

A Comparative Assessment of Nurses' Perceptions and Practices on Hospital Waste Management in Nigeria and South Africa, and their Impact on Nosocomial Infection Risks: A Systematic Review

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Abstract

Introduction: Healthcare waste management (HCWM) plays a critical role in infection prevention and control, particularly in low- and middle-income countries where systemic health infrastructure challenges persist. This systematic review set out to assess the perceptions and practices of nurses regarding HCWM in general hospitals across Nigeria and South Africa, and to explore the impact of these practices on the prevalence of nosocomial infections.

Methodology: A scoping review methodology was adopted, guided by the PRISMA framework. Five electronic databases including Google Scholar, PubMed, MEDLINE, Embase (Ovid), and CINAHL (EBSCO) were systematically searched using a defined Boolean strategy. The initial search yielded 785 records: 742 from Google Scholar, 42 from MEDLINE, 1 from PubMed, and none from Embase or CINAHL. After removing 12 duplicates, 773 studies were screened for relevance. Title and abstract screening led to the exclusion of 707 studies. 66 full-text studies were screened, 3 could not be retrieved. 63 articles were assessed based on eligibility. Of the 63, 50 were excluded for not meeting inclusion criteria. Ultimately, 13 studies met all criteria and were included in the synthesis.

Results: The review revealed that nurses in both Nigeria and South Africa generally demonstrated strong awareness and positive attitudes toward healthcare waste management (HCWM). However, this awareness did not consistently translate into safe or standardized practices. Actual compliance was often hindered by inadequate training opportunities, insufficient infrastructure, and weak enforcement of institutional policies. South African facilities showed relatively better adherence to waste management protocols than their Nigerian counterparts, reflecting more structured institutional frameworks, yet significant operational gaps and inconsistencies remained across both settings.

Conclusion: Overall, the evidence suggests that the challenges of HCWM transcend individual behaviour and are rooted in systemic and structural weaknesses within healthcare systems. Sustainable improvement requires more than periodic training; it demands an integrated reform approach that links technical capacity building with institutional accountability and equitable resource allocation. Only through such structural alignment can hospitals effectively reduce the risk of nosocomial infections and safeguard both healthcare workers and patients.

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1. Introduction

Healthcare waste management (HCWM) constitutes a foundational pillar of hospital hygiene, occupational health, and patient safety (World Bank, 2003). However, in many health systems, especially within low- and middle-income countries (LMICs) such as Nigeria and South Africa, HCWM remains systematically underprioritized. This neglect is not merely the result of technical inadequacy or resource scarcity but reflects broader institutional and policy-level dysfunctions that marginalise waste management within the health governance hierarchy. According to the World Health Organization (WHO, 2024), only about 15% of healthcare waste is classified as hazardous, comprising sharps, infectious materials, pathological waste, and chemical or pharmaceutical residues. Nevertheless, this relatively small proportion poses disproportionately high risks when not properly segregated, stored, transported, or treated. These risks manifest in hospital-acquired infections (HAIs), environmental contamination, and occupational injuries among healthcare workers. Moreover, the hazardous waste stream becomes a vector for disease transmission when safety protocols are inconsistent, waste infrastructure is lacking, and frontline workers are neither adequately trained nor supported (Haylie et al., 2025). In LMICs, particularly in underfunded public hospitals, the problem is compounded by chronic infrastructural deficits ranging from non-functional incinerators to irregular waste collection schedules (Chisholm et al., 2021). Moreover, the regulatory environment often lacks the enforceability to hold institutions accountable. Therefore, HCWM should not be treated as an isolated technical challenge, but rather as an integrated component of infection prevention and public health systems.

Nosocomial infections are defined as infections acquired 48 hours after hospital admission (Kelly & Monson, 2012). Despite global declines in HAI (hospital acquired infections) incidence due to advances in infection prevention, Nigeria and South Africa consistently report prevalence rates ranging from 12% to 20%, significantly exceeding the global average of 7% (WHO, 2022; Otu et al., 2021). This disparity is not coincidental but symptoms of deeper systemic lapses in hygiene protocols, infrastructure, and institutional oversight. Notably, HAIs are frequently linked to exposure to improperly managed medical waste used sharps, pathological specimens, blood-soaked dressings, contaminated personal protective equipment (PPE), and re-used or poorly sterilised surgical tools (Padmanabhan & Barik, 2019). These vectors often go unrecognised in IPC frameworks that disproportionately emphasize hand hygiene, surface disinfection, and antimicrobial stewardship. Although, while those elements are critical, they are not sufficient when solid waste acts as an uncontrolled reservoir of pathogens. Recent studies have begun to challenge the marginalisation of HCWM in mainstream infection control narratives. Ibáñez-Cruz et al. (2025), for instance, argue that IPC guidelines must integrate waste management as a core, not peripheral, element of infection control strategy. This shift requires rethinking policy design, resource allocation, and training priorities. It also necessitates a more holistic approach to infection control and accountability mechanisms for hospital waste disposal. Failure to integrate HCWM meaningfully into IPC leaves a dangerous gap in hospital safety protocols and compromises public health outcomes. Critically, HCWM is not just a technical or logistical concern, it is a socio-political and institutional issue, reflecting broader systemic challenges such as governance deficits, underfunded public health systems, weak policy enforcement, and fragmented professional responsibilities. The role of nurses, who are the principal generators and handlers of healthcare waste at the point of care, becomes essential in both operational and policy terms (Janik-Karpinska et al., 2023).

However, a multitude of studies have documented gaps in knowledge, practice, and institutional support for nurses in fulfilling this role. For example, Abiola et al. (2011), in a cross-sectional study in Sokoto, Nigeria, revealed high general awareness among nurses (over 79%) but poor knowledge of critical technical components, such as the colour codes for infectious waste and proper sharps disposal procedures. This contradiction between theoretical knowledge and practical adherence is not unique to Nigeria. In South Africa, Lizbeth-Mugivhisa et al. (2020) found that although 82% of nurses were aware of the risks associated with healthcare waste, only 44% knew of relevant national policies, and needle recapping a known risk practice was still being carried out by over 20% of respondents. These findings call into question the effectiveness of current training and orientation programmes and raise concerns about whether national guidelines are reaching the intended stakeholders or merely residing within bureaucratic documentation. Nosocomial infections, or hospital-acquired infections (HAIs), represent one of the most pressing yet under-researched health challenges in sub-Saharan Africa (Sikora & Zahra, 2023). The World Health Organization (2022) estimates that HAIs occur in up to 20% of patients in developing nations; Nigeria and South Africa have some of the highest rates because of lax waste disposal, low levels of infrastructure, and poor enforcement of regulatory restrictions. These statistics are strongly associated with poor HCWM practices. Improper processing, storage, and disposal of healthcare waste, particularly, sharps and contaminated dressings and body fluids, have also been known as a direct correlation to HAI outbreaks (WHO, 2018). This is further compounded by the fact that nurses assume one of the most pivotal roles as far as being the most endangered and also the least influential members of any infection control chain. Allegranzi et al. (2017) couch their positions in the idea that nursing perceptions and behaviours related to HCWM are an outcome of not only clinical education but also of systemic challenges that include: staffing scarcity, policy incompleteness, and inefficient logistical planning. Studies such as those by Abiola et al. (2011) and Awodele et al. (2016) reveal that while nurses in Nigeria demonstrate reasonably good theoretical knowledge (over 70% scoring high on knowledge assessments), practical adherence such as proper color-coded segregation or PPE use remains alarmingly deficient.

In South Africa, similar contradictions abound. According to Motlatla and Maluleke (2021), over 90% of healthcare professionals knew correct sharps disposal procedures, but fewer than 30% complied with broader waste management protocols, such as segregation of cytotoxic or anatomical waste. Moreover, Mugabi and Chima (2025) found statistically significant but weak correlations between training and practical adherence, raising the critical question: Is the issue one of awareness, or of institutional and infrastructural failure? Although these problems are more structural than behavioural. For instance, Jones et al. (2014) contend that systemic underfunding, political negligence, and policy incoherence, not individual laziness or ignorance, are the root causes of poor HCWM outcomes. In Nigeria, despite the introduction of the National Healthcare Waste Management Plan in 2013 and its revision in 2020, actual implementation has been erratic and largely donor-dependent (Salubi et al., 2022). This failure in policy translation is echoed by Godfrey and Oelofse (2017) in South Africa, who argue that even the technically robust Waste Act (No. 59 of 2008) suffers from provincial enforcement disparities, rendering hospital protocols ineffective in rural areas. Furthermore, the WHO (2024) emphasizes that though only 15% of healthcare waste is classified as hazardous, it contributes disproportionately to infection risk when not properly handled. In 2010 alone, poor sharps disposal accounted for 33,800 new HIV infections, 1.7 million hepatitis B cases, and 315,000 hepatitis C cases. Therefore, this study is not merely about individual behaviour but interrogates the structural, institutional, and epistemological failures that allow HCWM to remain a secondary concern despite its high-stakes implications. A systematic review is essential to disentangle these multi-layered issues, especially as they relate to nurses' roles and capacities in both Nigeria and South Africa. As such, this study aim to systematically assess the perceptions and practices of nurses regarding healthcare waste management and determine their impact on the incidence of nosocomial infections in public hospitals in Nigeria and South Africa.

2. Methodology

Research Design

This study adopts a scoping review design to systematically map existing literature on nurses' perceptions and practices of healthcare waste management (HCWM) and their link to hospital-acquired infections (HAIs) in Nigeria and South Africa. As Grant and Booth (2009) note, scoping reviews are ideal for broad topics marked by conceptual diversity and methodological variation. This approach was deliberately chosen to address the complex, underexplored relationship between HCWM and infection control in contexts where HAIs remain high due to weak waste management systems (Mkwanazi et al., 2021). Unlike traditional systematic reviews that focus narrowly on specific clinical questions (Moosapour et al., 2021), scoping reviews offer open and exploratory inquiry, though they risk limited appraisal depth (Peters et al., 2021). Their flexibility, however, enables inclusion of grey literature, policy reports, and mixed-methods studies to generate more contextually grounded insights (Gottlieb et al., 2021). Guided by the PRISMA-ScR framework and validated appraisal tools, this study balances methodological breadth with analytical rigour.

Search Strategy

The literature search employed a structured Boolean strategy: *(nurses AND (perception OR knowledge OR practice OR attitude) AND ("hospital waste" OR "medical waste" OR "waste management")) AND (Nigeria OR "South Africa") AND ("nosocomial infection" OR "hospital-acquired infection")*. Searches were conducted across five databases Google Scholar, PubMed, MEDLINE, Embase (Ovid), and CINAHL (EBSCO) selected for their complementary coverage of clinical, nursing, and public health disciplines. The use of Boolean operators enhanced search precision and facilitated the identification of studies aligning with the research aim (Ugwu & Opah, 2023). However, as Bramer et al. (2018) and Ugwu and Opah (2023) caution, complex Boolean strings may inadvertently exclude relevant studies due to inconsistent indexing, especially in multidisciplinary literature. To mitigate this, manual verification was undertaken to capture studies misclassified under ambiguous terms. Geographic filters ("Nigeria" and "South Africa") ensured contextual relevance. Inclusion of Google Scholar introduced methodological tension: while it improved access to grey literature, theses, and policy reports often excluded from traditional databases, it also reduced search reproducibility (Haddaway et al., 2015). This trade-off was accepted to capture non-traditional sources that provide crucial insights into practical and policy dimensions of healthcare waste management.

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria adopted in this review were strategically selected to ensure methodological rigour while maintaining contextual relevance (as seen in Table 1).

Table 1: Inclusion and Exclusion Criteria with Justifications

S/N	Inclusion Criteria	Justification for Inclusion	Exclusion Criteria	Justification for Exclusion
1	Studies conducted in Nigeria or South Africa	These countries are the specific geographic focus of the study, enabling a comparative analysis of two healthcare systems in Sub-Saharan Africa.	Studies outside Nigeria or South Africa	Inclusion of other countries would introduce contextual inconsistency and compromise focus.
2	Studies focusing on nurses or nurse-related perspectives on HCWM	Nurses are frontline actors in healthcare waste handling and infection control. Their practices are central to the research question.	Studies not specific to nurses	Broadening to all healthcare workers would dilute the specificity and analytical depth of the review.
3	Studies with empirical data on perceptions, practices, or knowledge	Empirical evidence grounds the review in observable reality, increasing relevance for policy and practice.	Theoretical papers lacking empirical data	Theoretical works lack practical applicability and fail to inform current real-world practice.
4	Studies linking HCWM to HAIs or infection prevention	This link is essential to exploring the risk implications of poor waste management practices.	Studies that do not address infection outcomes	Without this linkage, the study would lose its relevance to hospital-acquired infections.
5	Studies using quantitative, qualitative, or mixed-methods design	Inclusion of diverse methodologies enriches the analysis and acknowledges the complexity of the issue.	Studies outside 2015–2025	Older studies may not reflect current practice or post-Ebola and post-COVID shifts in healthcare systems.
6	Peer-reviewed articles and grey literature (2015–2025)	The time range ensures inclusion of current, contextually relevant evidence and recent policy developments.	Non-English language studies	Translation challenges and resource constraints limited inclusion to English-language material.
7	English-language publications	Language limitation was necessary for feasibility and accurate interpretation by the research team.	Editorials, commentaries, or abstracts without full text	These lack sufficient methodological transparency and data depth.
8	Full-text studies (not editorials or abstracts)	Full-text articles provide comprehensive data for critical appraisal and synthesis.		

Study Selection

All retrieved records were exported into MyBib reference manager for systematic organisation, accurate referencing, and duplicate removal. As shown in Figure 1, the search produced 785 records: 742 from Google Scholar, 42 from MEDLINE, 1 from PubMed, and none from CINAHL (EBSCO). After removing 12 duplicates, 773 records remained. The lack of results from Embase and CINAHL, though unexpected, underscores the persistent under-indexing of African nursing literature in major global databases, reinforcing the need to incorporate grey literature from accessible sources like Google Scholar. Screening followed the Population, Exposure, Outcome (PEO) framework (Munn et al., 2018). Titles and abstracts were reviewed independently to identify studies addressing nurses' perceptions, knowledge, or practices concerning healthcare waste management (HCWM) and its association with hospital-acquired infections (HAIs) in Nigerian or South African general hospitals. At this stage, 707 studies were excluded for failing to meet inclusion criteria typically due to focus on other health worker populations, lack of infection control relevance, or differing geographical settings.

The eligibility phase involved full-text assessment of 66 studies; 3 could not be retrieved due to restricted access or missing archives. Of the 66 reviewed in full, 50 were excluded for reasons such as non-target countries, irrelevant themes (e.g., non-clinical waste), or non-hospital settings. Ultimately, 13 studies met all inclusion criteria and were incorporated into the final synthesis. This selection process adhered strictly to the PRISMA 2020 guidelines (Page et al., 2021), ensuring transparency, reproducibility, and methodological accountability. Each selected study was further appraised for relevance and quality alignment with the review's objectives, as summarised in the PRISMA flow diagram (Figure 1) depicting identification, screening, eligibility, and inclusion stages.

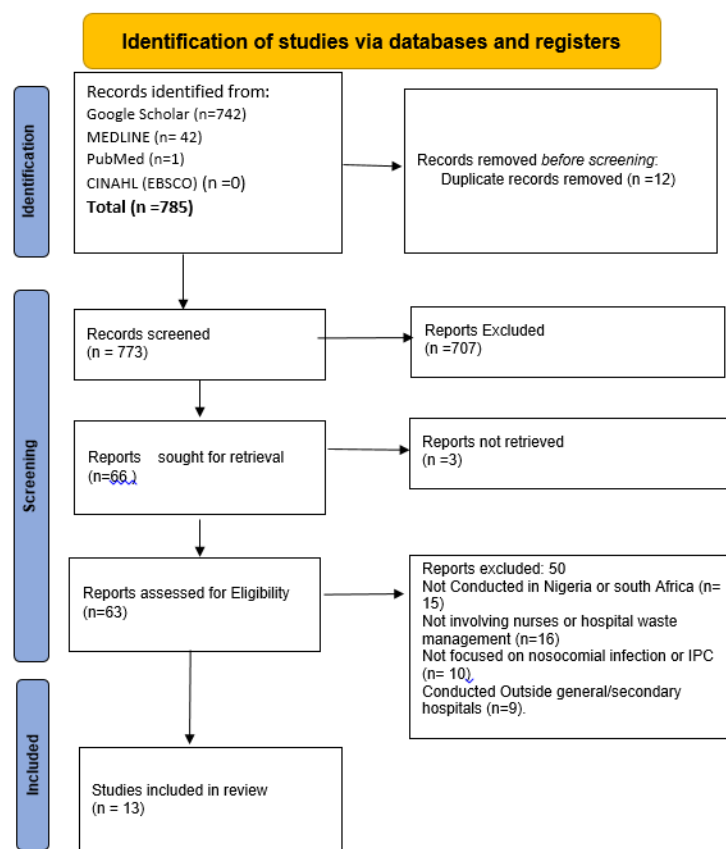


Figure 1: PRISMA Flow Chart

Data Extraction

The process of data extraction in this review was approached with deliberate structure and methodological rigour. A pre-designed Excel matrix was employed to facilitate consistency, transparency, and systematic organisation of the data. This tool was chosen because it allowed for the structured capture of key study characteristics while also enabling easy comparison across multiple sources (Büchter et al., 2020). The matrix served not only as a data entry form but also as a framework for synthesis, ensuring that no relevant variables were overlooked. Key variables extracted from each of the 14 included studies included the author(s) and year of publication, country of research, study aim, study design, and the main findings and implications (as seen in Table 2).

Table 2: Summary of the included Articles

S/N	Authors, date, location	Aim of study (nurse role / performance / attitudes)	Study design	Findings	Implications
1	(Akunneh-Wariso & Nwokoro, 2023). Abia State Nigeria	This study investigated nurses and midwives awareness and management of maternity wastes in compliance with WHO guidelines in healthcare facilities in Abia State.	The research design was descriptive survey. The population comprised 93 midwives and nurses all of which were used for the study implying that the census sampling method was used	Results show that nurses and midwives in the healthcare facilities in Abia State are aware of and comply with the (WHO) guidelines on general waste management(68.5%) and to a great extent; infectious waste management (56.75%) to a great extent; guideline for hazardous waste management (69%) and guideline for pharmaceutical waste management (61.5%).Test of hypotheses conducted at 0.5% probability level or $p < 0.05$ comparing the opinion of nurses and midwives on compliance to the WHO guidelines did not reject any of the hypotheses.	Though compliance with WHO guidelines is relatively high, there is variability across waste categories. Uniformity in adherence suggests the importance of standardized institutional policy enforcement. Regular audits, refresher trainings, and infrastructural support (like labelled bins and segregation tools) are needed to sustain and improve adherence, especially in high-risk maternity care environments.
2	(Awodele et al., 2016) Lagos, Nigeria	The study assessed the medical waste management practices in selected hospitals and also determined the impact of Lagos Waste Management Authority (LAWMA) intervention programs. A descriptive cross-sectional survey method was used.	A descriptive cross-sectional survey method was used.	The majority 56 (53.3 %) of the respondents were females with mean age of 35.46 (± 1.66) years. The hospital surveyed, except hospital D, disposes both general and medical waste separately. All the facilities have the same process of managing their waste which is segregation, collection/on-site transportation, on-site storage and off-site transportation. Staff responsible for collecting medical waste uses mainly hand gloves as personal protective equipment. The intervention programs helped to ensure compliance and safety of the processes; all the hospitals employ the services of LAWMA for final waste disposal and treatment. Only hospital B offered on-site treatment of its waste (sharps only) with an incinerator while LAWMA uses hydroclave to treat its wastes. There are no policies or guidelines in all investigated hospitals for managing waste.	The role of institutional partnerships, such as with LAWMA, appears crucial in facilitating effective HCWM. However, the absence of hospital-specific policies and limited use of PPE point to systemic vulnerabilities. Developing in-house protocols and expanding PPE availability and training are essential to improve staff safety and environmental health outcomes.
3	(Ezirim & Agbo, 2018) 36 states in	Role of National Policy in Improving	Role of National Policy in Improving Health Care	The present study found that 44.8% of health facilities surveyed had healthcare waste management work plans	Following the introduction of healthcare waste management policy, health facilities in Nigeria have improved waste

	Nigeria including FCT	Health Care Waste Management in Nigeria	Waste Management in Nigeria	adapted from the 2013 national policy. In addition, 89.2% of health facilities segregated waste. This is an important improvement, as previous studies reported that there was little to no waste segregation at health facilities. Furthermore, 41.4% of health facilities had designated persons or units handling healthcare waste, in contrast to previous studies which found no designated person or unit responsible for healthcare waste. However, the quality of healthcare waste management varied across states and health facilities.	management practices. However, training, availability of required tools and functional governance structures are essential to the implementation of an effective healthcare waste management policy. The study findings show that safe healthcare waste management can be implemented if the government leads by providing policy and required resources, while health facilities put standard operating procedures in place to guide day to day healthcare waste management operations.
4	(Jonathan, 2022) Abuja, Nigeria	The purpose of this study is to assess risk perceptions and awareness among healthcare workers handling hospital waste in Abuja, Nigeria.	In this study, mixed methods design of quantitative approach using cross-sectional study and qualitative approach using descriptive case study were applied to explore the risk perceptions and awareness of healthcare waste handlers within the four selected (two public and two private) hospitals in Abuja.	Major trends found through investigations, include that: most Abuja hospitals were fraught with poor healthcare waste management practices; healthcare waste attendants handling hospital waste in Abuja seldom appreciate the danger involved; there exists risky exposures of hospital waste to human health; coupled with negative environmental impacts.	The low perception of risk and inadequate awareness among healthcare waste handlers present significant threats to occupational and environmental safety. Policies must prioritize behavior change communication, enforce accountability, and implement periodic risk assessments to ensure waste handlers understand the dangers involved and comply with safe practices.
5	(Lizbeth-Mugivhisa et al., 2020) Pretoria, South Africa	The study assessed perceptions of healthcare workers on the adherence and risks associated with the practices of healthcare waste management.	A total of 126 questionnaires were administered in selected wards at an academic hospital to establish training and knowledge on legislations regarding healthcare waste and health hazards associated with such waste.	Sixty-nine% (69.0%) of participants had received training on healthcare waste handling. The highest number of cleaning staff (85.7%) received training from work while 34.8% of the doctors also received training from work. Only 44.1% of the nurses had knowledge about policies on healthcare waste. The majority of the participants (82.0%) had knowledge on the risks associated with handling of healthcare waste. However, only 20.0% of the participants re-capped needles after use and of these 43.5% were doctors.	Despite high general awareness of HCWM risks, gaps in specific practices such as needle recapping and policy knowledge underline the need for procedural standardization and stricter compliance enforcement. Exposure to needle-stick injuries among nurses suggests urgent review of clinical protocols, continuous competency-based training, and stronger monitoring mechanisms to safeguard healthcare workers.

				Most of the nurses (64.0%) had been exposed to needle pricks.	
6	(Moloi & Onwubu, 2024) Gauteng, South Africa	This study investigated waste handlers' knowledge of the management of isolation waste at Dr. George Mukhari Academic Hospital in Gauteng, South Africa.	A survey was conducted to assess waste handlers' understanding of waste types, colour codes, safety precautions, and awareness of internal policies related to isolation waste management.	The study found that the majority of waste handlers demonstrated a good understanding of waste types generated in the isolation unit, including sharps waste, human tissue waste, infectious waste, and general waste. They also correctly identified examples of sharp waste, such as injections, blades, glass slides, and needles. Additionally, most respondents were aware of the colour code used for representing infectious waste as "yellow" and "red." The study revealed a statistically significant association between waste handlers' age and their knowledge of isolation waste, suggesting that age may influence their understanding of waste management practices. Furthermore, experience was found to be significantly associated with waste handlers' knowledge of the health-hazardous nature of isolation waste. While the majority of waste handlers recognized the importance of wearing protective clothing and correctly marking isolation waste, some respondents were not aware of the internal policy for waste handling such as guidelines and protocols specific to the segregation, packaging, labeling, and disposal of waste generated within the isolation units.	While knowledge of isolation waste management is generally strong, gaps in policy awareness present serious compliance challenges. Health institutions must ensure clear dissemination of internal protocols and mandate regular policy reviews. Age- and experience-based disparities in knowledge highlight the need for tailored capacity-building programs for both new and long-term staff.
7	(Motlatla & Maluleke, 2021) Northern Cape Province, South Africa	This study aimed at assessing the knowledge about healthcare risk waste (HCRW) management among doctors, professional nurses, pharmacists and laboratory technicians, in	The quantitative cross-sectional study was conducted, using self-administered questionnaires and stratified random sampling was used	The majority 90.28% of the participants were aged 19–50 years, females (71%), professional nurses (36%), and they had 1–10 years of experience (71%). The health professionals were knowledgeable of sharps waste (89%), slightly over (52%) knew anatomical waste, whereas (27%) and (17%) knew radioactive and cytotoxic waste, respectively. Health professionals (92%) agreed that the sharps-waste container should be disposed of in a	The uneven distribution of knowledge across waste types and waste container identification signifies partial compliance with legal standards. Targeted interventions are required to bridge knowledge gaps, particularly in less familiar waste types such as cytotoxic and radioactive waste. Furthermore, training strategies should be designed considering demographic factors like age and profession.

		accordance with National Environmental Management, Waste Act 59 of 2008, Constitution of South Africa and sustainable development goals (SDG).		yellow bin container, at least (63%) and (27%) agreed that red liner and box should be used for both infectious non anatomical waste and for cytotoxic waste. The null hypothesis was tested on knowledge versus age, profession and gender, and evidence against it was found on waste storage period in all three variables where chi-square and Fisher exact p-values were less than the 5% significant level.	
8	(Mugabi & Chima, 2025) Kwazulu-Natal Province, South Africa	Evaluate factors that influence awareness and practice of medical waste management among healthcare workers.	A mixed-methods study carried out from October to November 2019 at four public hospitals in EThekweni metropolitan municipality of KwaZulu-Natal province, South Africa, among doctors, nurses, laboratory staff and waste-handler	Results showed that respondents' professional category was strongly associated with general knowledge of healthcare waste management, and median scores showed that a higher proportion of nurses had higher scores when compared to laboratory scientists/technicians and medical doctors. Further, general knowledge scores were significantly positively correlated with the practice scores, while waste segregation was significantly, but weakly, associated with training regarding healthcare waste differentiation (p=0.025; V=0.14). Also, knowledge of recommendations in the medical waste management implementation plan was significantly but weakly associated with waste segregation (p=0.028; V=0.14). Findings revealed a strong correlation between training, availability of waste management related workshops, and proper medical waste management amongst healthcare workers.	The strong link between professional category, training access, and HCWM competence suggests systemic inequities in knowledge dissemination. Training should be standardized across all healthcare worker categories. Workshop availability and frequent competency evaluations will enhance sustainable practice and help reduce inter-professional discrepancies in HCWM.
9	(Olaifa et al., 2018) KwaZulu-Natal, South Africa	The aim of this study was to assess the knowledge, attitudes and practices of staff working at a district hospital about HCW management, and measure associations	This was an observational descriptive study among 241 professional and non-professional staff. Data were collected using a questionnaire and analysed using the Statistical	Knowledge of HCW management was generally inadequate, with 42.7% of the participants scoring 'poor' overall. Just over half of the participants reported a good attitude towards the appropriate disposal of HCW but only 53.9% demonstrated good HCW management practices. There was a significant (p < 0.05) relationship between knowledge and practice and	Inadequate knowledge and poor translation into practice signal a disconnect between attitude and effective behavior. Structured training programs that focus not just on knowledge but also on skill application and behavioral reinforcement are vital. Institutional leadership must support a culture of continuous learning and practice audits.

		between these variables.	Package for the Social Sciences.	between attitudes and practices (p < 0.05).	
10	(Onoh et al., 2019) Southeast Nigeria	The study was intended to assess the knowledge and practices of HCWM among the cleaning staff in a Lassa fever (LF) treatment facility.	This was a cross-sectional descriptive study of 234 cleaning staff of Federal Teaching Hospital Abakaliki recruited by systematic random sampling. Data collection was with semi-structured questionnaires	There were 177 (75.6%) female and 57 (24.4%) male cleaning staff with a mean age of 33.4 years (± 8.3). Among all the respondents, 18 (7.7%) had no formal education, while others had varying levels of education (primary, 43 [18.4%]; secondary, 133 [56.8%]; tertiary, 40 [17.1%]). Only 134 (57.3%) of the respondents had ever been trained on HCWM, of which 77 (57.5%) of them were trained in 2018. The proportion of respondents with good knowledge of HCWM was 41.5%. In addition, only 83 (35.5%) properly categorized the body parts, body fluids, and fetuses as pathological waste. About one-third, 77 (33.3%), had knowledge of steps in HCWM and 45.3% knew of diseases transmitted through health-care waste with 171 (62.8%) identifying LF as one of the diseases. The proportion of respondents with good practices of HCWM was 53.9% with only 131 (56.0%) segregating waste in specified color-coded containers. Among the factors examined, none was significantly associated with knowledge and practice of participants on HCWM.	The findings highlight an urgent need for foundational training, especially among cleaning staff who are frontline waste handlers. Educational interventions should consider literacy levels and involve visual aids and supervised practice. Policy should mandate periodic re-training and performance assessments to elevate practice standards and ensure consistent compliance.
11	(Ramodipa et al., 2023) Gauteng Province, South Africa	This study evaluated the status quo of health care waste management plans (HCWMPs) and practices in public health care facilities in Gauteng Province, South Africa.	A situational analysis was employed in health care facilities (HCFs) that generated more than 20 kg (N = 42) of health care risk waste (HCRW) per day.	The results showed that most (79.0%) of the health care waste officers (HCWOs) as well as management (84.6%) agreed to have HCWMPs in place. The majority (76.9%) of the HCFs have a dedicated person appointed to manage health care waste with the majority (67%) being environmental health practitioners. According to management, only 30.8% have formally appointed an integrated HCW committee. Only 11.7% of the HCWOs are guided by the Occupational Health and Safety Act to develop their HCWMPs with only 20.5% with health care waste minimisation strategies in place	While the presence of HCWMPs is encouraging, low adherence to national occupational health legislation and minimal use of waste minimization strategies raise concern. Healthcare institutions need to integrate legal frameworks into operational guidelines and invest in sustainability-oriented waste strategies. Leadership commitment and interdepartmental coordination are essential to achieve this.

12	(Salubi et al., 2022) Ogun State Nigeria	Assess nurses' knowledge about, find out nurses' attitude towards HCW management and identify the factors influencing HCW management among nurses in selected hospitals in Abeokuta, Ogun State	A cross-sectional nonexperimental descriptive survey design and convenient sampling technique was employed	findings of the study which can be deduced that revealed that majority (75.0%) of the respondents have high knowledge on HCW management while only few (25.0%) of them have low knowledge on it. Majorities (88.3%) of the respondents have positive attitude toward health care waste management while only few (11.7%) of them have negative attitude toward it. About factors influencing HCW management among respondents almost all (99.2%) of the factors have high impact and influence on health care waste management while only few (0.8%) of the factors is of low impact on HCW among respondents.	Despite high knowledge and positive attitudes among nurses, the overwhelming impact of external factors suggests that systemic support (resources, policy clarity, infrastructure) is critical. To optimize waste management, hospitals must address contextual barriers through policy interventions, regular training, and structural improvements that align staff capabilities with institutional expectations.
13	(Utip et al., 2025). Nigeria	Waste handlers' health and experiences of healthcare waste management in a Lassa fever treatment centre in Nigeria	This study employed a qualitative case study design, gathering data from healthcare waste handlers (n = 34) through four focus groups.	The findings revealed that waste handlers were subjected to various occupational health risks, including back pain, needlestick injuries, psychological distress, fatigue, anxiety, and prolonged exposure to sunlight. Concerns were raised regarding the inadequate supply of personal protective equipment and other essential tools, which suggests a need for organisational commitment to ensure the continual availability of these resources to protect the health and safety of these employees. A critical issue identified was the lack of comprehensive training for waste handlers, highlighting a form of organisational negligence. The consensual views expressed by the waste handlers indicated a sense of dissatisfaction with their working environment, largely attributable to organisational and societal stigmatisation. Furthermore, the study underscored that the hospital management faced significant financial constraints and advocated for increased funding to effectively implement best practice standards.	To effectively manage healthcare waste and reduce hazards to waste handlers, the organisational leadership should prioritise training and support. This initiative will not only benefit the waste handlers but also the patients, other healthcare workers, and the general public. Although the findings focus on the case context of a Nigerian Lassa fever treatment hospital, the wider implications of this study are linked to the role of institutional support for waste handling practice. Moreover, it extends to the potential positions of institutions as displaying a form of "benign anomie" in not ensuring the wellbeing of waste handlers through sufficient regulation and governance focused on prioritisation, processes, and procedures. The study highlights the relevance of embedding WHO guidelines in other similar contexts as part of implementation across institutions involved with waste handling.

Quality Assessment of included articles

The Critical Appraisal Skills Programme (CASP) checklist was applied to evaluate the methodological rigour of the 14 included studies (Table 3). CASP provides a systematic and replicable framework for assessing credibility, relevance, and trustworthiness across qualitative and quantitative designs (Long, French & Brooks, 2020). Each study was appraised against ten CASP domains: research aims, methodological appropriateness, design adherence, recruitment strategy, data collection rigour, researcher reflexivity, ethical considerations, data analysis quality, clarity of findings, and overall contribution. A three-point rating scale was used (2 = full compliance, 1 = partial, 0 = none). This structured appraisal enabled objective identification of methodological strengths and weaknesses, ensuring that synthesis was grounded in the quality of evidence, not merely reported outcomes.

Table 3: Critical appraisal of the included articles using the CASP checklist

Authors, date, location	Clear Aims	Appropriate Methodology	Research Design	Recruitment Strategy	Data Collection	Reflexivity	Ethical Considerations	Data Analysis	Findings	Value of Research	Total
(Akunneh-Wariso & Nwokoro, 2023).	2	2	2	2	2	1	2	2	2	2	19
(Awodele et al., 2016)	2	2	2	2	2	1	2	2	2	2	19
(Ezirim & Agbo, 2018)	2	2	2	2	2	1	2	2	2	2	19
(Jonathan, 2022)	2	2	2	2	2	1	0	2	2	2	17
(Lizbeth-Mugivhisa et al., 2020)	2	2	2	2	2	1	0	2	2	2	17
(Molosi & Onwubu, 2024)	2	2	2	2	2	1	2	2	2	2	19
(Motlatla & Maluleke, 2021)	2	2	2	2	2	1	2	2	2	2	19
(Mugabi & Chima, 2025)	2	2	2	2	2	0	2	2	2	2	18
(Olaiifa et al., 2018)	2	2	2	2	2	1	2	2	2	2	19
(Onoh et al., 2019)	2	2	2	2	2	1	2	2	2	2	19
(Ramodipa et al., 2023)	2	2	2	2	2	1	2	2	2	2	19
(Salubi et al., 2022)	2	2	2	2	2	0	2	2	2	2	18
(Utij et al., 2025)	2	2	2	2	2	1	2	2	2	2	19
Total	26	26	26	26	26	11	22	26	26	26	241

As Table 4.1 illustrates, scores across the studies were consistently high. The CASP appraisal scores reveal that most of the included studies demonstrated strong methodological quality, with the majority achieving between 17 and 19 out of a possible 20 points. Overall, while methodological robustness is generally high, reflexivity and ethics reporting remain recurring weaknesses.

$$QA = \frac{\text{Total Score Obtained}}{\text{Total possible score if each article get the maximum score}} \times 100$$

Applying the quality assessment formula, $QA = (\text{Total Score Obtained} \div \text{Total Maximum Score}) \times 100$ as seen in the study of (Odubia, Ajileye, et al., 2025; Odubia, Olalere, et al., 2025), the result of $(241 \div 260) \times 100 = 92.69\%$ reflects an overall high level of methodological quality across the included studies. This suggests that, as a collective body of evidence, the articles are largely rigorous in their design, credible in their execution, and sufficiently transparent in their reporting to justify inclusion in the synthesis. From a positive standpoint, such a score implies that the findings drawn from these studies are built on a relatively robust foundation, which strengthens the reliability of any conclusions and recommendations made in this dissertation. Moreover, it indicates that most authors demonstrated clear aims, appropriate methodological choices, coherent designs, and well-articulated findings. However, a balanced interpretation must acknowledge that a high overall score can mask recurring weaknesses in specific domains. Reflexivity, which scored just 42.9% of its possible total, remains a critical gap, suggesting that many studies underexplored the researchers' positionality, potential biases, and influence on the data. Ethical reporting also showed variability, raising concerns about whether all ethical safeguards were rigorously followed or simply underreported. These gaps challenge the assumption that methodological soundness alone guarantees research validity; transparency in reflexivity and ethics is equally vital for trustworthiness. Thus, while the 92.14% score confirms that the evidence base is generally fit for purpose, it also signals the need for the research community to embed deeper reflexive practice and more explicit ethical reporting into future HCWM studies, ensuring that high scores truly reflect comprehensive quality rather than selective methodological strengths.

Ethical Considerations

This scoping review was based entirely on previously published and publicly accessible literature. Therefore, it did not involve direct human participants, and as such, formal ethical approval from an institutional review board was not required. However, the absence of primary data collection does not negate the need for ethical responsibility. Instead it insists on an increased sense of intellectual honesty, transparency and methodological rigour in secondary data synthesis and presentation. Any sources that have been used were duly cited in order to avoid unjust attribution as well as to guard against academic misappropriation. In addition to citation, the findings of each study were interpreted in a proper manner and the results could not be extracted out of context to reach a conclusion predetermined by the researcher. This played a significant role in ensuring credibility of the review, and the ethical duty of respecting the intention of the original authors. Moreover, since this review deals with sensitive topics defined by infection control, public health, and healthcare waste management in two countries of Africa, it was crucial to remain neutral and not to approach this analysis and interpretation inflammatory and biased. Poor practice sensationalisation or bias towards just informing on one area of policy lapse may promulgate an unbalanced criticism or sacred cow treatment which might in turn cement where these stereotypes are directed. Instead, findings were presented critically, with attention to socio-political and institutional contexts that shape nursing practices in Nigeria and South Africa.

3. Results

The perceptions of nurses regarding healthcare waste management in public hospitals in Nigeria and South Africa.

Table 4: Perceptions of nurses regarding healthcare waste management

Subtheme	Verbatim Quotes / Author Insight	
	Nigeria	South Africa:
Knowledge and Awareness of Waste Segregation	<p>“The proportion of respondents with good knowledge... was 41.45%” (Onoh et al., 2019).</p> <p>“Many of the nurses knew waste was to be segregated, but did not know the final disposal process” (Utip et al., 2025)</p> <p>"Majority (98.3%) of the respondents indicated yes with the statement that ‘HCW is defined as all types of waste generated from health care environments, whether it is infectious or non-infectious in nature, chemicals, and hazardous as well as non-hazardous materials’." (Salubi et al., 2022)</p>	<p>South Africa:</p> <p>“Ninety% (90.0%)... knew the proper colour coding for waste” (Lizbeth-Mugivhisa et al., 2020).</p> <p>“Majority (n=30; 88.2%) correctly indicated ‘yellow’ and ‘red’” for infectious waste (Moloiisi & Onwubu, 2024).</p> <p>“Nurses’ knowledge of HCW management was better than that of the other healthcare professionals, with an aggregate of 63% of nurses scoring ‘good’ or ‘excellent’” (Ramodipa et al., 2011).</p>
Attitude and Commitment to Best Practices	<p>“Respondents agreed to a great extent that they comply with WHO guidelines... but colour codes are used... to a low extent” (Akunneh-Wariso & Nwokoro, 2023).</p> <p>“We are always willing to do what is right, but the hospital doesn’t give us everything we need... We still try” (Utip et al., 2025).</p>	<p>“82%... felt there were enough management measures... but 71.4% of nurses felt there were not enough” (Lizbeth-Mugivhisa et al., 2020).</p> <p>“85.3%... indicated the training helped change their understanding of isolation waste” (Moloiisi & Onwubu, 2024).</p>
Practice Gaps and Barriers to Implementation	<p>“Only 56.0% segregating waste in specified color-coded containers” (Onoh et al., 2019).</p> <p>“I have never seen them involve the waste handlers in these trainings... they do as they think is right” (Utip et al., 2025)</p>	<p>“74.0%... used the correct bins for disposing the needles... but 64% of nurses had been exposed to needle pricks” (Lizbeth-Mugivhisa et al., 2020).</p> <p>“General waste becomes contaminated... as HCW segregation is not done properly” (Motlatla & Maluleke, 2021).</p>
Perceived Link to Nosocomial Infections and Safety Risks	<p>“Improper waste handling... linked... to higher rates of hospital-acquired infections” (Jonathan, 2022).</p> <p>“There was a case... who was pricked... and... diagnosed with hepatitis B infection. She stopped work because of the sickness” (Utip et al., 2025)</p>	<p>“49.0% mentioned infections as the most common risk” (Lizbeth-Mugivhisa et al., 2020).</p> <p>“100%... recognised the importance of wearing protective clothing” (Moloiisi & Onwubu, 2024).</p>
Institutional Systems and Resource Constraints	<p>“47.6% indicated the non-availability of all the required categories of colour-coded containers” (Onoh et al., 2019).</p> <p>“22.2% of health facilities had standard incinerators... the rest disposed of waste by open air burning or burying” (Ezirim & Agbo, 2018)</p> <p>“When you talk of infection prevention and control you need certain resources and equipment, but the hospital cannot afford all these things” (Utip et al., 2025).</p>	<p>“44.8% of all facilities sampled had healthcare waste management plans... 41.4% had a designated person or department” (Ramodipa et al., 2011).</p> <p>“Less than half (47.1%) of the HCFs having no HCW committee in place” (Motlatla & Maluleke, 2021).</p>

The practices of nurses in handling healthcare waste in public hospitals in Nigeria and South Africa.

Table 5: Practices of nurses in handling healthcare waste in public hospitals in Nigeria and South Africa

Subtheme	Verbatim Quotes / Author Insight	
	Nigeria:	South Africa:
Compliance with Guidelines and Policies	<p>“Waste segregation was carried out in 89.2% of health facilities” (Ezirim & Agbo, 2018)</p> <p>yet “no enforced policy...such as colour coding and labelling” (Jonathan, 2022).</p>	<p>“82% felt enough measures were enforced... but 71.4% of nurses disagreed” (Lizbeth-Mugivhisa et al., 2020).</p> <p>“79% reported having HCWMP in place” (Ramodipa et al., 2023).</p>
Risk of Nosocomial Infections from Poor Practices	<p>“Needle stick injuries...higher among nurses (18%) and waste handlers (29%)” (Jonathan, 2022).</p> <p>“57.3% had not received any form of training” (Onoh et al., 2019).</p>	<p>“64% of nurses had been exposed to needle pricks” (Lizbeth-Mugivhisa et al., 2020)</p> <p>“Improper segregation contaminates general waste” (Motlatla & Maluleke, 2021).</p>

The systemic factors affecting the implementation of proper waste management practices by nurses in Nigeria and South Africa.

Table 6: Systemic factors affecting implementation of proper waste management by nurses in Nigeria and South Africa

Subtheme	Verbatim Quotes / Author Insight	
	Nigeria	South Africa:
Inadequate & inconsistent training on HCWM	<p>“Lack of training, especially among healthcare waste handlers... limited budgets for training purposes” (Jonathan, 2022).</p> <p>“Only 134 (57.3%) of respondents had received any form of training on HCWM” (Onoh et al., 2019).</p>	<p>“Only 51 (35.42%) health professionals... were trained on HCRW management” (Motlatla & Maluleke, 2021).</p> <p>“Just under half... reported that they have never received any formal training in HCW management” (Olaifa et al., 2018).</p>
Weak enforcement of policies & lack of dedicated HCWM structures	<p>“No dedicated department to deal with HCWM... No enforced policy in place” (Jonathan, 2022).</p> <p>“44.8%... had healthcare waste management plans developed from the national policy” (Ezirim & Agbo, 2018).</p>	<p>“More than half... had no knowledge of the availability of policy documents... no HCW committee in place” (Motlatla & Maluleke, 2021; Ramodipa et al., 2023).</p> <p>“Waste segregation was significantly but weakly associated with knowledge of the recommendations in the waste management implementation plan (p=0.028; V=0.14).” (Mugabi & Chima , 2025)</p>
Knowledge–practice gaps and occupational risk link	<p>“Adverse human health... is dependent on HCW management knowledge... higher cases of needle stick injuries and hepatitis B & C among nurses” (Jonathan, 2022).</p> <p>“Only 33.3%... could identify colour code for infectious waste as yellow” (Awodele et al., 2016).</p> <p>“Majority (34.2% and 42.5%) of the nurses strongly agreed and agreed (respectively) that ‘inconsistent correct labeling of the waste bins using the colour coding schedule’ (mean = 3.88) is a factor that influence HCW management.” (Salubi et al., 2022)</p>	<p>“Unsafe HCW disposal practices are placing staff, patients and the hospital environment at risk” (Olaifa et al., 2018).</p> <p>“Most of the nurses (64%) had been exposed to needle pricks” (Lizbeth-Mugivhisa et al., 2020).</p>

The relationship between poor healthcare waste management practices and the risk of nosocomial infections in public hospitals in Nigeria and South Africa.

Table 7: Link of poor HCW management to nosocomial risk.

Subtheme	Verbatim Quotes / Author insight (from uploaded file)
Knowledge gaps about HCW policy, colour-coding and disposal	<p>“Ninety% (90.0%) and eighty one% (81.0%) of the participants knew the proper colour coding for waste and the signs of each waste bin at the hospital respectively whereas only 10.0% and 19.0% did not know about the proper colour coding for waste bins and the signs of each waste bin at the hospital.” (Lizbeth-Mugivhisa et al., 2020)</p> <p>“Just under half of the participants reported that they have never received any formal training in HCW management.” (Olaifa et al., 2018).</p>
Poor segregation practices despite stated knowledge	<p>“We are committed to our jobs, but the non compliance often comes from most HCW as there is no segregation of wastes at source.” (Jonathan, 2022)</p> <p>“Only 51.2% of other professionals and 52.8% of nurses reported sorting HCW when depositing it into collection bins... 33% reported temporary piling of medical waste in open spaces.” (Olaifa et al., 2018)</p> <p>“Waste segregation was carried out in 89.2% of health facilities but proper treatment facilities existed in far fewer (only 22.2% had standard incinerators).” (Ezirim & Agbo, 2018)</p>
Needle-stick injuries and bloodborne infections reported among staff	<p>“Reported cases of needle stick injuries were higher among the healthcare waste handlers (public-hospitals = 29%) and nurses (public-hospitals = 18%). ... recorded hepatitis B & C infection rates were higher among the healthcare waste handlers (public-hospitals = 37%) and nurses (public-hospitals = 13%).” (Jonathan, 2022)</p> <p>“she was pricked with an infected needle, and after a few months, she fell sick and was diagnosed with hepatitis B infection.” (Utip et al., 2025)</p> <p>“20.0% of the participants had been pricked with needles; 7.0% had been exposed to infections.” (Lizbeth-Mugivhisa et al., 2020)</p>
Training (frequency and inclusivity) affects practice	<p>“Most (69%) indicated that they had received training while only 30% had not received any form of training.” (Lizbeth-Mugivhisa et al., 2020)</p> <p>“Only 57.3% of the respondents had received any form of training on HCWM.” (Onoh et al., 2019)</p> <p>“I have never seen them involve the waste handlers in these trainings.” (Utip et al., 2025)</p>
Resource constraints (PPE, colour-coded bins, incinerators) and outsourcing	<p>“The hospital cannot afford all these things. Even training requires funds. So, the major challenge is finance.” (Utip et al., 2025)</p> <p>“22.2% of health facilities had standard incinerators for proper treatment of hazardous waste; the rest disposed of waste by open air burning or burying at the facility.” (Ezirim & Agbo, 2018)</p> <p>47.6% (115) indicated the non-availability of all the required categories of colour-coded containers (Olaifa et al., 2018).</p>
Management/governance: policy documents exist but implementation/committees are weak	<p>“44.8% of facilities had HCW management plans developed from the national policy; (Ezirim & Agbo, 2018)</p> <p>41.4% had a designated person/department to operate and monitor HCW disposal.” (Ezirim & Agbo, 2018)</p> <p>“Only 24% reported that an integrated HCW committee has been formally appointed; 47.1% of HCFs had no HCW committee in place.” (Gauteng, South Africa).</p> <p>“More than half (53.8%) of management reported having HCW included in their job descriptions, but only 15.3% reported ensuring HCWMPs are completed and approved.” (Ramodipa et al., 2023)</p>
Direct link: association between poor HCWM knowledge/practice and adverse health outcomes	<p>“Reported/recorded adverse human health among the health workers significantly is dependent on health workers’ (Jonathan, 2022)</p> <p>HCW management knowledge. Health workers with no HCW management knowledge significantly had higher reported cases of needle stick injuries and hepatitis B & C infections (Ezirim & Agbo, 2018)</p> <p>“Waste segregation was significantly, but weakly, associated with training regarding healthcare waste differentiation (Mugabi & Chima, 2025)</p> <p>knowledge significantly positively correlated with practice scores.” (Mugabi & Chima, 2025)</p>

4. Discussion

Perceptions of nurses regarding healthcare waste management in public hospitals in Nigeria and South Africa.

The lesson from the scoping of the literature as shown in Table 4 is that practice gaps are multidimensional: they may stem from procedural omission, unsafe shortcuts, or breakdowns in other aspects of the waste management chain, attitudes and barriers to behavioural change. The findings on nurses' perceptions of healthcare waste management (HCWM) in Nigeria and South Africa (as depicted in Table 4) reveal a paradox of high general awareness yet persistent gaps in technical precision, practical application, and systemic support. The domains of knowledge and awareness, Nigerian studies reported notably high overall knowledge rates, with some studies showing up to 99% of respondents demonstrating awareness of HCWM principles (Abiola et al., 2011; Salubi et al., 2022). However, the same studies identified weaknesses in specific technical areas, such as colour coding for infectious waste, where only 19.4% could identify the correct bin (Abiola et al., 2011). This disconnect between general awareness and technical detail is not isolated to Nigeria. A broader African review by Emilia, Julius, and Gabriel (2015) confirmed that inappropriate use of colour codes and symbols remains a recurrent weakness in waste management systems across the continent. Similarly, Adu et al. (2020), in their study of Ghanaian hospitals, found that while staff recognised types of healthcare waste, many could not correctly label or match them to the appropriate colour codes, leading to unsafe practices and occasional mixing of hazardous and non-hazardous waste. The implications are particularly significant for nurses, given that they constitute the primary handlers of waste at the point of generation. Although awareness levels are high, the inability to translate such awareness into accurate technical application suggests that training is either inadequate or inconsistently reinforced. Affordofe et al. (2025) demonstrated this gap among waste handlers in Ghana, who, despite recognising categories of waste, struggled with the practical task of applying correct colour codes. Their findings parallel Nigerian and South African evidence, indicating that lapses in technical precision compromise segregation and increase the risk of nosocomial infections.

South African studies show relatively stronger alignment with technical standards, with 90% of participants in Pretoria hospitals knowing the correct colour codes for infectious waste (Lizbeth-Mugivhisa et al., 2020), and 88.2% in Gauteng identifying yellow and red as the appropriate markers (Molosi & Onwubu, 2024). However, even in South Africa, there are lapses even though stated high levels of knowledge are achieved, due to inconsistent coding, poor enforcement in certain areas (Motlatla & Maluleke, 2021). This implies that, one needs technical knowledge though it is not sufficient with the absence of effective institutional systems. This implies that cognitive understanding of HCWM as an abstract concept may not automatically translate into the skills of the actual application of safety and compliance-enabling practical details. What this means is that the competence of HCWM should be based not only on general awareness that is measured through surveys but also on tasks-oriented assessments. Unlike waste management handlers, South African nurses exhibited a high level of consistency in knowing technical background with 88.2 to 90% getting their answers right when it comes to the colour code of infectious waste (Lizbeth-Mugivhisa et al., 2020; Molosi & Onwubu, 2024). This implies that the intellectual understanding of HCWM as an intangible notion is not always applicable to the knowledge of practical particulars that guarantee the safety and adherence. It means that the competence of HCWM cannot be checked in terms of general awareness surveys but also the ability to process specific tasks. Compared to waste management handlers, South African nurses exhibited more aligned technical knowledge, and 88.2% to 90% of the nurses gave the right answers to colour codes of infectious waste (Lizbeth-Mugivhisa et al., 2020; Molosi & Onwubu, 2024). This suggests that structured and standardised training frameworks in South Africa may be more effective at embedding procedural knowledge.

When comparing both countries, important differences emerge from the studies. In Nigeria, Abiola et al. (2011) cited that notwithstanding the fact that 99 % of nurses reported awareness of HCWM principles, they were only able to identify colour code of infectious waste correctly in 19.4 % of the study participants, a finding replicated in the study by Onoh et al. (2019) that only half the number of nurses were identified to correctly put waste in colour-coded containers. This is shown to be a paradox of high general senses and little technical accuracy. On the contrary, South African researches demonstrate greater procedural accuracy. Lizbeth-Mugivhisa et al. (2020) revealed a successful recognition rate of colour codes in 90% of nurses, whereas Molosi and Onwubu (2024) state that 88.2% of them would use proper coding of infectious waste. Such results indicate that South African training and policy frameworks might be more effective in the entrenchment of technical competence. However, it is impossible to attribute the differences solely to the training. In the case of Nigeria, the research findings emphasize the system-wide vulnerabilities like the lack of colour-coded bins and enforcement of the existing policies (Ezirim & Agbo, 2018; Jonathan, 2022), but in South Africa, the research findings express the discrepancies in application and overall underreporting of unsafe behavior despite the existence of the stronger frameworks (Motlatla & Maluleke, 2021). Thus, the comparison reflects broader disparities in health governance, professional development, and institutional accountability. A balanced perspective indicates that while South Africa shows higher technical compliance, gaps in enforcement and occupational safety remain, and Nigeria, despite higher awareness levels, requires more consistent training, resourcing, and policy implementation to translate knowledge into practice.

A competing argument, however, is that while technical knowledge is important, it does not automatically translate into safer or more compliant behaviour. Research through both Nigeria and South Africa has indicated that a positive behavioural change can be achieved through a concoction of reinforcing mechanisms, availability of resources and institutional culture. In another example, Mugabi and Chima (2025) established that training combined with frequent workshops and supervisory checkups

were also associated with a high positive correlation of the performance of nurses with regard to good segregation practices. In the same pattern, Ramodipa et al. (2023) observed that the existence of healthcare waste management committees among South African hospitals helped to ensure accountability, and peer learning that was likely to promote continued compliance. The implication of these findings is that behavioural change is more probable when the knowledge is incorporated in well-structured networks of back up, assessment and institutional reinforcement. Meanwhile, there are several barriers that remain unaddressed, which do not allow nurses to translate their knowledge into practice. Lack of colour-coded bins, non-functional incinerators, and a lack of training budget can be considered the most common obstacles in Nigeria (Abiola et al., 2011; Jonathan, 2022; Ezirim & Agbo, 2018). Better-resourced South African hospitals also mention spotty enforcement of safety policies and an underreporting of unsafe behaviors, like recapping needles or an informal waste storage (Lizbeth-Mugivhisa et al., 2020; Motlatla & Maluleke, 2021). Some barriers are common to both contexts, such as exposure to needle-stick injuries and insufficient vaccination coverage against hepatitis B, while others are more context-specific. Nigerian hospitals are more affected by infrastructural deficits and irregular supplies, whereas South African facilities face challenges of enforcement and accountability despite stronger legal frameworks.

Olaifa et al. (2018) observed that in South Africa, even with relatively high technical competence, lapses in segregation and exposure to contaminated waste still occurred, suggesting that behavioural and institutional enablers are equally critical. The behavioural enablers bring forth provisions like the refresher training, peer accountability and staff motivation, which have been found to enhance compliance to waste segregation practices and minimise unsafe shortcuts (Mugabi & Chima, 2025; Affordofe et al., 2025). Institutional enablers, on the contrary, are described as systemic provisions like proper availability of colour coded bins and protective utilities, forming functional waste committees, and monitoring mechanisms of supervising it in all respects, which amplifies consistency of practice (Ramodipa et al., 2023; Adu et al., 2020). This implies that enhancing the perception should be accompanied by thorough reinforcement of procedural adherence by use of monitoring and feedback systems. One approach is that the underlying issue is the nature of training contents, regularity, and inclusiveness. In Nigeria, Abiola et al. (2011) found that although 99% of nurses were aware of HCWM principles, only 19.4% could correctly identify the bin for infectious waste, highlighting weaknesses in the specificity of training content. Similarly, Onoh et al. (2019) reported that only 57.3% of respondents had ever received training on HCWM, showing inconsistency in coverage. By contrast, South African studies suggest more structured training frameworks, with 85.3% of nurses trained in isolation waste practices (Molosi & Onwubu, 2024). Mugabi and Chima (2025) further demonstrate that training correlated positively, though weakly, with segregation practices, suggesting that while training does improve competence, its impact depends on how it is reinforced.

An alternative perspective is that training alone cannot guarantee compliance unless embedded in supportive institutional systems. Evidence from Nigeria highlights systemic gaps: shortages of bins, lack of incinerators, and absence of dedicated HCWM departments often undermine safe practice regardless of staff knowledge (Jonathan, 2022; Ezirim & Agbo, 2018). In South Africa, despite stronger frameworks, systemic weaknesses such as inconsistent enforcement and underreporting of unsafe practices continue to compromise compliance (Motlatla & Maluleke, 2021). Ramodipa et al. (2023) show that hospitals with functional HCWM committees and supervisory mechanisms achieved more consistent adherence, underscoring the role of institutional reinforcement. Therefore, systems-level factors such as resource provision, monitoring, and policy enforcement appear just as critical as knowledge itself in shaping behaviour. This suggests that structured and standardised training frameworks in South Africa may be more effective at embedding procedural knowledge. When comparing both countries, notable contrasts become clear. Evidence in Nigeria, as seen in Abiola et al. (2011) and Onoh et al. (2019) reveals the same paradox with 70.6% of nurses knowing the bin that infectious waste should be disposed of and only half of them putting waste into containers using colour as a guide. In comparison, evidence in South Africa indicates increased procedural accuracy; it was 88.2 to 90% of nurses showed proper application of a colour code (Lizbeth-Mugivhisa et al., 2020; Molosi & Onwubu, 2024). Such differences can not only show more formalised and standardised training regimes in South Africa, but also differences in health governance, resource allocation and professional development pathways between the two states.

Attitudes and commitment are the major issues in ensuring that improvements in HCWM can be achieved. According to several studies, a positive attitude toward the right waste management is generally observed among nurses in Nigeria as well as South Africa. The study by Abiola et al. (2011) in Nigeria revealed that 94.4% of the respondents have intentions of attending HCWM seminars, whereas Salubi et al. (2022) reported an 88.3% positive attitude towards HCWM of nurses. The same results can be observed in South Africa, where it was mentioned by Molosi and Onwubu (2024) that 85.3% of nurses recognized the fact that training helped them better understand isolation waste. Nevertheless, the sole change of attitudes is not always the change of behaviour. Akunneh-Wariso and Nwokoro (2023) confirmed that WHO compliance was intermittent even though the intents of compliance were reported. Similarly, Lizbeth-Mugivhisa et al. (2020) found that even with positive attitudes, over 64% of nurses reported experiencing needle-stick injuries, revealing gaps between intention and safe practice. For behavioural change to occur, positive attitudes must be supported by enabling conditions such as adequate knowledge, access to resources, mentorship, and institutional rewards. What Utip et al. (2025) demonstrate is that in Nigeria, nurses were open to following instructions but did not receive even basic resources to do so, but as a result, they became frustrated and simply improvised, despite this being unsafe. In comparison, as the analysis in Lizbeth-Mugivhisa et al. (2020) of South Africa nurses found, similar to the current phenomenon, they recognized the importance and usefulness of training, yet the institutional support apparatus was too weak, with no proper monitoring and implementation of hospital waste regulations. These results show that

the lack of resources, poor supervision, and lack of incentives are the institutional gaps which erode translation of positive attitudes into sustainable behavioural change.

The high point of tension of the whole work is revealed around a question of whether the good attitudes can be fully employed to forecast positive practice even in situations of low resources. Other researchers believe that a driven labour force can offset shortages with adaptive dynamic accounting options (Ferreira et al., 2024). Nevertheless, in a highly governable field like HCWM, improvisation can increase the dangers of contamination and occupational exposure (WHO, 2022). Nigerian evidence indicates that intent to comply is commonly verbalised by nurses; however, structural factors like the inadequacy of protective equipment or inadequate quantities of colour-coded bins are found to prevent the repetitive enactment of expressed intentions in the safe practice (Utip et al., 2025; Abiola et al., 2011). Likewise, South African nurses show positive feedback on training and awareness programmes but still, there are gaps in the areas like recapping a needle and insufficient usage of PPE (Lizbeth-Mugivhisa et al., 2020). Taken together, this suggests that attitudes are an essential foundation but insufficient on their own; sustainable change requires reinforcement through adequate resources, continuous training, and institutional monitoring. Both Nigeria and South Africa show gaps between knowledge and practice, but the scale and nature of these gaps differ. In Nigeria compliance with segregation is poor (56% compliance, 56% of nurses use coloured-coded bins (Onoh et al., 2019) and some even segregate waste to a relative of the patient (Abiola et al., 2011), which represents both poor institutional efforts and cultural influences. In South Africa, on the contrary, compliance with segregation regulations is somewhat higher (Lizbeth-Mugivhisa et al., 2020), but occupational exposures are also common because 64% of nurses indicate needle-stick injuries. This comparison implies that the issues facing Nigeria are grounded in poor institutionalisation of norms and severe resource scarcities whereas those in South Africa revolve around the reinforcement of behaviour and good dealing behaviour in a safe manner. The implication is that interventions must be tailored: Nigeria requires stronger institutional infrastructure and policy enforcement, whereas South Africa needs targeted behavioural interventions such as eliminating needle recapping and reinforcing PPE use.

Practices of nurses in handling healthcare waste in public hospitals in Nigeria and South Africa.

The practices of nurses in handling healthcare waste in public hospitals form a crucial determinant of infection prevention outcomes and occupational safety in both Nigeria and South Africa (as shown in Table 5). The technical competence of nurses in the waste segregation context and colour coding is a critical point of departure in assessing practice since it is a basic skill in the context of healthcare waste management. Lizbeth-Mugivhisa et al. (2020) reported 90% of the South Africa respondents knowing the correct colour coding of waste and 88.2% of the respondents correctly named yellow and red as infectious waste (Molosi and Onwubu 2024). These statistics indicate that there is a fair and decent level of technical competency of the nurses which is critical since proper segregation at the source of generation minimises cross contamination and disposal cost down the line. Nonetheless, other sources depict that colour coding was not always used throughout all staff types. In Ghana, Adu et al. (2020) concluded that non-nursing personnel (including waste handlers) experienced problems associating waste types to appropriate colour codes, which was also identified by Affordofe et al. (2025) in their research on Southern Ghana, when even competent nurses could not maintain appropriate segregation because of the failure of the auxiliary team. Similarly, Emilia et al. (2015) highlighted that inappropriate use of colour codes remains a persistent weakness in African healthcare systems, suggesting that while nurses may achieve higher technical accuracy, overall compliance can still be undermined by gaps among non-nursing staff.

By contrast, Nigerian data show persistent gaps, with only 19.4% of respondents in Abiola et al. (2011) knowing the correct colour code for infectious waste, and Awodele et al. (2016) reporting only 33.3% identifying yellow for infectious waste. This difference can be indicative of the systemic differences in the pre-service training, rates and quality of in-service capacity building, and waste management content integration into the nursing curriculum. Nevertheless, Mugabi and Chima (2025) offer a more balanced interpretation of the results, as the laboratory personnel had indeed better training scores in practice compared with the nurses and doctors, and the training was found to be significantly and yet weakly related to waste segregation ($p=0.025$). This relative lack of correlation indicates that although training is capable of affecting behaviour, it is not significant whether or not employees will comply with it and the other structural issues, like workloads and institutional observation could play a more significant role. Mugabi and Chima (2025), in their critique, mention that staff in the laboratory managed to get higher scores in practice than nurses and doctors, and that waste segregation was also strongly connected to training, but the links were weak ($p=0.025$). This means that training will only be effective when it is accompanied by a supportive institutional framework that would minimize limitations to workloads and also offer periodic supervision. Therefore, while South Africa's stronger performance in colour coding indicates institutional advantages, the Nigerian case underlines the fragility of practice when training is inconsistent or inadequately reinforced.

Governance and Policy Enforcement

Compliance with guidelines and policies offers another lens for understanding practice quality, but it ultimately reflects broader governance dynamics. In Nigeria, Ezirim and Agbo (2018) indicated that out of 89.2% of the health facilities, waste segregation occurs, but Jonathan (2022) pointed out the lack of implemented laws on crucial activities like colour coding, and labelling. Such variance casts doubt on the actual compliance reported as Lip service being paid on the issue of adherence or just name alignment with no long term enforcement. Governance systems seem to be more formalised in South Africa, where Ramodipa

et al. (2023) discovered that 79% of facilities possessed healthcare waste management plans [HCWMPs] and Lizbeth-Mugivhisa et al. (2020) wrote that 82% of participants assumed actions to be implemented. Yet, in the same research 71.4% of the nurses surveyed in the study did not agree with that perception indicating a disconnect between the self-perception of the management and the ground opinion among the frontline employees. This divergence matters because when enforcement mechanisms are perceived as weak or inconsistent, compliance becomes situational rather than habitual.

Training Impact

Training and capacity building are central to bridging the gap between policy and practice, yet their impact across Nigeria and South Africa is uneven. In Nigeria, training remains limited and fragmented, with Abiola et al. (2011) reporting that 68.9% of nurses had attended a healthcare waste seminar, while Onoh et al. (2019) found only 57.3% had received any form of training. These figures suggest a reliance on ad-hoc, often donor-driven workshops that fail to reach all nurses or to address workplace-specific realities. By contrast, South African studies indicate a stronger institutionalisation of training, with 85.3% of nurses trained on isolation waste practices (Moloi & Onwubu, 2024) and 69% receiving training on waste disposal (Lizbeth-Mugivhisa et al., 2020). This comparatively broader coverage reflects greater integration of healthcare waste management into national occupational health programmes and routine hospital orientation processes. However, evidence also suggests that the impact of training is modest when unaccompanied by reinforcement. Mugabi and Chima (2025) found that although training correlated with improved segregation, the effect size was weak, highlighting the need for continuous refresher sessions, peer accountability, and supervisory oversight to sustain behavioural change. Thus, training can create awareness and basic competence, but its long-term impact depends on being embedded within institutional performance systems rather than delivered as isolated events.

The implications of a continued delay in correct management of hospital waste are profound. Particularly in light of changing factors (eg. global warming increases the risk of highly transmissible fatal infections). The occupational risks arising from poor practices, particularly the risk of nosocomial infections, underscore the urgency of closing practice gaps. In Nigeria, Jonathan (2022) reports that needle-stick injuries were higher among nurses (18%) and waste handlers (29%), which is concerning given the high prevalence of bloodborne pathogens like hepatitis B in the region. In South Africa, Lizbeth-Mugivhisa et al. (2020) found that 64% of nurses had been exposed to needle pricks, while Motlatla and Maluleke (2021) identified improper segregation as a cause of general waste contamination. While at first glance South African exposure rates seem higher, this may be due to more comprehensive reporting systems, whereas underreporting is a known issue in Nigerian healthcare facilities. This distinction matters because accurate data are essential for targeted interventions, yet cultural or institutional barriers to reporting can create an illusion of safety where risks remain high. Furthermore, both contexts illustrate that technical compliance, such as correct segregation, does not automatically eliminate occupational hazards if complementary safety measures like sharps disposal training, PPE provision, and post-exposure prophylaxis protocols are not rigorously enforced.

A cross-cutting theme in these findings is that the persistence of unsafe practices is not simply a matter of individual negligence but often reflects deeper systemic constraints. Nigerian institutions, according to Jonathan (2022) regularly run non-enforceable policy frameworks and use obsolete infrastructure, and do not have enough oversight capacity. The hospitals in South Africa are more typically better prepared, however, they also experience enforcement inconsistencies as well as represent a lack of translation of formal plans into coherent frontline practice. This fact implies that the multi-level solution that comprises of individual skills, institutional structure, and national policy systems are going to be needed to ameliorate the situation on the level of nurses. The place of professional autonomy comes under question as well: should there be professional discretion in waste management regulations to fit the local context or should rigid standardisation be the priority even at the risk of lack of compliance to such regulations in poorly resourced settings?.

Continued issuances regarding waste management in Nigeria and South Africa put this issue into perspective as to why waste management in healthcare is such a vital issue. Accommodated issues are insufficient colour-coded bins, poor policy enforcement, poor training and high levels of occupational exposure to injuries including needle-stick injuries (Abiola et al., 2011; Lizbeth-Mugivhisa et al., 2020; Jonathan, 2022). Such problems are further worsened by the problem of institutional complacency whereby policies exist on paper but there is never regular monitoring and accountability of them. Projected concerns relate to the increasing volume of healthcare waste generated by expanding hospital systems, rising antimicrobial resistance which heightens the risks of cross-contamination, and the growing costs of safe disposal technologies, which may further strain underfunded facilities. Against this backdrop, several forward-looking strategies emerge. To begin with, in both Nigeria and South Africa, there is the need to enhance the exposure of pre-service nursing students to healthcare waste management to the point that every nursing graduate would leave pre-service and join the workforce with a good sense of technical and procedural proficiency. Second, the current emphasis on one-off seminars in in-service training must be replaced by more competency based programme that are embedded and related to performance appraisal and career progression. Third, to assure real-time data management, the digital monitoring system can be implemented and piloted to monitor the precision of segregation, the usage of PPE and exposure cases. Fourth, national policy frameworks must move beyond prescriptive guidelines to include enforceable accountability mechanisms, possibly through regular external audits tied to funding allocations. Finally, fostering cross-country learning exchanges between Nigerian and South African hospitals could accelerate the spread of best practices, as each context offers valuable lessons for the other.

Systemic factors affecting the implementation of proper waste management practices by nurses in Nigeria and South Africa

The ability of nurses to implement proper healthcare waste management (HCWM) practices is heavily influenced by systemic factors that extend beyond individual competence (as seen in Table 6). A foundational systemic factor is the adequacy and consistency of HCWM training. In Nigeria, Jonathan (2022) highlights the lack of training among healthcare waste handlers, attributing this to limited budgets. Onoh et al. (2019) found that only 57.3% of respondents had received any form of HCWM training, indicating that almost half of the workforce is likely operating without formal instruction. This matters because training equips nurses with the procedural competence to carry out safe waste segregation, storage, and disposal. In South Africa, the picture is not uniformly better. Motlatla and Maluleke (2021) report that only 35.42% of health professionals had been trained on healthcare risk waste management, while Olaifa et al. (2018) found that just under half of respondents had never received formal training. These figures suggest that even within a more structured policy environment, training provision is uneven and often dependent on facility-level priorities rather than national mandates. Advocates for improved training argue that without consistent skill development, nurses cannot be expected to translate policy into practice effectively. However, others contend that training alone is insufficient without the tools and institutional culture to support its application. The consensus emerging from these perspectives is that training must be regular, inclusive, and integrated into a broader system of operational support. The enforcement of policies and the existence of dedicated HCWM structures form another pillar of systemic implementation. Nigerian hospitals often lack both, as Jonathan (2022) notes the absence of a dedicated department for waste management and the non-existence of enforced policies. Ezirim and Agbo (2018) found that while 44.8% of facilities had HCWM plans adapted from national policy, this still leaves a majority without such frameworks. The absence of enforcement means that even when policies exist, they risk becoming symbolic documents without tangible impact. In South Africa, Ramodipa et al. (2023) report that more than half of respondents did not know whether policy documents were available, and Motlatla and Maluleke (2021) note that many facilities lacked a waste management committee. The weak correlation between waste segregation and knowledge of the implementation plan, as reported by Mugabi and Chima (2025), suggests that policy awareness does not necessarily drive practice in the absence of consistent oversight.

Resource and infrastructure constraints remain one of the most tangible barriers to effective HCWM. In Nigeria, Jonathan (2022) points to shortages of safety boxes and inadequate budgets for waste management, while Abiola et al. (2011) reveal that a significant number of nurses leave healthcare waste for patients' relatives to dispose of, a practice that undermines infection control principles. This is symptomatic of a system where staff may be willing to comply but are hampered by material shortages. In South Africa, Olaifa et al. (2018) found that 47.6% of respondents reported the non-availability of all required colour-coded containers, and Ramodipa et al. (2023) noted that more than 70% of healthcare facilities lacked formal conservation strategies. This suggests that even in a better-resourced context, distribution and maintenance of equipment are inconsistent. Proponents of prioritising infrastructure argue that without basic tools such as bins, PPE, and treatment facilities like incinerators, safe HCWM is structurally impossible. Others caution that resource provision without behavioural enforcement may result in underutilisation or misuse of equipment. The balance lies in ensuring that infrastructure investment is accompanied by training, monitoring, and a maintenance culture that sustains equipment functionality.

The persistent gap between knowledge and practice, and its direct link to occupational risk, is perhaps the most critical systemic challenge. In Nigeria, Jonathan (2022) connects adverse health outcomes, including higher rates of needle-stick injuries and hepatitis B and C among nurses, to deficiencies in HCWM knowledge and practice. Awodele et al. (2016) reported that only 33.3% of respondents could identify yellow as the correct colour code for infectious waste, and Salubi et al. (2022) found that a large proportion of nurses acknowledged inconsistent bin labelling as a major influencing factor. In South Africa, Olaifa et al. (2018) concluded that unsafe disposal practices place staff, patients, and the environment at risk, while Lizbeth-Mugivhisa et al. (2020) reported that 64% of nurses had been exposed to needle pricks. This illustrates that even when knowledge is present, translating it into safe, routine practice is hindered by systemic factors such as workload, resource gaps, and insufficient monitoring. Some scholars argue that this gap reflects a failure in behavioural reinforcement strategies, while others suggest that it is an inevitable outcome of operating within resource-constrained health systems. Bridging this gap requires a dual focus on reinforcing positive behaviours and eliminating systemic barriers that make unsafe practices the path of least resistance. Future strategies must therefore move beyond isolated interventions to create a coherent, multi-level framework for HCWM improvement. First, both Nigeria and South Africa should institutionalise mandatory, periodic training for all healthcare staff, including auxiliary personnel, to standardise competence across professional categories. Second, national health authorities must enforce the establishment of dedicated waste management committees in all public hospitals, with clear reporting lines and performance targets. Third, infrastructure investment should prioritise both availability and sustainability, ensuring that equipment is maintained and replaced as needed. Fourth, monitoring and evaluation systems, potentially supported by digital tools, should be introduced to track compliance in real time and provide actionable feedback. Finally, cross-sectoral collaboration between health, environment, and education ministries could foster a more holistic approach, integrating HCWM into broader public health and environmental sustainability agendas.

Relationship between poor healthcare waste management practices and the risk of nosocomial infections in public hospitals in Nigeria and South Africa.

The relationship between poor healthcare waste management (HCWM) practices and the risk of nosocomial infections is both direct and multidimensional, spanning issues of knowledge, policy, practice, resources, and governance (as evident in Table 7). One of the most fundamental drivers of risk is the gap between general HCWM awareness and specific procedural knowledge. Nigerian studies, such as Abiola et al. (2011), reveal that while 99.0% of respondents claimed good knowledge of HCWM, only 19.4% knew the colour code for infectious waste. This is a critical weakness because colour coding is the first safeguard in preventing cross-contamination between hazardous and non-hazardous waste streams. South African data from Lizbeth-Mugivhisa et al. (2020) show a better picture, with 90% of respondents knowing correct colour codes, but Olaifa et al. (2018) report that almost half had never received formal HCWM training. This implies that even in settings with stronger regulatory frameworks, knowledge may be unevenly distributed across staff categories. While some might argue that practical experience compensates for gaps in formal training, the documented persistence of unsafe practices suggests otherwise. Therefore, specific and technical knowledge, supported by regular training, must be seen as a non-negotiable prerequisite for reducing nosocomial risk.

Poor segregation practices emerge as a second and more visible risk factor, with significant implications for the spread of healthcare-associated pathogens. In Nigeria, Jonathan (2022) notes the absence of segregation at source in many facilities, and Ezirim and Agbo (2018) report that while 89.2% of facilities practice segregation, only 22.2% have standard incinerators for treatment. This means that even when segregation occurs, the downstream disposal stage often undermines its infection control value. In South Africa, Olaifa et al. (2018) found that barely half of nurses and other professionals consistently sort waste, and 33% reported temporary piling of waste in open spaces. The infection risk here is twofold: direct contact with contaminated sharps and materials, and indirect exposure through environmental contamination. The most compelling evidence of the HCWM–nosocomial infection link lies in the documented prevalence of needle-stick injuries (NSIs) and bloodborne infections among staff. Jonathan (2022) reports that in Nigerian public hospitals, 29% of waste handlers and 18% of nurses experienced NSIs, with corresponding hepatitis B and C infection rates of 37% and 13% respectively. The qualitative account from Utip et al. (2025) of a nurse contracting hepatitis B following an NSI adds a human dimension to the statistics, illustrating the career-ending consequences of poor waste handling. South African studies, such as Lizbeth-Mugivhisa et al. (2020), also report high NSI rates, with 20% of participants pricked by needles and 7% exposed to infections. While higher reported rates in South Africa may reflect more robust surveillance and reporting systems, the similarity in patterns across both contexts underlines the universal nature of the risk. Some may argue that NSIs are an unavoidable occupational hazard in healthcare, yet the clustering of these injuries in contexts with poor segregation, inadequate PPE, and weak enforcement suggests they are largely preventable.

Training frequency and inclusivity also have a measurable influence on risk reduction. South African data from Lizbeth-Mugivhisa et al. (2020) show that 69% of participants received training, yet Utip et al. (2025) highlights that waste handlers were often excluded from such programmes. In Nigeria, Onoh et al. (2019) report only 57.3% training coverage, suggesting that almost half the workforce may be managing hazardous waste without structured guidance. The exclusion of lower-status workers is particularly concerning because these staff are often at the highest risk of direct exposure to infectious waste. Advocates for inclusive training argue that infection prevention is a collective responsibility that requires every worker handling waste to be equally competent. Opponents of blanket training programmes sometimes cite cost and resource constraints, but the potential savings from reduced infection treatment costs and absenteeism make a strong economic case for investment in comprehensive training.

Resource constraints, including shortages of PPE, colour-coded bins, and functional treatment facilities, create additional systemic exposure points. In Nigeria, Ezirim and Agbo (2018) found that only 22.2% of facilities had standard incinerators, with many resorting to open burning or burial of waste, both of which are unsafe disposal methods. In South Africa, Olaifa et al. (2018) report that nearly half of facilities lacked all required categories of colour-coded containers, undermining segregation efforts. While some may argue that better-resourced systems like South Africa's should eliminate such shortages, decentralised procurement and maintenance often lead to localised gaps. In both contexts, financial limitations cited by staff, such as in Utip et al. (2025), suggest that HCWM is often deprioritised in budget allocations. This financial neglect perpetuates unsafe practices that compromise both staff and patient safety. Governance and management capacity play a decisive role in translating policy into practice. Nigerian data from Ezirim and Agbo (2018) show that while 44.8% of facilities had HCWM plans adapted from national policy, less than half had a designated department or person responsible for oversight. South African data from Ramodipa et al. (2023) reveal that only 24% of facilities had formally appointed HCW committees, and almost half lacked such structures altogether. Without dedicated accountability mechanisms, even well-designed policies cannot ensure consistent compliance, leaving gaps where unsafe practices can persist. The evidence suggests that effective governance requires both a clear policy mandate and local structures empowered to enforce it.

Conclusion

This review critically examined the perceptions and practices of nurses regarding healthcare waste management (HCWM) in Nigerian and South African hospitals and how these shape the risk of nosocomial infections. Synthesising evidence from 14 rigorously appraised studies (2011–2025), it revealed a paradox: nurses across both contexts demonstrate commendable

awareness and positive attitudes toward HCWM, yet this knowledge rarely translates into consistent and safe practice. The gap between theoretical understanding and technical execution stems not merely from individual lapses but from deep structural and institutional deficits weak policy enforcement, inadequate infrastructure, and chronic underinvestment in healthcare systems. Nigerian hospitals face acute infrastructural deprivation, such as absent colour-coded bins and malfunctioning incinerators (Ezirim & Agbo, 2018), whereas South African institutions, despite more structured waste management plans, still grapple with enforcement gaps and occupational exposures (Ramodipa et al., 2023; Lizbeth-Mugivhisa et al., 2020). Across both systems, nurses and waste handlers are marginalised in policy formulation despite their central operational roles. This exclusion perpetuates what Utip et al. (2025) describe as “institutional neglect” a fragmentation of responsibility that erodes accountability and sustains infection risks. Crucially, HCWM is not an environmental afterthought but a cornerstone of infection prevention and control (IPC). Failure to integrate it holistically into hospital safety frameworks reflects a conceptual blind spot in public health governance. Moreover, gendered hierarchies given that the nursing workforce is predominantly female intensify this marginalisation, reducing the visibility of those most exposed to occupational hazards. Therefore, improving HCWM requires a shift from individual behavioural blame to systemic reform anchored in governance, resource allocation, and equity. In essence, the problem is structural, the risk is institutional, and the solution must be systemic.

Recommendations

To operationalise effective and sustainable HCWM in Nigeria, South Africa, and similar LMIC contexts, interventions must be **multi-level, multi-stakeholder, and enforceable**.

A. Policymakers and Government Agencies

- Institutionalise HCWM policy enforcement by integrating waste management indicators into national health performance frameworks and accreditation systems.
- Allocate dedicated budgets for waste infrastructure (colour-coded bins, incinerators, PPE supply) and monitor compliance through independent audits.
- Mandate inclusion of nurses and waste handlers in policy formulation and hospital infection control committees to ensure operational relevance and accountability.

B. Hospital Administrators and Management Boards

- Embed accountability structures through designated Waste Management Officers, regular internal audits, and public reporting of compliance outcomes.
- Institutionalise continuous training by making HCWM education compulsory in staff induction and ongoing professional development.
- Ensure infrastructure functionality by maintaining incinerators, segregated collection points, and consistent PPE supply. Failure to provide such tools should be treated as an occupational health violation.

C. Nursing Councils, Unions, and Professional Bodies

- Advocate for professional recognition of nurses’ roles in waste management within IPC frameworks and hospital governance.
- Develop competency-based curricula focusing on applied HCWM skills and behavioural reinforcement through mentorship and peer monitoring.
- Champion gender-sensitive policies that address power imbalances and promote nurses’ participation in leadership and safety decision-making.

D. Donors, NGOs, and Development Partners

- Fund sustainable interventions rather than one-off training workshops invest in long-term capacity building, digital tracking of waste streams, and community outreach on post-hospital waste disposal.
- Support local research and innovation on cost-effective HCWM models and context-appropriate waste treatment technologies.

E. Researchers and Academics

- Conduct longitudinal and ethnographic studies assessing the real-world impact of HCWM interventions on infection rates and occupational safety.
- Undertake cost–benefit analyses to demonstrate the economic justification for waste management investment.
- Investigate community-level impacts of poor HCWM on surrounding populations and ecosystems to widen the policy relevance of hospital waste control.

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