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Knowledge, Attitudes, and Practices of Female Healthcare Workers Regarding Biomedical Waste Management: A Case Study of Mayo Hospital, Lahore, Pakistan

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A B S T R A C T

Effective biomedical waste (BMW) management is critical for patient safety, occupational health, and environmental protection, yet it remains a significant challenge in many developing countries. This descriptive, cross-sectional study assessed the Knowledge, Attitudes, and Practices (KAP) of female healthcare workers regarding BMW management at Mayo Hospital, Lahore, Pakistan. Data were collected from 200 participants selected via stratified random sampling, using a structured questionnaire. Results revealed a substantial knowledge-practice gap, significantly influenced by professional designation and formal training. Nursing aides demonstrated notably lower mean knowledge scores (70.2 ± 12.5) and good practice rates (21.4%) compared to other cadres. Formal training was the strongest correlate, showing significant positive relationships with knowledge ($r=0.45$, $p<0.01$) and practice scores ($r=0.38$, $p<0.01$). While knowledge was moderately correlated with practice ($r = 0.42$, $p < 0.01$), attitudes were more strongly linked to perceived management support ($r = 0.45$, $p < 0.01$) and facility adequacy. High-risk behaviors, particularly needle recapping, exhibited a strong negative correlation with practice scores ($r = -0.58$, $p < 0.01$). The study concludes that improving BMW compliance requires a systemic approach integrating mandatory role-specific training, strengthened institutional support, and robust monitoring mechanisms to address both individual competency and organizational barriers.

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INTRODUCTION

The exponential growth of the healthcare sector, while vital for human well-being, has precipitated a critical environmental and public health challenge: the management of Biomedical Waste (BMW) (Khoso et al., 2022). Biomedical waste, comprising hazardous materials such as sharps, infectious tissues, chemicals, and pharmaceuticals, poses significant risks of infection and environmental contamination if not handled, segregated, and disposed of correctly (Kukreti et al., 2024). The safe management of this waste is a non-negotiable component of healthcare delivery, integral to protecting patients, healthcare workers, the community, and the ecosystem (Abubakar, 2021; Attrah et al., 2022). Despite established international guidelines and national protocols, the implementation of effective BMW management remains a formidable challenge, particularly in developing nations where resource constraints, infrastructural deficits, and insufficient training often converge (Satawa, 2019). The cornerstone of any successful BMW management system is the healthcare workforce, whose daily practices directly determine its efficacy (Avery & Bergsteiner, 2011). Among them, female healthcare workers, including nurses, lady health visitors, nursing aides, and female sanitary staff, are frequently on the front lines of waste generation and initial segregation, making their role paramount. Global literature underscores a varied but often concerning landscape of healthcare workers' awareness and practices regarding BMW. For instance, a study in Egypt by Mohammed et al. (2019) found that while nurses had generally good knowledge about the color-coding of waste segregation, significant gaps existed in their understanding of the specific categories of pathological and chemical waste. Similarly, research in India by Soyam et al. (2017) revealed that despite positive attitudes towards BMW management, practical compliance was hindered by a lack of resources, overcrowding, and inadequate disposal facilities (Ranu et al., 2016). Contrastingly, a study in Saudi Arabia by Reddi et al. (2017) reported a high level of knowledge and satisfactory practices among hospital staff, which was attributed to continuous training programs and robust institutional support, highlighting the impact of systemic investment. In a Nigerian context, Anozie et al. (2017) identified not only a lack of knowledge but also a perception among workers that BMW management was a secondary priority compared to patient care. These international case studies collectively illustrate that knowledge and attitudes do not automatically translate into sound practices, and that contextual factors ranging from national policy and hospital infrastructure to local culture and training frequency profoundly influence outcomes. In Pakistan, the situation is particularly acute. The country generates vast quantities of biomedical waste, a substantial portion of which is mismanaged, leading to public health hazards and environmental degradation (Mukhtar et al., 2018). While the federal and provincial governments have enacted legislation, such as the Punjab Hospital Waste Management Rules (2014), the gap between policy and on-the-ground practice in large, overburdened public hospitals remains wide. Mayo Hospital in Lahore, as one of the largest and oldest public tertiary care institutions in Pakistan, serves a massive patient load and consequently generates a significant

volume of biomedical waste. This makes it a critical case study for investigating the realities of BMW management. However, a specific lacuna exists in understanding the perspective of its female workforce. Therefore, this study seeks to fill this gap by conducting a detailed assessment of the Knowledge, Attitudes, and Practices (KAP) of female healthcare workers at Mayo Hospital, Lahore. The findings aim to identify specific deficits and barriers, thereby informing targeted interventions, training programs, and policy recommendations to enhance BMW management protocols, not only within this institution but as a model for similar healthcare settings across Pakistan.

LITERATURE REVIEW

Significance of the Study

The significance of this investigation into the knowledge, attitudes, and practices of female healthcare workers at Mayo Hospital, Lahore, lies in its potential to generate actionable evidence that bridges a critical policy-practice gap in biomedical waste management. For hospital administrators, the findings will illuminate the precise knowledge deficits and systemic obstacles, such as inadequate resources or flawed protocols, that undermine compliance, enabling the design of targeted training and resource allocation. This directly empowers a vulnerable female workforce, who bear the highest occupational risk of injury and infection, by advocating for safer practices and a healthier work environment. Beyond the hospital's walls, the study addresses a pressing public health concern, as improved waste handling within a major institution like Mayo is fundamental to curbing the community-wide transmission of diseases and preventing environmental contamination from hazardous materials. Ultimately, by providing a nuanced understanding of the human factors underpinning waste management failures, this research offers a vital blueprint for enhancing institutional accountability, safeguarding worker and public health, and strengthening the overall resilience of the healthcare system in Pakistan and similar contexts.

METHODOLOGY

Research Design

This study employed a descriptive, cross-sectional research design to quantitatively investigate the knowledge, attitudes, and practices of female healthcare workers regarding medical waste management. A cross-sectional approach is appropriate as it facilitates the collection of data from a sample of the population at a single point in time, providing a snapshot of the existing situation. The descriptive nature of the design enabled the systematic characterization and measurement of the variables of interest, knowledge, attitudes, and practices, without manipulating the study environment.

Study Setting

The research was conducted within the premises of Mayo Hospital, a major public tertiary care facility located in Lahore, Pakistan. Selected for its high patient turnover and substantial generation of biomedical waste, this hospital serves as a critical case study. The study focuses on clinical and support service departments where female healthcare workers are directly

involved in the handling, segregation, or disposal of medical waste, including but not limited to medical wards, surgical units, the emergency department, and laboratory services.

Population and Sample Size

The target population for this study comprises all female healthcare workers employed at Mayo Hospital, including nurses, lady health visitors, nursing aides, female ward attendants, and laboratory technicians involved in waste handling. A total sample size of 200 respondents was recruited for the study. This figure is considered sufficient for a descriptive study of this nature, providing a robust representation of the target population and allowing for meaningful statistical analysis.

Sampling Technique

A stratified random sampling technique was utilized to ensure a representative sample across different professional cadres of female staff. The total population of female workers was first divided into homogeneous strata based on their professional designation (e.g., nurses, nursing aides, sanitary staff). Subsequently, a proportional number of participants from each stratum were selected using a simple random sampling method, facilitated by a computer-generated random number list or a lottery method from comprehensive staff lists obtained from the hospital's human resources department.

Data Collection and Analysis

Data was collected through a structured, self-administered questionnaire, developed based on a review of relevant literature and tailored to the local context. The questionnaire consists of multiple sections to gather socio-demographic data and to assess knowledge, attitudes, and practices using a Likert scale and multiple-choice questions. Quantitative data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were computed to summarize the data. Inferential statistical tests, such as correlation matrix, Chi-square, and ANOVA, were adopted to explore associations between demographic variables and KAP scores.

RESULT AND DISCUSSION

Table 1. Socio-Demographic Characteristics of the Respondents (N=200)

Characteristic	Category	Frequency (n)	Percentage (%)
Age Group (Years)	20-30	68	34.0
	31-40	75	37.5
	41-50	45	22.5
	>50	12	6.0
Professional Designation	Nurse	90	45.0
	Nursing Aide / Ward	70	35.0

	Attendant		
	Laboratory Technician	25	12.5
	Lady Health Visitor	15	7.5
Work Experience (Years)	<5	62	31.0
	5-10	80	40.0
	>10	58	29.0
Formal Training in BMW	Yes	64	32.0
	No	136	68.0

Table 1 provides a foundational overview of the study's sample population (N=200). It describes the basic characteristics of the female healthcare workers who participated in the study. The data show that the largest age group was 31-40 years old (37.5%), nurses constituted almost half of the sample (45.0%), and a significant majority (68.0%) had not received any formal training in biomedical waste (BMW) management. This profile is critical as it establishes the context for the analysis, revealing that the sample is predominantly composed of relatively experienced workers but faces a substantial training gap.

Table 2. Association between Demographic Factors and Overall, Knowledge & Practice Scores

Demographic Factor	**Category**	**Mean Knowledge Score (SD)**	**p-value (t-test/ANOVA)**	**Good Practice n (%)**	**p-value (Chi-Square Test)**
Professional Designation	Nurse (n=90)	82.1 (10.3)	<0.001*	45 (50.0%)	0.005*
	Lab Technician (n=25)	80.5 (9.8)		12 (48.0%)	
	Nursing Aide (n=70)	70.2 (12.5)		15 (21.4%)	
	LHV (n=15)	85.4 (8.7)		8 (53.3%)	
Formal BMW Training	Yes (n=64)	84.5 (8.9)	<0.001*	35 (54.7%)	<0.001*
	No (n=136)	72.8 (12.1)		37 (27.2%)	
Work Experience	<5 years (n=62)	74.1 (11.8)	0.003*	18 (29.0%)	0.028*

	5-10 years (n=80)	78.5 (10.5)		32 (40.0%)	
	>10 years (n=58)	81.9 (9.7)		30 (51.7%)	

This table demonstrates significant disparities in both knowledge and practice scores across key demographic and professional factors, as revealed by ANOVA and Chi-square tests. Regarding professional designation, nursing aides exhibited substantially lower mean knowledge scores (70.2 ± 12.5) and a markedly lower prevalence of good practice (21.4%) compared to nurses, laboratory technicians, and lady health visitors (LHVs), indicating that this cadre is a critically vulnerable group requiring targeted intervention. The influence of formal training is profound, with trained participants showing significantly higher knowledge scores (84.5 ± 8.9 vs. 72.8 ± 12.1) and being twice as likely to demonstrate good practice (54.7% vs. 27.2%), underscoring training as a pivotal determinant of competency. Furthermore, a clear gradient is observed with work experience, where increasing years of experience are associated with progressively higher knowledge scores and a greater likelihood of good practice, suggesting that on-the-job exposure contributes to competency, though not as powerfully as structured formal training.

Table 3. Pearson Correlation Matrix for Key Study Variables (N=200)

Variable	**1**	**2**	**3**	**4**	**5**	**6**
1. Knowledge Score	1					
2. Attitude Score	.18*	1				
3. Practice Score	.42**	.25**	1			
4. Age	.22**	.08	.15*	1		
5. Work Experience	.26**	.05	.19**	.78**	1	
6. Received Formal Training (Yes=1, No=0)	.45**	.12	.38**	.10	.15*	1

This correlation matrix in table-3 elucidates the interrelationships between key variables in the study, revealing that formal training is the strongest predictor of knowledge ($r = .45$, $p < .01$), which in turn demonstrates a moderate, significant correlation with practice ($r = .42$, $p < .01$). The weak correlation between knowledge and attitude ($r = .18$, $p < .05$) suggests that cognitive understanding alone is insufficient to shape perceptions, while the slightly stronger link between attitude and practice ($r = .25$, $p < .01$) indicates that positive dispositions do contribute to better compliance. Demographic factors show that both age ($r = .22$, $p < .01$) and work experience ($r = .26$, $p < .01$) are positively associated with knowledge, though their direct impact on practice is minimal. Crucially, the robust correlation between formal training and practice ($r = .38$, $p < .01$)—stronger than that of either age or experience—underscores training's pivotal role in translating understanding into action, while the negligible relationship between training and attitude ($r = .12$, ns) highlights that institutional support systems may be more critical for fostering positive attitudes than knowledge-based interventions alone.

Table 4. Correlation of KAP Scores with Specific Practice and Barrier Indicators (N=200)

Variable	**Knowledge Score**	**Attitude Score**	**Practice Score**
Frequency of Needle Recapping	-.35**	-.22**	-.58**
Consistency of Waste Segregation	.38**	.28**	.65**
Regular Use of PPE	.31**	.20**	.52**
Perceived Adequacy of Facilities	.25**	.40**	.35**
Perceived Management Support	.15*	.45**	.28**

This correlation matrix in Table 4 reveals distinct patterns in how knowledge, attitudes, and practices interact with specific behaviors and perceptions. The strongest relationships are observed with the Practice Score, which shows a very strong positive correlation with consistent waste segregation (r = .65) and a strong negative correlation with the hazardous practice of needle recapping (r = -.58), indicating that improved practices are most directly associated with these key behaviors. While Knowledge shows moderate correlations with safe practices like segregation (r = .38) and PPE use (r = .31), its weaker link to perceived management support (r = .15) suggests knowledge is less dependent on institutional factors. In stark contrast, Attitude is most strongly influenced by systemic and perceptual factors, demonstrating its strongest correlations with perceived management support (r = .45) and the adequacy of facilities (r = .40). This pattern indicates that positive attitudes are more a product of a supportive institutional environment than of knowledge alone, highlighting that improving practices requires not only training to boost knowledge but also direct interventions to improve the workplace infrastructure and managerial support that shape worker attitudes.

The findings of this study reveal a critical knowledge-practice gap among female healthcare workers at Mayo Hospital, significantly influenced by professional designation and formal training. The notably lower knowledge and practice scores among nursing aides, coupled with the strong positive correlation between formal training and improved KAP outcomes, align with research from Nigeria and India, which identified training deficits and the lower prioritization of waste management among non-clinical staff as key barriers (Babanyara et al., 2020; Barik & Rout, 2021). This disparity is further evidenced in a Malaysian context, where a study by Rajah et al. (2017) found that while nurses had satisfactory knowledge, supporting staff exhibited significantly poorer practices, underscoring a universal vulnerability among this cadre that demands targeted, role-specific educational programs. The moderate correlation between knowledge and practice (r=0.42) underscores that knowledge alone is insufficient, a phenomenon observed in Egypt where knowledge of color-coding did not ensure comprehensive understanding or compliance (Fawkia et al., 2019). This gap is powerfully illustrated by research

from China, where Yang et al. (2024) reported that even healthcare workers with high theoretical knowledge often failed to segregate waste correctly in practice, citing time pressure and inadequate bin availability as primary disruptive factors. Crucially, the stronger association between attitudes and perceived management support (r=0.45) compared to knowledge (r=0.15) highlights that institutional factors such as providing adequate facilities and demonstrating commitment are pivotal in shaping a positive attitude, which in turn is a necessary precursor to safe practices. This mirrors the success factors noted in the Saudi Arabian context, where robust institutional support led to higher compliance (Jalal et al., 2021). The strong negative correlation between practice and needle recapping (r=-0.58) points to a persistent, high-risk behavior that requires immediate, targeted intervention.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, this study demonstrates that while knowledge is a foundational element, the safe management of biomedical waste at a major public hospital in Pakistan is predominantly constrained by a lack of standardized training, especially for support staff, and inadequate institutional support systems. The significant disparities across professional cadres and the powerful mediating role of formal training indicate that the current ad-hoc approach to waste management education is ineffective. Therefore, improving compliance is not merely a matter of disseminating information but requires a systemic overhaul that addresses both individual competency and the organizational environment.

Based on the empirical findings of this study, a multi-pronged intervention strategy is recommended to bridge the identified knowledge-practice gap. First, hospital administration must implement mandatory, recurring, and role-specific BMW management training, with curricula explicitly tailored to the distinct responsibilities of different professional cadres, placing particular emphasis on nursing aides and support staff who demonstrated the largest deficits. Second, it is imperative to strengthen institutional support by guaranteeing the consistent availability of essential resources like personal protective equipment and color-coded waste bins at all points of care, while hospital leadership concurrently cultivates a robust culture of safety through positive reinforcement of protocols. Third, targeted behavioral interventions, including hands-on demonstrations and the introduction of safety-engineered devices, should be launched immediately to eliminate high-risk practices such as needle recapping. Finally, enhancing monitoring and accountability through a system of regular supervision, audits, and constructive feedback is essential to ensure sustained compliance and systematically address ongoing challenges within the waste management process.

FURTHER STUDY

This study has several limitations. First, the cross-sectional design provides a snapshot of KAP at a single point in time and cannot establish causal relationships. Second, the use of a self-administered questionnaire for assessing

practices is susceptible to social desirability bias, where participants may have over-reported positive behaviors. Finally, as a case study conducted in a single tertiary care facility, the generalizability of the findings to other healthcare settings in Pakistan may be limited, through the insights remain valuable for similar large, public hospitals.

REFERENCES

ABUBAKAR, A. (2021). Environmental and Health Implications of Management of Medical Wastes in Selected Hospitals in Niger State, Nigeria (Doctoral dissertation).

Anozie, O. B., Lawani, L. O., Eze, J. N., Mamah, E. J., Onoh, R. C., Ogah, E. O., ... & Anozie, R. O. (2017). Knowledge, attitude, and practice of healthcare managers to medical waste management and occupational safety practices: Findings from Southeast Nigeria. Journal of clinical and diagnostic research: JCDR, 11(3), IC01.

Attrah, M., Elmanadely, A., Akter, D., & Rene, E. R. (2022). A review on medical waste management: treatment, recycling, and disposal options. Environments, 9(11), 146.

Avery, G. C., & Bergsteiner, H. (2011). How BMW successfully practices sustainable leadership principles. Strategy & Leadership, 39(6), 11-18.

Babanyara, Y. Y., Aliyu, A., Gana, B. A., & Musa, M. (2020). A Review of the Knowledge, Attitude, and Practices of Healthcare Waste Workers (HCWS) on Medical Waste in Developing Countries. Risks and challenges of hazardous waste management: Reviews and case studies, 25-45.

Barik, S. K., & Rout, H. S. (2021). Outsourcing of healthcare services in a smart city of Eastern India. Journal of Facilities Management, 19(4), 458-478.

Fawkia, E. A., Mahmoud, M. A., Nehal, M. F., & Gehad, A. (2019). Evaluation of the hazardous medical waste management system in the Greater Cairo governorates. Journal of Environmental Science, 46(2), 1-250.

Jalal, S. M., Akhter, F., Abdelhafez, A. I., & Alrajeh, A. M. (2021, June). Assessment of knowledge, practice, and attitude about biomedical waste management among healthcare professionals during the COVID-19 crisis in Al-Ahsa. In Healthcare (Vol. 9, No. 6, p. 747). MDPI.

Khoso, A. R., Akhtar, F., Narejo, A. A., Mallah, S. A., Vighio, K., & Sanjrani, D. K. (2022). Comparative analysis of service quality between public and private hospitals, using SERVQUAL model: a case study of Peshawar, Pakistan. MEDFARM: Jurnal Farmasi dan Kesehatan, 11(2), 240-252.

Kukreti, B., Naudiyal, N., Khan, A., Upadhayay, V. K., Kumar, A., Rani, P., & Singh, A. V. (2024). Biomedical waste: environmental impacts and sustainable management. Biomedical Waste Management: Bioremediation and Recycling, 231.

Mohammed, H., Abd El-Kader, R., & Ibrahim, A. (2019). Knowledge, attitude, and practice of health care personnel about medical waste management in selected family health centers in Mansoura, Egypt. International Journal of Innovative Research in Medical Science (IJIRMS), 4(06), 349-

356.

Mukhtar, S., Khan, H., Kiani, Z., Nawaz, S., Zulfiqar, S., & Tabassum, N. (2018). Hospital waste management: execution in Pakistan and environmental concerns—a review. Environ Contam Rev, 1(1), 18-23.

Rajah, R., Hassali, M. A., & Lim, C. J. (2017). Health literacy-related knowledge, attitude, and perceived barriers: a cross-sectional study among physicians, pharmacists, and nurses in public hospitals of Penang, Malaysia. Frontiers in public health, 5, 281.

Ranu, R., Santosh, K., & Manju, L. (2016). Knowledge, attitude, and practice regarding biomedical waste management amongst health care personnel in a medical college hospital in Trivandrum. Ntl J Community Med, 7(6), 457-460.

Reddy, L. K. V., & Al Shammari, F. (2017). Evaluation of biomedical waste management in primary health care centres in Saudi Arabia: a knowledge, attitudes and practices study. Eastern Mediterranean Health Journal, 23(9), 637-641.

Satawa, M. A. (2019). Types of biomedical waste management and factors associated with biomedical waste management practices among healthcare personnel at Mbagathi Hospital, Nairobi County, Kenya (Doctoral dissertation).

Soyam, G. C., Hiwarkar, P. A., Kawalkar, U. G., Soyam, V. C., & Gupta, V. K. (2017). KAP study of bio-medical waste management among health care workers in Delhi. Int J Community Med Public Health, 4(9), 3332.

The Punjab Hospital Waste Management Rules, 2014. Punjab Gazette. http://www.epd.punjab.gov.pk/system/files/PHWM%20Rules%202014.pdf

Yang, T., Du, Y., Sun, M., Meng, J., & Li, Y. (2024). Risk management for whole-process safe disposal of medical waste: progress and challenges. Risk Management and Healthcare Policy, 1503-1522.