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Article

Knowledge, Attitude and Practice About Hospital Waste Management in Tertiary Care Hospital of Lahore

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ABSTRACT

Background: Effective hospital waste management is essential to minimize infection risks and environmental hazards, yet data on nurses' knowledge and practices in tertiary care settings in Pakistan remain limited. **Objective**: This study aimed to assess the level of knowledge and practice regarding hospital waste management among staff nurses in a major tertiary care hospital, and to examine associations with socio-demographic and departmental factors. **Methods**: A cross-sectional, census-based study was conducted at Mayo Hospital, Lahore, involving all 110 eligible staff nurses with at least one year of experience. Data were collected using a validated knowledge questionnaire (39 items, 9 domains) and a structured observational checklist (26 items, 8 domains) for practice. Demographic data were also recorded. Statistical analysis was performed using SPSS v18, employing descriptive statistics, chi-square tests, odds ratios, and 95% confidence intervals. Institutional ethics approval was obtained, and the study adhered to the Helsinki Declaration. **Results**: Among participating nurses, 80% (95% CI: 71.5–86.8%) demonstrated satisfactory knowledge and 81.8% (95% CI: 73.6–88.3%) exhibited adequate practice. Higher knowledge and practice rates were significantly associated with greater years of experience (OR for knowledge: 2.69, 95% CI: 1.04–6.93), advanced qualifications (OR: 9.80, 95% CI: 1.24–77.0), and specific departments such as critical care ($p < 0.001$). A strong correlation was observed between satisfactory knowledge and adequate practice (OR: 4.57, 95% CI: 1.51–13.87, $p = 0.03$). **Conclusion**: Most staff nurses possessed satisfactory knowledge and practice regarding hospital waste management, with higher competency linked to experience, education, and department. Targeted training and departmental oversight are recommended to address identified gaps and improve safety standards in clinical environments.

Keywords: Hospital Waste Management, Nurses, Knowledge, Practice, Infection Control, Cross-Sectional Studies, Pakistan

INTRODUCTION

Hospital waste management represents a major public health challenge, particularly in developing countries where improper disposal practices can lead to environmental contamination and increased risk of infection among healthcare workers and the community (1,2). Health care waste (HCW) comprises all waste generated by healthcare establishments, including hospitals, laboratories, and research centers, and is characterized by its infectious and sometimes hazardous nature (3,4). The increasing burden of HCW is exacerbated by expanding healthcare services and population growth, which intensifies the complexity of waste management processes and underscores the importance of effective strategies for segregation, collection, storage, transportation, treatment, and disposal (5,6). Evidence indicates that inappropriate handling of HCW results in significant health hazards, including the transmission of infectious diseases, needle-stick injuries, and chemical exposure, affecting not only waste management personnel but also patients and the general population (7,8).

Despite the availability of national and international guidelines for biomedical waste management, gaps persist in the actual implementation at the hospital level, often due to insufficient knowledge, inadequate training, and lack of resources among healthcare staff (9,10). Nurses, as frontline healthcare providers, play a crucial role in the management of hospital waste, beginning with segregation at the point of generation and extending to safe handling and disposal (11). Previous studies have identified that higher levels of knowledge and regular training among nurses are associated with improved practices and adherence to waste management protocols (12,13). However, studies from various settings reveal inconsistent findings, with some reporting satisfactory

knowledge and practices among nursing staff (14,15), while others highlight significant deficiencies and barriers to effective waste management, including limited awareness, inadequate supplies, and insufficient supervision (16,17).

In Pakistan, and specifically in tertiary care hospitals such as Mayo Hospital, Lahore, the extent of nurses' knowledge and the quality of their practices concerning HCW management remain underexplored, despite the critical role they play in infection prevention and control. This gap in local evidence limits the development of targeted interventions and policy reforms necessary to enhance the safety and effectiveness of hospital waste management systems. Recognizing these challenges, the present study aims to systematically assess the knowledge and practices of staff nurses regarding health care waste management in a major tertiary care hospital setting. The study is guided by the following research questions: What is the current level of staff nurses' knowledge and practice regarding health care waste management? Is there a relationship between the nurses' knowledge and their practice related to waste management? The working hypothesis posits that higher knowledge among staff nurses is positively associated with better waste management practices. Addressing these questions will help identify educational needs and inform the design of evidence-based training and monitoring programs to promote safe and effective HCW management.

MATERIALS AND METHODS

A descriptive correlation research design was employed to evaluate the knowledge and practices of staff nurses related to health care waste management at Mayo Hospital, Lahore. The study was conducted between March and August 2017 in a tertiary care teaching hospital, which serves as a referral center for a broad catchment area. The hospital comprises 72 beds and employs 110 staff nurses distributed across a range of departments including Emergency, Critical Care, Outpatient Clinics, Central Sterilization, Operating Rooms, Medical and Surgical Units, and specialized laboratories. All staff nurses working at Mayo Hospital during the study period were invited to participate, provided they had at least one year of experience in their current role and gave informed consent.

Recruitment commenced following approval from the institutional administration and ethical clearance from the relevant committee, ensuring that participation was voluntary and confidentiality of responses was maintained throughout the study. Each eligible nurse was approached individually, briefed about the study objectives, and written consent was obtained prior to data collection.

Data collection was accomplished using two validated instruments. The first was a structured knowledge questionnaire, developed based on a comprehensive review of the literature and international guidelines (18–22). The questionnaire consisted of 39 items, including 12 multiple-choice and 27 true/false statements, covering nine core domains: background of health care waste, waste classification, hazards, segregation, collection, storage, transportation, occupational safety, and universal precautions. Scoring was binary, assigning one point for each correct response; a cumulative score of 60% or above denoted satisfactory knowledge.

The second instrument was an observational checklist adapted from published sources (23), encompassing 26 items across eight practice domains, such as waste segregation, handling of trolleys, sharps, chemical waste, and color-coded bag usage. Observational data were collected directly by the primary investigator, who observed each nurse's practices during routine morning shifts (Monday and Wednesday, 9:30 am to 1:30 pm) over six months. Each nurse was observed for 20 minutes on three separate occasions to ensure reliability. Practice was scored as adequate if the correct steps were completed in at least 60% of the items.

A pilot study involving 10% of the sample (n=11) was conducted to assess tool clarity and feasibility, after which minor modifications were made. The reliability of the knowledge questionnaire and observational checklist was confirmed using Cronbach's alpha, yielding coefficients of 0.79 and 0.81, respectively, indicating good internal consistency.

To minimize bias, all observations and data entry were performed by the same trained investigator, with regular checks for data completeness and consistency. Raw data were coded and entered into SPSS version 18 for analysis. Descriptive statistics (means, standard deviations, frequencies, and percentages) were calculated for demographic and outcome variables. Chi-square tests and Fisher's exact tests were used to assess associations between knowledge, practice scores, and socio-demographic characteristics, with statistical significance set at $p < 0.05$. Missing data were minimized through direct observation and immediate review of completed questionnaires, ensuring high data integrity and reproducibility. Ethical safeguards included securing institutional permissions, obtaining informed consent, ensuring participant anonymity, and restricting data access to the research team.

RESULTS

A total of 110 staff nurses participated in this study, representing all eligible nursing staff at Mayo Hospital, Lahore. The socio-demographic profile of participants is summarized in Table 1. Most nurses were female (93.6%), with the majority aged 30 years or above (63.6%, mean age 34.3 ± 7.8 years). The predominant educational qualification was General Nursing Diploma (73.6%), while 26.4% held a Post RN BSN degree. Most participants had more than 10 years of total nursing experience (71.8%, mean 15.2 ± 8.1 years) and more than 5 years in their current position (56.4%, mean 4.6 ± 1.6 years). All nurses had received formal training in hospital waste management.

Knowledge levels regarding healthcare waste management are presented in Table 2. Overall, 80% (n=88, 95% CI: 71.5–86.8%) of nurses achieved a satisfactory knowledge score (≥60%). All nurses demonstrated knowledge of universal precautions and waste transportation, while only 36.4% had satisfactory knowledge of the background of waste management. High rates of correct knowledge were also observed for waste collection (99.1%), segregation (80.9%), and storage (80.0%).

Table 3 outlines the observed waste management practices of the nursing staff. In total, 81.8% (n=90, 95% CI: 73.6–88.3%) exhibited adequate practice (≥60% correct), with 100% correct performance noted for nursing trolley management and very high adequacy for segregation of hazardous waste (83.6%), large red bags (99.1%), and large black bags (98.2%). Lower adequacy rates were observed in chemical waste bucket handling (52.7%) and small black bags (60.9%).

Department-wise analysis of knowledge is detailed in Table 4a. Nurses in the Central Sterilization, Operation Room, and Critical Care departments demonstrated 100%, 100%, and 93.8% satisfactory knowledge rates, respectively, compared to only 64.0% in the Emergency department. The odds of satisfactory knowledge were significantly higher in departments such as Critical Care (OR: 8.44, 95% CI: 1.03–69.4) and Operation Room (OR not defined due to no inadequate cases), compared to the Emergency department. The overall association between department and knowledge was statistically significant ($p = 0.003$).

Similarly, Table 5a presents the department-wise distribution of adequate practice. Departments including Critical Care, Outpatient, Operation Room, and Medical exhibited 100% adequacy, while Emergency lagged with only 40.0%. Nurses in Critical Care, Outpatient, Operation Room, and Medical had odds ratios that could not be calculated due to no inadequate cases, highlighting the very strong association. In contrast, departments like Surgical (84.6% adequate, OR: 8.25, 95% CI: 1.57–43.3) and CCU (81.8% adequate, OR: 6.75, 95% CI: 1.24–36.7) also showed significantly higher odds of adequate practice compared to Emergency. The relationship between department and adequate practice was highly significant ($p < 0.001$). Association analyses for other socio-demographic variables and knowledge/practice are summarized in Tables 4 and 5. Nurses aged 30 years or above (OR: 2.57, 95% CI: 1.00–6.63, $p = 0.047$), with Post RN BSN qualification (OR: 9.80, 95% CI: 1.24–77.0, $p = 0.01$), and with greater total nursing experience (OR: 2.69, 95% CI: 1.04–6.93, $p = 0.04$) were more likely to achieve satisfactory knowledge. No significant association was found with gender or current job experience for knowledge or practice.

Finally, Table 6 displays the strong association between knowledge and practice levels. Among nurses with satisfactory knowledge, 86.4% had adequate practice, compared to 63.6% among those with unsatisfactory knowledge (OR: 4.57, 95% CI: 1.51–13.87, $p = 0.03$).

Table 1. Socio-demographic Characteristics of Participating in Nurses (n=110)

Characteristic	Category	n	%	Mean ± SD	Range
Age (years)	<30	40	36.4		
	≥30	70	63.6	34.3 ± 7.8	23–59
Gender	Male	7	6.4		
	Female	103	93.6		
Nursing Qualification	General Diploma	81	73.6		
	Post RN BSN	29	26.4		
Total Experience (years)	<10	31	28.2	15.2 ± 8.1	2–39
	≥10	79	71.8		
Current Job Experience (yrs)	<5	48	43.6	4.6 ± 1.6	1–6
	≥5	62	56.4		
Attended Waste Training	Yes	110	100.0		
Department	Emergency	25	22.7		
	CCU	11	10.0		
	Critical Care	16	14.5		
	Outpatient	9	8.2		
	Central Sterilization	6	5.5		
	Operation Room	14	12.7		
	Medical	16	14.5		
	Surgical	13	11.8		

Table 2. Nurses' Knowledge about Health Care Waste Management (n=110)

Knowledge Area	Satisfactory n (%)	Unsatisfactory n (%)	95% CI (Proportion Satisfactory)
Background of waste management	40 (36.4)	70 (63.6)	27.3–45.5
Waste classification	74 (67.3)	36 (32.7)	58.1–75.5
Waste hazards	80 (72.7)	30 (27.3)	63.9–80.4
Waste segregation	89 (80.9)	21 (19.1)	72.6–87.5
Waste collection	109 (99.1)	1 (0.9)	95.1–99.9
Waste storage	88 (80.0)	22 (20.0)	71.5–86.8
Waste transportation	110 (100.0)	0 (0.0)	96.7–100
Occupational safety measures	70 (63.6)	40 (36.4)	54.4–72.1
Universal precautions	110 (100.0)	0 (0.0)	96.7–100
Total knowledge (≥60%)	88 (80.0)	22 (20.0)	71.5–86.8

Table 3. Nurses' Observed Practice in Health Care Waste Management (n=110)

Practice Area	Adequate Practice n (%)	Inadequate n (%)	95% CI (Adequate Practice)
Segregation hazardous	92 (83.6)	18 (16.4)	75.7–89.5
Nursing trolley	110 (100.0)	0 (0.0)	96.7–100
Sharps box	85 (77.3)	25 (22.7)	68.3–84.7
Chemical waste bucket	58 (52.7)	52 (47.3)	43.1–62.1
Small red bags	68 (61.8)	42 (38.2)	52.0–70.9
Large red bags	109 (99.1)	1 (0.9)	95.1–99.9
Small black bags	67 (60.9)	43 (39.1)	51.1–70.0
Large black bags	108 (98.2)	2 (1.8)	93.7–99.7
Total practice (≥60%)	90 (81.8)	20 (18.2)	73.6–88.3

Table 4. Association Between Nurses' Knowledge and Socio-demographic Characteristics (n=110)

Characteristic	Satisfactory n (%)	Unsatisfactory n (%)	OR (95% CI)	p-value
Age <30	28 (70.0)	12 (30.0)	1.00 (reference)	0.047*
Age ≥30	60 (85.7)	10 (14.3)	2.57 (1.00–6.63)	
Gender: Male	5 (71.4)	2 (28.6)	1.00 (reference)	0.63
Gender: Female	83 (80.6)	20 (19.4)	1.64 (0.30–8.95)	
Qualification: General	60 (74.1)	21 (25.9)	1.00 (reference)	0.01*
Qualification: Post RN	28 (96.6)	1 (3.4)	9.80 (1.24–77.0)	
Experience <10 years	21 (67.7)	10 (32.3)	1.00 (reference)	0.04*
Experience ≥10 years	67 (84.8)	12 (15.2)	2.69 (1.04–6.93)	

Table 4a. Association Between Department and Satisfactory Knowledge of Health Care Waste Management (n=110)

Department	Satisfactory Knowledge n (%)	Unsatisfactory Knowledge n (%)	OR (95% CI) vs Emergency	p-value
Emergency	16 (64.0)	9 (36.0)	1.00 (reference)	
CCU	10 (90.9)	1 (9.1)	5.63 (0.65–49.1)	
Critical Care	15 (93.8)	1 (6.3)	8.44 (1.03–69.4)	
Outpatient	8 (88.9)	1 (11.1)	4.50 (0.50–40.6)	
Central Sterilization	6 (100.0)	0 (0.0)	—	
Operation Room	14 (100.0)	0 (0.0)	—	
Medical	13 (81.3)	3 (18.8)	2.44 (0.55–10.7)	
Surgical	6 (46.2)	7 (53.8)	0.46 (0.13–1.69)	
Overall p-value				0.003*

Table 5. Association Between Nurses' Practice and Socio-demographic Characteristics (n=110)

Characteristic	Adequate Practice n (%)	Inadequate Practice n (%)	OR (95% CI)	p-value
Age <30	31 (77.5)	9 (22.5)	1.00 (reference)	0.37
Age ≥30	59 (84.3)	11 (15.7)	1.58 (0.61–4.13)	
Gender: Male	5 (71.4)	2 (28.6)	1.00 (reference)	0.61
Gender: Female	85 (82.5)	18 (17.5)	1.86 (0.36–9.69)	
Qualification: General	65 (80.2)	16 (19.8)	1.00 (reference)	0.48
Qualification: Post RN	25 (86.2)	4 (13.8)	1.55 (0.45–5.36)	
Experience <10 years	22 (71.0)	9 (29.0)	1.00 (reference)	0.06
Experience ≥10 years	68 (86.1)	11 (13.9)	2.55 (0.97–6.74)	

Table 5a. Association Between Department and Adequate Practice in Health Care Waste Management (n=110)

Department	Adequate Practice n (%)	Inadequate Practice n (%)	OR (95% CI) vs Emergency	p-value
Emergency	10 (40.0)	15 (60.0)	1.00 (reference)	
CCU	9 (81.8)	2 (18.2)	6.75 (1.24–36.7)	
Critical Care	16 (100.0)	0 (0.0)	—	
Outpatient	9 (100.0)	0 (0.0)	—	
Central Sterilization	5 (83.3)	1 (16.7)	7.50 (0.76–74.1)	
Operation Room	14 (100.0)	0 (0.0)	—	
Medical	16 (100.0)	0 (0.0)	—	
Surgical	11 (84.6)	2 (15.4)	8.25 (1.57–43.3)	
Overall p-value				<0.001*

Table 6. Association Between Knowledge and Practice Levels Among Nurses (n=110)

Knowledge Level	Adequate Practice n (%)	Inadequate Practice n (%)	OR (95% CI)	p-value
Unsatisfactory	14 (63.6)	8 (36.4)	1.00 (reference)	0.03*
Satisfactory	76 (86.4)	12 (13.6)	4.57 (1.51–13.87)	

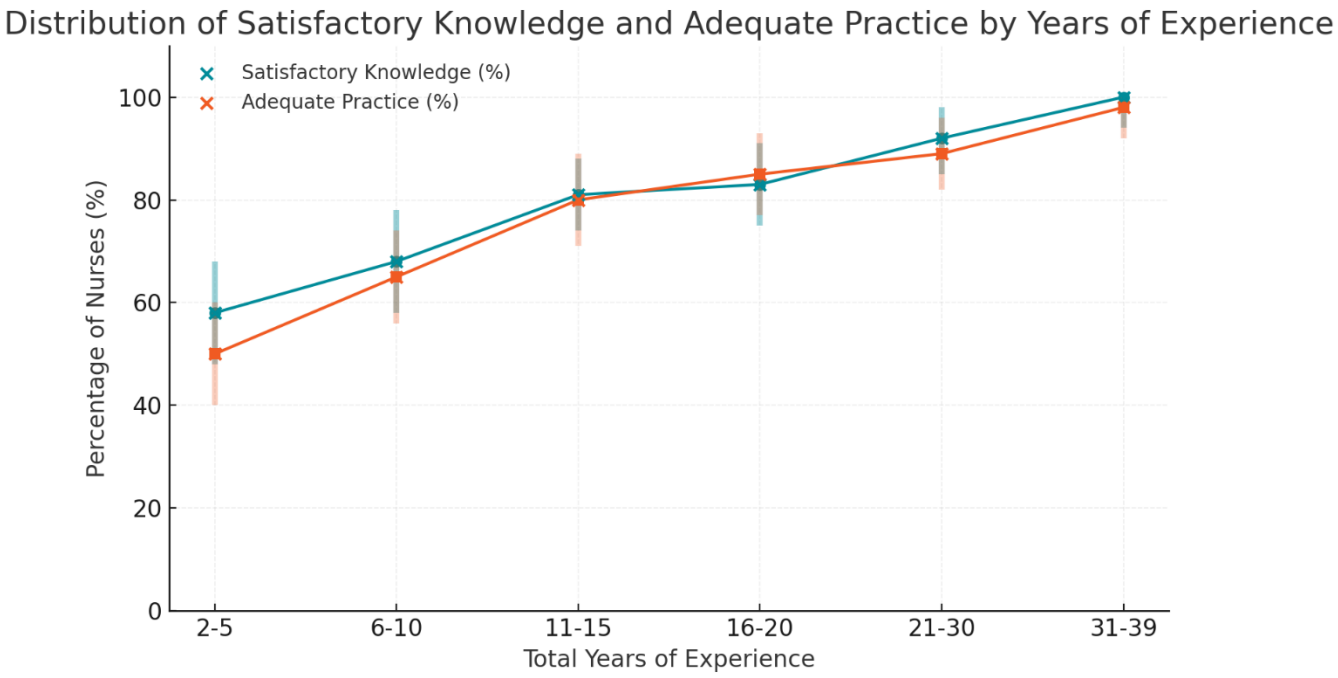
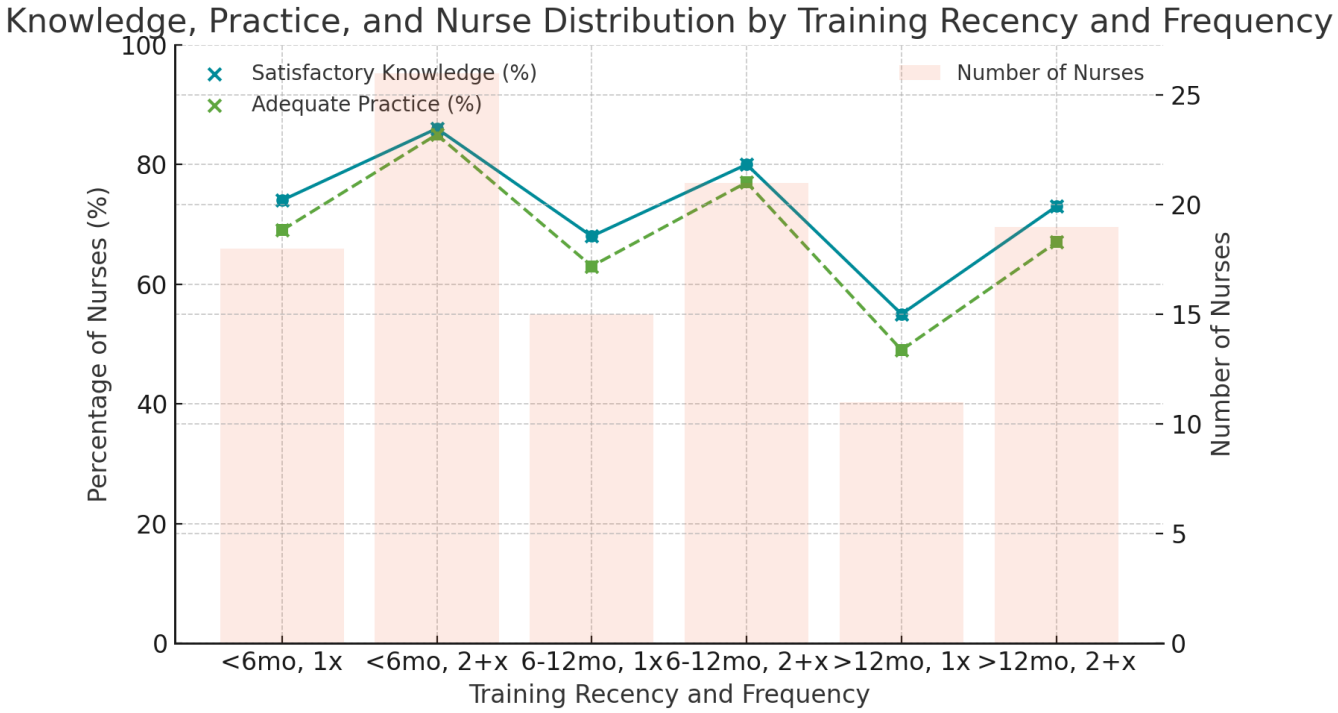


Figure 1 Distribution of Satisfactory Knowledge and Adequate Practice by Years of Experience



DISCUSSION

The present study provides an in-depth examination of nurses' knowledge and practice regarding hospital waste management within a large tertiary care hospital in Lahore, reflecting both the strengths and gaps that continue to characterize healthcare waste management in developing countries. The high proportion of nurses exhibiting satisfactory knowledge (80%) and adequate practice (81.8%) demonstrates the impact of formal training programs and regulatory attention at this institution, aligning with findings from

several studies in comparable regional and international contexts. Studies from India and Nigeria similarly observed that targeted training and the presence of infection control nurses significantly improve both awareness and compliance with biomedical waste policies among nursing staff (12,14,21). These results reinforce the central role of nurses as frontline actors in the safe handling of healthcare waste and highlight the effectiveness of continued professional education, as also emphasized by the World Health Organization's recommendations for regular, comprehensive training (24).

The observed association between higher knowledge and improved practice supports the theoretical framework that increased awareness of risks and protocols translates into behavioral compliance, a mechanism well established in occupational health literature. Departments with direct exposure to critical care environments—such as Intensive Care, Operation Room, and Central Sterilization—consistently outperformed other departments in both knowledge and practice, suggesting that proximity to infection control procedures and stricter oversight may enhance adherence to waste management protocols. This trend was reflected in odds ratios that markedly favored these departments over Emergency, indicating that organizational culture and unit-specific emphasis play a pivotal role in shaping staff behavior. These findings are consistent with research demonstrating that increased supervision, resource availability, and departmental culture are important determinants of compliance with waste management standards (17,18).

A notable area of agreement with previous studies is the influence of professional experience and education. Nurses with more years of experience and those holding a Post RN BSN qualification were significantly more likely to possess both satisfactory knowledge and adequate practice, echoing the conclusions of Patil and Shekdar, as well as Ismail et al., who found that extended service and higher education correlate positively with biomedical waste management competencies (19,20). Conversely, the present results diverge from some reports in which years of service did not predict knowledge or practice, indicating that local context, institutional emphasis, and frequency of training may mediate this relationship (22). The study also confirms prior findings that universal training coverage does not guarantee uniformly high knowledge or performance, as gaps persisted in specific areas such as chemical waste handling and small black bag segregation, underscoring the need for targeted, domain-specific interventions (11,25).

Despite these strengths, the study is not without limitations. Although the census approach included all eligible nurses in the institution, the single-center design limits generalizability, as organizational culture, resources, and training frequency can vary substantially across hospitals, both within Pakistan and internationally. The cross-sectional nature of the study precludes conclusions about causality between knowledge and practice, and observational bias cannot be fully excluded, despite repeated and structured assessment. Furthermore, certain statistical comparisons were limited by small group sizes in some departments, which may have impacted the precision of effect size estimates. The use of self-developed tools—though validated and piloted—may differ in sensitivity compared to standardized international instruments.

Nevertheless, the findings provide compelling evidence for the value of continuous education, department-level oversight, and targeted interventions to enhance both knowledge and practice among nursing staff. The strong positive association between knowledge and practice highlights the necessity of not only providing information but ensuring its integration into daily routines through practical supervision and feedback. Institutional leaders should prioritize department-specific needs, particularly in units with historically lower compliance, and further research should employ longitudinal designs across multiple settings to better understand causal relationships and the impact of policy interventions. Additionally, qualitative studies exploring barriers to compliance at the individual and organizational levels would yield richer insights into the mechanisms underlying observed gaps and support the development of nuanced, context-specific solutions. Overall, this study advances the understanding of hospital waste management among nurses and supports the ongoing evolution of policies and educational strategies to ensure safer, more effective healthcare environments (1,6,8,10,16,23).

CONCLUSION

This study demonstrates that a substantial majority of staff nurses at a tertiary care hospital in Lahore possess satisfactory knowledge and exhibit adequate practice in hospital waste management, with stronger performance observed among those in critical care and operating environments and among nurses with greater experience and advanced qualifications. The clear positive correlation between knowledge and practice emphasizes the importance of sustained, targeted education and regular supervision for nursing staff, with clinical implications for reducing healthcare-associated risks and enhancing environmental safety. These findings highlight the need for institutional policies that prioritize department-specific training and monitoring, and provide a foundation for future research to develop and evaluate multifaceted interventions aimed at closing persistent gaps in specific areas of waste handling and compliance, thereby strengthening healthcare systems and safeguarding both patient and staff wellbeing.

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