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Knowledge, Attitude, and Practices Regarding Biomedical Waste Management Among Healthcare Personnel: A Cross-Sectional Study

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Abstract

Background: Improper biomedical waste management (BMWM) poses significant risks to healthcare workers, patients, and the environment. Despite regulatory frameworks in Pakistan, gaps in knowledge, attitude, and practices persist among healthcare personnel. **Methods:** A descriptive cross-sectional study was conducted among healthcare personnel at Sir Ganga Ram Hospital, Lahore. A pretested structured questionnaire assessing knowledge, attitude, and practices (KAP) was administered to doctors, nurses, and auxiliary staff. Data were analyzed using SPSS version 23. Descriptive statistics and Spearman's correlation were applied. **Results:** A total of 200 participants were included. Awareness regarding biomedical waste generation was reported by 76% of participants. Doctors demonstrated higher knowledge compared to nurses and auxiliary staff. While 93.5% identified BMWM as a team responsibility, only 55% were aware of waste auditing procedures. Training participation was limited, although 82% expressed willingness for further training. Knowledge levels significantly differed across professional categories ($p < 0.05$). **Conclusions:** Although general awareness of BMWM was satisfactory, significant gaps exist in technical knowledge and practices, particularly among auxiliary staff. Continuous training programs and institutional policy enforcement are essential to improve compliance.

Keywords: Biomedical waste management; Healthcare workers; Knowledge attitude practice; Infection control; Pakistan

BACKGROUND

Biomedical waste (BMW) refers to waste generated during diagnosis, treatment, or immunization of humans or animals. Improper management of BMW poses serious risks including infection transmission, environmental contamination, and occupational hazards among healthcare workers (Bhattacharjee and Roy, 2025, Bansod and Deshmukh, 2023).

Globally, approximately 10–25% of healthcare waste is hazardous (Janik-Karpinska et al., 2023). In Pakistan, increasing healthcare facilities have led to a significant rise in waste generation, emphasizing the need for effective waste management practices (Malik et al., 2025). Although national guidelines for BMW management exist, their implementation remains inconsistent across healthcare settings (Saxena et al., 2022).

Healthcare workers play a critical role in ensuring proper segregation, handling, and disposal of biomedical waste (Okechukwu et al., 2022). Their knowledge, attitude, and practices (KAP) directly influence the effectiveness of waste management systems. Previous studies have reported gaps in awareness and compliance, particularly among auxiliary staff (Khashaba et al., 2023, Conti et al., 2024).

However, limited data exist assessing KAP among different categories of healthcare personnel within tertiary care hospitals in Pakistan. Therefore, this study aimed to evaluate the knowledge, attitude, and practices regarding biomedical waste management among healthcare personnel at a tertiary care hospital in Lahore.

METHODOLOGY

This descriptive cross-sectional study was conducted at Sir Ganga Ram Hospital, Lahore, Pakistan, a tertiary care teaching hospital. The study population comprised healthcare personnel, including doctors, nurses, and auxiliary staff directly involved in patient care. A non-probability convenience sampling technique was employed to recruit participants. A total of 200 participants were included in the study. Individuals who had undergone formal training in biomedical waste management within the preceding year, administrative staff, and those unwilling to participate were excluded.

Data were collected using a pretested, structured, self-administered questionnaire consisting of 25 items designed to assess knowledge, attitude, and practices (KAP) related to biomedical waste management. The questionnaire included both closed- and open-ended questions covering domains such as awareness of biomedical waste regulations, waste segregation, disposal practices, and perceived barriers. Prior to data collection, participants were informed about the purpose of the study, and informed consent was obtained. Confidentiality and anonymity were maintained throughout the study.

Data collection was carried out during departmental meetings, where eligible participants were approached and provided with the questionnaire. Completed questionnaires were collected on the same day. The collected data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 23. Descriptive statistics, including frequencies and percentages, were used to summarize the data. Spearman's rank correlation coefficient was applied to assess the relationship between professional category and knowledge level, with a p-value of <0.05 considered statistically significant.

RESULTS

The quantity of biomedical waste generated across hospital wards varied, with 76% of participants reporting awareness of daily waste generation in their units, while 24% were unaware.

Regarding knowledge of biomedical waste management (BMWM) as shown in Table 1, approximately half of the doctors (52.6%) and nurses (52.4%) were aware of relevant legislation, whereas awareness was lower among auxiliary staff (26.1%). Doctors primarily acquired knowledge through theoretical education (59.8%), followed by CME (33.1%) and seminars (28.5%). Nurses reported theory (42.9%), CME (40.5%), and seminars (40.5%) as learning sources. Training participation was limited, particularly among doctors (36.6%) and auxiliary staff (26.1%), though higher among nurses (57.2%). Institutional annual education programs were attended by 43.7% of doctors, 69.1% of nurses, and 67.4% of auxiliary staff.

Table 1: *Knowledge of Biomedical Waste Management (BMWM)*

Descriptions	Doctors (n=112)		Nurses (n=42)		Others (n=46)	
	Present/ Yes	Absent/ No	Present/ Yes	Absent/ No	Present/ Yes	Absent / No
Knowledge of Law	59 (52.6%)	53 (47.4%)	22 (52.4%)	20 (47.6%)	12 (26.1%)	34 (73.9%)
Learnt through theory	67 (59.8%)	45(40.2%)	18 (42.9%)	24 (57.1%)	17 (36.9%)	29 (63.1%)
Learnt through CME	37 (33.1%)	75 (66.9%)	17 (40.5%)	25 (59.5%)	2(4.3%)	44 (95.7%)
Learnt through seminar	32 (28.5%)	80 (71.5%	17 (40.5%)	25 (59.5%)	20 (43.5%)	26 (56.5%)
Attended training programmes on BMWM	41 (36.6%)	71 (63.4 %)	24 (57.2%)	18 (42.8%)	12 (26.1%)	34 (73.9%)
A hospital providing annual education on BMWM	49 (43.7%)	63 (56.3%)	29 (69.1%)	13 (30.9%)	31 (67.4%)	15 (32.6%)
Categorizing Wastes Necessary	108 (96.4%)	4(3.6%)	30 (71.4%)	12 (28.6%)	39 (84.8%)	7(15.2%)
Color coding disposal Necessary	112 (100%)	-	40 (95.2%)	2 (4.8%)	38 (82.6%)	8 (17.4%)
Labeling of BMW with Biohazard symbol	99 (88.3%)	13 (11.7%)	36 (85.7%)	6 (14.3%)	36 (78.3%)	10 (21.7%)

Most participants demonstrated awareness of key BMWM practices, including waste segregation (overall >70%) and color coding (doctors 100%, nurses 95.2%, others 82.6%). Awareness of biohazard labeling was also high across groups.

Institutional practice of BMWM was reported as satisfactory, with 91% aware of the hospital waste management plan. About 80% received training on proper disposal practices, and 74.5% confirmed monitoring of segregation and handling. However, only 56% of departments maintained waste records. Overall, 74% reported regular discussion of BMWM in departmental meetings.

Table 2: *Practice Regarding Biomedical Waste Management (BMWM)*

Descriptions	Doctors (n = 50)	Nurses (n = 50)	Paramedical Staff (n = 50)	Others (n = 50)
Disposal of sharps in puncture proof container	43(86%)	40 (80%)	42 (84%)	39(78%)
Disposal of expired drug in black colour bag	41(81%)	38(76%)	26(52%)	14(28%)
Disposal of used gauze piece in yellow colour bag	48(96%)	46(92%)	38(76%)	31(62%)
Not recapping the used needle	50(100%)	46(92%)	33(66%)	12(24%)
Discarding of used needles by hub cutter	40 (80%)	42(84%)	30(60%)	8(16%)
Vaccinated for Hepatitis-B	43(86%)	40(80%)	27(54%)	5(10%)
Ever undergone training for bio-medical waste management	21(42%)	16(32%)	14(28%)	5(10%)

Attitudes toward BMWM were largely positive, with 93.5% considering it a team responsibility and 71% acknowledging its importance. However, 40% perceived financial burden and 24.5% reported increased workload.

Table 3: *Attitude Regarding of Biomedical Waste Management (BMWM)*

Descriptions	Doctors (n = 50)	Nurses (n = 50)	Paramedical Staff (n = 50)	Others (n = 50)
Waste management is a responsibility	50(100%)	46 (92%)	47 (94%)	39(78%)
Financial burden increases because of BMW management	45(90%)	26(52%)	40(80%)	12(24%)
Bio medical waste management is an important issue	50(100%)	46(92%)	47(94%)	39(78%)
Reporting to concern authorities if centre is not complying with the guidelines of bio-medical waste management	40(80%)	30(60%)	18(36%)	14(28%)
BMW management increases burden of work	11(22%)	42(84%)	44(88%)	46(92%)
Willing to attend training on BMW management to enhance knowledge	48(96%)	50(100%)	50(100%)	23(46%)

Knowledge scores showed doctors with the highest proportion of good knowledge (84%), followed by nurses (76%), paramedical staff (70%), and others (20%). A significant positive correlation was observed between professional level and knowledge ($r_s = 0.168$, $p = 0.003$).

Practices were better among doctors and nurses, particularly in sharps disposal and infection control, while vaccination and training coverage were lowest among auxiliary staf

DISCUSSION

This study evaluated the knowledge, attitude, and practices (KAP) regarding biomedical waste management among healthcare personnel in a tertiary care hospital in Lahore. The findings indicate that although overall awareness was satisfactory, substantial gaps

persist in technical knowledge and practical implementation, particularly among auxiliary staff.

The present study demonstrated that doctors had significantly higher knowledge levels compared to nurses and auxiliary staff. This finding is consistent with previous studies conducted in similar healthcare settings, where knowledge disparities were attributed to differences in educational background and access to training opportunities. The relatively lower knowledge among auxiliary staff is concerning, as they are directly involved in waste handling and are at increased risk of exposure to hazardous materials(Sharior et al., 2023). This highlights the need for targeted educational interventions focusing on this group.

Although a large proportion of participants recognized the importance of biomedical waste management, practical adherence to recommended guidelines was inconsistent. While most participants reported following proper disposal practices, critical gaps were identified in areas such as waste auditing, record maintenance, and adherence to standard operating procedures. These findings suggest that awareness alone does not necessarily translate into correct practice, which is a common issue reported in previous studies (Jha et al., 2022).

The attitude of healthcare personnel towards biomedical waste management was generally positive, with the majority recognizing it as a collective responsibility. However, a notable proportion of participants perceived biomedical waste management as an additional workload and financial burden. This perception may negatively influence compliance and highlights the importance of institutional support, adequate staffing, and resource allocation to facilitate effective waste management practices (Waxin et al., 2023).

Another important finding of this study is the disparity in occupational safety measures, particularly vaccination coverage. While doctors and nurses demonstrated relatively higher rates of Hepatitis B vaccination, auxiliary staff had significantly lower coverage. This indicates gaps in occupational health policies and underscores the need for ensuring universal vaccination and protective measures for all categories of healthcare workers (Young et al., 2024).

The findings of this study have important implications for nursing practice and healthcare management. Nurses play a central role in implementing biomedical waste management protocols, and strengthening their knowledge and leadership in this area can significantly improve compliance across healthcare teams. Institutional policies should emphasize regular monitoring, auditing, and reinforcement of waste management practices.

CONCLUSION

This randomized controlled trial demonstrates that structured oral care is associated with improved clinical outcomes among mechanically ventilated ICU patients. The intervention significantly reduced duration of mechanical ventilation and ICU length of stay and was associated with lower mortality compared with routine care.

These findings highlight the potential value of incorporating structured oral hygiene protocols into standard ICU nursing practice to improve patient recovery and reduce complications associated with mechanical ventilation.

LIMITATIONS

This study has certain limitations. It was conducted in a single tertiary care hospital, which may limit the generalizability of the findings. Additionally, data were collected using self-reported questionnaires, which may be subject to response bias. Future studies should consider multi-center designs and observational assessments to validate reported practices.

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