

Impact of Training on Knowledge, Attitude and Perceived Barriers for Compliance Regarding use of Personal Protective Equipment Kit among Frontline Healthcare Workers during COVID-19 Pandemic

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ABSTRACT

Introduction: Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), the novel Coronavirus, the causative agent of Coronavirus Disease-2019 (COVID-19) pandemic has grasped the whole world. Healthcare Workers (HCWs) are at an increased risk. The usage and awareness of entire Personal Protective Equipment (PPE) kit in hospitals on such wide scale has not been seen for some time in healthcare setting. Improper use of these equipment may result in the spread of infection.

Aim: To assess the knowledge and attitude of HCWs regarding the correct use of PPE at the beginning of COVID-19 pandemic in order to find the gap in knowledge and to address the perceived barriers in compliance and further to assess the same after training and reinforcement to ensure the HCWs safety.

Materials and Methods: A cross-sectional hospital based study was carried out in a designated COVID-19 hospital of Shaheed Hasan Khan Mewati Government Medical College from April 2020 to October 2020 on frontline HCWs posted in various areas of hospital. Sample size was calculated as a minimum of

500 HCWs using appropriate statistical formula. A predesigned, pretested structured questionnaire both online and offline mode was used. The data that was obtained was analysed using Statistical Package for the Social Science (SPSS) version 20.0.

Results: Seven hundred frontline HCWs were included in the study. Mean age of study population was 30.5 years. Among 700 HCWs, 200 (28.57%) were doctors, 360 (51.42%) were nursing staff and 140 (20%) were housekeeping staff. Knowledge level of PPE kit and its use varied across doctors, nursing staff and housekeeping staff. Knowledge about donning and doffing was largely lacking with only 9% doctors and none of other staff were aware which improved to more than 80% post-training. Attitude regarding PPE kit usage was largely positive.

Conclusion: The study concludes that there is a constant need of training and re-training of HCWs in order to keep them safe from not only COVID-19 but also from future infections. An active infection prevention training program is crucial to ensure HCWs safety.

Keywords: Coronavirus disease-2019, Doffing, Donning, Infection control

INTRODUCTION

The novel Coronavirus Disease-2019 (COVID-19), which first emerged in the Chinese city of Wuhan in December 2019, has infected more than 169,597,415 people globally, leading to 3,530,582 deaths as on May 2021 as per World Health Organisation (WHO) [1]. Indian subcontinent is no exception, with being world's second most populous country and spending a meagre 4.69% GDP expenditure on health, we only have 20 HCW for every 10,000 people [2]. With such statistics we were bound to face a larger impact of COVID-19 pandemic than anywhere else.

The COVID-19 is known to have a higher mortality than the seasonal influenza, even as wide variation is reported. Though continuing research on COVID-19 provides hope but taking precautions remain the mainstay. Global healthcare workforce bears the intense pressure in two forms. First being the overwhelming patient load stressing healthcare system capacity and second the heightened risk of acquiring the infection while caring for COVID-19 patients [3].

Centers for Disease Control and Prevention's (CDC) has recommended guidelines to ensure safety of HCWs. The SARS-CoV-2 is spread by droplet and contact with possibility of air borne transmission. Hence, observing droplet barrier precautions, environmental hygiene and following Infection Control Practices (IPC) is must. For the HCWs, while treating or caring for patients with COVID-19, the CDC recommends

the utilisation of Personal Protective Equipment (PPE) [4]. The term PPE as per definition given by the Occupational Safety and Health Administration (OSHA), is the "equipment that protects employees from serious injury or illness resulting from contact with chemical, radiological, physical, electrical, mechanical, or other hazards. PPE includes gown, gloves, boots and either an N95 respirator plus a face shield/goggles or a Powered, Air-Purifying Respirator (PAPR) [5].

The HCWs providing care to COVID-19 patients are at increased risk of getting infected themselves and subsequently their families. It is therefore mandatory for them to have correct knowledge, awareness about PPE, its correct use and disposal. This can be addressed by specific training and encouragement of adherence to correct PPE usage, contact precautions and hygiene recommendations [4]. In the present pandemic, because of lack of adequate knowledge about coronavirus and the panic that the world is facing, the varied perceptions exist among HCWs. Telling caregivers to focus on their safety and being clear and specific about how to do so can promote calm during an epidemic. However, many times due to urgency in caring for the patients, overlook, lack of knowledge about its importance, breach happens in healthcare settings as was observed in studies conducted in Ohio and Pittsburgh which reported self-contamination rates >40% while doffing PPE, especially during the removal of gloves [6,7].

With this background, present study was conducted to assess the knowledge and attitude of HCWs regarding the correct use of PPE at the beginning of COVID pandemic in order to find the gap in knowledge and to address the perceived barriers in compliance and further to assess the same after training and reinforcement to ensure HCWs safety.

MATERIALS AND METHODS

This hospital based cross-sectional study was carried out at a designated COVID-19 hospital of Shaheed Hasan Khan Mewati Government Medical College, Nalhar, Nuh, Haryana, India from April 2020 to October 2020. Institutional Ethics Committee approval was obtained wide letter no SHKM/IEC/2020/35 dated 24-04-2020.

Sample size calculation: Sample size was calculated as 424 using paired t-test formula using statistical software with $\alpha=1\%$, $\beta=20\%$, Effect size=0.5 and Standard Deviation (SD)=3.0. Therefore, minimum sample size was decided as 500. Study population was frontline HCWs employed at our institute such as Senior Residents (SRs), Junior Residents (JR), Interns, Nursing staff and Housekeeping staff who gave consent to be part of study. These frontline HCWs were involved in various areas catering for COVID-19 patients such as, Flu corner, Triage, COVID-19 ICU and COVID-19 ward.

Inclusion criteria: HCWs working as front line HCWs having maximum risk of getting in contact with COVID-19 patients only, were included.

Exclusion criteria: All those HCWs who did not give consent to fill the questionnaire and those who did not fill both pre and post test questionnaire were excluded.

Questionnaire Design

A pre-tested and pre-validated questionnaire containing 21 closed ended questions along with demographic information (Cronbach alpha score was 0.69) and two open ended questions based on OSHA and CDC guidelines was used to collect data from HCWs regarding PPE knowledge, attitude and perceived barriers for compliance [4,5]. An online Google form as well as offline print version (for those who did not have access to online form) survey was conducted in English and in Hindi for those who were not comfortable with English language. The questionnaire consisted of three components including: demographic information, knowledge/awareness and attitude/perceptions. Knowledge or awareness items were 12 multiple choice/multi option questions marked as 1 if correct and 0 if incorrect/partially correct. Attitude or perceptions items were 9 and were scored using a Likert-scale, which ranged from 1 (disagree) to 3 (agree). In the end there were two open ended questions about perceived barriers hampering the adequate use of PPE kit and suggestions to improve the same.

Study Procedure

A total of 15 training sessions were organised under aegis of Hospital Infection Control Committee (HICC) under infection prevention and control program from beginning of COVID pandemic during study period. The session was taken by Infection Control Officer assisted by Infection Control Nurses. All norms of social distancing were followed while conducting these sessions. Every session had less than 50 participants maintaining social distancing. A pre-test was taken before starting the session for knowledge assessment. The session comprised of brief introduction followed by live demonstration of donning and doffing and hand hygiene steps by trained staff under supervision of the Infection Control Officer. Correct usage of all the components of PPE and all seven steps of hand hygiene as per WHO guidelines were explained followed by clarification of all

doubts [1,4,5]. A post-test was taken for knowledge improvement if any after the training session. Also, the questionnaire was filled by participants after the session for assessing the attitude, perceived barriers in compliance and suggestion for improvement. All the data was compiled and analysed.

STATISTICAL ANALYSIS

Qualitative data were expressed in percentages and mean was calculated. Pre and postscore for knowledge were compared by t-test. A p-value of <0.05 was considered statistically significant. All statistical calculations were done using computer program Microsoft Excel version 7 (Microsoft Corporation, NY, USA) and SPSS version 20.0 (Statistical Package for the Social Science SPSS Inc. Chicago, USA).

RESULTS

A total of 700 participants took part in the study. Among these 200 (28.57%) were doctors (SRs, JRs and Interns), 360 (51.43%) were nursing staff and 140 (20%) were housekeeping staff. Mean age of study population was 30.5 years being 27 years for doctors, 32 years for nursing staff and 31 years for the housekeeping staff.

While assessing the knowledge among doctors before training, it was observed that 166 (83%) and 159 (79.5%) doctors knew the correct meaning and intended use of 'PPE' respectively but only 46 (23%) were aware of all the types of PPE kits available and further 137 (68.5%) could name all the components of PPE kit correctly. Only 99 (49.5%) knew about the term donning and doffing and only 18 (9%) frontline doctors had correct knowledge of all the steps of donning. Similarly, though 171 (85.5%) knew about importance of hand hygiene in preventing COVID, only 73 (36.5%) knew all the steps of hand hygiene correctly. Knowledge about all the above aspects of PPE usage improved to more than 96% post-training [Table/Fig-1]. Mean score for knowledge before and after training were 5.7 and 11, respectively, the difference being significant ($p<0.05$) [Table/Fig-2].

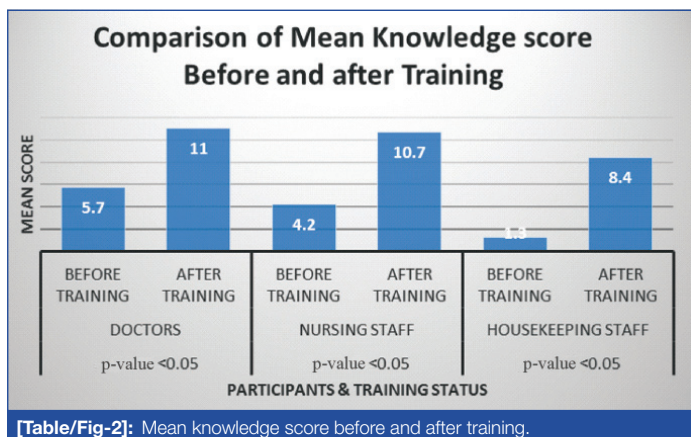
About the knowledge among nursing staff before training, it was observed that only 59 (16.3%) and 68 (18.8%) nurses knew the correct meaning and intended use of 'PPE' but no one had complete knowledge of all the types of PPE kits available however 168 (46.6%) could name all the components of PPE kit correctly. None of the nursing staff knew about the term donning and doffing and the steps involved. Similarly, 208 (57.7%) nurses knew about importance of Hand hygiene in preventing COVID and only 68 (18.8%) knew all the steps of hand hygiene correctly. Knowledge about all the above aspects of PPE usage improved to more than 90% post-training [Table/Fig-1]. Mean knowledge score before and after training were 4.2 and 10.7, respectively, the difference being significant ($p<0.05$) [Table/Fig-2].

Similarly, no housekeeping staff was aware of PPE kit or its correct use. However, 36 (25.7%) staff were able to tell the disposal of PPE components correctly. A total of 48 (34.2%) housekeeping staff knew about importance of hand hygiene in preventing COVID-19 but none could identify all the steps of hand hygiene correctly. Knowledge about all the above aspects of PPE usage improved to more than 64% post-training [Table/Fig-1]. Mean knowledge score before and after training were 1.3 and 8.4, respectively, the difference being significant ($p<0.05$) [Table/Fig-2].

The attitude of HCWs is presented in [Table/Fig-3]. Total of 94.5% doctors, 85.8% nurses and 100% housekeeping staff agreed that COVID-19 made them more aware about PPE usage than ever before. Almost all HCWs agreed that correct use of PPE can prevent chances of infection. A 89% doctors, 90.8% nurses and 100% housekeeping staff agreed that wearing of PPE kit is

S. No.	Items	Doctors (n=200)		Nursing staff (n=360)		Housekeeping staff (n=140)		Total (N=700)	
		Before training n (%)	After training n (%)	Before training n (%)	After training n (%)	Before training n (%)	After training n (%)	Before training n (%)	After training n (%)
1.	Knew the meaning of term 'PPE' correctly	166 (83)	200 (100)	59 (16.3)	360 (100)	0	109 (77.8)	225 (32.1)	669 (95.5)
2.	Knew the intended use of 'PPE' correctly	159 (79.5)	200 (100)	68 (18.8)	360 (100)	0	115 (82.1)	227 (32.4)	675 (96.4)
3.	Able to enumerate correctly the types of PPE kit available for HCWs	46 (23)	193 (96.5)	0	332 (92.2)	0	96 (68.5)	46 (6.5)	621 (88.7)
4.	Able to enumerate all the components of PPE kit correctly	137 (68.5)	198 (99)	168 (46.6)	358 (99.4)	0	96 (68.5)	305 (43.5)	652 (93.1)
5.	Knew the meaning of 'donning'	99 (49.5)	200 (100)	0	360 (100)	0	107 (76.4)	99 (14.1)	667 (95.2)
6.	Knew the meaning of 'doffing'	99 (49.5)	200 (100)	0	360 (100)	0	110 (78.5)	99 (14.1)	670 (95.7)
7.	Able to identify all the items to be avoided inside the hospital correctly	132 (66)	200 (100)	203 (56.3)	360 (100)	0	123 (87.8)	335 (47.8)	683 (97.5)
8.	Could identify the correct order of donning	18 (9)	197 (98.5)	0	327 (90.8)	0	91 (65)	18 (2.5)	615 (87.8)
9.	Could identify the correct order of doffing	19 (9.5)	198 (99)	0	332 (92.2)	0	94 (67.1)	19 (2.7)	624 (89.1)
10.	Had correct knowledge of disposal of PPE kit components	63 (31.5)	200 (100)	103 (28.6)	360 (100)	36 (25.7)	127 (90.7)	202 (28.8)	687 (98.1)
11.	Knew the importance of Hand Hygiene in preventing COVID	171 (85.5)	200 (100)	208 (57.7)	360 (100)	48 (34.2)	140 (100)	427 (61)	700 (100)
12.	Had the correct knowledge of all the steps of hand hygiene	73 (36.5)	196 (98)	68 (18.8)	352 (97.7)	0	90 (64.28)	141 (20.1)	638 (91.1)

[Table/Fig-1]: Knowledge level of HCWs before and after the training.

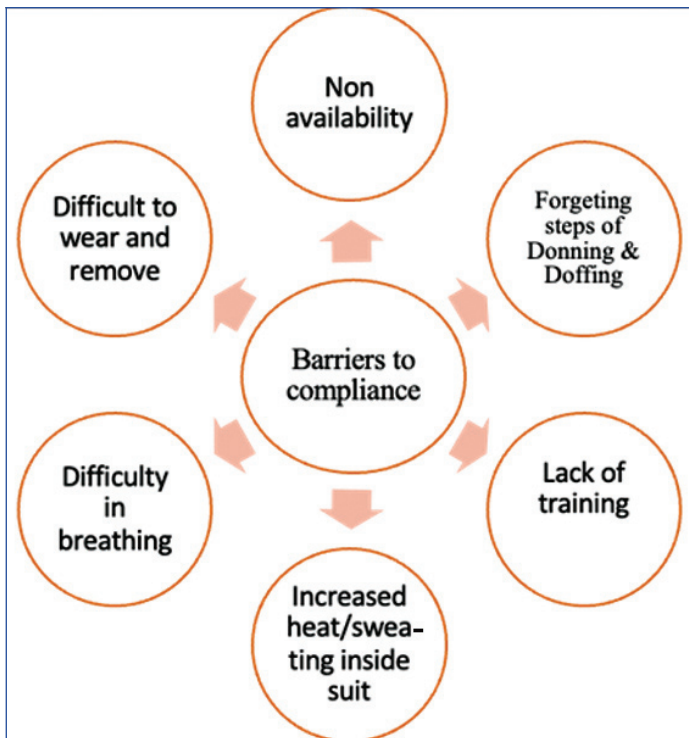


[Table/Fig-2]: Mean knowledge score before and after training.

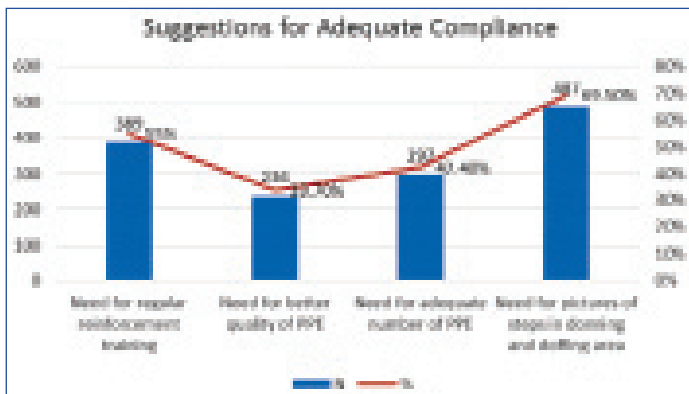
cumbersome and time consuming but almost all ($\geq 96\%$) agreed that they are still willing to wear it in order to stay safe. A 94% doctors, 97.5% nurses and 100% housekeeping staff agreed that remembering the order of donning and doffing is important. A 100% HCWs agreed that hand hygiene plays an important role in preventing not only COVID-19 but any infection. A 98.5% doctors, 98.8% nurses and 100% housekeeping staff agreed that there is need of regular training on donning and doffing of PPE. Also, 99.5% doctors, 98.6% nurses and 94.2% housekeeping staff found the training on donning and doffing of PPE useful. The barriers responsible for inadequate compliance towards PPE use as perceived by HCWs are listed in [Table/Fig-4]. Similarly, the suggestions for improved compliance as given by study participants are depicted in [Table/Fig-5].

S. No.	Item	Doctors n=200 (%)			Nursing staff n=360 (%)			Housekeeping staff n=140 (%)			Total N=700 (%)		
		Agree	Neutral	Disagree	Agree	Neutral	Disagree	Agree	Neutral	Disagree	Agree	Neutral	Disagree
1.	Has COVID-19 made you more aware about PPE usage	189 (94.5)	10 (5)	1 (0.5)	309 (85.83)	23 (6.3)	28 (7.7)	140 (100)	0	0	638 (91.1)	33 (4.7)	29 (4.1)
2.	Correct use of PPE can prevent infection	200 (100)	0	0	351 (97.5)	9 (2.5)	0	140 (100)	0	0	691 (98.7)	9 (1.2)	0
3.	Do you find it cumbersome to use PPE kit	178 (89)	21 (10.5)	1 (0.5)	327 (90.8)	33 (9.16)	0	140 (100)	0	0	645 (92.1)	54 (7.7)	1 (0.1)
4.	Would you use PPE kit while caring for COVID patients in spite of difficulty faced	200 (100)	0	0	349 (96.9)	11 (3.0)	0	140 (100)	0	0	689 (98.4)	11 (1.5)	0
5.	Do you think remembering the order of Donning and Doffing is important	188 (94)	12 (6)	0	351 (97.5)	8 (2.2)	1 (0.2)	140 (100)	0	0	679 (97)	20 (2.8)	1 (0.1)
6.	Hand hygiene plays an important role in preventing infection	200 (100)	0	0	360 (100)	0	0	140 (100)	0	0	700 (100)	0	0
7.	Have received any IPC training recently (less than 6 months back)	197 (98.5)	3 (1.5)	0	356 (98.8)	4 (1.1)	0	140 (100)	0	0	693 (99)	7 (0.01)	0
8.	There is need of regular training on donning and doffing of PPE	197 (98.5)	3 (1.5)	0	356 (98.8)	4 (1.1)	0	140 (100)	0	0	693 (99)	7 (0.01)	0
9.	Did you find the training about PPT donning and doffing useful	199 (99.5)	1 (0.5)	0	355 (98.6)	5 (1.3)	0	132 (94.2)	8 (5.7)	0	686 (98)	14 (2)	0

[Table/Fig-3]: Attitude/perception of HCWs towards all aspects of PPE usage.



[Table/Fig-4]: Perceived barriers in compliance as given by participants.



[Table/Fig-5]: Suggestions given by participants for adequate compliance.

DISCUSSION

Before the 2014 Ebola outbreak, the majority of studies on PPE kit usage were in industrial setup to safeguard their employees [8,9]. In HCWs the most studies have been carried out post Ebola [10,11]. Indian subcontinent has largely remain deficient in such studies in HCWs. The usage and awareness of entire PPE kit in hospitals on such wide scale has not been seen for some time in our healthcare setting. In present pandemic, because of lack of adequate knowledge about coronavirus and the panic world is facing, the varied perceptions exist among HCWs. All these can be addressed only by specific training and encouragement/reinforcement of adherence to barrier precautions and hygiene recommendations. Therefore, the present study was conceived.

The present study demonstrated that the level of knowledge regarding the term ‘PPE’, its use and all the components of PPE kit was higher in doctors (83%, 79.5 and 68.5%, respectively) compared to nurses (16.3%, 18.8, 46.6%, respectively) and housekeeping staff (no knowledge). This can be simply because the education level and training of former is better and more rigorous than later. However, the knowledge about donning and doffing and its correct order was largely poor across all three groups, only 9% of doctors being aware and none of nursing and housekeeping staff being aware. All three groups had similar knowledge about correct disposal of PPE components also was largely lacking. It was observed that knowledge about importance of hand hygiene in spread of COVID-19 was maximum in doctors compared to nurses and housekeeping

staff but when it comes to practical aspect of knowing all steps of hand hygiene, even doctors had inadequate knowledge.

This was an alarming situation as nursing staff and housekeeping staff is in direct vicinity of patients and their environment and can play an important role in spreading the disease. Recently, Mishra A et al., from West Bengal have also documented 0% knowledge of donning and doffing among doctors in their study [12]. All these issues were addressed in training and the post test scores were significantly better across all groups difference being statistically significant (p<0.05).

The present study concludes that all the HCWs had positive attitude towards PPE kit usage for prevention of infection (more than 84% agreeing). All HCWs (100%) agreed that inspite of difficulty faced they would want to use PPE kit to keep themselves safe. Similarly, all staff agreed that memorising all steps of donning and doffing are important to stay safe. More than 90% participants did not receive any training in infection prevention and control in last six months which was way below than other studies [12,13]. Almost everyone agreed that there is constant need of training and re-training for correct and adequate use of PPE kits. Similarly, more than 90% participants agreed that training was useful to them. Other recent study also demonstrated positive attitude of HCWs towards PPE usage [12].

While studying the perceived barriers for non compliance, it was found that non availability of PPE, forgetting steps, cumbersome to wear and remove, difficulty in breathing and increased sweating inside PPE kit and lack of training were main reasons. Others studies have found non availability and lack of proper training as main cause [14,15]. This could be because during COVID-19 pandemic, all HCWs have to stay donned for extended hours. To improve the compliance, some of the suggestion given by participants is depicted in [Table/Fig-5].

Corrective measures: Post training, many steps based on the study findings were taken to ensure HCWs safety. All new joined HCWs are being trained in IPC at the beginning only. Weekly re-enforcement sessions are being conducted. Also charts depicting all steps of donning, doffing and steps of hand hygiene are pasted at donning, doffing areas and across the hospital. Due to these, the HCWs infection rate in the institute was considerably lower during first wave of COVID-19.

Limitation(s)

It was a hospital-based study with cross-sectional design. The study was conducted over a shorter period of time however authors tried to include a large number of participants. Real time observation of the practice of donning and doffing of PPE among the participants could not be done due to infectious nature of disease and time constraints. To continue achieving compliance for correct and adequate use of PPE, the training for the same needs to be included as an integral part of ongoing IPC training in the healthcare settings whereby along with education, regular surprise visits and evaluations should be conducted to observe the IPC practices of HCWs and taking remedial actions based on observations.

CONCLUSION(S)

COVID-19, inspite of being more than a year old with vaccines being available, largely remains an enigmatic disease with more and more complications being reported. Therefore, prevention is the mainstay. HCWs due to their work are largely exposed to the disease. The adequate and correct use of PPE can be a key to prevent infection spread. Present study concludes that though doctors are aware about the importance of PPE, still lack training as to correctly use it. The housekeeping staff remains largely untrained and hence end up spreading infection. Therefore, periodic training and re-training of HCWs holds a key to prevention of not only COVID-19 but future infections.

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