

Knowledge, Practices, and Other Influencing Factors of Healthcare Waste Management in a referral Hospital-Ghana: A Qualitative Study Among Healthcare Workers

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Abstract

Background

Healthcare waste management remains a critical public health challenge in Ghana, with significant implications for healthcare workers, patients, and the broader community. Despite increasing awareness, gaps remain in understanding country-specific difficulties, hence the need to assess current practices and challenges of healthcare waste management within health care facilities in Ghana.

Methods

A qualitative study was conducted in a referral hospital. Twelve participants representing diverse healthcare roles were purposively sampled, including nurses, midwives, laboratory technicians, waste handlers, pharmacists, and hospital administrators. Data were collected through semi-structured interviews lasting 20–30 minutes each and analysed using thematic analysis with Atlas.ti software. Six main themes were identified: waste composition, current practices, influencing factors, staff knowledge, staff perceptions, and improvement suggestions.

Results

Healthcare waste composition was diverse and heterogeneous, comprising infectious waste (most dominant), sharps, pathological waste, chemical/pharmaceutical waste, and general waste. Poor segregation practices were prevalent, with frequent mixing of hazardous and non-hazardous waste. Staff knowledge varied significantly across professional categories, with clinical staff (nurses, laboratory technicians) demonstrating better awareness than support staff (cleaners, porters). Despite adequate knowledge among some groups, practices were often inconsistent due to resource constraints, inadequate training, and weak supervision. Key influencing factors included budget constraints (most prominent), operational challenges (autoclave downtime, collection delays), human resource issues, weak regulatory enforcement, and community concerns about disposal practices.

Conclusion

Healthcare waste management is characterized by awareness without consistency, infrastructure without adequacy, and policies without strong enforcement. The study reveals significant gaps between knowledge and practice, particularly among support staff who handle waste daily but receive limited training. Effective improvement requires an integrated approach combining resource provision, inclusive capacity building, regulatory enforcement, and community engagement.

Introduction

Healthcare waste refers to any waste generated because of medical procedures, diagnosis, treatment, or immunization of humans or animals [1]. According to the WHO, hospital waste typically consists of 75–90% non-hazardous materials and 10–25% hazardous waste. It encompasses sharps (needles and blades), pathological waste (tissues and body fluids), contaminated materials (used bandages), and pharmaceutical waste (expired medications) [2]. The improper management of healthcare waste poses substantial risks to public health and environmental safety due to the presence of infectious agents, toxic chemicals, and hazardous materials. Globally, healthcare waste management disparities exist between developed and developing nations. Developed countries employ well-established policies, financial support, and regulatory frameworks that ensure compliance with waste management best practices [1]. However, developing countries struggle with inadequate infrastructure, weak regulatory enforcement, and limited financial resources, making biomedical waste management a significant public health concern [3]. Sub-Saharan Africa faces particularly severe healthcare waste management challenges. Kenny et al. [3] highlight that healthcare waste management remains especially challenging in many low- and middle-income settings, where inadequate segregation and treatment capacity increase occupational and environmental risks. The improper disposal has been directly linked to the spread of infectious diseases, including HIV, hepatitis, and tuberculosis [2]. Additionally, mismanagement of the waste contributes to environmental pollution, contaminating soil, water, and air [4].

In Ghana, evidence indicates persistent challenges with healthcare waste management, including inadequate segregation, limited PPE, poor supervision, and over-reliance on open burning and unregulated landfills [5, 6, 7]. Although national guidelines exist, their implementation is inconsistent, and many healthcare facilities lack the financial and technical capacity to meet required standards. Recent studies have linked poor waste handling practices to increased occupational injuries, needle-stick incidents, and environmental contamination [6]. These issues are particularly concerning given Ghana's growing healthcare demands and the corresponding increase in waste volumes.

Preliminary observations and stakeholder reports indicate frequent mixing of infectious and general waste, inconsistent use of color-coded bins, delays in waste collection, inadequate PPE for frontline waste handlers, and limited staff training, especially among cleaners and porters who are most exposed. Despite these challenges, there is limited empirical research that assesses the current waste management practices, staff knowledge, systemic influencing factors, and the operational realities within health facilities in this municipality. Most existing studies focus on national-level reviews or other regions, leaving a critical knowledge gap regarding context-specific constraints and opportunities for improvement.

Given the potential consequences, including infection transmission, occupational hazards, environmental pollution, and community health risks, there is an urgent need for a comprehensive assessment of biomedical and hazardous waste management practices in the hospital. Understanding the knowledge levels, daily practices, and systemic barriers faced by healthcare workers is crucial to informing effective interventions, strengthening policy implementation,

and enhancing the safety and sustainability of waste management systems in this setting. Therefore, this study aimed to assess knowledge, practices, and influencing factors of healthcare waste management among healthcare workers in the referral hospital.

This study is significant because it provides evidence-based insights into healthcare waste management practices, an area where empirical data is limited despite increasing healthcare service demands. By exploring the knowledge levels, daily practices, and systemic constraints faced by healthcare workers, including support staff who are most exposed, this study highlights critical gaps that directly influence occupational safety, infection control, and environmental health. The findings offer practical direction for strengthening waste segregation, improving staff training, enhancing supervision, and allocating resources more effectively. Additionally, the study contributes to national efforts to improve healthcare waste management in Ghana by generating context-specific data that can inform policy revision, guide institutional planning, and support compliance with WHO and national guidelines. Ultimately, the study provides a foundational evidence base for designing targeted interventions that protect healthcare workers, safeguard communities, and promote safe, sustainable, and efficient biomedical waste management practices in health facilities.

Methods

Study Setting

The study was conducted at a referral hospital comprising ten departments: Medical Ward (Male and Female Units), Surgical Ward (including Orthopedic and Urology Units), Maternity & Neonatal Intensive Care Unit (NICU), Accident & Emergency Unit, Intensive Care Unit (ICU), Pediatrics Ward, Psychiatric Ward, Specialized Consultation Clinics, Diagnostic Imaging Unit (X-ray, Ultrasound, CT-Scan), and Laboratory and Blood Bank Services. Data collection was conducted between August and September 2025, following ethical approval and administrative permissions from relevant authorities.

Study design

This study employed a descriptive cross sectional qualitative design. This design was deemed appropriate as it allows for data collection and analysis from a population at a specific point in time, making it suitable for concluding on healthcare waste management practices in the study setting.

The study employed thematic analysis as the methodological framework. This approach was chosen to identify, analyze, and report patterns (themes) within the qualitative data. Both deductive and inductive coding strategies were used: deductive coding based on predetermined themes from study objectives (waste composition, knowledge and practices, influencing factors), and inductive coding to allow emerging themes from participant narratives.

Participants

The study population consisted of healthcare workers and personnel directly involved in waste generation, handling, and management within various departments of the Hospital.

The study included nurses, midwives, laboratory technicians, waste handlers, pharmacists, and hospital administrators, actively involved in healthcare waste generation, handling, segregation, storage, transportation, or disposal. Also, staff members with at least three months of experience in their current roles, personnel willing to provide informed consent, and participate in the study.

However, the study excluded hospital personnel who were not involved in healthcare waste handling and management, as well as staff members with less than three months of experience.

The sample size for this qualitative study was guided by the principle of data saturation, where data collection continued until no new themes or information emerged. Saturation is the most common guiding principle for assessing the adequacy of purposive samples in qualitative research [9]. The study initially aimed to conduct 12–20 in-depth interviews among purposively selected healthcare workers and waste handlers, with the final sample size determined by saturation achievement. Purposive sampling was employed to recruit participants. This non-probability sampling technique is particularly appropriate when examining context-specific activities like biomedical and hazardous waste management. Purposive sampling ensures that specific categories of participants with significant and divergent opinions regarding the concepts under consideration are represented in the sample [10].

The sample comprised 12 healthcare workers and waste handlers:

Sex

6 males (50.0%), 6 females (50.0%)

Age

20–29 years (n = 2, 16.7%); 30–39 years (n = 4, 33.3%); 40–49 years (n = 4, 33.3%); ≥50 years (n = 2, 16.7%)

Education

Secondary (n = 2, 16.7%); Diploma/HND (n = 4, 33.3%); Bachelor's degree (n = 5, 41.7%); Master's degree (n = 1, 8.3%)

Staff Category

Senior Nurse-Surgical Ward (n = 1), Staff Nurse-Maternity Ward (n = 1), Theatre Nurse (n = 1), Midwife (n = 1), Medical Laboratory Technician (n = 1), Pharmacist (n = 1), Cleaner/Sanitation Worker (n = 1), Waste Handler/Porter (n = 1), Health and Safety Officer (n = 1), Hospital Administrator (n = 1), Mortuary Attendant (n = 1), Public Health Officer (n = 1)

Experience

<5 years (n = 3, 25.0%); 5–10 years (n = 5, 41.7%); >10 years (n = 4, 33.3%).

Data Collection Tool and Procedure

A semi-structured interview guide was adopted and revised based on previously published literature [2, 3, 11, 12, 13, 14]. The guide contained four sections:

1. Socio-demographic information
2. Knowledge of biomedical and hazardous waste management
3. Current practices in waste handling and
4. Factors influencing proper waste disposal

No repeat interviews were conducted with the same participants. All interviews were audio-recorded using phone voice recorders after obtaining explicit verbal consent from participants. An audio recording was chosen to capture complete verbal responses, spontaneous insights, and allow researchers to focus on the conversation rather than note-taking. Field notes were made during and after interviews. During interviews, brief notes captured non-verbal cues, participant emotions, and contextual observations. After interviews, researchers expanded field notes to include reflections on interview dynamics, emerging themes, and methodological considerations. Additionally, structured observational checklists were used to document waste management conditions, including availability of disposal units, segregation practices, labelling, and staff adherence to protocols. Each interview lasted between 20 and 30 minutes.

Data saturation was discussed and actively monitored throughout data collection. The research team reviewed transcripts after every 3–4 interviews to assess whether new themes were emerging. By the 12th interview, no new themes or significant information emerged, confirming saturation had been achieved. Transcripts were not returned to participants for comment or correction. This decision was made due to time constraints and the cross-sectional nature of the study.

The research team comprised undergraduate students who had completed coursework in research methodology, qualitative research methods, and public health research ethics. We received specific training in semi-structured interview techniques, informed consent procedures, and ethical research conduct as part of our academic preparation. Before data collection, the team underwent additional training on healthcare waste management concepts and interview guide piloting. Participants were informed that researchers were undergraduate students researching healthcare waste management practices for academic purposes. The study's objectives were to identify gaps and propose improvements in waste management systems.

Analysis and Findings

Data were coded by all three members of the research team. Initial coding was conducted independently by each team member on the first three transcripts to establish inter-coder reliability. The team then met to discuss discrepancies, refine the codebook, and reach consensus on coding definitions. Subsequent transcripts were coded collaboratively with regular team meetings to ensure consistency. A codebook was developed to ensure consistency in coding. The coding tree had both predetermined and emergent branches. The main code groups (themes) were;

1. Waste Composition (sub-codes: infectious waste, sharps, chemical waste, pathological waste, general waste)
2. Current Practices (sub-codes: segregation, collection, PPE protocols, documentation, supervision, training, monitoring)
3. Influencing Factors (sub-codes: budget constraints, operational challenges, staffing issues, community concerns, regulatory gaps)
4. Staff Knowledge (sub-codes: training adequacy, awareness levels, safety protocols, segregation knowledge)
5. Staff Perceptions (sub-codes: challenges, inadequate training, insufficient resources, risk awareness)
6. Improvement Suggestions (sub-codes: training needs, resource allocation, practical options). Codes were organized hierarchically with major themes containing multiple sub-themes derived from the data. Themes were derived using both deductive and inductive approaches. The final thematic framework resulted from combining theoretical expectations with patterns identified in participant narratives.

The Atlas.ti 25 qualitative data analysis software was used to manage, code, and analyze the data. The software facilitated systematic coding, retrieval of coded segments, generation of code reports, and visual representation of thematic relationships.

Participant quotations are presented throughout the results section to illustrate themes and findings. Each quotation is identified by participant role (e.g., [Senior Nurse, Surgical Ward], [Cleaner/Sanitation Worker], [Pharmacist]). Participant names were not used to maintain confidentiality. There is consistency between the data presented (quotations) and the findings (themes). Each theme is supported by multiple quotations from different participants, and contradictory or divergent perspectives are noted where they occur (e.g., variations in knowledge between professional and support staff).

Minor themes and diverse cases are described. For example, under Influencing Factors, minor themes included seasonal variations in waste volumes and community pressure specific to certain disposal methods. Under Waste Composition, variations by department (surgical vs. maternity vs. laboratory) are discussed. Divergent views between staff categories are highlighted, such as administrators emphasizing budget while cleaners emphasize workload.

Results

Socio-Demographic Characteristics of Participants

From Table 1 (P. 259), a total of 12 participants were successfully recruited and completed the study, representing diverse staff categories directly or indirectly linked to healthcare waste handling and management. No participants withdrew from the study, resulting in a 100% completion rate. The demographic profile demonstrates gender balance, with equal representation of males (50%) and females (50%). The majority of participants (66.6%) were between 30 and 49 years, reflecting a mature workforce with substantial experience. Regarding educational attainment, 83.3% of participants had obtained a diploma or higher qualification, suggesting adequate academic preparation to understand hospital protocols and healthcare waste management standards. Only 16.7% had secondary education, mainly among cleaning and sanitation staff. Professional distribution showed diversity across departments: nurses (both general and theatre) and midwives accounted for 33.3% of participants. Other representations included pharmacy (8.3%), medical laboratory (8.3%), mortuary services (8.3%), administration (8.3%), health and safety (8.3%), public health (8.3%), cleaning services (8.3%), and waste handling (8.3%). Experience levels indicated substantial exposure to waste management practices, with 41.7% having 5–10 years of experience and 33.3% having more than 10 years. Only 25% had less than 5 years of experience, ensuring that most participants could provide informed perspectives on waste management practices.

Table 1
Socio-Demographic Characteristics of Participants (N = 12)

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	6	50
	Female	6	50
Age (years)	20–29	2	16.7
	30–39	4	33.3
	40–49	4	33.3
	50 and above	2	16.7
Level of Education	Secondary	2	16.7
	Diploma/HND	4	33.3
	Bachelor's Degree	5	41.7
	Master's Degree	1	8.3
Staff Category	Nurse (General)	2	16.7
	Midwife	1	8.3
	Theatre Nurse	1	8.3
	Medical Laboratory Technician	1	8.3
	Pharmacist	1	8.3
	Cleaner	1	8.3
	Waste Handler	1	8.3
	Health and Safety Officer	1	8.3
	Hospital Administrator	1	8.3
	Mortuary Attendant	1	8.3
Years of Experience	Public Health Officer	1	8.3
	< 5 years	3	25.0
	5–10 years	5	41.7
	> 10 years	4	33.3

3.2 Thematic Analysis Results

Table 2 shows the qualitative analysis revealed six major themes with multiple sub-themes, generating a total of 259 coded responses across all participant groups. The themes were: waste composition, current practices, influencing factors, staff knowledge, staff perceptions, and improvement suggestions.

Table 2
Thematic analysis results

Theme	Definition	Number of codes	Key Findings
Waste Composition	Types and categories of waste generated	45	Diverse, heterogeneous waste; poor segregation is prevalent
Current Practices	How staff currently handle biomedical waste	49	Role-specific practices; inconsistent compliance
Influencing Factors	Conditions affecting waste management	67	Budget constraints are most prominent; multiple barriers
Staff Knowledge	Understanding of waste management protocol	38	Variable knowledge; gaps among support staff
Improvement Suggestion	Proposed solutions and recommendations	28	Training focus: practical implementation needs
Staff Perceptions	Views and attitudes about waste management	32	Challenges recognized; resource inadequacy noted

Waste Composition

The healthcare waste generated in the hospital was heterogeneous and poorly segregated. Five main categories emerged: infectious waste, sharps, chemical/pharmaceutical waste, pathological waste, and general waste.

Infectious Waste

This included blood-soaked materials, contaminated dressings, used gloves, and disposables. Clinical staff identified infectious waste as the most concerning category due to infection risks.

"The most common wastes we generate are sharps (needles, scalpels), infectious soft waste (blood-soaked gauze, dressings), and disposable surgical supplies (gowns, drapes)." [Senior Nurse, Surgical Ward]

"In terms of quantity, infectious bags are the most common loads we transport." [Waste Handler/Porter]

Sharps

Needles, scalpels, broken glass, and other sharp instruments were frequently mentioned across all departments. Improper disposal was a recurring concern.

"Biomedical waste in the lab includes used sample tubes, culture plates, pipette tips, reagent bottles, and contaminated PPE." [Medical Laboratory Technician]

Chemical and Pharmaceutical Waste

Laboratory staff and pharmacists described improper disposal of expired medications, reagents, and chemical solutions, often mixed with general waste.

"Pharmaceutical waste includes expired medicines, damaged containers, and packaging. We interact with these daily during stock checks and dispensing." [Pharmacist]

"Common wastes are infectious sample materials, sharps like broken tubes, chemical wastes from reagents, and general packaging." [Medical Laboratory Technician]

Pathological Waste

Tissue samples, placenta, and body fluids were identified mainly by mortuary attendants, midwives, and surgical staff.

"Pathological and contaminated linens are the largest items by weight and risk." [Mortuary Attendant]

"Biomedical waste encountered includes contaminated linens, body fluids, pathology specimens, and sometimes sharps associated with post-mortem procedures." [Mortuary Attendant]

Current Practices

Current practices analysis generated 101 coded responses, revealing significant variation in waste management approaches across professional categories. With waste management procedures, clinical staff demonstrated more structured approaches to waste handling, with clear protocols for segregation and disposal:

"Regarding waste management, I supervise segregation at the point of generation, ensure sharps boxes are available, monitor waste collection times, and mentor juniors on safe disposal practices." [Senior Nurse, (Surgical Ward)]

Safety Practices Safety emerged as a prominent concern (26 codes), with clinical staff showing greater awareness of protective measures:

"We use gloves, gowns, and masks while handling contaminated materials. For sharps, staff use puncture-proof containers and avoid manual handling." [Senior Nurse, (Surgical Ward)]

Collection and Transportation Waste handlers and porters described systematic collection procedures but noted challenges with timing and equipment availability:

"We separate sharps boxes and labelled bags and never open them during transport." [Waste Handler, (Porter)]

Special Procedures Maternity and mortuary departments employed specialized handling protocols: *"Yes, pathological materials and placenta have special handling: double-bagging and prompt disposal."* [Midwife]

Influencing Factors

The analysis identified multiple interconnected factors influencing waste management effectiveness: Budget Constraints (Most Prominent). Financial limitations emerged as the primary barrier across all participant categories:

"Management supports, but budget priorities sometimes delay safe disposal actions." [Pharmacist]

"Budget limits and equipment breakdowns (e.g., incinerator) most impact our ability to manage waste effectively." [Hospital Administrator]

Operational challenges, Infrastructure, and Equipment issues significantly impacted daily operations:

"Challenges are high birth rates during some months, limited placenta containers, and occasional delays in porter collection." [Midwife]

Human resource issues, Staffing challenges, and Workload pressures affected waste management quality:

"Management sometimes provides basic supplies, but cleaners are often overlooked when it comes to regular PPE supply." [Cleaner/Sanitation Worker]

Community and environmental concerns, External pressures from community members regarding disposal practices:

"The community is worried about where the waste is burned; sometimes, smoke causes complaints." [Cleaner/Sanitation Worker]

Regulatory and enforcement gaps, Weak implementation of existing policies:

"External regulations exist but are not strictly enforced here; community complaints about incinerator smoke have happened." [Midwife]

Staff Knowledge

Knowledge levels varied significantly across professional categories, with clinical staff demonstrating better understanding than support staff. With knowledge of waste segregation, most clinical staff understood color-coding principles but noted inconsistent application:

"We encourage color-coded segregation and community-safe storage until proper disposal can be arranged." [Public Health Officer]

Safety Awareness; Variable understanding of risks and protective measures:

"We are told not to handle infectious or sharps directly --- those should be handled by trained staff and porters." [Cleaner/Sanitation Worker]

Training Adequacy: Significant disparities in training access and quality:

"Training was basic hygiene and how to use cleaning chemicals, not much on biomedical waste specifics." [Cleaner/Sanitation Worker]

"Formal training included infection control during mortuary handling and safe embalming practices." [Mortuary Attendant]

Staff Perceptions

Staff perceptions revealed both challenges and areas of good practice: Risk Awareness; High-risk areas demonstrated consistent safety consciousness:

"Segregation is practiced consistently in the mortuary due to the high risks involved." [Mortuary Attendant]

Resource Inadequacy; Widespread recognition of resource limitations:

"Management sometimes provides basic supplies, but cleaners are often overlooked when it comes to regular PPE supply." [Cleaner/Sanitation Worker]

Training Needs: Recognition of knowledge gaps and training requirements:

"I feel more training on chemical waste handling and emergency spill response would be valuable." [Waste Handler, (Porter)]

Improvement Suggestions

Staff proposed practical recommendations for enhancing waste management systems. Training Needs:

"I think the training was useful but too brief; repeated practical sessions would improve adherence." [Staff Nurse, Maternity Ward]

"Training is adequate but more practical options for disposal (e.g., take-back programs) would be useful." [Pharmacist]

"I feel more training on chemical waste handling and emergency spill response would be valuable." [Waste Handler/Porter]

Discussion

This qualitative cross-sectional study investigated biomedical waste management practices in the referral hospital. The findings reveal significant challenges in waste composition management, knowledge disparities among staff, and multiple systemic factors influencing practice effectiveness. The study identified diverse healthcare waste composition with poor segregation practices as a critical issue. Infectious waste and sharps emerged as dominant categories, while frequent mixing of general and infectious waste increased contamination risks and disposal costs. Staff knowledge varied significantly across professional categories, with clinical personnel demonstrating better awareness than support staff, who often have the highest exposure risks. Multiple interconnected factors influenced waste management effectiveness, with budget constraints, operational challenges, and weak regulatory enforcement being the most prominent.

Waste Composition and Segregation Challenges

The finding of poor waste segregation aligns with WHO estimates that while only 10–25% of hospital waste is hazardous, inadequate segregation in developing countries significantly inflates this proportion [1]. Similar patterns have been documented across Sub-Saharan Africa, with studies in Ethiopia [13] and Uganda [15] reporting high proportions of improperly classified hazardous waste. The frequent mixing of general waste with infectious waste observed in this study reflects broader systemic issues beyond technical knowledge gaps. Despite Ghana having national guidelines for healthcare waste segregation, weak enforcement and insufficient infrastructure remain major barriers. This suggests that interventions must address both resource provision and accountability mechanisms rather than focusing solely on education.

Knowledge and Practice Disparities.

The significant knowledge gap between clinical and support staff represents a critical patient safety and occupational health concern. While nurses, laboratory technicians, and pharmacists demonstrated adequate theoretical knowledge, cleaners and waste handlers, despite daily exposure to hazardous materials, received minimal specialized training. This disparity is consistent with findings by Parida et al. [11], who observed that sanitary workers had the lowest knowledge levels despite facing the highest occupational risks. The disconnect between knowledge and practice observed among clinical staff reflects findings by Deress et al. [16], who emphasized that knowledge alone does not ensure safe practices without adequate resources, institutional commitment, and effective supervision. Even participants with good theoretical understanding reported inconsistent practices due to resource constraints, time pressures, and inadequate support systems.

Systemic Influencing Factors

The identification of budget constraints as the primary barrier aligns with research from similar healthcare settings. Studies in Sri Lanka documented how financial limitations create cascading effects that compromise multiple aspects of waste management, from basic infrastructure to operational support [17]. The finding that 75% of health facilities globally lack basic healthcare waste services [1] underscores the widespread nature of resource constraints affecting waste management. The prominence of community concerns in participant narratives highlights an important dimension often overlooked in waste management studies. Community complaints about incinerator smoke and disposal practices demonstrate how hospital waste management failures extend beyond institutional boundaries to affect public trust and environmental justice. This finding suggests that effective interventions must incorporate community engagement and environmental considerations.

Limitations

This study has several limitations. First, transcripts were not returned to participants for verification (member checking), which may have strengthened credibility. Second, the study was conducted at a single facility, limiting generalizability. Third, the cross-sectional design captured practices at one time point, potentially missing temporal variations. Finally, social desirability bias may have influenced some responses, particularly regarding compliance with protocols.

Recommendations

The findings of this study underscore the need for a coordinated, system-wide improvement in healthcare waste management. Firstly, the Hospital must institutionalize continuous and inclusive training programs targeting all staff categories, particularly cleaners, waste handlers, and ancillary personnel who have the highest exposure but receive the least training. Such capacity-building should include practical demonstrations on segregation, safe handling of sharps, spill response, and proper use of personal protective equipment (PPE).

Also, the hospital should allocate dedicated budget lines for waste management infrastructure, ensuring the availability of color-coded bins, durable sharps containers, functional autoclaves or incinerators, and uninterrupted supplies of PPE. Investment in routine equipment maintenance and monitoring systems is critical to minimizing operational downtime.

Strengthening supervision and internal accountability mechanisms is also essential. This can be achieved through periodic quality audits, enforcement of standard operating procedures, and assigning clear responsibilities to departmental heads for compliance oversight.

Additionally, improving data management and record-keeping on waste generation, segregation, and disposal can enhance decision-making and support regulatory reporting. Collaboration between hospital management, municipal authorities, and environmental health directorates should be intensified to

ensure safe off-site transportation and environmentally sound disposal of hazardous waste. Policymakers should prioritize the development and enforcement of clear, context-appropriate waste management regulations and incorporate biomedical waste management into broader public health and environmental policies.

From a policy perspective, the study underscores the urgent need for national and local health authorities to strengthen regulatory frameworks, allocate targeted funding, and streamline monitoring systems for effective healthcare waste management. Encouraging community participation, particularly through public education on the risks associated with improper waste disposal, can also help reduce environmental and public health concerns. Overall, implementing these recommendations will contribute to safer healthcare environments, protect workers and surrounding communities, and enhance compliance with national and international waste management standards.

Conclusion

Healthcare waste management is characterized by awareness without consistency in practice, infrastructure without adequacy, and policies without strong enforcement. Poor waste segregation, knowledge gaps among support staff, budget constraints, operational challenges, and weak regulatory enforcement are key barriers. Addressing these challenges requires holistic approaches integrating resource provision, capacity building, regulatory enforcement, and community participation.

The study revealed that healthcare waste generated in the hospital is highly diverse, consisting of infectious waste, sharps, pharmaceuticals, chemical reagents, pathological waste, and a large proportion of general waste. Among these, infectious and sharps waste were consistently identified as posing the greatest risks to both healthcare workers and the community. However, poor segregation practices resulted in the mixing of general and clinical waste, which not only increases disposal costs but also heightens occupational and environmental hazards. This finding underscores the need for stricter segregation systems and monitoring mechanisms to ensure compliance with established standards.

Knowledge and practices among healthcare workers varied widely. Nurses, laboratory staff, and safety officers generally demonstrated better awareness of healthcare waste protocols, whereas cleaners, porters, and some ancillary staff, despite their direct involvement in handling waste, reported limited training and weak familiarity with waste management policies. Although safe practices such as the use of sharps containers and double-bagging of pathological waste were reported, their application was inconsistent. These inconsistencies were attributed to shortages of resources, irregular refresher training, and weak supervision. The results highlight a critical gap: those at greatest risk of exposure, particularly cleaners and waste handlers, often have the least knowledge and protection.

The study also identified multiple systemic factors that hinder effective waste management. Budgetary limitations were the most prominent, restricting the hospital's ability to procure adequate PPE, maintain treatment equipment such as incinerators, and invest in training programs. Operational challenges, including autoclave downtime, delays in waste collection, and limited supply of containers, further disrupted daily waste management routines. Staffing and workload issues were equally important, with cleaners and porters describing themselves as overstretched and under-supported. Weak enforcement of existing policies and guidelines allowed lapses in compliance to persist without accountability. Beyond the hospital environment, the community expressed concerns about smoke from incineration, reflecting how poor healthcare waste management practices erode public trust and raise environmental health concerns.

Taken together, these findings demonstrate that healthcare waste management in the hospital is constrained by a complex interplay of knowledge gaps, resource shortages, operational difficulties, and institutional weaknesses. The consequences are far-reaching: unsafe practices endanger healthcare workers, patients, and nearby communities while also contributing to environmental degradation.

The study, therefore, concludes that improving healthcare waste management requires more than isolated interventions. A comprehensive and coordinated strategy is needed, one that integrates adequate funding, strengthened infrastructure, inclusive and continuous training, strict enforcement of policies, and active community engagement. By addressing these dimensions holistically, the hospital can move towards safer, more sustainable biomedical waste management practices that protect both human health and the environment.

Declarations

Ethical Approval Declaration: University of Health and Allied Sciences, Research Ethics Committee [UHAS-REC B.10[136]24-25].

Human Ethics and Consent to Participate declaration: Applicable as stated at the 'Participant' section in the manuscript. This study adhered to the Declaration of Helsinki. Also, Pseudonyms are used to protect the identities of the hospital and participants, and the study location within Ghana is intentionally omitted.

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Availability of data and materials: Available upon request

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Author's contribution

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