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Original Research Article

Personal protective equipment (PPE) and Hand hygiene training sessions: Knowledge and perceptions in the current COVID pandemic

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ABSTRACT

Introduction: The rise of cases of the infectious COVID -19 pandemic has led to significant burden on healthcare settings.
Aim & Objective: The current study tried to evaluate the knowledge, perceptions and experiences of Health care workers (HCW) towards a well-executed PPE and Hand Hygiene (HH) training before and after attending the sessions
Materials and Methods: Study was planned for a period of twelve months for various HCWs of different departments of the Institute. Every participant was evaluated for pre-test as well as post-test knowledge (cognitive domain) assessment using a pre-structured format along with demonstration (psychomotor domain).
Results: A total of 535 HCWs were included for the study. Statistically significant ($P < 0.001$) increase in post test score was noted in different domains of learning of Faculty, residents and Nurses group. The mean pre-test and post test score was significantly higher for Critical care units (CCU) as compared to other units. The difference in overall scores for various parameters in pre and post training was as follows: 5.2 for MCQs,2.5 for PPE OSPE,5.1 for HH OSPE and13.1 for total scores.
Conclusion: HH and PPE training sessions will impart knowledge and confidence to HCWs working in hospitals for better patient care as well as infection control practices.

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1. Introduction

Coronavirus disease 2019 also known as COVID-19, first originated from the sea food market of Wuhan, China, in December 2019.[1,2] Since then, it has been spreading worldwide and has taken the form of global pandemic. The World Health Organization (WHO) declared COVID-19 as a pandemic on March 11, 2020.[3]

It has emerged as a global pandemic affecting millions of people world wide and is proving to be a greater danger than MERS and SARS Coronaviruses.[4]

The rise of cases of this infectious pandemic has led to significant burden on healthcare settings especially of developing countries. High population burden, low income and lesser investment in health care sector has worsened the problem of these countries. Health care workers (HCWs) are facing a double edged sword; on one hand the fear of contagion/infection and on the other hand the trust and support of their institution /organisation in combating the disease.[5] Long hours of hospital work, improper /inadequate supply of PPEs (personal protective equipments), and sometimes inadequate pay are some inherent limitations and problems faced by HCWs in developing countries.[6] Proper and adequate PPE training

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of HCWs will help to mitigate the stress and anxiety faced by them. PPEs prove to be an effective and efficient barrier in preventing the spread of this infectious disease. Regular hand hygiene practices and proper use of N95 masks provides with significant protective effects as reported by some studies.[7] Hence; proper and correct use of all the PPEs by the HCWs is of utmost importance during these COVID times. On 24^{th} March 2020, the country went for a nationwide lockdown in order to mitigate the spread of COVID among the general population and hence, reduce the burden on healthcare systems. In this context; the trauma centres and cancer units from various institutes were converted to COVID hospitals to deal with the rising cases.

Various reports and studies have already been published wherein fear, anxiety and stress of HCWs has been highlighted during these COVID times. Proper infection control practices, organisational/ institutional support and adequate PPE training are some of the cornerstones to fight this deadly pandemic. However, proper data and research regarding the PPE training sessions among HCWs is still missing.

The current study tried to evaluate the knowledge, perceptions and experiences of HCWs towards a well thought and executed PPE and Hand Hygiene (HH) training before and after attending the sessions in a tertiary care institute of North India.

2. Materials and Methods

2.1. Study design

Cross sectional study.

2.2. Place & duration of study

The study was conducted at a tertiary care hospital of North India between April 2020 to March2021 (twelve months) during the COVID pandemic. The PPE training program was conducted by the residents at the Microbiology department of the Institute in two sessions i.e 11 - 1 pm and 3-5 pm on all the five-week days excluding Saturday under the guidance of expert faculty of the department.

2.3. Case /Sample selection

During the time span of twelve months; a total of 535 HCWs were included for the study. These HCWs comprised of doctors, nurses, staff as well as sanitation workers who were deployed as front line workers directly in patient care as well as COVID testing.

2.4. Methodology

At the start of each day training program, every participant was evaluated for pre-test knowledge (cognitive domain) assessment using a pre-structured format (as mentioned subsequently) along with demonstration (psychomotor domain for PPE and HH). PPE training was conducted with highlighting the objectives of the training program followed by interactive sessions ,open discussions, and demonstration of various skills with the active participation of both the participants as well as trained faculty (physicians, surgeons), and infection control nursing officers (NOs). On completion of the interactive session, every participant again underwent post-test evaluation similar to the pre-test one.

The Knowledge of the attendees was assessed using 30 multiple-choice questions (MCQ) on various aspects of PPE as well as Hand Hygiene (HH). To avoid any biasing ,All the participants were categorised according to the professional cadre as well as place of work and any previous trainings attended(If Yes, then how many). Confidentiality about the participants personal information was maintained at all the stages. The questions were framed by the expert faculty group and residents of the department based on various guidelines of PPE training and questions for HH were adopted from the WHO HH Knowledge Questionnaire for Health-Care Workers with slight modifications.[8] Every correct response was given a single mark with a maximum score of 30 marks. Skill demonstration was assessed using objective structured practical examination (OSPE) checklist by a trainer with a maximum of 15 marks for HH and 15 for PPE. Thus, a total maximum score of 60 was calculated by adding the marks of MCQ (maximum = 30), HH skill demonstration (maximum = 15), and PPE skill demonstration (maximum = 15 marks).

MCQs assessment in the pre and post training was same for all the categories. A participant was declared successful in the training session on scoring ≥45 out of 60 marks in the posttest questionnaire and evaluation. Attendees getting less than the 75% score were advised for repeating the session and were called back for improvement in their scores after repeat evaluation.

According to their place of work, participants were divided as follows:

1. Surgical unit: CVTS, gastrosurgery, pediatric surgery, gynaecology, plastic surgery, urology, etc.
2. Non-Surgical unit: Medicine, gastroenterology, endocrinology, psychiatry, cardiology, pediatric, genetics, etc.
3. Critical care unit (CCU): Trauma ICU, HDU, ICUs of various departments, liver and transplant units, dialysis, hematology etc.
4. Paraclinical/Laboratory unit: Microbiology, pathology, transfusion medicine, biochemistry, nuclear medicine, radiodiagnosis, etc.
5. Other unit: Nursing and paramedical staff, BSc and MSc staff and students, other miscellaneous department.

According to the professional cadre, participants were divided as follows:

1. Faculty (Group I: Faculty of various departments
2. Residents (Group II: all residents of para as well as clinical departments.
3. Nursing staff (Group III: nursing staff of all the grades and nursing superintendents.
4. Technical staff (Group IV: various technicians and technical officers working in all the departments.
5. Students (Group V: MSc, BSc students, DMLT students, nursing students, various paramedical students.
6. Miscellaneous (Group V : sweepers, lab attendents, sample receivers, any other, etc.

2.5. Statistical analysis

The results were analysed using the SPSS version 22 software (SPSS Inc., Chicago, IL, USA). The frequencies are shown with 95% confidence intervals (95%CI)(n%) and continuous data was expressed as mean + SD. The Chi-square and Mann–Whitney U test /Kruskal–Wallis H-test was was used to analyse the statistically significant variables.

Paired sample t-test was performed to evaluate pre and post-test results in the case of continuous variables. Univariate analysis using one or two-way analysis of variance was used in the case of one or more independent variables with >2 groups, against continuous dependent variables. In the case of a significant difference in groups, post hoc analysis using Tukey's test was performed. The statistically significant values were considered as p-value < 0.05.

3. Results

During the time span of twelve months of study period; a total of 535 HCWs were included for the study.15-20 participants were trained in each group (mean 17 /group). Attendees belonged to various departments as well as professional cadre of the institute as listed in Table 1. Male: Female ratio was 59:41. Prior training was attended by 145 out of 535 (27.3%) participants at some or the other time in the same or a different hospital in the last 10 years. Out of these, 82(15.4%) had attended prior both PPE as well as HH training; whereas 39 (7.3%) had attended only PPE and 25 (4.6%) had attended only HH training.

Table 2 shows the detailedscores of HCWs according to professional cadre during different stages of training. Statistically significant (P < 0.001) increase in post-test score as compared to pre-test score was noted in different domains of learning [Figure 1 and Table 2]. Sixteen participants (2.9%) required re-evaluation through repeat training to be declared as successful in the HH and PPE course. The post-test score improved significantly before and after re-evaluation in these patients and was 38.2 ± 2.1 and 47.4 ± 2.6, respectively. After re-evaluation, all the participants completed the training successfully and none was declared as fail.

Evaluation of HCWs was also done according to different units/departments. The mean pre-test and post-test score was significantly higher for CCUs as compared to other units like SU, NSU, paraclinical and other units. The pre-test score and post test score for CCU were 41.2 + 1.5 and 46.4 + 2.2. While for other units the pre-test and post-test score was 35.6 + 1.4 and 42.1 + 1.8.

The influence of prior training on HH and PPE training on various marks during different stages of training is shown in Figures 2 and 3. The difference in overall scores for various parameters in pre and post training was as follows: 5.2 for MCQs, 2.5 for PPE OSPE,5.1 for HH OSPE and 13.1 for total scores.

Table 1: Detailed description of participants according to department and professional cadre

Description of characteristics	**n (%) 535 (100%)**
1.Surgical unit (SU)	209 (39.0)
Faculty	47 (8.7)
Residents	97 (18.1)
Nursing staff	44 (8.2)
Technical staff	9 (1.6)
Students	0
Miscellaneous	12 (2.2)
2.Non-Surgical unit(NSU)	157 (29.3)
Faculty	39 (7.2)
Residents	58 (10.8)
Nursing staff	37 (6.9)
Technical staff	12 (2.2)
Students	0
Miscellaneous	11 (2.0)
3.Critical Care unit(CCU)	81 (15.1)
Faculty	19 (3.5)
Residents	28 (5.2)
Nursing staff	20 (3.7)
Technical staff	9 (1.6)
Students	0
Miscellaneous	5 (0.9)
4.Paraclinical/Laboratory unit (PU)	67 (12.5)
Faculty	15 (2.8)
Residents	33 (6.1)
Nursing staff	3 (0.5)
Technical staff	12 (2.2)
Students	0
Miscellaneous	2 (0.3)
5.Other unit(OU)	21 (3.9)
Faculty	0
Residents	0
Nursing staff	0
Technical staff	4 (0.7)
Students	17 (3.1)
Miscellaneous	0

Table 2: Pre- and Post-training evaluation scores of various professional cadres of Health care workers in the training

Time of assessment &Learning parameters	faculty (Category I) (n = 120)	Residents(Category II)(n =216)	Nursing staff (Category III)(n=104)	Technical staff (Category IV)(n=47)	Students (Category V)(n=18)	Miscellaneous (Category VI)(n=30)	Statistical significance
Pretraining MCQ	22.6+2.3	22.4+2.4	22.0+2.2	21.9+2.3	22.2+2.3	20.8+2.3	P<0.05 between Cat I &IV,I&VI,II&IV, II&VI,III &VI.
Pretraining HH OSPE	8.7+2.7	8.9+2.5	8.9+2.3	7.3+2.4	8.5+2.3	7.1+2.1	P<0.05 between Cat I &IV,I&VI,II&IV, II&VI,III&IV, III &VI.
Pretraining PPE OSPE	12.1+2.3	12.2+2.5	11.3+2.1	11.3+2.3	11.1+2.4	10.2+2.3	P<0.05 between all the categories except I &II
Pretraining total marks	42.9+2.4	42.8+2.3	41.2+2.5	40.3+2.5	41.1+2.4	39.8+2.5	P<0.05 between all the categories except I &II
Posttraining MCQ	27.5+2.4	27.6+2.4	27.5+1.9	25.6+2.3	27.1+2.4	24.9+2.5	P<0.05 between Cat I &IV,I&VI,II&IV, II&VI,III&IV, III &VI.
Posttraining PPE OSPE	14.5+2.3	14.6+2.4	14.9+2.4	13.4+2.3	14.5+2.5	13.0+2.4	P<0.05 between Cat I &IV,I&VI,II&IV, II&VI,III &IV,III &VI.
Posttraining HH OSPE	14.2+2.4	14.8+2.4	15.1+2.2	13.5+2.4	14.1+2.1	13.6+2.4	P<0.05 between all the categories except I &III, I& IV,I &VI,II &IV, II &VI.
Posttraining total marks	55.6+2.4	55.6+2.6	54.9+2.4	53.3+2.3	54.8+2.3	52.2+2.5	P<0.05 between Cat I &IV,I&VI,II&IV, II&VI,III&IV, III &VI.

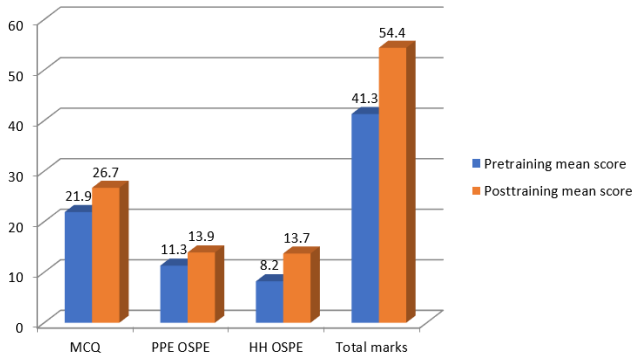

Figure 1: Overall mean scores during different stages of training of HCW.

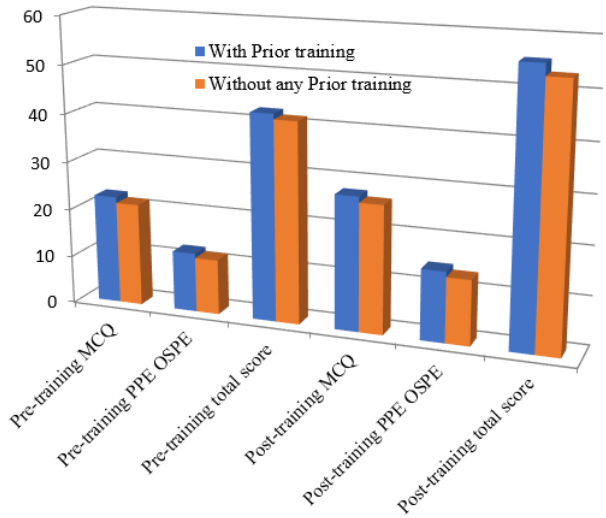

Figure 2: Influence of prior training on various scores during different phases of PPE training

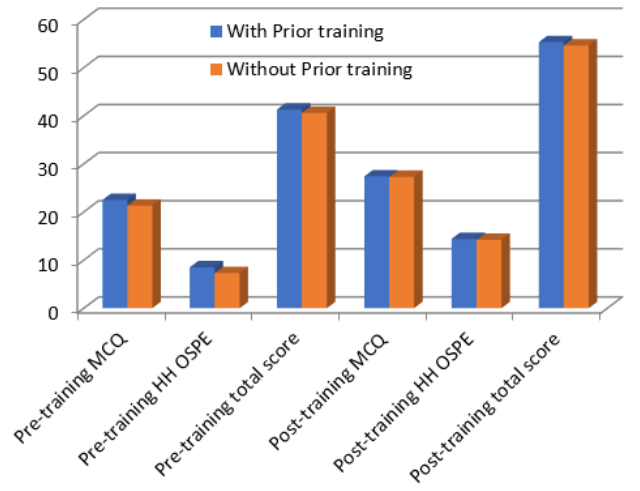

Figure 3: Influence of prior training on various scores during different phases of HH training

4. Discussion

The present study was an effort to assess the knowledge, perceptions and cognitive ability of various HCWs of the Institute before and after attending the training sessions on hand hygiene and PPE.[8] Proper PPE and hand hygiene practices form the first line defence mechanisms against fight towards COVID pandemic. These training sessions form an important link towards skill enhancement and cognitive improvement of the frontline workers of various healthcare institutes.

The overall pre-test mean score of the HCWs of various departments of the institute was 42.5 and the score difference among all the categories of HH and PPE sessions was statistically significant. Faculty and resident group scored the highest, followed by nurses and technicians. These are the categories with maximum patient exposure, care and handling; and they ought to be expert in these PPE and HH skills. Training sessions like these can further enhance their skills and regular practise helps to strength then their abilities.

The overall mean post-training score was 54.6 as compared to 42.5 in pre-training. The difference of 12.1 in the overall score between pre and post training reveals the importance of our training program and our study. Faculty, residents and Nurses group scored the highest and the scores were statistically significant between Categories Cat I &IV,I&VI,II&IV, II&VI,III&IV,III &VI. Category IV and VI included all the sweepers, lab attendants students, technical staff, etc who are not directly involved in direct patient care and handling , so this may explain their lower scores in the training sessions and the statistical significance between the various categories.

In the pre-training MCQ assessment, there was a statistical difference between the scores of Category I,II,III and IV,VI as all these Categories are directly involved in patient care as compared to Category IV,VI and this explains their better scores. In the post-training MCQ assessment, there was a statistically significant difference between the scores of Categories III and IV which was not their in the pre-training scores .The nurses and nursing officers already have a baseline knowledge on these basic courses and the repeat training session led to the improvement in their post-training scores.

In the pre-training HH skill demonstration, score difference was not statistically significant between Category I,II and III; but the post-training scores improved for category III from 8.9 to 15.1 creating a statistical significance between Category I and III. This finding may be explained as Nurses working in the clinical departments, wards and operation theatres are involved in direct patient care handling and perform these hand hygiene skills much more frequently than the other paramedical staff and faculty members. This has also been emphasized by various previous studies.[9] The overall post-training scores for hand

hygiene OSPE improved significantly for all the categories and was 14.8.

In pre-training PPE OSPE, there was statistical significance between the categories I,II ,III and IV & VI. The post-training scores showed marked improvement in the overall score to 14.9, and statistical significance between the categories I,II,III and IV & VI still existed. The score was a little higher for nurses and resident doctors as they were the HCWs directly posted as frontline workers in various hospitals during the COVID pandemic. PPE forms the core and the most crucial part of protection when dealing directly with COVID infected patients and their family members. Hence; PPE training must form an important and unavoidable session in every healthcare institution which must be repeated at a regular interval for better outcomes in patient care.

The Medical council of India has now introduced a new level of education known as "Competency based Medical Education "which stresses on psychomotor skills apart from theoretical knowledge in graduate medical students for better patient care and understanding.[10] This will create more awareness as well as future backup to combat the pandemics.

Speaking of the different unit wise scores, the mean pre-training scores were highest for the critical care unit (CCUs) as compared to the other departments. The reason behind this is quite simple as the patients admitted in these CCUs require high level of infection control measures to minimise nosocomial and other hospital acquired infections. But, the post-training scores showed marked improvement in other categories of units as well realising the importance of these training sessions**.**

Figures 2 and 3 tried to highlight the impact of previous training sessions on the various aspects of knowledge of HCWs. In both the HH as well as PPE training sessions the pretraining scores were somewhat higher for the attendees who had prior trainings. But, repeated training sessions like these helps in knowledge building, retaining and strengthening the past known facts.[11] Hence, repeated trainings like these are a must for every healthcare institution. Teaching sessions should never be a one sided, monotonous lectures; rather they should be interesting, lively and interactive ones. The attendees must be given equal and timely opportunities to show their practical learned knowledge which they must have retained during the lectures.[12] This type of lectures will inculcate patient friendly behaviours as well as practices among the HCWs and participants which will lead to better patient care and infection control measures.

Similar studies done in the past by Gaikwad et al. and Liu M, et al in China have highlighted the importance of these training sessions in considerably improving the knowledge of HCWs in the form of better post training scores.[13,14] Our study has very well shown the difference in scores before and after these sessions in various categories of HCWs as well as across different units/departments. Our study is one among the very few studies done so far in various parts of the world during the current pandemic of COVID-19 for assessing the knowledge of HCWs on the two pillars of infection control measures i.e. HH and PPE training. In the near future, these training sessions will not only impart knowledge but also help in prompt management and recognition of the emerging pandemic situations. Proper HH practices and PPE use will itself help to curtail these deadly pandemics alone and their importance cannot be ignored at all.[15–17]

Despite it's strengths, limitations of our present study can be on the fact that these pre training as well as post training scores reflect the participants ability to retain the learned facts and does not ascertain the real time behaviour of the attendee. Therefore, regular and periodical sessions will take care of this knowledge lacune and will check the HCWs real time behaviour towards the patients and the health care institutions. Larger studies over a wider group of population can be planned in the future for better understanding and impact of these training sessions.

5. Conclusion

Cognitive and psychomotor training sessions will act as strong pillars in combating the current as well as near future pandemic situations. HH and PPE training sessions will impart knowledge as well as confidence to the HCWs working in hospitals for better patient care as well as infection control practices. These training sessions are need of the hour for every health care institutions fighting the battle against the deadly ongoing pandemic.

6. Ethics Approval

The study was approved by institute ethics committee. Informed consent was obtained from all the participants. They were informed of the confidentiality of the data.

7. Author's Contribution

S.S., A D, C.S, performed literature search, data analysis, and first draft of the manuscript and figures. CS,AG and UG contributed with the final draft of the manuscript and editing.

8. Abbreviations

COVID –Coronavirus disease; HH-hand hygiene; PPE-personal protective equipment; MCQs-multiple choice questions; OSPE-Objective structured practical examination

9. Research Quality

The authors of this manuscript declare that this scientific work complies with reporting quality, formatting, and

reproducibility guidelines set forth by the EQUATOR Network.

10. Conflicts of Interest

None.

11. Source of Funding

None.

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