

Knowledge and practices regarding doffing of Personal Protective Equipment among frontline health care workers during COVID-19

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Abstract

Background: Personal Protective Equipment (PPE) has become a widely talked topic due to the recent Corona virus pandemic which was declared a Public Health Emergency of International Concern in March, 2020. The objective of this study was to assess the knowledge and practices regarding doffing of Personal Protective Equipment among front line health care workers in District General Hospital Matara, Sri Lanka.

Method: A total of 279 front line health care workers attached to COVID-19 units in District General Hospital Matara were included in the study consisting of all categories of health care workers.

Results: Majority were nurses (55.2%; n=154) while 33.7% (n=33.7) were medical officers. Only 68.1% (n=190) have received training on how to wear PPE before appointing to work in COVID-19 units. Overall knowledge on types of PPE and doffing practices was >80% and >60% respectively. There was a significant positive association between participating in a training session on PPE and the knowledge on correct doffing practices ($X^2=7.081$; $p=0.012$). A significant number of medical officers did not wear impermeable gowns ($p=0.001$), gloves ($p=0.048$), face shields ($p=0.008$), goggles ($p<0.001$) and boots ($p<0.001$) compared to the other categories taken together. Majority of the participants (46.2%) stated 'shortage of PPE' as the reason for inadequate use of PPE.

Conclusion: Quality and timely training on PPE and continuous availability of PPE are important in reducing transmission of infectious diseases.

Key words: COVID-19, Personal Protective Equipment (PPE), health care workers, knowledge and practices

Introduction

As described by The Occupational Safety and Health Administration (OSHA), personal protective equipment (PPE) are specially designed clothing or equipment used to prevent or minimize contact with hazardous substances in a work place¹. In health care settings, PPE is an essential component to control of infection and safety of workers. PPE acts as a physical barrier and protects the health care worker (HCW) from getting exposed to hazardous materials such as blood, body fluids etc. It prevents transmission of communicable diseases from one person to another. Some of the PPE used in health care settings are face masks, gloves, gowns and goggles. According to OSHA, it is the responsibility of the employer to make appropriate PPE available for employees, ensure that employees are trained on proper handling of PPE and make sure that the employees are properly using the PPE².

PPE has become an important and widely discussed topic due to the recent coronavirus outbreak (COVID-19) which was declared a Public Health Emergency of International Concern (PHEIC) by the World Health Organization (WHO) on 11th March, 2020. Availability and proper usage of PPE became a major concern around the world. WHO and the Center for Disease Control (CDC) released guidelines on rational use of PPE and how to handle shortage of PPE^{3,4}.

In order to get the optimal effectiveness of using PPE, donning (putting on) and doffing (taking off) of PPE should be error-free. Doffing process is relatively more important in preventing transmission to infections than the donning process⁵.


Studies conducted in many parts of the world to assess the knowledge and practices regarding PPE among the health care personnel have found striking results.

A study conducted in a hospital in Chicago to assess the doffing practices of 107 HCWs, using an observation check list, found that 21% removed the gloves incorrectly and 65% removed the gown incorrectly while 26% removed the mask incorrectly. Overall incorrect

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doffing practices was 90%. But the study did not reveal any significant difference in doffing practices among different categories of HCWs ($p=0.79$)⁶.

Another study conducted in University of Pittsburgh, video recorded the donning and doffing of PPE among 65 HCWs, after obtaining their consent. Even knowing they are being videotaped, the percentage of incorrect doffing practices was as high as 79.2%⁷.

There were published data of few studies conducted in South East Asian region but, as far as author knows, there has not been any published work on this topic conducted in Sri Lanka.

A Korean study conducted in a tertiary care hospital recruiting 29 participants; physicians and nurses, revealed that frequent incorrect techniques were observed during removing respirators (79.2%), removing shoe covers (65.5%) and removing the hood (41.3%)⁸.

As PPE is one of the important strategies in prevention of transmission of infectious diseases in health care settings, the assessment of proper usage of PPE among HCWs is an important need. In a situation where the whole world is overwhelmed with the COVID-19 pandemic, assessment of adherence to standard PPE handling protocols is a timely need.

This study was conducted to explore the level of knowledge, practices and training exposure related to proper usage of PPE among HCWs and to determine the associations of knowledge and practices regarding doffing of Personal Protective Equipment with job category and training exposure of the HCWs in a local setting. Though both donning and doffing of PPE are equally important in blocking transmission of infections, this study only looked in to doffing practices. The findings of this study are expected to be used in identifying the gaps in infection control activities. Moreover, the results will aid in planning the training activities for different categories of HCW. The ultimate intention of this study is to reduce the infection rate and thereby to reduce the mortality rate and stabilize the health care system of the country via rational usage of PPE.

Methodology

The study was conducted in District General Hospital Matara from September to October 2020. All categories of front line HCWs in District General Hospital Matara were included in the study. Those who were refrained from working in the front line due to a medical reason were excluded from the study. All participants were fluent in Sinhala language. A total of 281 HCWs were randomly recruited from each category proportionate to the size of each category. A pre tested self-administered questionnaire developed by the investigator consisting of socio-demographic

data, data on training related to PPE and knowledge on doffing of PPE (as per Institutional guidelines used in District General Hospital Matara, WHO guidelines and CDC guidelines) was used for data collection. Pilot testing was done in Teaching Hospital Karapitiya. Questionnaire was adjusted according to the results of the pilot test. Data collection was done by the investigator. Data analysis was done using SPSS version 23 software. Permission to conduct the study was obtained from the Director of District General Hospital Matara. Informed written consent was obtained from the participants after explaining about the study. Questionnaires, information sheets and consent forms were in both Sinhala and English languages and the procedure was explained in a convenient language for the participants. Ethical clearance was obtained from Ethics Review Committee, Faculty of Medicine, University of Peradeniya.

Results

Socio-demographic details

A total of 281 health care workers participated in the study. There were 2 (0.71%) incompletely filled questionnaires; the response rate was 99.3%. All participants were Sinhalese, Buddhists while majority (75.6%; $n=211$) were females. Age of the participants ranged between 29 to 58 years while the mean age was 40.32 years. Majority of the participants were nurses (55.2%, $n=154$) followed by medical officers (33.7%, $n=94$), minor staff (10%, $n=28$) and matrons/sisters (1.1%, $n=3$).

Details related to work as a front line HCW and the training obtained on PPE

It was noted that 39.1% ($n=109$) have worked for 6 months or more in COVID-19 units while the rest ($n=170$, 60.9%) have worked for less than 6 months. Only 68.1% ($n=190$) have received training on how to wear PPE before appointing as a front line health care worker in COVID-19 wards. The number of training sessions the participants participated varied from 1 to 10. Out of these 190 participants, majority (36.8%, $n=70$) had participated only 1 training session. Sixty four (33.7%) and 33 (17.4%) had received 2 and 3 training sessions respectively while the rest of the participants ($n=23$, 12.1%) were exposed to more than 3 training sessions. The training sessions comprised of demonstrations of handling PPE (52.7%, $n=147$), lectures (45.5%, $n=127$), videos (41.2%, $n=115$), hands on skill training (28.3%, $n=79$), workshops (19%, $n=53$) and distribution of leaflets (4.3%, $n=12$) where some training sessions included more than one methods mentioned above.

Knowledge regarding PPE

Knowledge on PPE used in health care settings for COVID-19 was as shown in table 1.

Table 1: Knowledge regarding PPE

PPE used in a health care setting for COVID-19	Yes	
	n	%
Impermeable gown	234	83.9
Gloves	270	96.8
Face masks	270	96.8
Face shields	255	91.4
Goggles	252	90.3
Surgical hoods or caps	258	92.5
Covered shoes and fluid resistant shoe covers or boots	237	84.9

Majority (n=193,69%) knew the correct order of doffing of PPE. Out of that, 63 (32.6%) were medical officers. There was a significant positive association between participating in a training session on PPE and the knowledge on correct doffing practices ($\chi^2=7.081$; $p=0.012$). There was no significant association between job category and satisfactory knowledge on order of doffing of PPE ($p=0.586$). Knowledge on doffing practices was as shown in table 2. Majority gave the correct answer for all the practices assessed.

In the assessment to describe the source of information the participants used to obtain knowledge regarding proper usage of PPE, majority (n=262, 93.9%) stated they rely on hospital protocols. A reasonable number referred to WHO web site (82.8%, n=231) and Ministry of Health web site (69.5%, n=194).

Practices regarding Personal Protective Equipment The participants were asked about their practices regarding wearing PPE while working as a front line health care worker in COVID-19 units. More than 85% were wearing all required PPE when in contact with the COVID-19 patients (Table 3).

Association between job category and wearing PPE when in contact with COVID-19 patients is shown in table 4. Nurses, sisters, matrons and minor staff were grouped together as 'other categories'. Medical officers

were wearing impermeable gowns ($p=0.001$), gloves ($p=0.048$), face shields (0.008), goggles ($p<0.001$) and boots (<0.001) significantly less than the health care workers in other categories (table 4).

When asked whether they think they are adequately equipped with PPE, 145 (52%) said that they think they are wearing PPE adequately 'most of the times' while 115 (41.2%) said they think they are properly equipped with

PPE 'all the time'. Only 5 (1.8%) said that they 'never' think they are adequately equipped with PPE.

The reasons given by the participants for not wearing the PPE adequately were as shown in the table 5. One hundred and twenty nine (46.2%) stated that they had a shortage of PPE supply at some point in time (Table 5). The participants were asked whether there was any shortage of PPE and the type of PPE which was out of stock (Figure 1 and Table 6).

Table 2: Knowledge on doffing practices

Doffing practices	Correct answer	n	%
Hand rub should be used in between each step of doffing PPE	True	237	84.9
Removed boots should be washed with soap and water	False	207	74.2
Removed face shield/ goggles should be washed with 1% TCL	True	175	62.7
Should have a bath before going home	True	275	98.6
PPE should be discarded in to a closed bin with a yellow colour bag	True	263	94.3
PPE should be immediately removed after the procedure	True	258	92.5
If you are leaving the clinical area, you should not remove the PPE	False	265	95

Discussion

This study was conducted about 6 months after declaring COVID-19 as a Public Health Emergency of International Concern by WHO. The first

case of COVID-19 in Sri Lanka was reported on 27th January 2020; a 44 year old Chinese woman admitted to the National Institute of Infection Diseases. Since then the health sector of Sri Lanka took necessary measures to control the cases within the country by establishing COVID-19 units in certain hospitals. Therefore majority of the participants (36.2%) had an experience of 6 months working in COVID-19 wards. According to this study, only 68.1% (n=190) had received a training on proper use of PPE before appointing to COVID-19 wards. This is not a satisfactory

figure as it is evidenced that proper training on handling PPE reduces the risk of transmission of COVID-19 to HCW^{9,10}. The study showed a significant positive association between participating in a training

session on PPE and the knowledge on correct doffing practices ($\chi^2=7.081$; $p=0.012$). A similar finding was obtained in an intervention study conducted in a tertiary care hospital in Beijing, China where there

Table 3: Practice of wearing PPE

PPE the participants used to wear always when working in COVID-19 units	n	%
Impermeable gown	239	85.7
Gloves	263	94.3
Face masks	274	98.2
Face shield	268	96.1
Goggles	249	89.2
Surgical hood or cap	253	90.7
Covered shoes and fluid resistant shoe covers or boots	238	85.3

Table 4: Association between job category and wearing PPE

Variable	Yes	No	Chi square valve df	P value
Wearing impermeable gown				
Medical officers	71 (75.5%)	23 (24.5%)	11.84	0.001
Other categories	168 (90.8%)	17 (9.2%)	1	
Wearing gloves				
Medical officers	85 (90.4%)	9 (9.6%)	3.8	0.048
Other categories	178 (96.2%)	7 (3.8%)	1	
Wearing masks				
Medical officers	94 (100%)	0 (0%)	Fisher's exact test	0.126
Other categories	180 (97.3%)	5(2.7%)		
Wearing face shields				
Medical officers	86 (91.5%)	8 (8.5%)	Fisher's exact test	0.008
Other categories	182 (98.4%)	3 (1.6%)		
Wearing goggles				
Medical officers	72 (76.6%)	22 (23.4%)	23.64	<0.001
Other categories	177 (95.7%)	8 (4.3%)	1	
Wearing surgical cap or hood				
Medical officers	81 (86.2%)	13 (13.8%)	3.41	0.054
Other categories	172 (93%)	13 (7%)	1	
Wearing boots				
Medical officers	66 (70.2%)	28 (29.8%)	25.75	<0.001
Other categories	172 (93%)	13 (7%)	1	

was a very significant improvement in the post-test compared to the pre-test after an training programme on PPE ($p<0.001$)¹¹.

The current study revealed that more than 80% health care workers knew the types of PPE used in COVID-19 units while more than 70% had adequate knowledge on doffing practices. In contrast to this finding the studies conducted outside Sri Lanka revealed poor overall knowledge on doffing of PPE among health care workers^{6,7,12}. This difference could have been due to the observation component included in most of these studies which revealed more reliable information. A study conducted in West Indies, Jamaica revealed that 90% nurses, 88% doctors and 70% medical technicians were very knowledgeable of universal precautions⁴. The present study revealed that a significant number of medical officers did not wear impermeable gowns ($p=0.001$), gloves ($p=0.048$), face shields (0.008),

Table 5: Reasons given by the participants for not wearing PPE adequately

Reason	n		%
	Medical officers	Other categories	
I was not knowledgeable enough	5	10	5.4
I was not trained properly	19	48	24
Due to lack of time	2	6	2.9
My negligence	15	18	11.8
I do not consider it as a risk	6	3	3.2
Due to shortage of PPE/ other materials	39	90	46.2
Due to controversial health messages	14	16	10.8

goggles ($p<0.001$) and boots ($p<0.001$) compared to nurses and minor staff taken together. Contrary to the findings of this study, a study conducted in Tamil Nadu¹³ revealed that doctors had significantly good compliance towards using appropriate PPE compared to nurses and technicians ($p=0.0001$). As highlighted by this study, the shortage of PPE supply was a huge problem in many parts of the world

Table 6

Type of PPE on shortage	n	%
Impermeable gown	174	62.4
Gloves	7	2.5
Face masks	170	60.9
Face shields	115	41.2
Goggles	102	36.6
Surgical hoods or caps	77	27.6
Covered shoes and fluid resistant shoe covers or boots	101	36.2

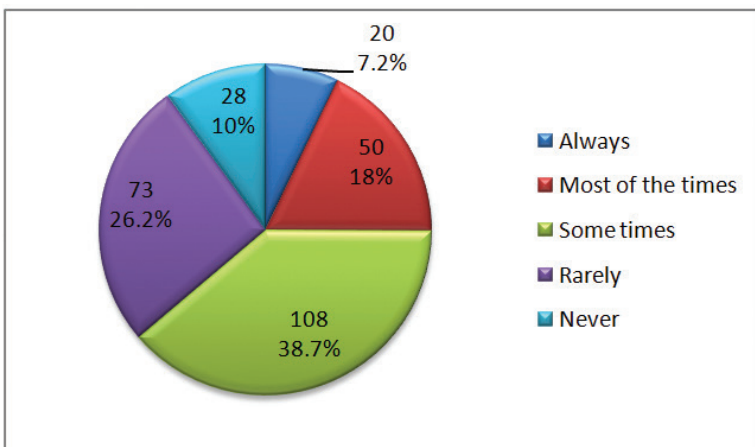


Figure 1: Presence of a shortage of PPE at any point in time

15,16 and high demand for face masks made the face masks the most scarce PPE¹⁶ as revealed by this study.

However, one limitation of this study was that the practices of doffing of PPE were assessed by asking them about their practices. But these practices would have been better assessed if the study included an observation component.

In conclusion it is very important that the relevant authorities take steps to give quality training on PPE to all categories of HCW including doctors, before appointing them to high risk units. Furthermore the hospital authorities should have plans to make PPE available without a shortage for high risk units throughout the pandemic period.

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