Section: Miscellaneous

Original Research Article

ASSESSING THE EFFECTIVENESS AND CHALLENGES OF HEALTHCARE WASTE MANAGEMENT PRACTICES IN FEDERAL GOVERNMENT HOSPITALS OF NEPAL: A QUALITATIVE INVESTIGATION

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Received *: 09/09/2025*
Received in revised form *: 18/10/2025*
Accepted *: 05/11/2025*

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DOI: 10.70034/ijmedph.2025.4.231

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (4); 1290-1295

ABSTRACT

Background: This study aims to assess the effectiveness and challenges of healthcare waste management (HCWM) practices in federal government hospitals of Nepal, based on qualitative data collected from interviews and observations.

Materials and Methods: Seven federal government hospitals, one from each province, were selected to represent the healthcare system of Nepal. Data were collected through in-depth interviews with two top-level administrators from each hospital, for a total of fourteen (n=14) participants. These interviews explored their waste management practices, challenges, and solutions. Additionally, observational data were collected using a checklist that examined waste segregation, disposal practices, and overall waste management processes. The interview data were analyzed using content analysis to identify emerging themes, which were then compared with the observational findings.

Results: This study provides valuable insights into the current state of healthcare waste management practices and the challenges hospitals face, and offers recommendations for improving waste management systems at the federal level. Based on the findings of this study Bharatpur hospital has best waste management practice among the hospital studied.

Conclusion: For best hospital waste management in Nepal, hospital can follow the strategy and practices followed by Bharatpur hospital because this hospital found best waste management practices and has strategies for the future too.

Keywords: Hospital-based waste, effective waste management strategies.

INTRODUCTION

Healthcare waste management (HCWM) is a critical issue worldwide, particularly in low- and middle-income countries (LMICs), where the rapid growth of healthcare facilities, combined with inadequate infrastructure and limited resources, exacerbates these challenges.[1] Nepal, as a developing nation with limited healthcare resources, is no exception. Improper waste disposal in hospitals has led to environmental contamination and significant health risks, including the spread of infectious diseases among staff and patients. Moreover, the lack of effective systems for segregating and disposing of hospital waste remains a persistent challenge in Nepal, hindering waste management.[2]

While healthcare waste management practices have been studied in various regions, there is a limited amount of research specifically focusing on the federal hospitals of Nepal, which serve as the primary public healthcare providers in the country. Given that hospitals are the largest producers of hazardous waste, the effectiveness of their waste management systems has a direct impact on public health and environmental sustainability.[3,4] Therefore, understanding the effectiveness of these practices and

the challenges faced by hospital administrators is crucial for designing sustainable and safe waste management strategies.

The objective of this study is to evaluate the effectiveness of HCWM practices in federal hospitals in Nepal and to identify the challenges associated with these practices. This is particularly important, as Nepal's healthcare system is undergoing reforms, and understanding the current state of waste management will inform policy recommendations to improve these practices. Several studies have examined healthcare waste management in Nepal. However, a lack of comprehensive, qualitative research remains on how these practices are carried out in the country's federal hospitals.[5,6] Moreover, research that considers both the perspectives of hospital administrators and direct observational data is scarce, especially in Nepal's diverse healthcare settings. This study seeks to fill this gap by conducting a detailed investigation of HCWM practices and challenges across seven federal hospitals nationwide.

Previous studies were conducted based on selected hospitals in Nepal, focusing on resource capacity. Raji and Adeogun (2024),[7] examine HCWM in developing countries and find that poor provision of logistics (bins, PPE, autoclaves) and irregular training significantly impair safe waste management. While Ali et al. (2017)[8] note in a mini-review of hospital waste management in developing countries that "resource-constrained" institutions struggle with segregation, transport, and disposal due to limited infrastructure. Poudel et al. (2023)[9] studied selected hospitals in the Kailali district of Nepal and reported that although materials were often available, consistent supply and maintenance of equipment remained a problem. Research conducted outside of Nepal shows similar findings. Berihun et al. (2025)[10] conducted a systematic review across Sub-Saharan Africa, found that only ~50% of healthcare workers practiced good HCWM, citing a lack of training and guidelines as key resource issues. These findings from previous research indicate that resource availability is a major concern in hospital waste management. While discussing behavioral Compliance, including segregation at source, attitudes, and staff turnover, many researchers have reported different findings. Kenny et al. (2021),[11] review current disposal methods worldwide, emphasizing that even where infrastructure exists, human factors such as low awareness or poor attitudes remain major barriers. Affordofe et al,[12] (2025) in Ghana report that although waste handlers knew the types of waste, they were often unable to apply colour-coding correctly, highlighting gaps in behavioral compliance. Husaini (2024),[13] highlights that even in LMICs with guidelines, behavioral change is essential, as infrastructure alone is insufficient to protect public and environmental health. These research findings indicate that behavioral aspects in the Nepalese federal hospital context remain understudied — especially from the perspective of administrators, rather than just those of waste handlers. There is limited qualitative data on the impact of institutional culture, turnover, and training on compliance.

While analyzing the previously conducted research findings regarding the institutional/governance structures, including policy, monitoring, and ownership, we found that there is a scarcity of deep qualitative investigation into how governance mechanisms operate in Nepal's federal hospitals — especially how monitoring loops, focal persons, committees, and quality assurance processes enable or hamper performance. A systematic review on international governance of HCWM by Clark (2018),[14] shows that governance frameworks (laws, regulations, committees) are imperative, but implementation is inconsistent across low-income settings. The UNDP Benchmarking report (2023),[15] across Asian countries reveals that weak monitoring mechanisms and low institutional ownership significantly limit HCWM performance. Joshi et al,[2] (2017) in Nepal found poor compliance with Nepal's guidelines and weak institutionalization of HCWM practices in many health-care institutions. Prior research has established that resources, human behavior, and governance/institutionalization are key pillars for effective waste management in healthcare. However, there is a research gap in exploring these themes in tandem, within the context of federal government hospitals in Nepal, using qualitative methods that incorporate both managerial perspectives and observational data.

The significance of this study lies in its potential to provide evidence-based recommendations to improve HCWM systems in Nepal, ensuring that healthcare facilities adhere to best practices that protect public health and the environment. Furthermore, this research will contribute to the broader global dialogue on effective healthcare waste management in resource-limited settings.

MATERIALS AND METHODS

This study employed a qualitative research design to assess the effectiveness of healthcare waste management practices in federal government hospitals of Nepal and identify the associated challenges. The qualitative approach was chosen because it allows for an in-depth exploration of hospital administrators' experiences, perceptions, and practices, providing valuable insights into the complex, context-specific nature of HCWM.[16] Two primary data collection methods were used: in-depth interviews and direct observations. These methods enabled the researchers to triangulate data and ensure the validity and reliability of the findings.[17]

Population and Sample: The sample for this study included seven federal hospitals, one from each of Nepal's seven provinces. A purposive sampling technique was employed to select these hospitals, ensuring that each represented a distinct geographical region and healthcare setting within the country. This

sampling method was appropriate for capturing diverse perspectives and practices in waste management across different hospital settings.[18] In each hospital, two top-level administrators responsible for HCWM were selected for interviews, providing a total of 14 interview participants. Administrators were selected for their key roles in decision-making and policy implementation for healthcare waste management.

Data Collection Methods: To gather data for this research, the research tools, including the interview guide and observation checklist, were pilot-tested to ensure their clarity and relevance to the research objectives.

Interviews: Semi-structured interviews were conducted with hospital administrators to explore their practices and challenges related to managing healthcare waste. The interview guide was designed based on existing literature on HCWM in healthcare settings,[16,19] and included 21 questions that addressed waste segregation, storage, disposal practices, and staff training. The interviews were conducted in person or via phone, depending on the participant's availability, and were audio-recorded with the participant's consent. The transcriptions were then analyzed to identify common themes and key issues in HCWM practices.

Observations: In addition to interviews, direct observations were conducted in each selected hospital to assess the practical implementation of waste management practices. An observation checklist was developed to evaluate waste segregation at the point of generation, waste transportation within the facility, and disposal methods. The checklist also included criteria for assessing the physical infrastructure for waste management, including waste bins, storage areas, and disposal sites. This method enabled the documentation of real-time waste management practices, providing objective data that complemented the interview findings.[17,18]

Data Analysis: The data were analyzed using qualitative content analysis, in accordance with established procedures for this method.[20] Initially, all audio recordings of interviews were transcribed verbatim, and each interviewee was assigned a unique code (for example, B1 and B2 for the two participants from Bharatpur Hospital; analogous codes were used for other hospitals). Next, the transcripts were read iteratively and coded using a thematic approach, where recurring patterns and categories relating to healthcare waste management practices and challenges were identified and grouped into higher-order themes. These themes enabled us to explore administrators' perceptions, implement policies, and encounter obstacles in waste management. To enhance credibility, the themes derived from interview data were triangulated with direct observational findings from the same hospitals.[21] Member-checking was also undertaken—preliminary findings were shared with participants for their feedback to ensure the interpretations faithfully reflected their views.[16] This multilayered approach supports the reliability and validity of the analysis.

Ethical Considerations: Ethical approval for this study was obtained from the Nepal Health Research Council (NHRC), Kathmandu, Nepal. Initially, consent was obtained from the hospital administration, followed by informed consent from all participants, ensuring they understood the purpose of the research and their rights to confidentiality and voluntary participation. The anonymity of the participants was maintained by assigning codes to interview transcripts and observation notes, ensuring that personal identifiers were not disclosed. Additionally, participants were informed that their participation would not impact their professional standing or the services provided by their hospitals.

RESULTS

We have separated our findings into sections according to the strategies applied.

Inputs: Resources and Institutional Capacity

All hospitals possessed at least basic PPE, bins, and trolleys; however, the adequacy and reliability of supplies varied. Bharatpur Hospital demonstrated full compliance with national standards, maintaining both human and material resources in surplus. Bheri and Koshi hospitals followed closely, ensuring a continuous supply and trained focal persons. In contrast, Dadeldhura and Karnali faced logistic constraints, periodic shortages, and equipment breakdowns, reflecting geographic and infrastructural disparities. Across cases, regular orientations were noted as a universal input strategy for sustaining awareness.

"All items mentioned in the guidelines… are all available to us." (B1)

"Since our hospital is in a remote area, we are compelled to order supplies from Kathmandu." (D2)

Processes: Implementation and Compliance with SOPs

Segregation at the point of generation was universally reported, though its consistency varied. Bharatpur, recognized as a benchmark institution, practiced segregation, transportation, and autoclaving in accordance with national SOPs, with designated focal personnel ensuring oversight. Bheri and Koshi adopted similar procedures but reported human behavior–related inconsistencies and segregation lapses during high workload. Dadeldhura and Karnali were in transitional phases, yet the intent to follow WHO and national guidelines was evident.

"Segregation is done at the very source where waste is generated." (B1)

"Visitors mix waste into different buckets." (N1)

Outputs: Effectiveness and Achievements

Marked improvements were observed in cleanliness, infection prevention, and staff safety. Hospitals with sustained SOP adherence reported fewer needle-stick injuries and a visible enhancement in environmental

hygiene. Bharatpur stood out with tangible results, including reduced infection rates and positive community feedback, which framed it as a model for replication.

"Pollution and risk of infection were high, but now those issues have been minimized." (B1)

"Hospital cleanliness has improved significantly, and there is positive feedback from the community." (B2)

Challenges: Persistent Barriers

Despite progress, behavioral and logistical issues continued to persist. Human factors—such as staff negligence, visitor behavior, and frequent turnover—were identified as universal impediments. Technical obstacles, including malfunctioning autoclaves and insufficient budget, were more pronounced in Dadeldhura and Karnali. The sustainability of practices depended largely on consistent supervision and motivation.

"Segregation remains very challenging because it is directly related to human behavior." (B1)

"Autoclave problem, trolley shortage, and behavioral issues… are the types of problems we face." (K1)

Feedback and Monitoring Systems

Structured committees and focal persons were critical enablers. Bharatpur, Bheri, and Koshi hospitals maintained formal reporting systems, regular audits, and checklists to identify lapses and plan reorientations. In less developed hospitals, informal or ad hoc supervision substituted for systematic reviews.

"We conduct regular reviews and audits through observation and checklists." (B1)

"So far, no formal system has been established." (D2)

Environmental and Policy Context

Across sites, national guidelines and SOPs were described as the backbone of waste management. The initial dependence on external support (e.g., GIZ, WHO, UNDP) had transitioned to institutional ownership, signaling the maturity of the systems. Policy enforcement and accountability mechanisms were credited for maintaining compliance and motivation.

"The guidelines and national protocols have shown a clear path for waste management." (B2)

Roles, Boundaries, and Coordination

Teamwork emerged as a key factor in achieving success. Clear delineation of duties among nurses, helpers, and municipal staff was a hallmark of Bharatpur's excellence, whereas occasional role ambiguity persisted in peripheral hospitals. Motivation and incentive mechanisms, such as waste-sale revenue sharing in Dadeldhura, enhanced engagement.

"The whole team is involved… doctors, nurses, paramedics, and office assistants." (B1)

"There are instances of role conflict due to a shortage of manpower." (D1)

Goals and Future Directions

All hospitals shared a commitment to sustainability, with aspirations ranging from biogas production and liquid waste treatment to full recycling systems. Bharatpur's integrated vision of energy recovery and wastewater treatment epitomized advanced practice, aligning with circular economy principles. Other hospitals sought to emulate this model within their specific contextual constraints.

"Our goal is to operate a biogas plant and manage liquid waste effectively." (B1)

"We aim to move toward the recycling concept—turn waste into wealth." (K1)

Field observations in the selected hospitals reveal that all hospitals implemented waste segregation at the point of generation, with infectious and general waste placed in separate, color-coded bins. However, in Bharatpur hospital, these wastes are transported on distinct trolleys to a dedicated waste-management and storage center, where infectious waste undergoes autoclaving, recyclable materials are sorted in cages for sale, biodegradable waste is composted, and general waste is handled in coordination with the Bharatpur Metropolitan City for final disposal. The data from interviews and observations align completely with one another. In accordance with Nepal's National Health Care Waste Management Standards and Operating Procedures 2020 (MoHP),[22] and the World Health Organization guidelines on health-care waste management,[23] the hospital demonstrates an appropriate and effective HCWM practice. Although other federal hospitals in Nepal have likewise based their practices on the national SOP and WHO guidance, they encounter significant challenges—particularly in changing human behavior and attitude. Hence, effective waste management is neither achieved by abandoning efforts nor by assuming a one-time implementation is sufficient; rather, it can only be achieved through continuous effort, persistent monitoring, and a positive institutional culture, enabling hospitals to achieve proper and sustainable HCWM. Bharatpur Hospital was consistently recognized as a best-practice model, demonstrating full adherence to national standards, strong institutional ownership, formalized feedback loops, and continuous quality improvement. At the same time, other hospitals displayed partial compliance and incremental improvement. The comparative analysis highlights that policy-driven structures, consistent monitoring, and behavioral reinforcement remain the cornerstones of effective HCWM in Nepal's federal hospitals.

DISCUSSION

The findings of this study reveal a nuanced portrait of healthcare waste management (HCWM) in federal government hospitals across Nepal, one that both aligns with and diverges from existing literature. Previous investigations, such as the large-scale mixed-methods study in Madhesh Province, which showed "full adherence to HCWM guideline 2014 was extremely low" despite adequate amenities being present Patel et al., 2024),[24] underscore longstanding gaps in knowledge, practice, and

institutionalization of HCWM. Similarly, a study at central hospitals in Kathmandu by Sharma et al (2010),[25] found weak liquid-waste treatment and limited committee structures for waste management. In contrast, the hospitals investigated in the present research demonstrate considerable progress, especially one exemplar hospital (Bharatpur), which appears to have institutionalized inputs, processes, monitoring, and outcomes into a coherent system. These findings are supported by the case study at Tribhuvan University Teaching Hospital, which demonstrated that the adoption of source segregation, autoclaves, recycling, and a circular economy orientation significantly improved performance.[26] Nonetheless, across most sites in my study, the human-behavior dimension (segregation at source, visitor compliance, staff turnover) remained a persistent obstacle—matching the behavioural-governance challenges flagged by earlier works (e.g., only 10 % of HCFs in Biratnagar used incinerators, 80 % separated waste, yet 50 % used colored dustbins).[6] Where this study diverges is in the prevalence of formal monitoring & feedback systems: where previous reports often cited absence of committees or audits, several of my sites reported dedicated focal persons and regular audits—a positive shift. Thus, in summary, this investigation supports the broader narrative that while material inputs and policy frameworks are necessary, they are insufficient without a behavioral culture, systematic feedback loops, and institutional ownership. The standout performance of one hospital suggests that the convergence of these elements transforms HCWM from ad hoc compliance into an embedded organizational practice.

CONCLUSION

This study, conducted across seven federally-run hospitals (one per province) via interviews with senior and mid-level management and direct observation of waste management practices, offers compelling evidence that effective, sustainable healthcare-waste management (HCWM) in Nepal depends on four foundational pillars: sufficient resources, well-designed processes, behavioral compliance, and continuous monitoring. While the promulgation of national guidelines—the National Health Care Waste Management Standards and Operating Procedures 2020 (Nepal) and infrastructural deployment have improved significantly, the critical differentiator appears to be institutionalization. In particular, one hospital stands out as a model, institutionalizing waste management from a technical sidebar into a strategic component of governance and quality assurance. For policy and practice, the imperative is clear: the focus must shift from mere supply-side provisioning toward embedding cultural change, robust accountability mechanisms, and continual capacity building for improvement. Only in this way can Nepal's hospitals progress beyond partial compliance to the performance levels required to protect staff, patients, and communities from the health and environmental hazards of mismanaged healthcare waste. If other hospitals adopt the comprehensive model exemplified by the institution, the nationwide implementation and effectiveness of both the national SOP (2020) and WHO guidelines (2014) will be significantly strengthened.

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