



ORIGINAL ARTICLE

Knowledge, attitude, and practices regarding bio-medical waste management among healthcare personnel in a tertiary care hospital, Thiruvallur district. A cross-sectional study

Sivaanusuya SUDHAKARAN, Hemavathe SIVAJI, Renju YOHIDHASAN

ABSTRACT

Introduction. The substantial amount of biomedical waste generated by healthcare facilities poses a significant threat to public health and the environment if it is not properly segregated and treated. As healthcare personnel are directly involved in waste generation, segregation, handling, and transportation, they must possess adequate knowledge, a positive attitude, and appropriate practices regarding biomedical waste management to prevent health hazards and environmental contamination. Despite the existence of biomedical waste management regulations, gaps in awareness and compliance among healthcare workers persist. **Objective.** To assess the knowledge, attitudes, and practices (KAP) regarding biomedical waste (BMW) management among healthcare personnel (HCP) in a tertiary care hospital in the Thiruvallur district and to identify factors associated with KAP scores. **Materials and Methods.** A hospital-based cross-sectional study was conducted among 120 healthcare personnel, including doctors, staff nurses, laboratory technicians, and cleaning staff, at VELS Medical College and Hospital, Thiruvallur district, between October 2025 and February 2026. Healthcare personnel who had been employed at the institution for more than six months and provided informed consent were selected using simple random sampling. Data were collected through face-to-face interviews using a pre-tested, semi-structured questionnaire after obtaining ethical approval and informed consent. Data were entered into Microsoft Excel 2010 and analyzed using SPSS version 20.0. Descriptive statistics and the chi-square test were used for data analysis, with statistical significance set at $p < 0.05$. **Results.** Among the 120 healthcare personnel included in the study, the majority were female (70.8%). Overall, 83.3% demonstrated adequate knowledge, 66.7% had a favourable attitude, and 61.7% reported appropriate biomedical waste management practices. More than 90% of participants were aware of colour-coded waste bins, the hazards associated with improper waste disposal, and the importance of using personal protective equipment. However, only 60% had been vaccinated against hepatitis B. Higher educational qualifications and longer work experience were significantly associated with better KAP scores ($p < 0.001$). **Conclusion.** Although healthcare personnel demonstrated good knowledge of biomedical waste management, deficiencies in attitudes and practices were evident, particularly among cleaning staff and laboratory technicians. Regular training programmes, continuous monitoring, and improved provision of occupational safety equipment are essential to strengthen biomedical waste management practices in healthcare settings.

Department of Community Medicine, Vels Medical College and Hospital (VISTAS), Thiruvallur, Chennai, India

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Correspondence to: sivaanusuya SUDHAKAN
E-mail: anusudhakaran@gmail.com

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1. INTRODUCTION

Bio Medical Waste means any waste that is generated during the treatment, diagnosis, or immunization of human beings or animals, or in research activities pertaining thereto, or in the production or testing of biological [1].

The substantial amount of biomedical waste (BMW) generated from healthcare facilities is the major public health challenge. As primary handlers, healthcare personnel (HCP) must have adequate awareness about the various steps in waste management [1,2]. Around 10 - 25 % of the wastes that are generated were hazardous and have the high potential of causing serious health problems [3]. According to BMW management rules 1998, every HCPs should have adequate knowledge and should practice well in handling and disposal of wastes [2,3]. Incorrect handling may end up in major concerns of HIV/AIDS, Hepatitis B, Hepatitis C, nosocomial infections, air, water, and soil pollution due to defective incineration, misuse of disposed drugs and medical wastes, risk of infections for waste handlers, scavenging by rag picking and animals, and it also attracts a variety of vectors like mosquitoes and flies [4]. Hence, there should be a safe and reliable method in handling and disposal. Major sources are hospitals, labs, research centers, animal research, blood banks, nursing homes, and minor sources from ambulance services, cosmetic piercing, funeral services, vaccination centers, and dental clinics [5].

WHO states that 85% were non-hazardous, only 10% and 5% were infectious and non-infectious, respectively [5]. In India, despite the implementation of BMW management rules and increased global awareness of safe handling practices, the awareness levels among the health care personnel remain inadequate [6]. These observations were initiated to assess the KAP regarding BMW management among health care personnel so that necessary interventions can be planned and implemented in the study setting. Thus, this study is conducted to assess the Knowledge, Attitude, and Practices (KAP) regarding biomedical waste management among healthcare personnel in Tertiary Care Hospital, Thiruvallur district, and also to identify the factors responsible for the KAP scores.

2. MATERIALS AND METHODS

A hospital-based cross-sectional study was conducted among the health care personnel working in Vels Medical College and Hospital, Thiruvallur district, Tamil Nadu, India, from October 2025 to February 2026. Resident doctors, staff nurses, lab technicians, and cleaning staff were included for the study. The sample size was calculated using the formula $n = z^2pq/d^2$ with $p=59.6\%$ [3], relative precision 15% of p and 95% of the confidence interval. A total of 120 health care personnel were included using a simple random sampling method. Whoever was willing to participate and employed for at least 6 months in this institution was included in the study. Those who are unwilling to participate and who are on leave or unavailable after 2 consecutive visits during data collection time were excluded from the study.

The semi-structured questionnaire was used after reviewing previously published articles and relevant literature; the questionnaire was reviewed for content validity, and a pilot study was done among 10 health care personnel before the conduction of the study. A face-to-face interview was conducted after obtaining informed consent from the participants. Ethical clearance for the study was obtained from the institutional ethical committee-VMCH (VE-001/2024 issued on 03.01.2025). The survey had questions in four major categories. Category 1 consisted of socio-demographic questions, including the gender, work experience, and qualification. Category 2 is to assess the knowledge using 10 questions. Each correct response will score one mark, and the incorrect responses will get zero marks. The total scores ranged from 0-10 and if the scores were ≥ 8 will be categorized as having good knowledge; otherwise, poor knowledge. Category 3 to assess the attitude towards BMW management practice using 10 questions. Participants scoring more than or equal to 8 will have a favorable attitude, and if less than 8 will be considered as having an unfavorable attitude. Category 4 will be assessing the practice using 10 questions. Participants who scored ≥ 8 were categorized as doing good practice, and those who scored < 8 were categorized as doing poor practice. The data were entered in Microsoft Excel v10.0 and analyzed using SPSS v20.0. Descriptive statistics were assessed and expressed as frequencies and percentages. Chi-square tests were done to assess the associations between KAP scores and demographic variables; a P value < 0.05 was considered statistically significant.

3. RESULTS

A total of 120 healthcare personnel were interviewed in this study. The demographic characteristics of the participants were summarized in Table 1. Among the study participants, 85 (70.8%) were females and 35 (29.2%) were males. Based on the educational qualification and occupation, 40 were doctors (33%), 44 were staff nurses (36.7%), 20 were cleaning staff (16.7%) and 16 were lab technicians (13.3%). Regarding work experiences, 44 (36.7%) participants had been working in this institute for 2-5 years, 43 (35.8%) participants had worked here for 6 months to 2 years, and 33 (27.5%) were working for more than 5 years. The overall good knowledge, favourable attitude and good practices among HCPs were found to be 100 (83.3%), 80 (66.7%), 74 (61.7%), respectively (Fig. 1). As

described in Table 2, the knowledge, attitude, and practices regarding the study subject were compared across the professional groups in the study setting. Out of 120 participants, only 20 (16.7%) had poor knowledge, and among them, the majority were cleaning staff (18, 90%). This difference in knowledge levels among the professional groups was found to be highly statistically significant using a chi-square test with p value <0.001. The majority were known about the hazards associated with BMW management, > 90% (110) were known about the usage of color codes, universal protective measures, and discarding objects causing puncture wounds. The majority had a good attitude towards decontamination and disinfection that reduces the chances of infections; color codes are necessary, and everyone considers it as teamwork. All the interviewed participants (120, 100%) reported they were using heavy puncture-proof containers for disposal of sharps waste. >90% (108) were segregating the wastes at the point of origin and were using personal protective devices, and only 72 (60%) were vaccinated. Table 2 implies that there is a statistically significant association between KAP and qualifications with p value < 0.001. However, causality cannot be inferred as it is a cross-sectional study. Table 3 implies that there is a significant association between KAP and years of experience with p value < 0.001.

Table 1. Demographic characteristics of Health Care Personnel.

Variables	Total n=120	Percentage (%)
Sex frequency		
Male	35	29.2%
Female	85	70.8%
Qualification		
Doctors	40	33.3%
Staff nurses	44	36.7%
Lab technicians	16	13.3%
Cleaning staff	20	26.7%
Experience		
6m-2 years	43	35.8%
2-5 years	44	36.7%
>5 years	33	26.7%

Table 2. KAP and qualification status on BMW Management among Health care personnel.

KAP STUDY	HEALTH CARE PERSONNEL				TOTAL n=120(%)	df	P VALUE
	DOCTORS n= 40(%)	NURSES n= 44(%)	LAB TECH n= 16(%)	CLEANING STAFF n= 20(%)			
GOOD KNOWLEDGE	40(100%)	44(100%)	14(87.5%)	2(10%)	100(83.3%)		<0.001*
POOR KNOWLEDGE	0	0	2(12.5%)	18(90%)	20(16.7%)	3	
FAVOURABLE ATTITUDE	35(87.5%)	38(86.4%)	5(31.2%)	2(10%)	80(66.7%)		<0.001*
UNFAVOURABLE ATTITUDE	5(12.5%)	6(13.6%)	11(68.8%)	18(90%)	40(33.3%)	3	
GOOD PRACTICE	35(87.5%)	34(77.2%)	4(25%)	1(5%)	74(61.7%)		<0.001*
POOR PRACTICE	5(12.5%)	10(22.8%)	12(75%)	19(95%)	46(38.3%)	3	

KAP: Knowledge, Attitude and Practices. BMW: Biomedical waste df: Degree of freedom *Significantly associated with p value <0.001

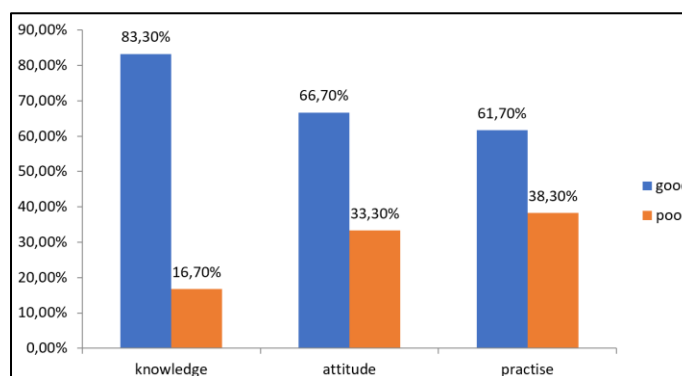


Fig 1. Distribution of KAP status regarding BMW management among Health care personnel (n=120).

4. DISCUSSION

Residents and staff nurses demonstrated higher proportions of knowledge regarding the BMW management rules and practices, whereas cleaning staff had the lowest proportion of knowledge. These findings were similar to those of Saini S et al. [7], Deo et al. [8], Mathur et al. [9], and Bathma et al. [10], who, in their studies among HCPs of tertiary care hospitals in India, reported that the persons with higher education levels (medical staff) were more aware of BMW management than non-medical staff. Malini A et al. [11] and Tenglikar et al. [12] reported that the average knowledge score was highest among doctors and nurses and lowest among housing staff, Sengodan VC et al. [13] concluded that knowledge is more in young doctors (interns and post-graduate students), followed by nursing students, nurses and lab technicians. But in the findings of Sharma S et al. [14], it was reported that there was a lack of knowledge and awareness regarding biomedical waste management even among qualified hospital personnel.

As far as attitude is concerned, our study once again shows that nurses, doctors, cleaning staff, and lab technicians had the highest proportion of those having favorable and unfavorable attitudes, respectively. Comparable findings were reported by Tenglikar et al. [12]; a favorable attitude regarding health care waste management was highest in doctors and nursing staff and least in housing staff and lab technicians. Similar findings were reported by Vijayakumar Mane et al. [4], Malini et al. [11], and Gyan P Singh et al. [15], who also proved that overall awareness, and knowledge were more satisfactory among doctors and staff nurses than among other non-medical staff. All the participants were aware of their colored bins of biomedical waste segregation; this may be attributed to the color-coded displays and posters near the bins throughout the hospital. But some studies disprove that the study participants don't know about the color codes of BMW management [16,17]. The majority of health care personnel reported needle stick injury reporting practices, which is an important practice for prevention and transmission of occupational exposure and bloodborne infections, which is comparable to Rawat Ranu et al. [3] and Sengodan et al. [13], but the study done by Malini A et al. [11], Sharma S et al. [14], Chudasama RK et al. [18], and Ismail IM et al. [19] in their study reported that the majority of the participants were not reporting about their needle stick injuries, which shows a major lack and spread of diseases in their study. There is particular concern about diseases and the spread of infection with human immunodeficiency virus (HIV) and hepatitis viruses B and C, for which there is strong evidence of transmission by health-care waste, especially sharp injuries.

Table 3. KAP and Experience status on BMW Management among Health care personnel.

	EXPERIENCE			TOTAL	df	P VALUE
	6M- 2 Years n= 43(%)	2-5 Years n= 44(%)	>5 Years n= 33(%)			
KAP STUDY						
GOOD KNOWLEDGE	43(100%)	31(70.5%)	26(78.8%)	100(83.3%)		<0.001*
POOR KNOWLEDGE	0	13(29.5%)	7(21.2%)	20(16.7%)	2	
FAVOURABLE ATTITUDE	38(88.3%)	20(45.4%)	22(66.7%)	80(66.7%)		<0.001*
UNFAVOURABLE ATTITUDE	5(11.7%)	24(54.6%)	11(33.3%)	40(33.3%)	2	
GOOD PRACTICE	38(88.4%)	18(41%)	18(54.5%)	74(61.6%)		<0.001*
POOR PRACTICE	5(11.6%)	26(59%)	15(45.5%)	46(38.4%)	2	

KAP: Knowledge, Attitude and Practices. BMW: Biomedical waste df: Degree of freedom *Significantly associated with p value <0.001

In our study, it shows that they all know about the biohazard symbol as a poster is pasted everywhere in the waste-collecting area and in all collecting bins. The findings are similar to Aashtha Pandey et al. [20], Kanchi et al. [21], and Madhavi et al. [22], who in their study show knowing the biohazard symbol of 94%, 65.2%, and 93%, respectively. Our study shows that most of the participants were segregating the wastes at the point of source, which is similar to that of Kanchi et al. [21] 93%, Madhavi et al. [22] 68.6%, and Basu et al. [23] 78.8%.

Around 95% of the study participants reported that improper management can lead to the spreading of various diseases, as that of Gyan P. Singh et al. [15], Bathma et al. [10], and Kavita et al. [24]. In our study, the majority of the participants were aware of precautionary measures and using the universal preventive measures like gloves, gowns, caps, and masks, but in the study by Hassan et al. [25] and Kumar et al. [26] it was shown that the majority of their hospital personnel were not aware of universal preventive measures and not using them regularly. Our study setting has the biomedical waste disposal policy that is generated on a daily basis.

They are all thinking that segregation should be at the source to prevent the spread of infections. Among them, more than 90% of study participants were aware that the Hepatitis B vaccination will prevent the disease, and 75% of doctors and nurses were fully vaccinated, and though awareness regarding Hepatitis vaccination was high, vaccination coverage was found to be lower among lab technicians and cleaning staff. This may be highlighting the important occupational health gaps requiring targeted interventions. Most

of the participants did not consider it as an extra burden, and everyone played their own role in biomedical waste management in proper segregation, transportation, storage, and disposal. The majority of the participants have not attended any training programs regarding BMW management.

This study helped us in identifying the gap and the necessity for training them and also made us take necessities like training programs that should be conducted regularly and advise all the HCWs to attend the session and update themselves and also provide the necessary items like needle destroyers, supply of disinfectants, and provide protocols for disinfection, transportation & disposal of waste at each source. In our study setting, regular surveillance and monitoring of the practices show good.

Limitations: This study was conducted in a tertiary care hospital, which is not generalizable. All the information collected with the self-reported questionnaire may be subjected to reporting bias. And all the dimensions of biomedical waste management practices could not be directly assessed.

5. CONCLUSION

The present study found that the majority of the health care personnel were knowledgeable on biomedical waste management. Yet, gaps were seen in attitude and practice, especially among cleaning staff and laboratory technicians. And we also found the significant association of KAP scores with qualification and years of experience. Efficient training programs, facilitating guidance, and strengthening occupational safety measures with Hepatitis B vaccination coverage may help to improve the biomedical waste management practices among health care personnel.

Competing interests: The authors declare that they have no competing interest.

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