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To study the knowledge about the handling of biomedical waste among health-care workers in a COVID-19 hospital setting

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Abstract:

BACKGROUND: The unexpected increase in COVID-19-related waste and its inappropriate disposal had blown up the threat of retransmission of this infection and adversely impacted the environment. The aim of this study was to evaluate the existing knowledge about the handling of biomedical waste (BMW) in the COVID-19 Hospital setting among health-care workers (HCWs).

MATERIALS AND METHODS: It was a prospective cross-sectional study done for 3 months, i.e., October 2020–December 2020 among nursing professionals across all seniority posted in COVID hospital. A pretested questionnaire comprised 20 questions was used as a study tool.

RESULTS: The response rate of our study was 94%. The mean age of respondents was 33.97 years, and the mean length of service was 8.32 years. The study revealed that the respondents had a mean knowledge score of 12.21 (Median 12, standard deviation 2.129 and 95% confidence interval of 11.92–12.51).

CONCLUSIONS: There is consensus among the researchers/scholars that COVID-BMW hazards are much more significant than regular BMW. Therefore, its awareness among the HCWs can be a panacea for safer handling of BMW generated in COVID Hospital.

Keywords:

Biomedical waste, central pollution control board, COVID-19, health care worker, pandemic, united nations environment program, World Health Organization

Introduction

Biomedical waste (BMW) means any debris generated during the diagnosis, treatment, or immunization of human beings or animals or research on it or in the production or testing thereof.[1] In a developing country like India, approximately 1.5–2 kg/bed/day BMW is generated.[2] BMW is of different types and may cause different infectious diseases,[3] and cause disruptions in the environment and an unfavorable impact on ecological equilibrium.[4,5] The recent outbreak of novel coronavirus (COVID-19) Pandemic had considerable public health implications.[6]

Among this Pandemic, BMW management may worsen due to indiscriminate use of personal protective equipment (PPE kits), N95 masks, gloves, etc. Despite Government guidelines regarding rational use, the hospitals face great demand for PPEs, etc., from health-care workers (HCWs) due to fear of contamination with COVID-19.[7,8] The unexpected increase in COVID-19-related waste and its inappropriate disposal had blown up the threat of retransmission of this infection and adversely impacted

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the environment.[9-11] The Central Pollution Control Board (CPCB) had published guidelines for the safe management of this highly infectious waste generated from COVID-19 hospitals and quarantine homes.[12] These guidelines are different from BMW (M and H) Rules, 2016.

With this background in mind, this study was planned to evaluate the existing knowledge about the handling of BMW in COVID-19 hospital setting among HCW of tertiary care, referral, academic and research hospital of Northern India. The study also aimed to find an association between the knowledge differential and selected variables for assessing the future needs of training (if any) and Protecting HCWs from occupational exposure to this highly infectious disease. The permission was obtained from the Institute Ethics Committee before conducting this study.

Materials and Methods

Study design and setting

It was a prospective cross-sectional study carried for 3 months, i.e., October 2020–December 2020 at a tertiary care Hospital in northern India.

Study participants and sampling

All nursing professionals (n = 218) posted in wards, Intensive Care Units, Operation Theatres, sample collection areas dedicated to treating COVID-19 patients were included in the study. They were directly involved in the patient care activities of COVID-19 and the generation of BMW in the COVID-19 hospital setting.

Data collection tool and technique

A self-administered survey questionnaire was prepared after extensive literature reading and used as a study tool. The questionnaire was pilot tested among 20 different experts to check its validity. The questionnaire had two parts. The first part includes questions related to the sociodemographic profile of the participants. The second part contains questions regarding various aspects of BMW management specific to the COVID hospital setting The questionnaire consisted of 19 closed-ended questions for measuring the existing knowledge about BMW in COVID hospital and one open-ended statement for assessing HCWs perception of their knowledge and training adequacy. The questionnaire was designed on Google form and administered to the study participants through their Whats app numbers. All the respondents furnished informed consent through Google forms. The study participants were requested to fill the questionnaire at the earliest and preferably within a week. The participants who failed to submit the filled questionnaires within the prescribed timeline were reminded a maximum of three times at an interval of 1 week for submitting their responses. Participants who failed to respond after repeated reminders were excluded from the study. The nursing staff involved in pilot testing was also not included in the study. All nineteen questions were scored. Each correct response was given a score of one. Wrong answers and unanswered questions were given zero marks. The overall mean score (95% confidence interval [CI]) was calculated for all participants. The descriptive and Chi-square test were used for subgroup analysis.

Ethical considerations

The ethical approval was obtained from Institute Ethics Committee before conducting the study. The informed consent was taken from each participant, and anonymity and confidentiality of the participants are maintained.

Results

A total of 205 nursing professionals responded to our questionnaire and submitted their responses. The sociodemographic analysis revealed that 70% were in the age group of 25–35 years, 84% were female, most were married (80%), and from the urban background (75.6%). The study revealed that 97% of respondents were staff nurses, and 64% of respondents had General Nursing Midwifery qualifications. Forty-four percent of the participants had 0–5 years of service [Table 1]. On the descriptive statistical analysis, the mean age of respondents was 33.97 years (Median 32, standard deviation [SD] 7.131 and 95% CI of 32.98–34.95). Similarly, the mean length of service was 8.32 years (Median 6, SD 6.719 and 95% CI of 7.39–9.24) [Table 2]. The respondents had a mean knowledge score of 12.21(Median 12, SD 2.129 and 95% CI of 11.92–12.51) with a minimum score of 05 and the maximum score of 16 [Figure 1]. The respondents were categorized as very good (>75% knowledge score), good (50%–75% knowledge score), and

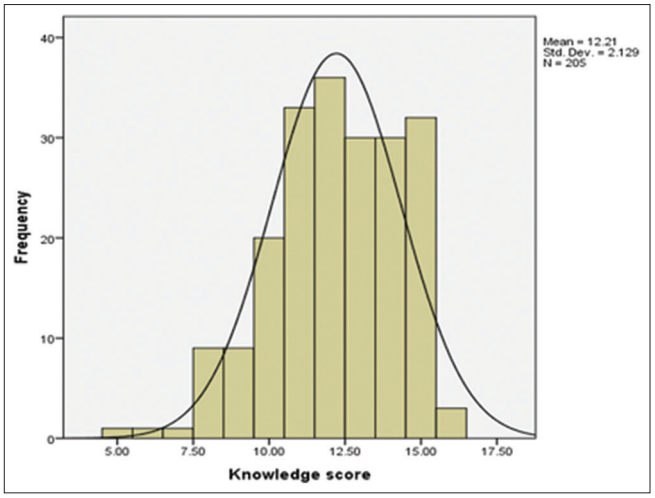

Figure 1: Diagram showing the frequency distribution of knowledge score

average knowledge group categories (<50% knowledge score). Most of the study participants (72.7%) had good knowledge, followed by very good knowledge (17%). On age group-wise analysis, most of the respondents in all age groups had good knowledge scores (Chi-square = 4.9522, P = 0.2923); similarly, females have slightly higher knowledge than males, and the majority of the study participants of these two groups also had good knowledge score (Chi-square = 0.2384, P = 0.8876). In the same way, on marital status (Chi-square = 1.6214, P = 0.9510), place of residence (Chi-square = 1.6489, P = 0.4385), educational qualification (Chi-square = 12.0545, P = 0.0169), designation (Chi-square = 0.9447, P = 0.6235), and length of service (Chi-square = 11.2156, P = 0.0819) wise analysis, it was found that majority of respondents had good knowledge score [Table 3]. The analysis revealed that most respondents (58%) had perceptions about adequate knowledge, but they need further self-updating [Figure 2].

Table 1: Distribution of sample size as per age group, gender, marital status, place of residence, educational qualification, designation, and length of service

Parameter	*n* (%)
Age (years)	
25-35	143 (69.8)
36-45	41 (20.0)
>45	21 (10.2)
Gender	
Male	32 (15.6)
Female	173 (84.4)
Marital status	
Married	164 (80.0)
Unmarried	38 (18.5)
Divorcee	1 (0.5)
Widow	2 (1.0)
Resident	
Urban	155 (75.6)
Rural	50 (24.4)
Education qualification	
GNM	132 (64.4)
BSc	20 (9.8)
MSc	53 (25.9)
Designation	
Staff nurse	198 (96.6)
Nursing officer	7 (3.4)
Length of service (years)	
0-5	91 (44.4)
6-10	52 (25.4)
11-15	37 (18.0)
>15	25 (12.2)

On individual question-wise analysis, the respondents had very good knowledge about the different color-coded bins used to segregate different BMW categories generated in COVID-19 Hospital. They also had very good knowledge about hazards associated with BMW of COVID hospital, labeling, cleaning/disinfection of waste transport trolley, protective gears of waste handlers, and HCWs dealing with packaging and disposal of COVID-19 patient's dead bodies. On the other hand, the participants had good knowledge about the correct color-coded category of bags for storage of contaminated glass and medicine vials, appropriate method of transporting and disposal of COVID 19 dead bodies, treatment of red bag waste, and layering of bags used to transport BMW from COVID areas. However, the participants had average knowledge about the date of the latest revision in COVID BMW management introduced by the CPCB, disposal of sharp waste, disposal of noninfected general dry waste, and the maximum time permissible for storage of COVID-19 BMW as per guidelines [Table 4].

Discussion

In our study, the response rate of participants was 94%. In our study, the mean knowledge score was higher among younger nurses, females, unmarried, staff nurses, and beginners in service, i.e., 0–5 years of experience and urban backgrounds. None of these subcategories has a statistically significant difference in mean knowledge score (i.e., $P > 0.05$). The declining trend in the mean

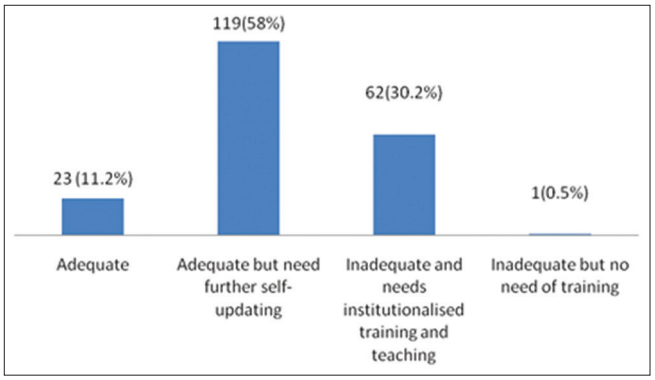

Figure 2: Bar diagram showing perception/opinion regarding knowledge and training adequacy on Biomedical Waste Management in COVID-19 Hospital Setting

Table 2: Descriptive statistical analysis of sociodemographic variables

Parameter	Mean	Median	Mode	SD	Minimum	Maximum	95% CI of the mean	
							Lower	Upper
Age (years)	33.97	32	28	7.131	25	54	32.9838	34.9479
Length of service (years)	8.32	6	3	6.719	2	32	7.39	9.24

SD=Standard deviation, CI=Confidence interval

Table 3: Chi-square analysis for association of knowledge scores with age group, gender, marital status, place of residence, designation, length of service, and educational qualification

Parameter	Knowledge score groups						χ^2, *P*
	Average knowledge		Good knowledge		Very good knowledge		
	Count	Percentage	Count	Percentage	Count	Percentage	
Age (years)							
25-35	14	9.8	100	69.9	29	20.3	4.9522, 0.2923
36-45	6	14.6	31	75.6	4	9.8	
46-55	1	4.8	18	85.7	2	9.5	
Sex							
Male	4	12.5	23	71.9	5	15.6	0.2384, 0.8876
Female	17	9.8	126	72.8	30	17.3	
Marital status							
Married	17	10.4	120	73.2	27	16.5	1.6214, 0.9510
Unmarried	4	10.5	26	68.4	8	21.1	
Divorcee	0	0.0	1	100.0	0	0.0	
Widow	0	0.0	2	100.0	0	0.0	
Resident							
Urban	14	9.0	116	74.8	25	16.1	1.6489, 0.4385
Rural	7	14.0	33	66.0	10	20.0	
Education qualification							
GNM	10	7.6	96	72.7	26	19.7	12.0545, 0.0169
BSc	1	5.0	13	65.0	6	30.0	
MSc	10	18.9	40	75.5	3	5.7	
Designation							
Staff nurse	21	10.6	143	72.2	34	17.2	0.9447, 0.6235
Nursing sister	0	0.0	6	85.7	1	14.3	
Length of service (years)							
0-5	11	12.1	58	63.7	22	24.2	11.2156, 0.0819
6-10	3	5.8	43	82.7	6	11.5	
11-15	6	16.2	26	70.3	5	13.5	
More than 15	1	4.0	22	88.0	2	8.0	

knowledge score with an increase in age, seniority, and length of service may be explained by the fact that the COVID-19 Pandemic is novel and is faced first time by all HCWs in early 2019. The CPCB has also issued the guidelines for handling BMW of COVID hospitals in March 2019. Thus, there is no impact of seniority, increase in age, or length of service on HCWs knowledge. However, on the other hand, more knowledge among younger and junior professionals may be attributed to the fact that younger professionals have more learning aptitude and are good learners than their senior colleagues. The knowledge differential due to gender, marital status, etc., can be attributed to the sample size difference. It was also found that respondents with BSc nursing have maximum mean knowledge followed by diploma holders and postgraduate degree holders. This difference in knowledge was found statistically significant (P = 0.0169). Better knowledge scores in certain groups compared to others could be because of better exposure to the topic in the former compared to the latter.

In our research, most of the respondents (78%) were not aware of the date of the recent revision in COVID BMW guidelines. Aggarwal,[13] has reported that these guidelines are kept specific for ensuring methodical disposal of COVID waste despite the existence of BMW (M and H) Rules, 2016. However, 66% were aware that COVID BMW is hazardous and needs segregation in the proper color-coded bin and must be separately treated. The correct disposal and treatment of COVID BMW are essential as the World Health Organization report,[14] has suggested that widespread discarding, open burning, and incineration can affect air quality and health consequences due to the exposure to pollutants.

Similarly, 90% of respondents were aware of the correct disposal of N 95, triple-layer mask, contaminated gauze, etc. About 79% of the study participants were aware of the proper disposal of infected plastic waste such as nitrile gloves, plastic coverall suit, and face shields. On the contrary, the study carried out by Mehrotra *et al*.,[15] had found that HCWs poorly understood the disposal of PPE. In our study, 84% of participants were aware of the correct disposal of sharp BMW generated in COVID Hospital. Understanding these aspects of COVID-BMW management is crucial, as United Nations Environment Programme,[16] in its report, has also pointed out that

Table 4: Individual question wise analysis of mean knowledge scores

Knowledge question	Count	Sum	Mean	SD
Recent revision in BMW guidelines introduced by Government of India	205	45	0.21951	0.41493
As per the recent guidelines waste generated in COVID treatment areas are considered?	205	136	0.66341	0.47370
As per the recent guidelines which among the following statement is true?	205	183	0.89268	0.31027
Which among the following statements about BMWM of COVID-19 are true?	205	181	0.88293	0.32229
Where do you dispose N 95, triple layer mask, contaminated gauze, cotton and other infected nonplastic items?	205	185	0.90244	0.29745
Where do you dispose plastic infected waste like nitrile gloves, plastic coverall suit and face shields?	205	162	0.79024	0.40813
In which color-coded container should the plastic water bottle used by the COVID-19-positive patients in the ward be collected?	205	8	0.03902	0.19413
How do you dispose the sharps like needle, stillets, and scalpels in COVID-19 areas?	205	172	0.83902	0.36841
Where do you dispose the contaminated glass and medicine vials and ampoules?	205	126	0.61463	0.48787
Which colour-coded bins are used to dispose non-infected general dry waste in the clean donning areas of COVID-19 treatment facilities?	205	30	0.14634	0.35431
What would be the protective gear for sanitation workers during BMWM duties?	205	195	0.95122	0.21594
Which among the following is true about the transport of COVID 19 waste trolley?	205	161	0.78537	0.41157
Which all PPE are required for ambulance drivers and helpers managing transporting and disposing COVID-19 dead bodies?	205	191	0.93171	0.25286
Which among the following is the appropriate method of transporting and disposing COVID 19 dead bodies?	205	116	0.56585	0.49686
Which among the following technique is used to treat waste collected in the yellow bag?	205	169	0.82439	0.38142
Which among the following is used for the treatment of red bag waste?	205	108	0.52683	0.50050
Which among the following is the correct way of disposing diapers of COVID 19 patients in ICU?	205	182	0.88780	0.31638
What is the maximum time of storage of COVID-19 bio medical waste as per CPCB guidelines?	205	26	0.12683	0.33360
How many layered bags are ought to be used to transport BM waste from COVID areas?	205	128	0.62439	0.48547

SD=Standard deviation, COVID-19=Coronavirus disease-2019, BMW=Biomedical waste, BMWM=Bio-medical waste management, PPE=Personal protective equipment, ICU=Intensive care unit, CPCB=Central pollution control board, BM=Biomedical waste

waste management is an important community service necessary to control the spread of COVID-19 infection.

Similarly, a study carried out in China,[17] suggested that inappropriate handling of COVID hospital waste may worsen the spread of COVID to waste handlers and other hospital staff. However, in our study, 93% were aware that full PPE kits are necessary for ambulance drivers and helpers transporting COVID-positive dead bodies. This finding is higher than the study carried out by Mehrotra *et al*.,[15] who reported that HCWs poorly understood handling dead bodies of COVID-19 positive. The proper understanding of this very aspect of BMW handling is critical to prevent occupational hazards to HCWs. A few other studies carried out in Bangladesh,[10-18] pointed out that the large number of informal waste handlers working without proper protection were at high risk of contamination with COVID infection. However, in the present study, slightly higher than half of the respondents (57%) were aware of the appropriate transporting method and disposing of COVID 19 dead bodies. About 89% of the respondents were aware of the correct way of disposing of diapers of COVID 19 patients in ICU, and 62% were aware that double-layered bags used to transport BMW from COVID areas.

Strength of the study

Our study's most significant strength is its novelty, i.e., probably no original research work is available in indexed literature regarding the assessment of knowledge about BMW management in COVID-19 hospital settings among HCWs during this critical period of the infectious disease pandemic. Our sample size was representative of nursing professionals across different seniority and age groups working in a COVID hospital setting created in 2050-bedded apex tertiary care hospital. Therefore, it will serve as an essential yardstick regarding awareness about different aspects of BMW management related to COVID hospital. This study also has a substantial social and ecological impact. The proper COVID BMW disposal will prevent secondary transmission of highly infectious disease in hospital staff and the surrounding environment.

Limitation and recommendation

The present study was a single-group questionnaire-based cross-sectional survey administered through the digital platform. Therefore, the researcher cannot rule out the possibility of respondents and participants' bias. Hence, the generalization of study findings on all HCWs may not be realistic. The hospitals providing COVID treatment facilities must start formal training programs that emphasize focused group training of all stakeholders regarding the proper management of highly infectious BMW.

Conclusions

There is consensus that COVID-BMW hazards are much more significant than regular BMW. Therefore, its

awareness among the HCWs can be a panacea for the safer handling of BMW generated in COVID hospital. This explorative analysis has thrown light on the areas where knowledge gaps exist among nursing professionals. Bridging this gap is the need of the hour in combating this Pandemic. Nevertheless, prospective studies on this topic for evaluating the change in understanding among HCWs with the Pandemic's advancement can be carried in future. The strict implementation of CPCB guidelines and a robust monitoring system will reduce secondary transmission risk within the hospital and the surrounding atmosphere. Besides, the chances of punitive action by the pollution board due to poor waste management will also be prevented.

Informed consent

Yes.

Ethical approval

Yes, Ethical Approval obtained from Institute Ethics Committee.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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