International Journal of Occupational Safety and Health

ISSN: 2091-0878 (Online) ISSN: 2738-9707 (Print)

Original Article

Assessment of knowledge, attitude, and practices of biomedical waste management among health care workers in a tertiary care hospital, Chengalpattu, Tamilnadu, India

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Date of submission: 25.02.2023
Date of acceptance: 14.09.2023
Date of publication: 01.01.2024

Conflicts of interest: None
Supporting agencies: None
DOI: https://doi.org/10.3126/ijosh.v14i1.52697

ABSTRACT

Introduction: Bio-medical waste (BMW) means any solid and/or liquid waste including its container and any intermediate product, which is generated during the diagnosis, treatment, or immunization of human beings or animals. Inadequate and inappropriate knowledge of handling healthcare waste may have serious health consequences and a significant impact on the environment. Thus, the study aims to assess the knowledge, attitude, and practice of biomedical waste management among healthcare workers from different strata in the hospital.

Methods: This was a cross-sectional study involving 383 participants conducted between June 2022 to October 2022. A structured, close-ended, self-administrated questionnaire was used to collect the data. The data were analyzed using R studio and presented as frequencies and percentages. The association between different variables was analyzed by the chi-square test.

Results: Most of the doctors (41.3%) and nurses (41.5%) had very good knowledge of Bio-Medical Waste Management (BMWM) but only 23.1% of laboratory technicians and housekeeping staff 18.2% showed very good knowledge. All the participants had a very good attitude (69.2% to 82.6%) towards BMWM but it needs some improvement concerning reporting needle stick injuries and taking post-exposure prophylaxis (PEP). More than 80 % of participants were immunized against Hepatitis B and followed the appropriate practice of BMWM except for wearing adequate personal protective equipment (PPE) while handling BMW. Knowledge and good attitude were observed to increase with experience.

Conclusion: From the study, it is identified that knowledge regarding BMWM is inadequate among the healthcare professions. It is concluded that there should be adequate training among the HCWs about BMWM like video lectures, symposiums, quiz programs, and role play that can help them update their knowledge.

Keywords: Biomedical Waste Management, Health care workers, Knowledge, attitude and practice study, Needle stick injury, Post-exposure prophylaxis.

Introduction

Biomedical Waste Management (BMWM) begins from the initial stage of generation of waste, segregation at the source, storage at the site, and proper disinfection of waste and finally ends at proper disposal of waste.[1] Since health care workers (HCWs) are the first in line in managing biomedical waste (BMW), and all the health care workers irrespective of cadre handle it, everyone in the chain needs to have adequate knowledge of BMWM and appropriate practice concerning the same. Inadequate and inappropriate knowledge of handling of healthcare waste may have serious health consequences on all the people involved in the management of the waste and cause an impact on the environment.[1,2]

The knowledge, attitude, and practices (KAP) of HCWs regarding BMWM play a crucial role in its proper management. Its mismanagement not only affects the hospital personnel but also the general population at large.[3] Many studies have been conducted in different parts of India.[4,5] In a study conducted in Allahabad, India, it was identified that all the hospitals lack periodical training regarding BMWM.[6] The same was observed in a similar study conducted in Saudi Arabia wherein it was found that the training on BMWM is inadequate in many hospitals and it is suggested that HCWs should get trained by different education modules.[7] However, considering the importance of the BMWM, the number of studies conducted is less, and information regarding this should be periodically accessed in different parts of the country regularly.[8] So, it is important to know about the present status of BMWM, that is, the knowledge about it, its attitude towards it, the practices followed, at the grassroots level, and the problems they are facing in the whole process, to bring in appropriate measures to decrease mistakes and their consequence.[9]

This study is conducted to throw light on the sources of errors and mistakes in various aspects of BMWM. The study aimed to assess the knowledge, attitude, and practices concerning BMWM in a tertiary care hospital in the Chengalpattu district of Tamil Nadu.

Methods

This was a cross-sectional study of knowledge, attitude, and practices (KAP). The study was conducted in tertiary care hospital, in Chengalpattu district, Tamil Nadu among doctors, post-graduates, interns, staff nurses, laboratory technicians, and housekeeping staff. The data was collected between June 2022 to October 2022, using a previously validated structured self-administered questionnaire by Basavaraj *et al* and an observational checklist reviewing the literature and international BMW management guidelines.[10] The questionnaire evaluated the socio-demographic information of HCWs, their knowledge related to BMW management, BMW management practices of BMW professionals (HCPs); and their attitudes towards BMW management.

The study was approved by the Institutional Research Committee and Institutional Ethical Committee (SP No 3/July/22). The required sample size was calculated as 383, anticipating a population proportion of 50%, a confidence interval of 95%, and a relative precision of 10% (of 50%).[11] The participants were recruited in the study by a simple random sampling method in which each individual in the sampling frame was assigned a number and selected by an online random number generator.[12] Each participant was given written informed consent mentioned with the purpose of the study and consent was obtained. Respondent confidentiality was maintained using anonymity. All the healthcare workers working in the hospital, who handle biomedical wastes at any level, and have given written consent, were evaluated with the questionnaire included in the study.

The knowledge section contains ten questions, each question has a 'Yes' or 'No' answer option. One mark was assigned for the correct response and zero for the wrong response. Total scoring ranged from 0 to 10. Scores of 0-2 were considered as very poor knowledge, 3-4 as poor knowledge, 5-6 as average knowledge, participants with scores of 7-8 had satisfactory knowledge and 9-10 had excellent knowledge regarding BMWM.

Ten questions were included in the attitude section, and responses to each question were documented on a 5-point Likert scale as follows: strongly agree (5-point), agree (4-point), neutral (3- point), disagree (2-point), and strongly disagree (1-point). The total score ranged from 8 to 50. A score of 10 was considered as a very poor attitude, 11-20 had a poor attitude, 21-30 had an average attitude, 31-40 had a good attitude, and above 41 had a very good attitude towards BMWM.

The practice section comprised 10 items, and each item comprised two responses: Yes (1-point) and No (0-point). Practice items total score ranged from 0 to 10. A score below 2 indicated very poor practice, a score of 3-4 poor practice, 5-6 was average practice, 7-8 was good practice, and 9-10 was very good practice toward BMWM.

The data that was obtained from the questionnaire were entered into Microsoft Excel. These data were analyzed by using RStudio-2023.03.1-446. The descriptive statistics were done in the form of frequencies and percentages. The chi-square test was done to find the association between the categorical variables.

Results

A total of 383 participants were included in this study. The majority of people belonged to the age group 21-30 (75.7%) followed by 31-40 years (12.8 %), 11-20 group (5 %), 41-50 (3.7%) group and above 50 (2.9 %) group. In this study, 244 (63.7%) were females and 139 (36.3%) were males.

Regarding the occupational status of HCWs majority of the participants were doctors who accounted for 281 (73.4%) and 65 (17 %) were nurses, the remaining were laboratory technicians and house-keeping staff with 26 (6.8%) and 11 (2.9%) respectively (Table1).

Table 1: Demographic variables of the participants in Biomedical Waste Management (BMWM)

Demographic variable	Category	Frequency and percentage (N=383)
Age group	11-20	19(5 %)
	21-30	292(76.3%)
	31-40	50(12.8%)
	41-50	11(3 %)
	>50	11(2.9 %)
Gender	Male	139(36.3%)
	Female	244(63.7%)
Category of HCWs	Doctors	281(73.3%)
	Nurses	65(17 %)
	Lab technician	26(6.8%)
	others	11(2.9%)

The study revealed that 80% of nurses had undergone training in BMWM while only up to 50 % of participants belonging to other groups had said they had got training in BMWM. About 65.5% of the laboratory technicians and housekeeping staff did not know how to identify biohazard symbols. People from all the sectors (90-100%) agreed that segregation is the most important aspect of BMWM and followed color coding for segregation. Surprisingly in this study, we found that 95-100% of all the groups agreed that wearing Personal Protective Equipment (PPE) reduces the risk of infection. More than half of the participants (35-45%) from all categories were not aware of the maximum storage time of untreated wastes in the hospital. However, more than 70 % of the participants of all categories knew about the disposal methods (Table 2).

Table 2: Knowledge of the participants in Biomedical Waste Management (BMWM)

SN	Knowledge on BMWM	Doctors (N= 281) %	Nurses (N=65) %	Laboratory Technicians (N=26) %	House-keeping staff (N=11) %	p-value
1.	Have you undergone any training in BMW management?	155.1(55.2%)	53(81.5%)	11(42.3%)	7.9(72.7%)	0.010
2.	Is there any hazard associated with BMW management?	226(80.4%)	43(66.2%)	15(57.7%)	6(54.5%)	0.013
3.	Do you know the symbol for biohazard?	262(93.2%)	54(83.1%)	17(65.4%)	7(63.6%)	0.010
4.	The most important aspect of BMW management is the segregation	274(97.5%)	63(96.9%)	23(88.5%)	11(100%)	0.079
5.	PEP can be taken at anytime	191(68%)	50(76.9%)	21(80.8%)	6(54.5%)	0.194
6.	Do you know about the color coding system for segregation?	269(95.7%)	58(89.2%)	26(100%)	10(90.9%)	0.097
7.	General wastes are to be collected in yellow bin	196(69.8%)	58(89.2%)	18(69.2%)	8(72.7%)	0.015
8.	Wearing PPE reduces the risk of infection	271(96.4%)	61(93.8%)	25(96.2%)	10(90.9%)	0.665
9.	Maximum storage time for untreated waste is 2 days or 48 h	190(67.6%)	25(38.5%)	11(42.3%)	6(54.5%)	0.010
10.	Yellow bag is treated by incineration	230(81.9%)	47(72.3%)	21(80.8%)	6(54.5%)	0.066

In this study, it was observed that doctors and nurses have better knowledge regarding hazards associated with BMW, the importance of BMW segregation and the incineration of biomedical waste than the other HCWs. Among the HCWs 281 (41.3%) doctors and 65 (41.3%) nurses had the very good knowledge category However, only 26 (23.1%) lab technicians and 11 (18.2%) housekeeping had the statistically significant and very good knowledge category ($p<0.05$). (Table 3).

An analysis was done to find out whether experience has any influence on the knowledge of BMWM. The results do not show any statistically significant result ($p>0.05$). (Table 4).

Table 3: Knowledge of HCWs of different strata in Biomedical Waste Management (BMWM)

Occupation	Knowledge					P value
	Very Poor (%)	Poor (%)	Average (%)	Good (%)	Very Good (%)	
Doctor	0	4(1.4%)	32(11.4%)	129(45.9%)	116(41.3%)	0.005
Nurse	1(1.5%)	1(1.5%)	10(15.4%)	26(40%)	27(41.5%)	
Laboratory Technician	0	0	10(38.5%)	10(38.5%)	6(23.1%)	
House-Keeping Staff	0	0	5(45.5%)	4(36.4%)	2(18.2%)	

Table 4: Relation between experience and knowledge

SN	Experience in years	Knowledge Group (%)					p-value
		Very Poor	Poor	Average	Good	Very Good	
1	11-20	0	4(1.1%)	57(15.1%)	173(45.4%)	145(38%)	0.938
2	21-30	0	20(5.3%)	61(15.8%)	101(26.3%)	201(52.6%)	
3	31-40	0	0	43(11.1%)	127(33.3%)	213(55.6%)	
4	41-50	0	0	0	191(50%)	191(50%)	
5	Above 50	0	0	0	0	383(100%)	

The majority of the HCWs thought that BMWM was an important issue. More than 95 % of the participants agreed that BMWM is a teamwork. About 95% of the participants agreed that proper disposal of BMWM prevents infection transmission and in this study, 95 % of the HCWs felt that BMWM should be included in the curriculum and taught to all the people who handle waste. The result shows 82.6% of favorable attitude towards BMWM and 17% shows unfavorable attitude towards BMWM. All of them had very good attitudes towards segregation and color coding and felt that occupational safety is equally important as others' safety. However up to 50 % of participants from all the categories thought that reporting needle stick injury is a work burden (Table 5).

The results further showed that there is no statistically significant ($p>0.05$) difference in the attitude among the different HCWs (Table 6).

Table 5: Attitude of the participants towards Biomedical Waste Management (BMWM)

SN	Attitude of healthcare workers on BMW management	Doctors (N= 281) %	Nurses (N=65) %	Laboratory Technicians (N=26) %	House-keeping Staff (N=11) %
1.	Proper BMW management is an issue	228(81.1%)	59(90.8%)	24(92.3%)	10(90.9%)
2.	Safe BMW management needs teamwork	278(98.6%)	63(96.9%)	26(100%)	10(90.9%)
3.	General public health can be adversely affected by BMW	236(84%)	55(84.6%)	20(76.9%)	9(81.8%)
4	Is needle stick injury/sharp injury a concern	276(98.2%)	64(98.5%)	24(92.3%)	11(100%)
5.	BMW should be segregated at the point of origin	259(92.2%)	59(90.8%)	22(84.6%)	11(100%)
6.	Do you think BMW management and handling should be a compulsory part of the curriculum	270(96.1%)	60(92.3%)	25(96.2%)	11(100%)
7.	Proper BMW disposal can prevent infection transmission	273(97.2%)	59(90.8%)	25(96.2%)	10(96.9%)
8.	Reporting of needle stick injuries is an extra burden on work	168(59.8%)	36(55.4%)	13(50%)	5(45.5%)
9.	Color code bag use for waste segregation is a must	273(97.2%)	59(90.8%)	25(96.2%)	9(81.8%)
10.	For persons involved in BMW handling occupational safety is a must	273(97.2%)	58(89.2%)	25(96.2%)	9(81.8%)

Table 6: Attitude of HCWs of different strata towards Biomedical Waste Management (BMWM)

Occupation	Attitude			p-value
	Average (%)	Good (%)	Very Good (%)	
Doctor	0	49(17.4%)	232(82.6%)	0.208
Nurse	1(1.5%)	15(23.1%)	49(75.4%)	
Laboratory Technician	0	8(30.8%)	18(69.2%)	
House-Keeping Staff	0	2(18.2%)	9(81.8%)	

In this study, we compared the attitude of participants with their experience. It was observed that there is no statistically significant ($p>0.05$) difference in the attitude among the different (Table 7).

More than 70 % of the participants followed appropriate practices according to the BMWM guideline but more than half of them did not wear PPE every time they handled BMW. Up to 75% of the HCWs knew the protocol for reporting needle sticks or sharp injuries and followed Post post-exposure prophylaxis (PEP) after needle stick injury. More than 80 % of them had been immunized against Hepatitis B. Close to 55 % of the participants did not know how to prepare 1 liter of 1% sodium hypochlorite solution from available 5% strength (Table 8). By comparing the greater number of studies best practices was noted in nurses, followed by housekeeping, doctors and lab technician.

Table 7: Relation between experience and attitude

S.N.	Experience in years	Attitude Group (%)			p-value
		Average	Good	Very Good	
1.	11-20	1(0.3%)	4(20%)	15(79.7%)	0.966
2.	21-30	0	31(10.5%)	261(89.5%)	
3.	31-40	0	11(22.2%)	39(77.8%)	
4.	41-50	0	0	11(100%)	
5.	Above 50	0	0	11(100%)	

Table 8: Practice of Biomedical Waste Management (BMWM) of the participants (N= 384)

SN	Questions on Practice of BMWM	Practice		
		Always (%)	Sometimes (%)	Never (%)
1.	Do you wear PPE while handling BMW?	157(41%)	183(47.8%)	44(11.2%)
2.	Do you segregate BMW at the point of into different categories?	286(74.7)	79(20.6%)	18(4.7%)
3.	Do you use puncture-proof plastic containers to collect waste sharps?	291(76%)	72(18.8%)	20(5.2%)
4.	Do you follow color coding for the segregation of waste?	343(89.6%)	37(9.7%)	3(0.8%)
5.	Do you maintain a record for BMW at the point of origin?	222(58%)	104(27.2%)	57(14.9%)
6.	Do you have a system for reporting injuries and accidents?	284(74.2%)	79(20.6%)	20(5.2%)

SN	Questions on Practice of BMWM	Practice		
		Always (%)	Sometimes (%)	Never (%)
7.	Have you been immunized against Hepatitis B?	315(82.2%)	32(8.4%)	34(8.9%)
8.	Do you follow PEP after needle stick injury or percutaneous injury?	305(79.6%)	66(17.2%)	12(3.1%)
9.	Do you put non-infectious wastes in black containers?	170(44.6%)	93(24.3%)	119(31.1%)
10.	Do you know the method to prepare 1 L of 1% Sodium hypochlorite from available 5% strength?	168(43.9%)	90(23.5%)	126(32.9%)

Discussion

This study was conducted to assess the knowledge, attitude, and practice of Biomedical Waste Management among health workers, in a tertiary care hospital, in Chengalpattu, Tamilnadu.

BMWM at any level is always a team work and it involves common and clear goals and coordination among HCWs of all the strata. However, the knowledge about BMWM and training given to HCWs of different strata are significantly different. This makes it difficult to bring coordination among all HCWs in managing BMWs. Therefore, by evaluating the knowledge, attitude, and practice concerning BMWM across different strata of HCWs, the points of mismanagement can be brought into light easily and, appropriate and efficient strategies to correct them can also be devised.

Many studies regarding BMWM in India have given information on the magnitude of the lack of adequate knowledge and appropriate practices among HCWs due to lack of awareness and improper implementation, but there is less information on the points of mismanagement.[9,10,13] In the wake of the COVID-19 pandemic, the BMW generation has been skyrocketing which adds to the already existing burden of waste management. Improper BMWM not only increases the transmission of infections like HIV, HBV, HBC, etc. but also pollutes air, water, and soil.[13] There is a lack of awareness about rules which reflects in inadequate and improper BMWM.[14]

Knowledge about biomedical waste management rules among doctors and nurses was high but was low among housekeeping staff. It was similar to the study where nurses had more training than other groups.[15] Similarly, 30% of participants from all the strata were not clear about the color coding of containers and waste segregation. This is in contrast with the study conducted where all the participants had very good knowledge about it.[10] Half of the participants from all categories were not aware of the maximum storage time of untreated wastes in the hospital. This was in contrast with the study where participants from all categories knew about the storage time.[15] This warrants proper training, evaluation, and periodic retraining of all the HCWs irrespective of their cadre.

This study assessed the knowledge attitude with their experience of HCWs of different strata and showed more experience gives more knowledge. In an overall view, the attitude of the participants was satisfactory but needs improvement in some areas. It is appreciable that more than 95 % of them thought BMWM was teamwork and felt it was important to teach it to everyone. In this study, we compared the attitude of participants with their experience, among them 100% of the people with more than 30 years of experience had a very good attitude.

As far as practices are concerned, 70% of the participants followed appropriate practices according to the BMWM guideline. The study showed that 70-80 % of the participants followed appropriate practices in case of segregation of BMW and reporting of needle stick injuries. This is better than the results of the study conducted in

West Bengal where only 52.8 % of the participants followed segregation before disposal.[16]

However, it is alarming that 50 % of participants of all strata thought reporting needle stick injury is a burden. It differed from the study wherein all of the participants except doctors and most of the nurses felt that it was a burden.[17,18] Many such injuries might not be reported or underreported due to this attitude. Interventions should be made to make the protocol of reporting needle stick injury less cumbersome and simpler to all the HCWs and appropriate PEP must be made available to them as soon as possible.

It can be observed that 50 % of participants did not maintain BMW records. Measures to incorporate record maintenance are imperative to ensure timely clearance of the wastes and reduction of infection transmission. Also, 56 % of the people did not know the method to prepare 1 liter of 1 % sodium hypochlorite solution with available 5 % strength. This percentage is less than the one shown in the study where all the nurses and more than 70 % of the other groups knew the preparation of 1 liter of 1 % sodium hypochlorite.[10]

Strict and supportive supervision by the Hospital Infection Control Committee of the process is required to pick up ignorance and unreported wrong practices among HCWs of all levels. The committee is expected to, give standard operating protocol concerning BMWM and reporting of needle stick injuries, and conduct training programs on BMWM. This is a proven fact because facilities that have separate BMWM committees have shown effective BMWM and, fewer sharp and needle stick injuries.[19,20]

The studies have stated that increasing awareness about the hazards associated with improper BMWM paired with regular training of all HCWs on BMWM, is the key to moving towards a more efficient BMWM.[10,18] Appropriate educational programs and strict execution of BMWM guidelines help to bridge the above-stated gap between knowledge and implementation.[18] Periodic well-structured training, followed by evaluation and retraining is the sole strategy to cut down on improper BMWM.[21] Structured training helps to increase participation and also makes it easier for the participant to learn the concept and its importance in less time.[22, 23, 24]

Conclusions

From the study, we were able to get a detailed insight into various aspects of BMWM among HCWs in this tertiary care hospital. We can conclude that the participants have adequate knowledge about the color coding system and segregation but need more training on the same and the related aspects like needle sick injury, PEP, storage of BMW, and its disposal. This is required more among the laboratory technicians and housekeeping staff as their knowledge is comparatively less and also, they handle BMW more frequently than doctors and nurses. It is concluded that there should be adequate training among the HCWs about BMWM like video lectures, symposiums, quiz programs, and role play that can update their knowledge.

Acknowledgments

The authors are thankful to the Indian Council of Medical Research (ICMR), New Delhi, India for approving this Project under ICMR-STS for the first author.

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