








Letter to the Editor

Donning and doffing technique for coverall personal protective equipment, is it safe?

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To the Editor—The sudden spread of coronavirus disease 2019 (COVID-19) increased the demand for personal protective equipment (PPE), resulting in shortages.^{1,2} An observational compliance study regarding specific precautions for COVID-19 patients showed that among improper PPE use, 193 of 322 (60.%) were classified as wasteful practices that contributed to the shortage of these products.³

The lack of gowns has ignited a search for alternative PPE such as coveralls. The World Health Organization (WHO) guideline did not recommend coveralls as alternative PPE.² The Centers for Disease Control and Prevention mentioned coveralls as alternative PPE, but it did not recommend standardized donning and doffing techniques in the context of COVID-19.⁴

In this study, in a simulated healthcare environment, we proposed replacing the standard gown by a coverall PPE for healthcare professionals (HCPs) providing assistance to patients suspected or confirmed of COVID-19. We tested the safety of donning and doffing the coverall PPE, and we evaluated the opinions of HCPs regarding its use. This donning and doffing technique was based on and adapted from WHO PPE guidelines on filovirus disease outbreak response.⁵

This experimental study was conducted from July to September 2020 in a Brazilian public university. Researchers produced a video and an educational poster based on the technique proposed. The donning sequence was divided into 8 steps, and the doffing sequence was divided into 12 steps (Supplementary Material online).

The study population consisted HCPs in a teaching hospital who assisted patients suspected or confirmed of COVID-19 and consented to volunteer in the study. Overall, 12 professionals were included in the study: 4 were nurses, 4 were physiotherapists, and 4 were physicians. The tests were simulated at the Skills and Simulation Center of the Federal University of São Paulo, Brazil, on 6 different days.

The HCPs were instructed to wear a scrub suit and to watch the video produced to this study. Nurses simulated intimate hygiene and patient positioning; physiotherapists simulated bag squeezing and early mobilization; and physicians simulated cardiac massage and orotracheal intubation.

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Before each experiment, a fluorescent marker was applied to the simulation dummy and bed surfaces. A poster showing the sequence of donning and doffing the PPE was placed on the wall of the simulation room.

The contaminated sites were assessed using ultraviolet light after patient care and removal of PPE, and each spot of contamination was recorded on a specific form. Additionally, all professionals were photographed and filmed during the following actions: donning the PPE, during the procedure, after the procedure, doffing the PPE, and after doffing the PPE. After the experiment, all HCPs filled out a form about the donning and doffing technique and their personal opinion of the coverall PPE. The data obtained from the forms completed by the researchers were validated by the videos and photos. A descriptive analysis was conducted.

Researchers identified 9 contaminated sites after patient care tasks. Some of the spots were common to almost all HCPs, such as the chest and hands (100%), abdomen and pelvis (11 of 12, 91.7%), and upper limbs (10 of 12, 83.3%). Some sites varied according to the HCP category and the care tasks simulated.

After the removal of PPE, the analysis showed that only 2 HCPs (16.7%) self-contaminated: a hand and a lower limb. The body surface contamination by both HCPs was 11% (1 of 9 sites), which could have been prevented by proper hand hygiene and compliance with the doffing technique (Table 1). Of the 12 HCPs included in the study, 7 HCPs (58.3%) reported difficulty with donning the coverall PPE, specifically during step 3, and 100% reported difficulty doffing the PPE, specifically from the steps 4 to 7. Furthermore, 4 HCPs (33%) found the PPE uncomfortable, but 11 (91.7%) rated it safe.

In the present study, we showed that the contamination sites before removal of PPE were task dependent and varied among the HCP categories. In a Cochrane review, studies included in evaluating PPE donning and doffing techniques proceeded with the direct contamination of PPE and evaluated only the post-doffing contamination.⁶ A study by Chughtai et al⁷ described the risk of self-contamination associated with the doffing of PPE compared 10 protocols recommended for Ebola, showed 13% contamination and, when coveralls were included, the contamination rate was 16.7%. In our study, we found 16.7% contamination, the same rate described by Chughtai et al.

Chen et al⁸ performed a simulation study that evaluated the contamination of 46 frontline nonmedical staff after doffing

Table 1. HCPs Contaminated Sites After Patient Care Tasks Simulation and After Removal of PPE

Sites	HCPs Contaminated Sites After Patient Care Tasks (Before Removal of PPE)								HCPs Sites Contaminated After Removal of PPE							
	Nurses (N=4)		Physiotherapists (N=4)		Physicians (N=4)		Total HCPs (N=12)		Nurses (N=4)		Physiotherapists (N=4)		Physicians (N=4)		Total HCPs (N=12)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Head	0	0	0	0	4 ^b	100	4	33.3	0	0	0	0	0	0	0	0
Neck	1 ^a	25	0	0	0	0	1	8.3	0	0	0	0	0	0	0	0
Chest	4	100	4	100	4	100	12	100	0	0	0	0	0	0	0	0
Abdomen	4	100	4	100	3	75	11	91.7	0	0	0	0	0	0	0	0
Pelvis	4	100	4	100	3	75	11	91.7	0	0	0	0	0	0	0	0
Upper limbs	4	100	4	100	2	50	10	83.3	0	0	0	0	0	0	0	0
Hands	4	100	4	100	4	100	12	100	1 ^d	25	0	0	0	0	1	8.3
Lower limbs	1	25	3	75	4	100	8	66.7	0	0	0	0	1 ^e	25	1	8.3
Back	0	0	2	50	0	0	2 ^c	16.7	0	0	0	0	0	0	0	0

Notes: PPE, personal protective equipment; HCPs, healthcare professionals.

^aAdjusted the mask during the patient care tasks simulation.

^bContamination during the pulmonary auscultation.

^cHCPs touched their backs after simulated patient care tasks.

^dContamination should be avoided with proper hand hygiene after removal of PPE.

^eHCP touched a lower limb during PPE removal.

PPE for COVID-19 (including a coverall). They found that 45.7% of HCPs contaminated their upper chest, 43.5% contaminated their hands, 32.6% contaminated their chest, 13% contaminated their upper limbs, and 10.9% contaminated their lower limbs. However, these researchers did not describe the donning and doffing technique used.⁸ Our results showed 8.3% contamination on the hands and lower limbs.

The body surface contamination rate in the present study was 11%, showing a low risk. We did not find other studies that analyzed these specific data. Chughtai *et al*⁷ evaluated user satisfaction in wearing coveralls, and 20% of HCP reported difficulty in donning PPE and 23% reported difficulty in doffing PPE.⁷ In our study, 58.3% reported difficulty in donning, 100% reported difficulty in doffing, and 91.7% felt safe in their PPE.

Despite the low risk of contamination with this proposed technique, we believe that coverall PPE should not be recommended as a standard for COVID-19 patient assistance, due to the difficulty reported in handling it. However, coveralls can be employed as an alternative to gowns during periods of shortage, like those we have faced during the COVID-19 pandemic, as long as HCPs follow a safe donning and doffing protocols.

Supplementary material. To view supplementary material for this article, please visit <https://doi.org/10.1017/ice.2020.1429>

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