Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 30s (2025)
https://www.jneonatalsurg.com
OPEN ACCESS

Healthcare Workers' Knowledge, Practices, and Involvement in Hospital Waste Management in Rupandehi, Nepal

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Cite this paper as: Chham Bahadur Adhikari, Monalisa Roy, Krishna Adhikari, Hom Prasad Adhikari, Ramendra Raman, Dikshya Timilsena, (2025) Healthcare Workers' Knowledge, Practices, and Involvement in Hospital Waste Management in Rupandehi, Nepal. *Journal of Neonatal Surgery*, 14 (30s), 1155-1161.

ABSTRACT

Healthcare waste management remains a major challenge in low and middle-income countries, where rapid urbanization, limited infrastructure, and weak enforcement hinder safe disposal practices. This study assessed knowledge, practices, and involvement of healthcare workers in hospital waste management at Rupandehi District Hospital, Nepal. A cross-sectional design was used, with data collected from 60 healthcare workers who were likely exposed to healthcare waste through a structured questionnaire covering knowledge, practices, and involvement. Descriptive and statistical analyses were performed to interpret the responses. The results showed that healthcare workers had a high level of knowledge, with a mean score of 4.67 out of 5 (93.4% accuracy). However, the practice score was somewhat lower at 4.05 out of 5 (81%), while involvement was the weakest area, with a mean score of 8.62 out of 14 (61.6%). This gap highlights a persistent disconnect between knowledge and its consistent application in daily hospital activities. The study emphasizes the urgent need for targeted interventions such as ongoing refresher training, providing protective gear, implementing monitoring systems, and establishing supportive policies to enhance HCWs' active participation in HCWM. These measures are vital to reduce occupational hazards, limit community exposure, and protect environmental health.

Keywords: *healthcare workers, knowledge–practice gap, hospital waste, waste segregation, occupational health*

1. INTRODUCTION

Healthcare waste (HCW) encompasses all forms of waste generated during the delivery of medical services, including diagnostic, therapeutic, and immunization activities. Such waste, particularly hazardous categories such as infectious, chemical, and radioactive waste, poses substantial risks to human health, the environment, and the economy when improperly managed. Unsafe disposal practices contribute to soil, water, and air contamination, facilitating the spread of infectious diseases and endangering not only patients and healthcare workers but also surrounding communities. With growing urbanization, increasing patient load, and advances in medical technologies, hospitals in developing countries are experiencing a rapid surge in waste generation, rendering their safe management an urgent public health priority (Karki et al., 2020).

In low- and middle-income countries, healthcare waste management (HCWM) systems are often poorly implemented due to limited resources, inadequate infrastructure, and insufficient training of healthcare personnel(Quttainah& Singh, 2024). Medical waste is frequently discarded in open landfills, burned in uncontrolled pits, or scavenged by marginalized populations, thereby amplifying exposure to toxic substances and pathogenic organisms. Nepal is no exception; despite policy frameworks, hospital waste management remains inconsistent and under-regulated. While studies conducted in the

Kathmandu Valley highlight gaps in segregation, disposal, and compliance with biomedical waste protocols(Karki et al., 2020), there is a lack of knowledge about practices in peripheral districts outside the Kathmandu Valley (Patel et al., 2024), where healthcare facilities continue to face logistical and institutional challenges. This knowledge gap underscores the need for localized assessments to understand better healthcare workers' (HCWs) awareness, practices, and involvement in waste management systems.

The central problem addressed in this study lies in the inadequate knowledge and inconsistent practices of HCWs regarding hospital waste management in Rupandehi district, which heightens risks of occupational hazards, community exposure, and environmental degradation. Evidence from other regions suggests that HCWs' knowledge and adherence to waste management protocols directly influence the effectiveness of hospital waste systems. However, in Rupandehi, where rapid urban expansion has intensified the demand for healthcare services, empirical evidence on HCWs' involvement in HCWM is nearly absent. Without such evidence, strategies to strengthen safe and sustainable waste management remain fragmented.

The present study aims to assess the knowledge, practices, and involvement of healthcare workers in hospital waste management in selected hospitals of Rupandehi district, Nepal. Specifically, the objectives are to evaluate healthcare workers' (HCWs') understanding of waste management protocols, to examine their level of involvement in waste handling and disposal practices, and to explore the associations between socio-demographic or institutional factors and HCWM practices. By doing so, this study seeks to generate evidence that can inform policymakers, hospital administrators, and local authorities in designing targeted interventions to strengthen HCWM systems and ensure compliance with national and international standards.

Existing literature reinforces the urgency of inquiry into the need for proper disposal of healthcare waste. The World Health Organization underscores that 10% to 20% of hospital waste is hazardous, with inappropriate handling leading to risks such as needle-stick injuries, blood-borne infections, and long-term environmental pollution(WHO, 2016). Studies from Nepal's urban hospitals report moderate knowledge but inconsistent practices among healthcare staff, often attributed to inadequate infrastructure and weak monitoring mechanisms. Research from neighboring countries similarly highlights a gap between awareness and practice, where even trained staff fail to adhere to segregation and safe disposal guidelines due to a lack of institutional enforcement. However, no prior study has systematically investigated the knowledge, practices, and involvement of HCWs in Rupandehi district, leaving a significant void in both scholarship and practice.

By situating HCWs at the center of inquiry, this study addresses a critical gap in Nepal's public health system. It emphasizes that effective waste management is not solely a technical challenge but also a behavioral and organizational one, dependent on the awareness, engagement, and accountability of healthcare providers. The findings are expected to contribute to evidence-based recommendations for strengthening HCWM in provincial hospitals, thereby safeguarding healthcare workers, communities, and the environment alike.

2. LITERATURE REVIEW

Healthcare waste management (HCWM) is a public-health and environmental priority in low- and middle-income settings, where rapid service expansion and resource constraints heighten risks to workers, patients, and communities (Karki et al., 2020). The World Health Organization estimates that roughly **15–25%** of healthcare waste is hazardous infectious, chemical, pharmaceutical, radioactive dedicated controls to prevent percutaneous injuries, transmission of blood-borne pathogens, and environmental contamination(WHO, 2016; Janik-Karpinska et al., 2023). In Nepal, national guidance has long recognized these risks: the Government of Nepal, Ministry of Health and Population (2020) sets out categorization, segregation, collection, transport, treatment, and disposal procedures; this was operationalized and updated through the **National Health Care Waste Management Standards & Operating Procedures (SOP)-2020**, which emphasize safer, non-burn options where feasible (NHRC, 2002). Still, implementation remains uneven. Case-study evidence notes **poor compliance** with guidelines, continued reliance on **open burning, burial, or rudimentary incineration** without adequate air-pollution control, and slow uptake of non-incineration technologies despite policy endorsement (IGES, 2021).

Hospitals are the principal sources of HCW, and growing patient volumes have increased waste loads. While global averages often cite nearly 2.5 kg/bed/day with approximately 20% infectious, Nepal-specific assessments report **approximately 1 to 1.7 kg/bed/day** in hospitals and health centers, with 55–75% being general (non-hazardous) waste-figures that underscore the centrality of **segregation at source** to avoid "infectious-by-mixing" effects (Health Care Without Harm, 2024). Because HCWM is an operational system as much as a technical one, effective programs depend on routine **segregation, labeled containers, protected internal transport, appropriate treatment/disposal, and periodic audits**, all under institutional oversight (Karki et al., 2020).

The role of **healthcare workers (HCWs)** is pivotal across this chain (generation, segregation, handling, and disposal), and their knowledge, motivation, and supervision are consistently associated with safer practices (Karki et al., 2020). Recent studies in Nepal and the region report mixed KAP (knowledge–attitude–practice) profiles: for example, provincial analyses in **Madhesh Province** (10 district hospitals) found gaps in **adherence** among waste handlers despite awareness of guidelines, highlighting needs for refresher training, protective equipment, and monitoring (Patel et al., 2024). Complementary studies

from South Asia similarly document **knowledge/attitude strengths but practice shortfalls** among nurses and other cadres, often attributable to missing bins at point-of-generation, inconsistent supervision, or weak enforcement patterns, echoed in prior Nepal reports and case studies(Nath et al., 2024).

At the system level, Nepal's waste-management discourse has evolved in response to emerging streams (e.g., vaccine-related sharps) and climate/air-quality concerns, and during the COVID-19 campaign in the Kathmandu Valley, partners piloted non-burn sharps management models for vaccination waste, demonstrating operational feasibility and providing a template for scaling up under the 2020 SOP(Unicef, 2022). Nonetheless, literature repeatedly identifies **implementation bottlenecks**: limited budgets for safe transport and treatment, insufficient PPE, the absence of routine **waste audits**, and weak data systems for tracking quantities and fates of different waste categories (Karki et al., 2020).

In summary, the global evidence and Nepal's normative framework converge on the same prescription**: source segregation, safe handling, non-burn treatment where feasible, and continuous training/monitoring,** but the **practice gap** persists, especially outside major urban centers (Karki et al., 2020). This gap is underscored by recent provincial studies and implementation reviews, as well as Nepal-specific generation rates that make efficient segregation and logistics non-negotiable priorities(Health Care Without Harm, 2024). These insights justify a focused assessment of healthcare workers' (HCWs') knowledge, practices, and involvement in districts such as **Rupandehi**, where evidence remains sparse and institutional constraints may differ from those in Kathmandu-based facilities (Karki et al., 2020).

3. METHODOLOGY

This study employed a cross-sectional research design and was conducted at the District Hospital of Rupandehi, Nepal. The target population consisted of healthcare workers (HCWs) across various departments, with a purposive sampling technique used to recruit participants. A total of 60 HCWs were included, following explicit inclusion criteria (those present during data collection and willing to participate), and exclusion criteria were applied to absent staff. Informed consent was obtained from all participants, and ethical considerations were upheld in alignment with established guidelines. The research tools were validated by a panel of experts, comprising three specialists in healthcare management and two language experts, including those proficient in English and Nepali.

Data collection was structured into four sections: (a) demographic information (gender, professional role), (b) knowledge assessment with five yes/no items, (c) practice of waste segregation and color coding through eight yes/no items, and (d) involvement in waste collection, storage, and disposal schemes assessed through 14 yes/no items. Descriptive and statistical analyses were employed to interpret the results.

4. RESULTS

The gender composition reveals that a substantial majority of the respondents were female (73.33%), while male participants made up only 26.67% of the total sample (see Figure 1). This suggests that women are more prominently represented in the study population.

Regarding the professional background shown in Figure 2, the largest group of participants were nurses (53.33%), followed by paramedics (28.33%). In contrast, only a small percentage of respondents were doctors (10%) and pharmacists (8.33%). This distribution highlights the predominance of nursing professionals in the sample, while

Representation from medical doctors and pharmacists was relatively limited.

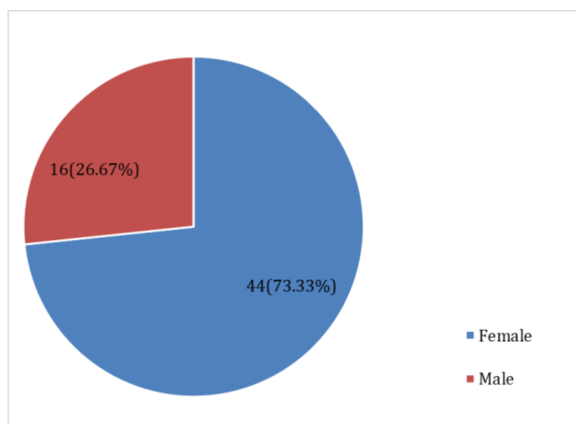


Figure 1: Gender distribution of Participants

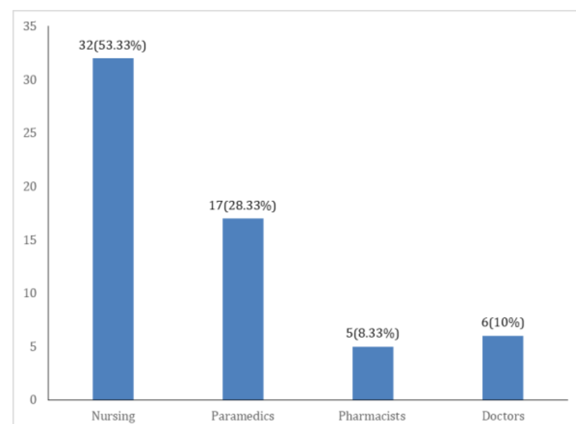


Figure 2: Distribution of Participants by Profession

The bar diagram in Figure 3 shows how healthcare workers responded to different questions about their knowledge of hospital waste management. The results reveal a high level of awareness among the respondents. Notably, all participants (100%) identified hospital waste as a potential source of infection, confirmed that they separate hazardous from non-hazardous waste, acknowledged that all healthcare workers share responsibility for waste management, and reported being familiar with healthcare waste categories. However, a misconception was found: two-thirds of respondents (66.7%) wrongly believed that all hospital waste is hazardous. In comparison, only one-third (33.3%) correctly understood that not all waste falls into this category. This indicates a common knowledge gap that needs more educational focus.

Based on the frequency distribution of responses, the overall knowledge score was calculated. The average score achieved was 4.67 out of 5, corresponding to a 93.4% accuracy rate. This high score indicates that the healthcare workers possess a commendable level of knowledge regarding hospital waste management, albeit with specific areas for improvement, particularly concerning the differentiation between hazardous and non-hazardous hospital waste.

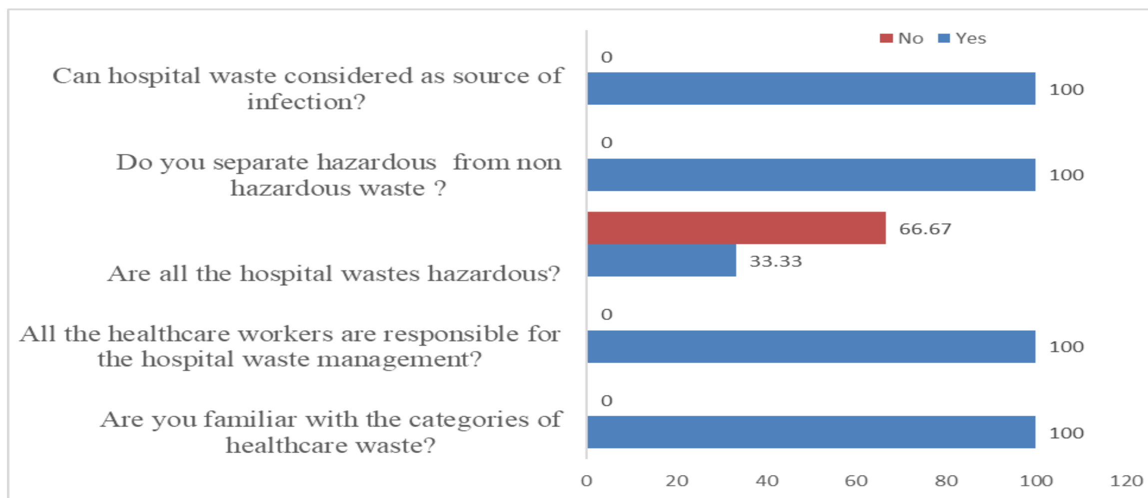


Figure 3: Knowledge of Respondents regarding healthcare waste management

The bar diagram in Figure 4 presents the responses of healthcare workers regarding their practices in hospital waste separation and the use of color-coding systems. The results highlight generally positive practices, though with some variation in adherence. A large majority (88.3%) agreed that color-coded bins should be equipped with lids, pedals, and bags, reflecting awareness of safe handling protocols. Similarly, three-quarters of respondents (75%) affirmed that separating hazardous from non-hazardous wastes facilitates safer management, and an equal proportion (75%) reported effective use of color coding in their settings. Importantly, all respondents (100%) acknowledged the necessity of using color-coding protocols for separating healthcare waste, emphasizing strong consensus on its vital role in waste management. However, a somewhat lower percentage (66.7%) reported that the segregation of hazardous and non-hazardous waste was effectively carried out in their institutions. In comparison, 33.3% indicated this was not the case, highlighting practical challenges in consistent implementation.

Based on the frequency distribution of responses, the average practice score was calculated as 4.05 out of 5, corresponding to 81%. This indicates overall good adherence to recommended waste segregation and color-coded disposal practices, albeit slightly lower than the knowledge score (93.4%). The findings suggest that while healthcare workers possess substantial knowledge, gaps remain in translating this knowledge into consistent and effective practice, particularly regarding the actual enforcement of segregation protocols.

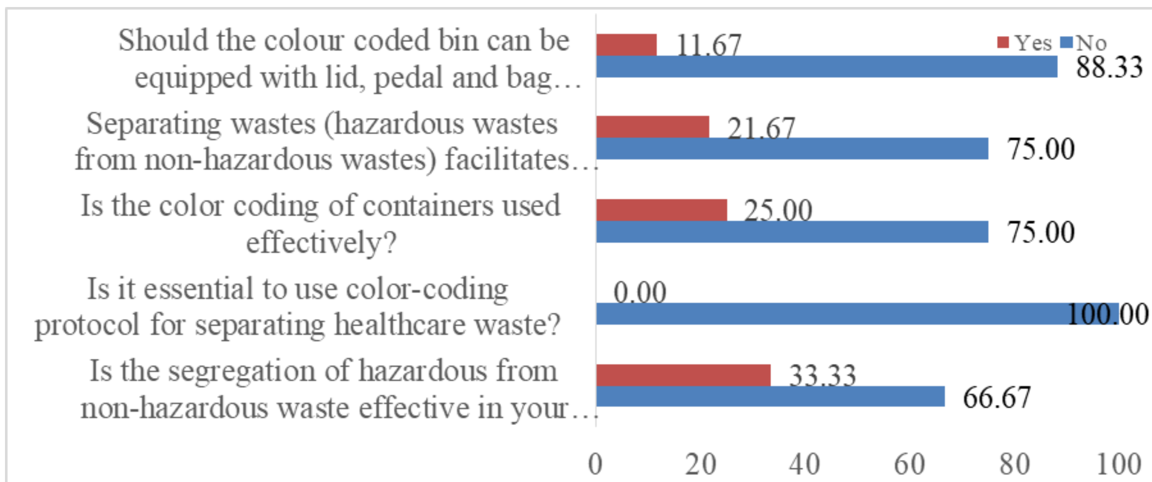


Figure 4: Response of Healthcare Practitioners for waste management practices in hospitals

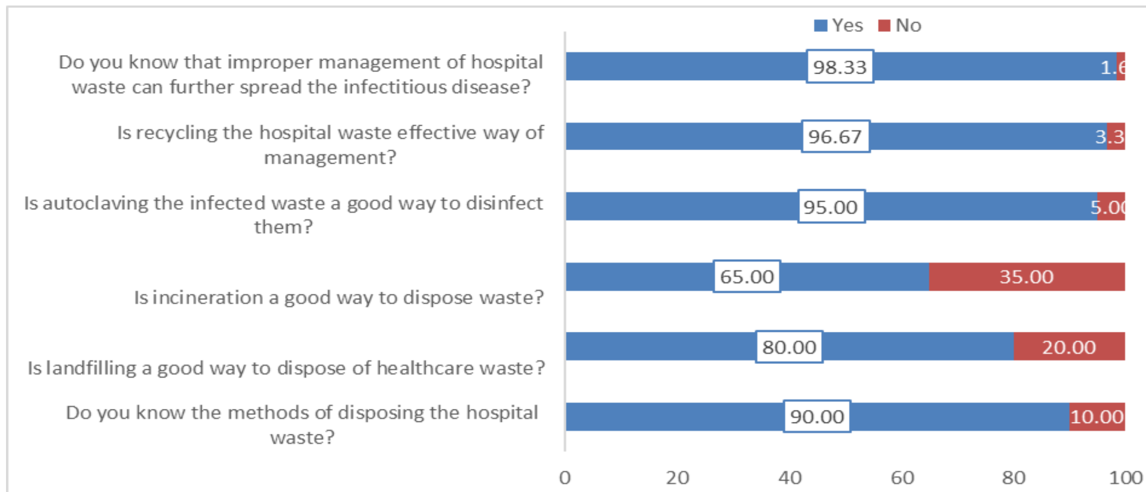
The bar diagram in Figure 4 illustrates the distribution of respondents' involvement in waste storage and collection practices within the hospital setting. The findings reveal considerable variability across different aspects of waste management. Only about one-third of participants (31.7%) reported having a separate space for storing collected waste, while the majority (68.3%) indicated its absence. Similarly, only 11.7% affirmed that infected waste is autoclaved prior to transportation for final disposal within 24 hours, reflecting a critical gap in adherence to safety protocols. With respect to staff protection, 86.7% acknowledged that workers involved in the collection and transfer of waste should be vaccinated against infectious diseases, and 80% emphasized the importance of equipping such workers with full protective gear, including gloves, boots, and scrubs. However, practical implementation appears weaker in other areas: less than half of respondents (43.3%) agreed that increasing the number of waste containers contributes effectively to control and maintenance, and only 30% reported the presence of a designated place for collecting waste in their workplace. On a positive note, all respondents (100%) recognized the necessity of collecting waste from different wards at least once daily, and 76.7% acknowledged the existence of a specific schedule for hospital waste collection.

When responses were aggregated, the level of involvement in waste storage and collection practices was found to be relatively low, with only 44.85% demonstrating a good level of involvement. This highlights a significant gap between knowledge of appropriate waste management procedures and their practical execution, particularly in areas of safe storage, timely treatment, and infrastructural provision for waste handling.

Figure 5: Response of Respondents on Involvement in the Waste Storage and Collection Scheme of Hospital Waste

The bar diagram in Figure 6 presents the responses of healthcare workers regarding their involvement in hospital waste disposal management. The distribution highlights both strengths and weaknesses in current practices. Only 31.7% of respondents reported having a separate space for storing collected waste, while the majority (68.3%) indicated its absence.

Similarly, just 11.7% confirmed that infected waste is autoclaved prior to transportation within 24 hours, suggesting gaps in compliance with standard safety protocols. On the other hand, certain protective and procedural aspects were more strongly endorsed. A large proportion of respondents (86.7%) agreed that staff engaged in waste collection and transfer should be vaccinated against infectious diseases, and 80% emphasized the need for workers to be fully equipped with protective clothing such as gloves, boots, and scrubs. Additionally, 70% indicated the presence of a designated place to collect waste, and 43.3% recognized the importance of increasing waste collection containers for effective management.



Findings show that the average involvement score was 8.62 out of 14 (61.55%), reflecting a moderate engagement level in tasks such as waste storage, collection, and disposal management.

5. DISCUSSION

The present study reveals that healthcare practitioners at Rupandehi district hospital display an exceptionally high level of knowledge about hospital waste management, with a mean knowledge score of 4.67 out of 5, which is 93.4% correct knowledge. However, this strong understanding does not seem to be fully mirrored in their everyday practices or in their active engagement in waste management procedures. The mean practice score is 4.05 out of 5, which is 81% good practice. In contrast, the involvement score is 8.62 out of 14, indicating 61.6% correct involvement in waste management, which shows a substantial drop-off from knowledge to practice and involvement, pointing to persistent implementation gaps.

These findings resonate closely with those from other studies in Nepal. Banstola et al. (2024)found that although many staff knew waste management, actual practices and institutional support (such as training, protective equipment, and vaccination) were much less consistent or universal. Similarly, Ghimire and Dhungana (2018)demonstrated that although waste generation rates and categorization (hazardous vs. non-hazardous) have been quantified, the handling practices, from segregation to storage and disposal, require significant improvement. This result is similar to the waste management study at the household level in Bharatpur conducted by Kafle et al. (2025), which found that although people have a high level of household waste management, their practice level is not as high as expected.

At the same time, some contrasts are evident. The magnitude of knowledge-practice gaps in prior studies is often even larger among certain cadres of staff (e.g., waste handlers, sweepers) than appears in this study, where practitioners are more directly involved in clinical work and may maintain somewhat higher practice levels. In the Madhesh Province study among waste-handlers conducted by Patel et al. (2024), the mean adherence to guidelines was around 75%, but knowledge was only moderate, and compliance was uneven. In contrast, current findings show very high knowledge, although involvement still lags considerably. Another difference lies in infrastructure and institutional support, as shown by Ghimire and Dhungana (2018) in the study in Bandipur Hospital. The findings of this study revealed inadequate physical infrastructure, including non-WHO color-coded bins, a lack of trolleys, and open dumping, as well as weak budgetary support for waste management, indicating low-level adherence to good practices. Such systemic obstacles may parallel those in Rupandehi, but they may be more severe in some hospitals.

6. CONCLUSION

These results highlight a small gap between knowledge and its practical application, but a critical gap is found between knowledge and involvement, underscoring the need for targeted interventions such as regular training, monitoring mechanisms, and motivation programs to strengthen compliance and active participation in hospital waste management. Taken together, this study contributes to the growing evidence that while strong knowledge among healthcare staff is

achievable in Nepal, translating that knowledge into consistently high practice and thorough involvement remains a continuing challenge. The comparative insights suggest that, in addition to knowledge, critical enablers include adequate training (especially refresher training), the availability of resources (bins, protective gear, color coding, and proper storage), strong institutional policies and supervision, and infrastructure for proper disposal and waste segregation. Enhancing these aspects is essential for promoting a safer hospital environment and effective waste handling practices.

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