC, NETEC and WHO, and search of PubMed and Twitter revealed no information specifically about the donning and doffing of airborne-contact PPE for providers performing sterile procedures in the operating room or other procedural suites. A multidisciplinary team of two surgeons, an anesthesiologist and an infection preventionist was assembled to create a process with sterile attire adapted from the NETEC donning and doffing process. The initial checklist was created on a shared file platform (Google Doc) to allow for version control and easy dissemination. Performance of the checklist was simulated in an empty operating room suite with four personnel roles represented: dofficer, surgeon, scrub nurse/tech and circulating nurse. The dofficer was defined as the person assigned to the task of ensuring proper conduct of the procedure. Adaptation of the NETEC protocol⁶ was necessary to account for the transition from non-sterile to sterile zone, and for maximal protection from potential overglove failure during the operation. It was also modified to provide guidance on donning and doffing utilizing various approved forms of protective eye and mask wear, optimized for preservation of the N95 mask in times of scarcity. The process was documented with photographs corresponding to each checklist step. The protocol was reviewed by local infectious disease and infection control experts in Ebola PPE procedures and approved for use at our facility on March 24, 2020. A video education module was produced and disseminated via hospital intranet for provider education. Laminated versions of the checklist were also made available for dofficers.

Protocol

This procedure clarifies the steps for the donning and doffing (removal) of sterile surgical attire for ALL STERILE SURGICAL PERSONNEL (surgeons and the scrub nurse/technologist) who will be scrubbed into operations on COVID-19 presumed and confirmed patients. Expect that donning will take slightly longer than

for standard sterile attire, and that doffing will be more complicated with more **hand hygiene** steps. The importance of the role of “dofficer,” who will coach the person performing these procedures for best adherence, cannot be overstated. Other personnel in OR who are not required to wear sterile attire should wear N95 mask, and follow donning and doffing procedures recommended by CDC⁸.

See next pages, which can be printed, laminated (for decontamination between cases), and used as checklists in operating rooms.

Donning Procedure

(see [Figure 1](#))

Steps 1-5 may be performed prior to arrival in OR area, if desired, but dofficer standing outside OR will check prior to proceeding with step 7. The circulator will take on the role of dofficer at step 10 when OR is entered. The checklist should be read aloud by dofficer to assist in procedure adherence.

- 1. Remove personal items on head/neck (e.g. earrings, necklaces, etc.)
 - a. Eyeglasses can remain on.
 - b. Tip: Long hair should be placed in a braid or bun. A hair band should be used to keep hair away from the face.
- 2. Don cloth OR hat or disposable skull cap
- 3. Don boot covers
- 4. Perform **hand hygiene**
- 5. Don N95 and perform seal check
- 6. Don Bouffant cap
- 7. Don Eye protection (choose from options below) with second mask placed over N95 ([Figure 2](#))*
 - a. Mask with attached face shield (inverted) PLUS simple surgical mask over N95 (for N95 preservation)
 - b. Full face visor (reusable ones acceptable if cleaned in decontamination solution)
 - c. Disposable visor glasses PLUS simple surgical mask over N95 (for N95 preservation)
 - d. Reusable goggles PLUS simple surgical mask over N95 (for N95 preservation)
- 8. Remove ALL communication devices including cell phones and pagers. Remove hospital ID badge. These should be left outside the OR entrance on a table manned by the runner. Clean items with disinfectant wipes.
- 9. Perform **standard surgical scrub** after dofficer confirms good respirator, eye protection and mask fit
- 10. Enter OR (runner can open door if needed)
- 11. Don first pair of sterile gloves (undergloves)
- 12. Don surgical gown with assistance from circulator (circulator in non-sterile PPE⁸)
- 13. Don second pair of sterile gloves over gown cuffs (overgloves)

*second mask donned over N95 only if N95 masks are to be reused after decontamination in times of scarcity

Contamination Event During Surgery

During operation, may exchange overgloves, with scrub nurse/tech changing their overgloves as well. If any other PPE is compromised during the case, remove gown and outer gloves, assess need for removal of visor and/or mask and follow steps in doffing procedure until contamination is resolved, then start over with donning (**must** re-scrub). The N95 mask should only be removed **after** exiting OR.

Doffing Procedure

(see [Figure 3](#))

Circulator will act as dofficer in the operating room and observe/coach through step 12, reading each step aloud from checklist. Steps 1-12 should be performed in the OR.

- 1. Wipe off gross contamination from overgloves with OR towel, dispose in biohazard trash
- 2. Perform **hand hygiene** (will have to use hand gel) over overgloves
- 3. Remove boot covers and dispose in biohazard trash
- 4. Perform **hand hygiene** over overgloves
- 5. Remove gown and overgloves, rolling the gown and gloves together in one unit and dispose in biohazard trash
- 6. Perform **hand hygiene** over undergloves
- 7. Remove visor and place in decontamination solution if reusable, biohazard trash if disposable mask/visor combo. If removing the visor/mask combo, take care to avoid touching the front of the mask. May require assistance from dofficer to remove mask safely.
- 8. Perform **hand hygiene** over undergloves
- 9. Remove outer bouffant and place in biohazard trash
- 10. Perform **hand hygiene** over undergloves
- 11. Remove undergloves and place in biohazard trash
- 12. With runner opening door so as not to touch door, exit OR
- 13. Perform **hand hygiene**, 20 seconds duration with soap and water
- 14. *Remove N95. If reusable type mask, place in bag for decontamination
- 15. Perform **hand hygiene**
- 16. Go to locker room and dispose of scrubs, shower before leaving OR area

*May opt to keep N95 on to preserve mask, follow procedure for reuse and decon if applicable in your hospital

Doffing Procedure for surgeons transporting unstable patient to OR

- 1. Surgeons transport patients into OR already wearing airborne PPE (non-sterile) per ACS COT recommendations⁴.
- 2. Position patient on OR table
- 3. Perform **hand hygiene** on top of gloves
- 4. Remove non-sterile gown and gloves
- 5. Perform **hand hygiene**
- 6. OR Dofficer (circulator) evaluates visor and N95 for fit.
 - a. If adjustment needed,
 - i. Put non-sterile gloves on
 - ii. Doff visor in OR, place in decontamination receptacle if reusable
 - iii. Perform **hand hygiene**
 - iv. Remove gloves
 - v. Exit OR and begin DONNING procedure at Step 3 with Dofficer
 - b. If visor and N95 ok,
 - i. Exit OR and begin DONNING procedure at Step 3

Conclusion

Coronavirus Disease 2019 (COVID-19) is a quickly evolving pandemic that has spread all over the globe. With the rapid increase of infections and the rising number of severely ill individuals, healthcare providers need easy to follow guidelines to keep themselves and patients as safe as possible. Surgeons and the staff who support them in the operating room are a special risk population. Even with postponing or averting elective or even urgent operations, emergent operations, such as those for penetrating and blunt trauma or solid organ transplant, may require entering the respiratory and/or gastrointestinal tract, organ systems which are known to contain live virus in COVID-19 positive individuals². As disease prevalence has increased regionally, surgeons and other proceduralists have been called upon to make difficult decisions about rationing operative interventions due to the risk of exposure and dwindling PPE supplies.

The processes for donning and doffing personal protective equipment (PPE) presented here provide an added measure of safety to surgeons and support staff to provide quality surgical care to positive and suspected positive COVID-19 patients. We have made an effort to document different options for eye protection and preservation of precious N95 masks, recognizing that availability of items in the supply chain is fluid and PPE a scarce resource ([Figure 2](#)). However, the importance of meticulous hand hygiene, and the role of the “dofficer” in ensuring proper PPE fit, donning and doffing in this process cannot be overstated. Prior to the removal of each item of PPE in the doffing process, hand hygiene **MUST** be performed ([Figure 4](#)). While the process may seem straightforward, the stress of the circumstances under which it must be executed and the significant deviation from age-old standard sterile OR practices make the dofficer’s role essential as a coach and safety check.

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Figures

DONNING PROCEDURE



Figure 1. Donning Procedure

Donning procedure of PPE for the sterile OR environment



Figure 2. **PPE Options for Eye and N95 Mask Protection**

Multiple options available to satisfy the three requirements of eye protection, N95 mask preservation, and usability in the OR under sterile conditions. If an integrated visor/mask is employed, it should be inverted on the forehead and a second simple surgical mask can be placed over the N95 for preservation of N95 in times of scarcity⁹. Some may not be suitable for full N95 coverage, especially if reusable N95 half-face masks are used, as they are bulkier than the disposable N95. If an overmask is used instead of a full face shield/visor, the overmask should be doffed prior to removal of the bouffant. Care must be taken not to contaminate the scrub shirt: the circulator can assist in removal of the overmask by untying the lower ties to the mask first (not pictured).

DOFFING PROCEDURE



Figure 3. Doffing Procedure

Doffing procedure of PPE in sterile OR environment

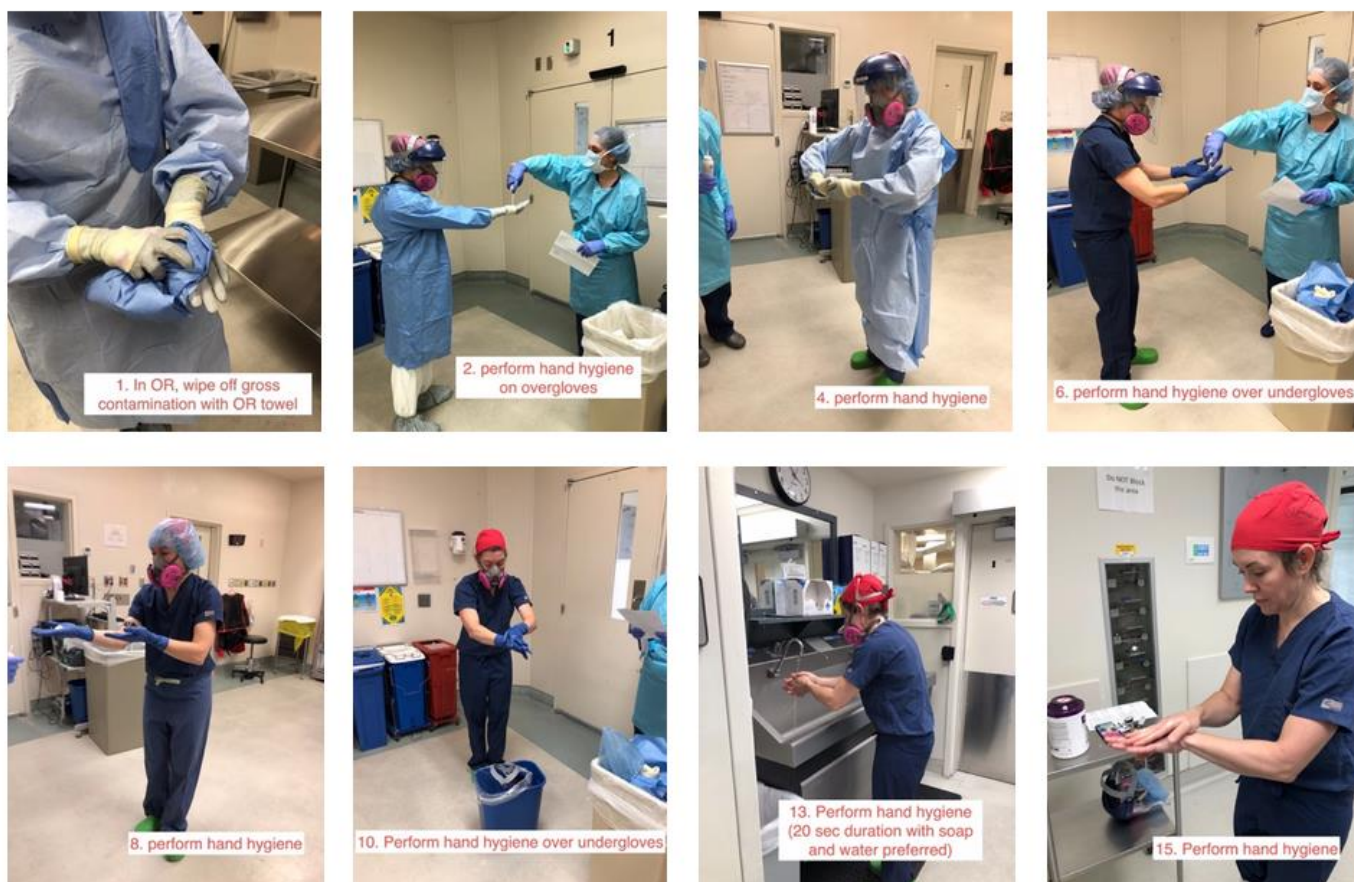


Figure 4. **Doffing Hand Hygiene Steps**

Doffing requires a meticulous attention to hand hygiene. There are 8 separate steps that involve decontamination of the hands, performed prior to removal of every PPE item and at the end of the process. The purpose of this is to decrease viral load at every possibility of contamination.