ORIGINAL ARTICLE

Evaluation of healthcare waste management among health functionaries of Gujarat

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ABSTRACT

Introduction: Health Care Waste (HCW) is generated by various activities in healthcare facilities like hospitals, clinical, research institutions, laboratories, blood banks, etc. HCW is both infectious and hazardous and, unless rendered noninfectious and safe, can prove to be hazardous to people coming in contact with it. **Objectives**: To assess the Knowledge and Practice regarding HCW Management among health functionaries of districts of Gujarat and its association between the designation and qualification with the Knowledge and Practice score. **Methodology**: It was an observational and cross-sectional study using pretested, reliable, and valid questionnaire. A sample size of 152 was calculated based on the findings of a pilot study. We have implemented our study in Gujarat, divided into four parts (Saurashtra, Central, South, and North Gujarat). Study sites were selected equally in all four areas. **Results**: A total of 163 healthcare participants were involved in the study, most respondents were from primary healthcare centers (31.7%), followed by medical college hospitals (14.5%). In our study, Bhavnagar district had the highest number of contributors (21.7%), followed by Morbi district (19.1%). The hospital administrator category had the highest knowledge score, while Infection Control or Waste Management Officer had the highest practice score. MBBS/AYUSH graduates had the highest knowledge and practice scores. It is also apparent that staff nurses had better knowledge and practice scores than ANM. **Conclusion**: The overall assessment score was good for all health workers. Doctors' better knowledge and practice scores signify qualification's role in BMW management.

KEYWORDS

Biomedical Waste, Health Workers, Gujarat

INTRODUCTION

Health Care Waste (HCW) is generated by various activities in healthcare facilities like hospitals, clinical, research institutions, laboratories, blood banks, etc. HCW is both infectious and hazardous and, unless rendered noninfectious and safe, can prove to be hazardous to people coming in contact with

it(1-3). Managing HCW is one of the essential steps in infection prevention and control. Health workers (HW) are the most vulnerable while managing HCW from generation to disposal(4). Therefore, adequate knowledge, positive attitude, and good practices among healthcare professionals concerning the proper management of HCW are essential in managing waste and reducing health hazards effectively. World Health Organization (WHO) has classified HW into several categories: general and specialist medical practitioners, nurses and midwifery professionals, complementary medicine practitioners, pharmacists, physiotherapists, etc(5). Some of the common causes for the failure of biomedical waste (BMW) Management, as stated by WHO include namely, lack of awareness about the health hazards related to BMW, inadequate trained HCWs in BMW management, lack of legislation and rules regarding waste management systems, insufficient human and monetary resources(3).

Researchers worldwide have conducted studies to identify gaps in knowledge, attitude, and practice among HW with varying results(5-15). A significant relationship has also been observed between the knowledge, attitude, and practice (KAP) among the staff of a district hospital in KwaZulu Natal province(12). This study has also shown that the duration of working experience in healthcare workers is one of the most significant factors in good practice in managing medical waste(12). People with long working experience tend to have better practices and management(12). This study aims to investigate the KAP of the various health functionaries in Gujarat in different districts and the gaps. This would help organize the training more scientifically in evaluating their effectiveness.

To assess the knowledge regarding health care waste management among different government health workers of Gujarat. To observe the practices regarding health care waste management among different government health workers of Gujarat

MATERIAL & METHODS

The present study was an observational, cross-sectional study conducted among Gujarat's government health care workers.

To calculate sample size, knowledge of nursing staff regarding correct content of Red bag from the study conducted in Surat was considered (88%). Based on this, calculated sample size was 152 at 95% confidence level.(16)

Current study was conducted in four regions (Saurashtra, Central, South, and North Gujarat) of Gujarat. One district from each region was selected from the list of districts of the region. One district hospital, one sub district hospital, two CHCs and two PHCs were selected from the list of health facilities of each district. Available health staff including Hospital administrator, doctors (Both allopathy and AYUSH), Infection control/Waste Management officer, Staff Nurse, ANM, Lab technician etc. of the center were included in the study after obtaining informed written consent.

The tool used for the study was a pre-tested, semi-structured closed-ended questionnaire encompassing 11 questions on Knowledge, 6 on Attitudes, and 10 Practices. The practices were divided in two sets, one set was regarding biomedical waste handling and other set was regarding documentations at the center. The questionnaire was formulated based on the literature review and the study's requirements. The questionnaire was pretested, and reliability and validity were ensured. Questions that were ambiguous or led to direct answers were removed. New questions were added where knowledge, attitude, and practice deficiencies were perceived while carrying out the pilot run. The questionnaire related to knowledge and attitude was filled up by the participants by the mode of self-administered questionnaires with the help of the volunteers as interpreters. The practices were observed and assessed by the investigator and recorded in the record form. The identity of the study respondents was maintained anonymously.

Statistical analysis

Collected data were compiled and analyzed using SPSS 21. Analysis of demographical variables was done by frequency distribution.

Statistical analysis of the KAP question was done by a nonparametric test. A score of 1 for a correct response and 0 for a wrong or un-attempted response was given for further analysis. The study population was categorized according to designation and qualification. The mean score with SD was calculated for each category. A normality test (Shapiro-Wilks test) was done to check whether the data were parametric. Analysis of variance (ANOVA)/Kruskal–Wallis (KW) was carried out to check the differences between the variables. For all the tests, p<0.05 was taken as statistically significant.

RESULTS

A total of 163 healthcare participants were involved in the study, out of which 11 were excluded due to incomplete data, so finally, 152 were included in the study. Most respondents were from primary healthcare centers (31.7%), followed by medical college hospitals (14.5%).

123 (81%) of the respondents were below 40 years of age, most of them were females (60%). The majority of the respondents had qualifications of GNM (37%), followed by the medical officer (27%) having regular jobs (63%) and job experience of fewer than ten years in majority (77.6%). Based on location, most participants were from OPD (38.8%), followed by 23.7% from the ward and less than 10 % from ICU, Labour Room, Laboratory, medical inspection room, and Covid-19 Session Site.

KAP question analysis

There were 11 knowledge-based questions, out of which 1 had 4 sub-questions, and 1 was open-ended, so a total of 14 questions were analyzed. Responses to all knowledge-based questions are outlined in Table 1. Statistical analysis by chi-square test revealed that the association was statistically significant (X^2=220, p=0.0001). In response to open-ended questions about problems associated with improperly managed BMW, most participants wrote chances of spreading infection and injury.

Table 1: Knowledge and Attitude questions analysis

Questions to assess the knowledge	correct	Wrong	Chi-square test value	p-value
The Rules followed for Management of biomedical waste in India at present are BMWM 2016	96 (63.16)	56 (36.84)		
The Rules of Biomedical waste management should be followed by	95 (62.5)	57 (37.5)		
Tick the color-coded bins for the biomedical waste segregation	60 (39.47)	92 (60.53)		
Categories of waste to be placed in the yellow bin *	104 (68.42)	48 (31.58)		
Categories of waste to be placed in the red bin *	103 (67.76)	49 (32.24)		
Categories of waste to be placed in the translucent puncture-proof container*	120 (78.95)	32 (21.05)	220	0.0001
Categories of waste to be placed in the blue puncture-proof container	47 (30.92)	105 (69.08)		
Mercury waste is which category of waste?	94 (61.84)	58 (38.16)		
Which is the most important aspect of Bio-Medical Waste Management?	122 (80.26)	30 (19.74)		
How does segregation help *	148 (97.39)	04 (2.61)		
Identify the Bio-Hazard Symbol	138 (90.79)	12 (9.21)		
What is the maximum time limit for storage of Bio-Medical Waste?	71 (46.71)	81 (53.29)		
Can mixing of BMW and municipal waste be done?	130 (85.53)	22 (14.47)		
Questions to assess the Attitude				
You have pricked yourself with the needle used to draw the patient's blood. You will…	126 (82.29)	26 (17.11)		
You have placed a yellow waste in the red bag. What will you do?	82 (53.95)	70 (46.05)		

Questions to assess the knowledge	correct	Wrong	Chi-square test value	p-value
For successful implementation of Bio-Medical Waste management, it is important to*	144 (94.74)	08 (5.26)	467	0.0001
How Has COVID changed your attitude toward managing waste?	05 (3.29)	147 (96.71)		
Handling which of the following waste requires wearing gloves*	149 (98.02)	03 (1.98)		

Answer of at least one correct option was considered as correct

Attitude-based questions were 6, out of which 1 was opinion-based, so 5 questions were analyzed, illustrated in Table 1. To establish statistical value, a chi-square test showed a significant difference (X^2=467, p=0.0001). In response to an opinion-based question regarding the need to participate in BMW management training programs, 121 (79.1%) were in the opinion of regular participation.

Participants were supposed to answer 10 practice-based questions, of which 1 had 5 sub-questions. At the same time, 2 were opinion based, and 2 were subjective in nature, so 10 questions were analyzed, highlighted in Table 2. On applying chi-square, these differences were found to be significant (X^2=35.12, p=0.0001).

Table 2: Practice Question Analysis

Questions to assess the Practice	correct	wrong	Chi-square test value	p-value
In which container will you place the cotton swab with blood?	122 (80.26)	30 (19.74)		
In which container will you place the broken medicine vial?	112 (73.68)	40 (26.32)		
In which container will you place the used needle after vaccination?	107 (70.39)	45 (29.61)		
In which container will you place the plastic gloves	104 (68.42)	48 (31.58)		
In which container will you place the plastic syringe after vaccination?	124 (81.58)	28 (18.42)		
A needle after taking a blood sample should be…	93 (61.18)	59 (38.82)		
The first action for wearing PPE is i. Wear scrub suit, boots and gown ii. PerformHand Hygiene iii. Perform hand hygiene and put on gloves iv. Wear face maskand head cap	86 (56.58)	66 (43.42)	35.12	0.0001
The first action for of packing and labeling Health Care Waste: i. Label the bagii. Tie the bag iii. Weigh the bag iv. Place the barcode	87 (57.24)	65 (42.76)		
Where do you segregate waste?	112 (73.68)	40 (26.32)		
Do you ensure tying up the waste bag when its _____the filled?	98 (64.47)	54 (35.53)		
Questions to assess the Practice	Correct	Wrong	40.47	0.0001
Do you have a BMWM policy in your institution?	141	11		
Do you maintain the register for BMW at the location of generation?	123	29		
Do you maintain records at storage site?	122	30		
Does your institution have a system of reporting and recording needle stick injuries or other BMW accidents?	115	37		
Does your institution have Adequate bins and bags for segregating waste?	137	15		
Does your institution have posters for placing different waste in different bags?	139	13		
Does your institution have adequate number of gloves?	132	20		
Does your institution have an adequate number of PPE?	134	18		
Does your institution have storage for waste?	130	22		
Does waste stored for more than 2 days in your institution?	116	36		

Knowledge and practice score analysis

In practical terms, knowledge and practice are more important elements of the KAP study, so further analysis was carried out for knowledge and Assessment of practices. The individual score was calculated for knowledge and practice.

Amongst the healthcare population, designation and qualification are two decisive core factors in BMW management, so the further statistical analysis was done for the categories of knowledge and practice score. Designation-wise analysis of knowledge and practice scores is mentioned in Table 3. The hospital administrator category had the highest knowledge score, while Infection Control or Waste Management Officer had the highest practice score. MBBS/AYUSH graduates had the highest knowledge and practice scores. It is also apparent that staff nurses had better knowledge and practice scores than ANM. Surprisingly diploma nursing holders scored better than graduate nurses. Normality tests done by the Shapiro-Wilk test (designation-wise knowledge score p=0.05, designation-wise practice score p=0.001) indicated that these data were not normally distributed. So, the KW test was done, which was significant for both designation-wise knowledge score (H=35.644, p=0.0001) and designation-wise practice score (H=15.787, p=0.04).

Table 3: Designation and qualification-wise analysis of knowledge and practice score

Knowledge score based on Designation	Mean SD	Shapiro-Wilk test	P-value	KW value	p-value	Inference
Hospital administrator	11.50 ± 1.91	0.975	0.05	35.644	0.0001	SIGNIFICANT
Medical officer allopathy	9.60 ± 2.68					
Medical officer AYUSH	8.43 ± 1.90					
Infection control/Waste Management officer	9.67 ± 1.5					
Staff Nurse	8.63 ± 1.9					
ANM	6.00 ± 2.86					
Lab tech	8.44 ± 2.8					
Other	4.33 ± 2.0					
Practice score based on Designation	Mean SD	Shapiro-Wilk test	P value	KW value	P value	Inference
		0.945	0.001	15.787	0.04	SIGNIFICANT
Medical officer allopathy	7.46 ± 1.94					
Medical officer AYUSH	7.0 ± 2.64					
Staff Nurse	6.74 ± 1.80					
ANM	6.05 ± 2.03					
Lab tech	7.00 ± 1.11					
Other	5.33 ± 3.05					
Practice score based on Designation	Mean SD	Shapiro-Wilk test	P value	Mann witney U value	P value	Inference
Hospital administrator	6.75 ± 1.70	0.968	0.001	8.39	0.001	Significant
Infection control/Waste Management officer	8.67 ± 1.52					
Knowledge score based on Qualification	MEAN SD	Shapiro-Wilk test	P-VALUE	KW VALUE	P-VALUE	INFERENCE
Diploma nursing	8.80 ± 2.04	0.975	0.007	18.793	0.0001	SIGNIFICANT
Graduate Nursing	7.46 ± 1.98					
Graduate MBBS/AYUSH	9.54 ± 2.65					
Other	7.18 ± 3.10					
Practice score based on Qualification	MEAN SD	Shapiro-Wilk test	P VALUE	KW Value	P Value	INFERENCE
Diploma nursing	6.83 ± 1.89	0.945	0.0001	8.269	0.041	SIGNIFICANT
Graduate Nursing	6.54 ± 2.06					
Graduate MBBS/AYUSH	7.42 ± 2.0					
Other	6.38 ± 1.83					

Qualification-wise analysis of knowledge and practice score is elucidated in Table 3. After applying the normality test by the Shapiro-Wilk test, which was significant (qualification-wise knowledge score p=0.007, qualification-wise practice score p=0.0001), the KW test was performed, which showed a substantial difference in both qualification-wise knowledge score (H=18.793, p=0.0001) and qualification wise practice score (H=8.269, p=0.041).

DISCUSSION

The BMW Management Rules were amended by Govt of India in 2016, with significant changes in the color codes for segregation and more stringent measures in place for non-compliance(17). This study was carried out to analyze the KAP levels in various categories of health personnel in multiple districts of Gujarat to decide on these personnel's training strategies. This study revealed that Bhavnagar district had the highest number of contributors (21.7%), followed by Morbi district (19.1%). Most respondents were from primary healthcare centers (31.7%), followed by medical college hospitals (14.5%). OPD was the chief place of data collection (38.8%), followed by the ward (23.7%).

Our study for the knowledge-based questions revealed that 97% were aware of the importance of segregation, which was high compared to 18% in other study(18). 80% have correctly answered segregation as the most important aspect, which is also higher than 68%, as shown in another study(19). Although most of the respondents correctly identified the categories to be placed in the red, yellow, and translucent puncture-proof bin, only 47 (%) were knowing the type of waste to be placed in a blue puncture-proof container. A study by Chudasama et al. found that although 86.9% of the responders mentioned practicing the segregation of BMW at the workplace, 59.6% were unaware of the BMW management categories(11). Correct knowledge regarding the maximum time limit for biomedical waste storage was known to

46.7 % as compared to other studies findings varying between 7-60%(18-20).

Analysis of the attitude questions revealed that 98% of the participants believed wearing gloves while handling infected waste is essential, and 96.7% responded that COVID Epidemic did not change their attitude toward handling waste. The majority (82.9%) knew the correct action to be taken if they pricked themselves while drawing blood. This was very high compared to other studies(10,12). This could be attributed to the high percentage of respondents (77.6%) who had undergone training in our study compared to the other studies with a low training percentage (44.3%) in health workers(11). Kulkarni et al. showed significant improvement in their participants' scores after training sessions(21).

The Key finding of the practice-based questions revealed that most were aware of containers based on the different waste categories. They also knew the correct procedure for packing and labeling the waste. These numbers were much higher than in other studies where Biomedical waste bag labeling practices were followed by only 23.2% of nurses and 27.39% of doctors(18).

Regarding BMW management policy at the institutional level, most respondents were aware of their institution's compliance for record maintenance, storage, and availability of resources like bins, PPE, etc., and reporting system for needle stick injuries.

Depending upon the category of health workers, knowledge varies, as shown in various studies(10,13,14,15). The knowledge about color coding of containers and segregation is better among the doctors and nurses than the sanitary staff(10,13,14,15). Our report also revealed that the knowledge score was significantly higher in the hospital administrator compared to other healthcare staff. The practice score was high among the Infection Control or Waste Management Officers. Comparisons based on qualifications showed that MBBS/Ayush doctors had the

highest knowledge and practice, followed by nursing personnel, technicians, and housekeeping workers. Thirunavikkarasu et al. noticed high expertise among those who had higher education qualifications (65.5%) but no correlation with attitude for the qualification or designation(22).

Similar to another study, our study revealed a weak positive correlation of knowledge with the attitude scores (rho = 0.249, *p* = 0.001) and a moderately strong positive correlation between attitude and practice scores (rho = 0.432, *p* = 0.001)(23). At the same time, another study found that many healthcare providers had an excellent attitude toward BMW management(13). Dress et al. also concluded that the healthcare worker's good knowledge led to a positive attitude and proper practice(23). Several studies have made similar statements that assessed KAP towards healthcare waste management in different countries(12,24,25).

Another study conducted in Cairo, Egypt, reported that the duration of work experience was not significantly associated with attitude(26); however, Thirunavikkarasu et al. found a significant correlation between high knowledge and attitude with work experience(22).

CONCLUSION
The overall KAP among the respondents was good. This was better among the doctors and nurses compared to the other categories of health care functionaries. It is also dependent on their cadre. Although the knowledge about the different types of waste among the HCWs was good, the knowledge regarding the blue color-coded bins needed to be higher in this study.

With the above results and discussion, it can be concluded that the overall KAP score was good for all health workers. Knowledge and practice scores were better than attitude scores which shows a significant level of practice of BMW amongst healthcare workers. The better knowledge score of the hospital administrator and better practice score of the waste control manager prove the impact of work profile on BMW management. Further Better knowledge and practice score of MBBS/AYUSH doctors signifies role of qualification in BMW management.

Limitations
This may have resulted in the over-reporting of correct responses. The associations have been assessed only through cross-section surveys and not by causation and direction. This study has been conducted in the districts of Gujarat and may not apply to all regions of the country or other countries.

Recommendations
Effective waste management is a legal requirement and a social responsibility. Our study revealed that although most had been trained, many still needed to undergo even one training. As per the BMW Management policy, all health functionaries must undergo essential yearly training. It is the institution's responsibility to organize such training programs as well as the duty of the health functionaries to participate, irrespective of their qualification, designation, or experience. Mandatory attendance and periodic assessments should be included in yearly performance assessments of all HCWs to increase compliance. It is also essential to carry out such studies regularly to find the gaps so that the training can be customized accordingly. The training programs could use multiple strategies like handouts, stickers, charts, quizzes, practical demonstrations, and exercises.

AUTHORS CONTRIBUTION
All authors have contributed equally.

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CONFLICT OF INTEREST
There are no conflicts of interest.

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