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Original Research Article

Knowledge, attitude and practices regarding the use of personal protective equipment during COVID-19 pandemic among health care workers at a tertiary health care center

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ABSTRACT

Background: The aim of the present study was to assess the knowledge, attitude and practices (KAP) regarding the use of personal protective equipment (PPE) during COVID-19 pandemic among health care workers.
Methods: A cross-sectional study was conducted among health care workers (HCW) including junior and senior resident doctors and nursing staff working at a tertiary health care center. A pre-designed, pre-validated, semi-structured questionnaire regarding the use of PPE was distributed online to eligible HCW and their responses were recorded electronically between 14 April 2020 and 20 April 2020. The survey questionnaire consisted of questions based on demographic and background characteristics along with KAP; knowledge (K1-K6), attitude (A1-A3) and practices (P1-P4).
Results: A total of 423 out of 475 eligible participants successfully submitted their responses and were included in the present study which included junior resident doctors (55.70%), senior resident doctors (19.60%) and nursing staff (24.60%). The mean total knowledge score was 4.169±1.006 with an overall correct response rate of 75.8%. The result of one way ANOVA indicated that there is significant difference in the mean total knowledge score according to designation ($F=6602$, $p<01$) with improved knowledge score seen in HCW with higher designation. Majority of HCW had positive attitude and appropriate practices regarding the use of PPE.
Conclusions: Optimal use of PPE is crucial to avoid transmission of infection in health care setting. Assessment of KAP of HCW regarding the use of PPE can help hospital authorities to introduce educational programs accordingly to gaps identified in the survey.

Keywords: COVID-19, Pandemic, Personal protective equipment, Knowledge, attitude and practices, Survey

INTRODUCTION

The COVID-19 outbreak was first reported following cases of respiratory tract infection reported in Hubei province in central China on 29 December 2019.[1,2] Since then the infection spread rapidly all across the world so that by 30 July 2020 213 countries and territories had been affected by on-going COVID-19 pandemic. In view of such unprecedented global health crisis, the WHO director general announced COVID-19 outbreak a public health emergency of international concern on 30 January 2020.[3]

Based on current evidence COVID-19 is transmitted from one person to other through close contact and respiratory droplets along with airborne transmission occurring during aerosol generating procedure.[4-7] The high infectivity of COVID-19 makes HCW particularly vulnerable of contracting the disease. Protection of HCW is therefore extremely crucial to prevent additional strain on already burdened existing health care system from the pandemic.[8] The WHO and center for disease control and prevention (CDC) are constantly updating infection prevention guidelines and various recommendations for HCW from the end of January 2020.[9,10]

As on June 2020, in the state of Maharashtra, India, more than 500 HCW had tested positive for COVID-19 most of which are from the capital city Mumbai.[11] Optimal use of personal protective equipment (PPE) by health care professionals can drastically reduce infection rates among frontline HCW which is dependent on their adequate knowledge, positive attitude and correct practices. Lapses in knowledge among HCW may impact their perception towards COVID-19 as reported from studies during pandemics in the past.[12,13] This can lead to rapid spread of infection in hospitals putting both the patients and HCW lives at risk.[14,15]

The present study aims to assess KAP regarding the use of PPE in a tertiary care hospital in Navi Mumbai. Adequate knowledge can translate into appropriate PPE usage and improved compliance thereby reducing hospital acquired infections (HAI).

METHODS

Study design and setting

This cross sectional study was conducted among HCW including all resident doctors and nursing staff working at Mahatma Gandhi missions (MGM) hospital which is a dedicated COVID-19 tertiary health care center situated in Navi Mumbai, India.

Data measurement methods

A pre-designed, pre-validated, semi structured questionnaire was prepared in english language based on the infection prevention guidelines recommended by WHO and CDC on their official websites. The survey questionnaire was distributed online to eligible participants through social media using whatsapp messaging application between 14 April to 20 April 2020. Participants failing to respond in the first instance were resend the survey questionnaire as a reminder after a gap of 3 days. Whatsapp application was chosen for the present study as it is the most common online mobile messaging application used in India.[16] A brief introductory message regarding the aims and objectives of the present study was sent to all participants along with google form link to the survey questionnaire. Participants could access the survey questions by clicking on the link and send their responses online which was recorded electronically.

Sampling technique and sample size

The method of universal sampling technique was used in the present study. The sample size for the present study was 475 participants. This included health care professionals such as resident doctors, junior and senior residents (n=225) and nursing staff (n=250) working at MGM hospital.

Survey instrument

The study was commenced after obtaining institutional ethics committee (IEC) approval. Consent was taken by asking the participants to answer a yes-no question at the start of survey questionnaire to confirm their willingness to participate voluntarily. After confirmation participants were directed to complete rest of the survey questionnaire. Confidentiality and anonymity of participants was maintained throughout the present study.

The survey questionnaire was divided into two different parts: (a) demographics and background characteristics and (b) KAP (total 13 questions) which included; knowledge (K1-K6), attitude (A1-A3) and practices (P1-P4). Overall knowledge was assessed using a 6 point scoring system. For questions on correct doffing and donning sequence, participants had to choose one out of 4 given options. For rest of knowledge based questions they had to respond either true or false. Each correct response was awarded 1 point and an incorrect response zero point. Attitude was assessed using a 5 point Likert's scale (strongly agree, agree, neutral, disagree and strongly disagree).[17] It was mandatory to answer all the survey questions for successful submission and recording of participant responses.

Inclusion and exclusion criteria

Eligible health care professionals including resident doctors (junior and senior residents) and nursing staff working in various departments at MGM hospital, Navi Mumbai, Maharashtra who successfully submitted their responses were included in the study. Health care professionals not willing to consent for the study or those who failed to respond to survey questionnaire distributed online on two separate occasions were excluded from the present study.

Statistical methods

The final results were expressed as mean with standard deviation and $p < 0.05$ was considered to be statistically significant. Chi-square test was used to determine association between different variables. The final analysis was done using Epi Info software (version 3.4.3) and Microsoft excel 2013 (Microsoft office version 15.0).

RESULTS

Demographic and background characteristics

A total of 423 out of 475 eligible participants responded to the survey questionnaire and were included in the present study. More than half (56.5%) of the total participants belonged between 25 to 29 years of age while only 2.6% of total participants were over 40 years of age. A slight female preponderance was seen in the present study forming 57.9% (n=245) of the total participants. Majority of the participants were unmarried comprising of 61.70% (261). Among the total HCW, nurses comprised of 24.60% (n=104), junior resident doctors 55.70% (n=236) and senior resident doctors 19.60% (n=83). Nearly half (49.4%) of the participants had received a formal training course regarding the use of PPE while others had not. The most common source of information regarding use of PPE was social media (18.3%) followed closely by the WHO/CDC website (17.3%). The demographic and background characteristics of study participants are shown in table 1.

Participants knowledge regarding PPE

Overall correct response rate of participants knowledge was 75.8%. Responses of HCW to individual questions based on knowledge are summarized in Table 2. About three quarter (76.1%) of participants believed that hand hygiene measures need to be followed despite of correct use of PPE. Participants knowledge regarding correct donning and doffing technique of PPE as per WHO guidelines was 74.5% and 62.6% respectively. Surprisingly about one third (31.4%) of participants considered that hand hygiene using alcohol based sanitizer is superior to soap and water when hands are visibly dirty and soiled. However a high proportion of participants thought that a filtering facepiece respirator mask (N95, FFP2, FFP3 or equivalent) rather than medical mask (87.2%) as well as eye protection measures (85.8%) should be used while performing aerosol generating procedures.

Table 3 shows comparison of mean total knowledge score according to the designation which is also depicted in figure 1. The result of one way ANOVA indicated that there is significant difference in the mean total knowledge score according to designation (F=6602, p<01).

Further multiple comparison using Tuckey's post HOC test (table 4) indicated that the first year junior resident doctors have least mean total knowledge score followed by the nursing staff, second year junior doctors, third year junior doctors and finally the senior residents who had the highest mean total knowledge scores.

The results of chi-square test (table 5) indicates that there was significant association between designation of HCW and their practices regarding the use of PPE (p<0.01). Likewise, except on the question A3, asking if India can step up mass production of PPE, there was significant association noticed between designation of HCW and attitude based questions regarding PPE.

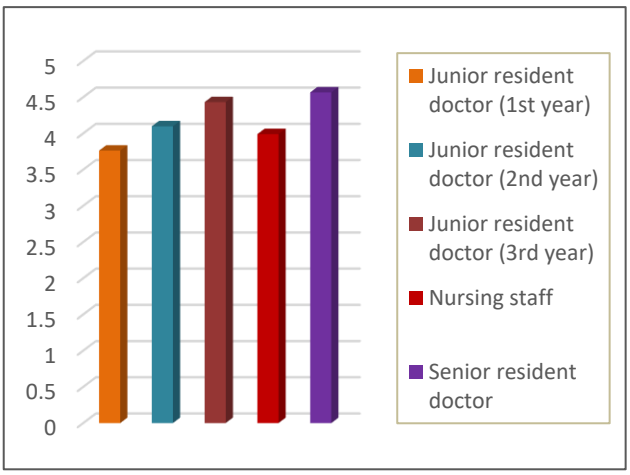

Figure 1: Mean total knowledge score.

Table 6 below gives the result of logistic regression analysis. The result indicates that the variables such as marital status, living status, training received were significant in predicting mean total knowledge score.

Participants attitude regarding PPE

As summarized in table 7 participants attitude regarding PPE showed that more than half (56.5%) of total participants strongly agreed that correct usage of PPE is crucial to prevent coronavirus transmission in hospital setting among health care professionals. Majority (65.4%) of participants agreed that it is inconvenient to use recommended PPE while taking care of patients with COVID-19. Mixed attitude was seen in terms of mass production of PPE with 47% of participants agreeing that India can step up mass production whereas 35.3% of participants disagreeing with it.

Participants practices regarding use of PPE

A high proportion (81.1%) of participants practiced wearing a mask every time while handling suspected or confirmed COVID-19 patients. More than half (54.1%) of participants noticed that their colleagues forgot to use certain component/s of recommended PPE sometimes while taking care of COVID-19 patients as compared to a quarter of participants (27%) who always used the complete PPE. Most of the participants (40.9%) practiced removing their PPE immediately after leaving infected patients room or ward. Similarly 59.3% of participants made all suspected or confirmed cases of COVID-19 without breathing difficulties wear a medical mask always. The response of participants towards questions based on practices regarding the use of PPE are summarized in table 8.

Table 1: Participants demographic and background characteristics (n=423).

Variables	Frequency	Percent
Age (in years)		
18-24	48	11.3
25-29	239	56.5
30-34	95	22.5
35-39	30	7.1
40-44	11	2.6
Gender		
Male	178	42.1
Female	245	57.9
Marital status		
Single	261	61.7
Married	162	38.3
Living status		
Living alone	21	5.0
Living in hostel	245	57.9
Living with children and spouse	45	10.6
Living with parents	30	7.1
Living with parents, children and spouse	46	10.9
Living with spouse	24	5.7
Living with spouse and living in hostel	12	2.8
Designation		
Junior resident doctor (first year)	63	14.9
Junior resident doctor (second year)	92	21.7
Junior resident doctor (third year)	81	19.1
Nursing staff	104	24.6
Senior resident doctor	83	19.6
Have you received any formal training course regarding the use of PPE?		
Yes	209	49.4
No	214	50.6
Source of information		
Colleagues and friends	217	15.3
Hospital training program	181	12.8
Medical journals	189	13.4
Social Media	259	18.3
Ministry of health, India	148	10.5
WHO/CDC	245	17.3
Television	176	12.4

Table 2: Participants knowledge of PPE (n=423).

S. no.	Question	Response	Frequency	Percentage
K1	Use of correct PPE eliminates the need for hand hygiene	True	101	23.9
		False	322	76.1
K2	Which of the following is the correct sequence of donning (putting on) PPE for contact/droplet precautions as per WHO guidelines?	Correct	315	74.5
		Wrong	108	25.5
K3	Which of the following is the correct sequence of doffing (removing) PPE for contact/droplet precautions is as per WHO guidelines?	Correct	265	62.6
		Wrong	158	37.4
K4	Hand washing using alcohol based sanitizer is always superior than soap and water for hand hygiene if the hands are visibly dirty and soiled.	True	133	31.4
		False	290	68.6
K5	A filtering facepiece respirator mask (N95, FFP2, FFP3 or equivalent should be used rather than medical mask while performing aerosol generating procedure	True	369	87.2
		False	54	12.8
K6	It is recommended for health care workers to use eye protection (goggles or a face shield) while performing aerosol generating procedures.	True	363	85.8
		False	60	14.2

Table 3: Comparison of mean knowledge scores according to designation.

Designations	N	Mean	SD	SE	95% confidence interval for mean		Min	Max	F stat	P value
					Lower bound	Upper bound				
Junior resident doctor (first year)	63	3.762	1.201	0.151	3.459	4.064	1.00	6.00	6.602	<01
Junior resident doctor (second year)	92	4.098	1.110	0.116	3.868	4.328	1.00	6.00		
Junior resident doctor (third year)	81	4.432	1.060	0.118	4.198	4.666	2.00	6.00		
Nursing staff	104	3.990	1.288	0.126	3.740	4.241	1.00	6.00		
Senior resident doctor	83	4.566	0.844	0.093	4.382	4.751	2.00	6.00		

Table 4: Multiple pairwise comparison using Tukey's post-HOC test.

Dependent variables						
Tukey HSD						
Designations		**Mean difference (I-J)**	**Standard error**	**Sig.**	**95% confidence interval**	
					Lower bound	**Upper bound**
Junior resident doctor (first year)	Junior resident doctor (second year)	-0.33592	0.183	0.352	-0.836	0.164
	Junior resident doctor (third year)	-.67019*	0.188	0.004	-1.184	-0.156
	Nursing staff	-0.22848	0.178	0.702	-0.717	0.260
	Senior resident doctor	-0.80436*	0.187	0.000	-1.315	-0.293
Junior resident doctor (second year)	Junior resident doctor (third year)	-0.33427	0.170	0.285	-0.800	0.132
	Nursing staff	0.10744	0.160	0.962	-0.330	0.545
	Senior resident doctor	-.46844*	0.169	0.046	-0.931	-0.005
Junior resident doctor (third year)	Nursing staff	0.44171	0.165	0.060	-0.011	0.895
	Senior resident doctor	-0.13417	0.174	0.939	-0.612	0.343
Nursing staff	Senior resident doctor	-.57588*	0.164	0.005	-1.026	-0.126

*. The mean difference is significant at the 0.05 level.

Table 5: Results of chi-square test.

Designations		A1	A2	A3		P1	P2	P3	P4
Junior resident doctor (first year) (n=63)	Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree	32 21 7 3 0	16 22 17 8 0	17 14 8 19 5	Always Mostly Sometimes Never	47 16 0 0	1 14 42 6	18 20 25 0	39 18 6 0
Junior resident doctor (second year) (n=92)	Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree	35 35 20 2 0	21 20 38 13 0	12 19 22 32 7	Always Mostly Sometimes Never	61 30 1 0	1 14 60 17	22 37 32 1	46 27 18 1
Junior resident doctor (third year) (n=81)	Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree	64 9 8 0 0	19 45 11 5 1	20 30 12 16 1	Always Mostly Sometimes Never	72 9 0 0	5 11 36 29	34 41 6 0	44 35 2 0
Nursing staff	Strongly agree Agree	56 38	26 52	26 19	Always Mostly	92 12	1 15	31 43	66 31

Continued.

Designations		A1	A2	A3		P1	P2	P3	P4
(n=104)	Neither agree nor disagree Disagree Strongly disagree	10 0 0	22 3 1	16 34 9	Sometimes Never	0 0	54 34	30 0	7 0
Senior resident doctor (n=83)	Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree	52 21 9 0 1	18 38 21 4 2	19 23 15 19 7	Always Mostly Sometimes Never	71 12 0 0	2 16 37 28	36 32 15 0	56 22 4 1
Total (n=423)	Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree	239 124 54 5 1	100 177 109 33 4	94 105 75 120 29	Always Mostly Sometimes Never	343 79 1 0	10 70 229 114	141 173 108 1	251 133 37 2
Chi-square		50.439	44.247	26.053		25.108	30.453	35.179	28.378
Df		16	16	16		8	12	12	12
P value		<0.01 (Significant)	<0.01 (Significant)	0.053 (Not significant)		<0.01(Significant)	<0.01 (Significant)	<0.01 (Significant)	<0.01 (Significant)

Table 6: Logistic regression analysis.

Variables	B	SE	Wald	df	Sig.	Exp (B)	95% C.I. for EXP (B)	
							Lower	Upper
Age (in years)								
18-24			9.195	4	0.056			
25-29	-1.003	1.171	0.733	1	0.392	0.367	0.037	3.642
30-34	-0.368	1.156	0.101	1	0.750	0.692	0.072	6.673
35-39	-0.986	1.130	0.761	1	0.383	0.373	0.041	3.418
40-44	-1.930	1.156	2.785	1	0.095	0.145	0.015	1.400
Gender (1)	0.264	0.286	0.848	1	0.357	1.302	0.743	2.281
Marital status (1)	-0.863	0.354	5.951	1	0.015	0.422	0.211	0.844
Living status								
Living alone			16.375	6	0.012			
Living in hostel	1.415	1.064	1.769	1	0.184	4.117	0.512	33.139
Living with children and spouse	0.252	0.751	0.113	1	0.737	1.287	0.295	5.610
Living with parents	0.125	0.774	0.026	1	0.871	1.134	0.249	5.167
Living with parents, children and spouse	-0.869	0.862	1.016	1	0.313	0.419	0.077	2.273
Living with spouse	1.769	1.039	2.900	1	0.089	5.864	0.766	44.915
Living with spouse and living in hostel	1.205	1.030	1.370	1	0.242	3.338	0.444	25.106
Designation								
Junior resident doctor (first year)			2.162	4	0.706			
Junior resident doctor (second year)	-0.649	0.552	1.383	1	0.240	0.522	0.177	1.542
Junior resident doctor (third year)	-0.317	0.564	0.315	1	0.575	0.728	0.241	2.202
Nursing staff	-0.602	0.543	1.228	1	0.268	0.548	0.189	1.589
Senior resident doctor	-0.476	0.494	0.926	1	0.336	0.622	0.236	1.637
Have you received any formal training course regarding the use of PPE? (1)	0.784	0.339	5.346	1	0.021	2.189	1.127	4.254
What is your level of risk exposure of contracting coronavirus infection in your health care setting? (1)	-0.474	0.323	2.150	1	0.143	0.623	0.331	1.173
Constant	2.212	1.379	2.573	1	0.109	9.135		

Table 7: Participants attitude towards regarding PPE.

	Frequency	Percent
A1: Correct usage of PPE is crucial to prevent coronavirus transmission in hospital setting among health care professionals		
Strongly agree	239	56.5
Agree	124	29.3
Neither agree nor disagree	54	12.8
Disagree	5	1.2
Strongly disagree	1	0.2
A2: It is inconvenient to use recommended PPE when taking care of patients with COVID-19.		
Strongly agree	100	23.6
Agree	177	41.8
Neither agree nor disagree	109	25.8
Disagree	33	7.8
Strongly disagree	4	0.9
A3: Do you think India can step up mass production of PPE to meet the ever increasing demand across the country?		
Strongly agree	94	22.2
Agree	105	24.8
Neither agree nor disagree	73	17.3
Disagree	120	28.4
Strongly disagree	29	6.9

Table 8: Participants practices regarding PPE.

	Frequency	Percent
P1: Do you wear a medical mask every time while handling suspected or confirmed COVID-19 patients?		
Always	343	81.1
Mostly	79	18.7
Sometimes	1	0.2
None	0	0
P2: Do you notice that your colleagues forget to use some component/s of recommended PPE while taking care of patients with COVID-19?		
Always	10	2.4
Mostly	70	16.5
Sometimes	229	54.1
Never	114	27.0
P3: Do you remove your PPE immediately after leaving infected patients room/ward?		
Always	141	33.3
Mostly	173	40.9
Sometimes	108	25.5
Never	1	0.2
P4: Do you make all suspected or confirmed patients of COVID-19 without breathing difficulties wear a medical mask?		
Always	251	59.3
Mostly	133	31.4
Sometimes	37	8.7
Never	2	0.5

DISCUSSION

Frontline HCW are at increased risk of acquiring nosocomial infection in hospital settings as seen in outbreaks of transmissible infectious diseases in the past. More than one-fifth (21%) of patients who acquired severe acute respiratory syndrome (SARS) which emerged in 2002 were HCW.[17] Likewise in 2009 during the influenza A (HINI) pandemic, possible infection transmission rate of 14% (9 out of 63) was seen among exposed HCW in a study conducted in southern California.[19] Increasingly high numbers during ongoing COVID-19 pandemic are also been reported from China (3,300) and Italy (20%).[20] Thus protection of frontline HCW from contracting nosocomial infection is of paramount importance to avoid collapse of existing health

care system. This can be achieved by adhering to appropriate and correct use of PPE in collaboration with other infection preventive measures as recognized in a variety of infection control guidelines and also as demonstrated during SARS outbreak in 2013.[12,21-23]

The CDC stresses the need to follow hand hygiene measures for PPE usage to be effective. It recommends use of soap and water than alcohol based sanitizer for hand hygiene if the hands visibly dirty and soiled.[24,25] Mingzhu Zhang et al published in their study that respirator facemasks such as N95 or equivalent are preferred over medical mask in preventing respiratory virus infection in HCW.[26] In the present study while 76.1% of participants correctly responded that adequate PPE usage does not undermine the importance of hand hygiene practices (question 1), a lower proportion of participants (68.6%) correctly believed that hand hygiene using soap and water is superior to alcohol based hand sanitizer when hands are visibly contaminated (question 4). In spite of higher knowledge of participants regarding the importance of various components of PPE such as respirator masks over medical mask-question 5 (87.2%) and eye protection wear-question 6 (85.8%) during aerosol generation procedures, the correct response rate for questions based on the process of donning (74.5%) and doffing (62.6%) of PPE as recommended by WHO was lower. We suggest presence of a supervisor during donning/doffing of PPE to avoid contamination and when this is not available a buddy-buddy system.[27]

The results using logistic regression analysis in the present study showed that participants who received formal training regarding the use of PPE had statistically significant higher mean total knowledge score. Hence, we suggest that hospitals should arrange formal education courses for training their clinical staff regarding correct use of PPE as their results in reducing infection transmission rates were also reported by Tomas ME et al.[28] The WHO has launched an online platform called as open-WHO which provides training courses regarding correct practices of hand hygiene and use PPE for HCW. This includes video demonstration of correct method of donning and doffing process of PPE during which risk of infection transmission is maximum.

Inconvenience caused by prolonged use of PPE such as heat stress may affect compliance especially in tropical countries like India due to minimized air flow.[29,30] Additionally reduced dexterity, impaired visibility and back pain has been reported from various components of PPE affecting compliance and thereby putting HCW at risk of infection.[31] In the present study about two-third (65.4%) of participants opined that they were inconvenienced by wearing of PPE. With high percentage (85.8%) of participants in the present study agreeing the crucial role of correct PPE usage in infection control, providing good quality PPE by hospital authorities may reduce inconvenience and improve compliance rate. A low proportion with less than half of HCW believed that India can step up mass production of PPE. This might be attributed to initial main stream media reports of shortage of available PPE secondary to sudden spike in number of cases and hospitalization.

Majority of study participants had appropriate practices while handling infected or suspected patients of COVID-19. However discrepancies were met in certain items. About three-fourth (73%) of participants noticed that their colleagues forgot to wear some component/s of recommended PPE in varying frequencies. To improve compliance rate we propose that HCW should regularly check themselves and their colleagues for any lapses in adherence to use of complete PPE and in case identified be brought to attention immediately. Also only 33.3% of participants removed their PPE immediately after leaving the infected patients room. The CDC recommends that if wearing a gown or full PPE it should be removed at the doorway or in an anteroom after exiting an infected patients room/ ward followed by immediately hand hygiene.[32]

Limitations

The present study is not without limitation. Firstly, ours was a cross-sectional conducted during mid-April when COVID-19 cases were on the rise in India and globally. Participants tend to answer self-administered questionnaire which they feel would be socially acceptable resulting into biased responses.[33] Additionally, they may also be subject to recall bias depending upon the ability of participants to recall correct information affecting their knowledge scores. This may influence interpretation of results and there by misguided correlations.

CONCLUSION

Protection of HCW from HAI during pandemic is extremely crucial to avoid collapse of health care system. Assessment of existing knowledge, attitude and practices of HCW can help hospital authorities to identify gaps in correct knowledge, positive perceptions and appropriate practices. This can further enable them to introduce effective education programs and modify them according to the needs of the clinical staff.

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