KNOWLEDGE, ATTITUDES AND PRACTICES OF HEALTH CARE WASTE MANAGEMENT AMONG UNDERGRADUATES NURSING STUDENTS IN A TERTIARY EDUCATIONAL INSTITUTION IN BENIN CITY

BY

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IN PARTIAL FULFILLMENT OF THE AWARD OF BACHELOR IN NURSING SCIENCES (BNSC), COLLEGE OF BASIC MEDICAL SCIENCES

UNIVERSITY OF BENIN

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OCTOBER, 2025

DECLARATION

This is to declare that this research project titled KNOWLEDGE**, ATTITUDES PRACTICES OF HEALTH CARE WASTE MANAGEMENT AMONG UNDERGRADUATES NURSING STUDENTS IN A TERTIARY EDUCATIONAL INSTITUTION IN BENIN CITY was carried out by ONYELA FAVOUR UCHE. It is solely the result of my work except where acknowledged as being derived from other person (s) or resources.**

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CERTIFICATION APPROVAL

This is to certify that this research project by ONYELA FAVOUR UCHE with matriculation number **BMS2004972** has been examined and approved for the award of BACHELOR OF NURSING SCIENCES CERTIFICATE.

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DEDICATION

This project is dedicated to God Almighty whose grace and mercy has kept me throughout the course of this study. To my dad who has supported me in every way and my mum who has been by my side always.

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I would like to begin by giving all the glory to the almighty God, the sovereign owner of my life for His guidance, protection, and peace throughout my life and academic joumey.

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ABSTRACT

Healthcare waste management is a critical issue in healthcare settings, with implications for infection control, environmental safety, and public health. This study investigated the knowledge, attitudes, and practices of healthcare waste management among undergraduate nursing students in a tertiary educational institution in Benin City. A descriptive cross-sectional survey design was employed. Stratified random sampling technique was used to select 255 undergraduate nursing students across 200-500 levels. Data were collected using a structured questionnaire with four sections examining socio-demographic characteristics, knowledge, attitudes, and practices related to healthcare waste management. Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 26.0. Descriptive statistics were generated, and hypothesis testing was performed using chi-square analysis at a significance level of 0.05. The study achieved a 97% response rate (247 valid questionnaires).

Findings revealed that 68% of respondents demonstrated good knowledge of healthcare waste management, while 32% exhibited poor knowledge. Regarding attitudes, 71% displayed positive dispositions toward healthcare waste management practices. In terms of practice, 77% demonstrated high levels of proper healthcare waste handling and disposal. The study identified several influential factors, including adequate training programs, availability of disposal facilities, supervision, and personal commitment. Notably, no statistically significant relationship was found between knowledge and practice $x^2 = 2.101$, $p = 0.07$*). While the majority of undergraduate nursing students demonstrated good knowledge, positive attitudes, and high compliance with proper waste management practices, significant gaps remain, particularly in specific knowledge areas and the translation of knowledge into practice.*

Educational institutions should implement regular, comprehensive training programs on healthcare waste management, with emphasis on practical applications. Healthcare facilities should ensure adequate provision of waste management infrastructure and regular supervision. Further research should explore interventions to bridge the gap between knowledge and practice in healthcare waste management among healthcare professionals in training.

Keyword: knowledge, attitudes, practices, waste management, nursing students

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Healthcare waste management (HCWM) is a crucial public health issue, particularly within hospital and clinical settings, due to the potential hazards it poses to patients, healthcare workers, waste handlers, and the general environment (Ferreira et al., 2024). Proper management of healthcare waste not only reduces the risk of infections and injuries but also ensures environmental sustainability and public safety. In developing countries like Nigeria, including cities such as Benin City, the management of healthcare waste faces numerous challenges, ranging from inadequate knowledge to poor compliance with existing guidelines (Hossain et al., 2022). Undergraduate nursing students, as future healthcare professionals, play a critical role in ensuring the safe handling, segregation, and disposal of healthcare waste. Their knowledge, attitudes, and practices (KAP) regarding HCWM are essential because they will soon be responsible for maintaining safe clinical environments (Dash et al., 2021). However, multiple studies have pointed out that nursing students often exhibit significant gaps between theoretical knowledge acquired during training and actual waste management practices in clinical placements (Álvarez-Nieto et al., 2022).

The increase in healthcare activities due to the COVID-19 pandemic, for instance, led to a dramatic surge in healthcare waste, highlighting existing deficiencies in waste management systems across healthcare institutions (Alanazi et al., 2023). In the Nigerian context, and particularly in Benin City, challenges such as lack of training, inadequate facilities, poor policy enforcement, and a low sense of environmental responsibility among healthcare providers further aggravate these deficiencies (Gupta, 2024).

Studies suggest that while nursing students may possess moderate knowledge about waste categories and disposal techniques, attitudes toward compliance and environmental stewardship are often lacking (Bhandari et al., 2024). Moreover, practical lapses, such as improper segregation at the source, mishandling of sharps, and unsafe disposal of pharmaceuticals, have been commonly reported among healthcare students (Pal et al., 2023). Training and education have been repeatedly emphasized as effective interventions to improve the knowledge and practices of nursing students regarding biomedical waste management (Chauhan et al., 2022). Integrating sustainable waste management modules into the nursing curriculum has been shown to foster better environmental attitudes and responsible behaviors (Aronsson et al., 2024). Despite the establishment of national and international policies on healthcare waste management, compliance among healthcare students remains suboptimal (El-Gohary, 2023). Cultural perceptions, organizational inefficiencies, limited access to protective equipment, and insufficient monitoring contribute significantly to the gaps observed in practice (Robat et al., 2022). In Benin City, anecdotal evidence and preliminary observations suggest that undergraduate nursing students might not be fully prepared to manage healthcare waste effectively upon graduation, which raises significant concerns for patient and environmental safety.

Additionally, the improper disposal of unused and expired medications by healthcare providers and students exacerbates environmental pollution and increases the risk of antimicrobial resistance (Gubae et al., 2023). Nursing students must thus be adequately trained not only in clinical waste management but also in pharmaceutical waste handling to align with global best practices. Understanding the current level of knowledge, attitudes, and practices of undergraduate nursing students in tertiary institutions in Benin City regarding healthcare waste

management is critical. It will enable educational institutions, regulatory bodies, and healthcare facilities to design targeted interventions, revise curricula, and implement more effective policies that ensure a safer, cleaner, and more sustainable healthcare system. Therefore, this study seeks to assess the knowledge, attitudes, and practices of healthcare waste management among undergraduate nursing students in Benin City's tertiary educational institutions. It aims to identify gaps and barriers that hinder effective waste management and propose strategies to enhance the environmental responsibility of future nursing professionals.

1.2 Statement of the problem

Healthcare waste management (HCWM) has become an increasingly critical public health concern worldwide due to the rapid growth of healthcare services and the corresponding rise in waste generation (Ferreira et al., 2024). Healthcare waste includes sharps, pathological waste, chemical waste, pharmaceutical waste, and general infectious materials that, if not properly handled, can pose serious risks to healthcare workers, patients, the community, and the environment (El-Gohary, 2023). Each year, millions of people, particularly healthcare personnel, suffer injuries and infections linked to improper healthcare waste management, highlighting the urgent need for effective and sustainable waste handling systems (Álvarez-Nieto et al., 2022). The World Health Organization (WHO) estimates that unsafe injections alone an outcome often tied to poor waste disposal cause over 1.3 million deaths annually, emphasizing the magnitude of the problem (World Health Organization, 2022). Several studies have revealed that the improper management of healthcare waste stems largely from insufficient knowledge, negative attitudes, and poor practices among healthcare workers and students (Dash et al., 2021). Among undergraduate nursing students, who represent the future workforce of the healthcare system, gaps in knowledge and unsafe practices are particularly troubling. Students often express

feelings of confusion, inadequate preparedness, and fear when handling hazardous waste materials, citing lack of formal training, inadequate supervision, and limited practical exposure during clinical postings as major barriers (Chauhan et al., 2022). This deficiency can lead not only to personal health risks but also to broader public health threats, environmental degradation, and increased healthcare costs (Qaraman et al., 2022).

Furthermore, poor healthcare waste management practices have been found to diminish overall hospital hygiene standards, expose communities to toxic hazards, and contribute to environmental pollution, especially in developing countries where regulatory frameworks are often weak (Alanazi et al., 2023). Nursing students' failure to internalize proper waste handling practices during training may translate into poor professional behaviors post-graduation, perpetuating a cycle of unsafe practices within the healthcare system (Hategekimana et al., 2025). The outbreak of the COVID-19 pandemic further intensified these challenges, significantly increasing the volume of infectious waste while exposing critical weaknesses in healthcare waste management practices among both trained staff and students (Robat et al., 2022). In response to the recognized importance of safe waste management, numerous guidelines, protocols, and educational programs have been developed globally to enhance HCWM practices (Gubae et al., 2023). However, despite the development of such frameworks, implementation remains inconsistent, particularly in resource-constrained settings such as tertiary institutions in Benin City. Many educational institutions do not consistently integrate comprehensive HCWM training into their nursing curricula, nor do they prioritize regular monitoring and assessment of students' competencies in this area (Ferreira et al., 2024).

Preliminary findings from small-scale intervention studies suggest that targeted educational programs can improve students' knowledge, shift attitudes positively, and promote safer waste management practices (Mahajan et al., 2024). However, these findings require further validation within specific local contexts, where cultural, infrastructural, and institutional factors may affect knowledge translation and behavior change. In Benin City, there is currently limited data on undergraduate nursing students' actual level of knowledge, their attitudes towards healthcare waste management, and their everyday practices regarding waste handling and disposal.

Given the vital role nursing students will play in future healthcare delivery and infection prevention, understanding their current knowledge, attitudes, and practices is essential. This understanding will aid policymakers, educators, and healthcare administrators in designing targeted interventions that can strengthen healthcare waste management, enhance patient and environmental safety, and contribute to achieving broader public health goals. Thus, this study seeks to fill an important gap by assessing the knowledge, attitudes, and practices of undergraduate nursing students toward healthcare waste management in selected tertiary educational institutions in Benin City.

1.3 Objective of the study

The general objective is to assess the knowledge, attitudes, and practices regarding health care waste management among undergraduate nursing students**.**

The specific objectives are:

1. To assess the level of knowledge of undergraduate nursing students about health care waste management.
2. To determine the attitudes of undergraduate nursing students towards health care waste management.

3. To ascertain the practices of undergraduate nursing students in the handling and disposal of health care waste.
4. To identify factors associated with knowledge, attitudes, and practices of health care waste management among undergraduate nursing students.

1.4 Research Question

1. What is the level of knowledge of undergraduate nursing students about health care waste management?
2. What are the attitudes of undergraduate nursing students towards health care waste management?
3. What are the practices of undergraduate nursing students in the handling and disposal of health care waste?
4. What are the factors associated with knowledge, attitudes, and practices of health care waste management among undergraduate nursing students?

1.5 Hypothesis

1. There is no significant relationship between knowledge of healthcare waste management and the practice of healthcare waste management among undergraduate nursing students in tertiary educational institutions in Benin City.

1.6 Significance of study

To the Nursing Profession

This study will contribute significantly to the nursing profession by highlighting the current levels of knowledge, attitudes, and practices of healthcare waste management among undergraduate nursing students. As future frontline caregivers, nurses play a vital role in ensuring safe and effective healthcare waste disposal, which directly impacts infection control

and patient safety. By identifying gaps in knowledge and practice, the findings can inform curriculum development and targeted training programs, thereby enhancing nursing education and preparing nursing graduates to uphold global standards in environmental health and occupational safety.

To Healthcare Providers

Healthcare waste, when not properly managed, poses serious risks to all healthcare providers, including nurses, doctors, laboratory personnel, and hospital support staff. This study provides valuable insights into the extent to which undergraduate nursing students the future workforce are prepared to manage healthcare waste responsibly. Strengthening their competencies will lead to a safer healthcare environment, reduce the incidence of healthcare-associated infections, and minimize occupational hazards related to improper waste handling. Moreover, the results can guide healthcare administrators and policymakers in designing continuing education programs and enforcing compliance with waste management protocols.

To the Society

Effective healthcare waste management extends beyond hospital walls and has a profound impact on public health and environmental sustainability. By improving knowledge, attitudes, and practices among future nurses, the study indirectly contributes to reducing the spread of infectious diseases, minimizing environmental pollution, and safeguarding the health of the broader community. Proper waste management practices help prevent the contamination of water sources, soil, and air, thereby promoting a cleaner, safer environment. Ultimately, this study supports the societal goal of achieving a healthier population and a sustainable ecosystem through the responsible disposal of healthcare waste.

1.7 Scope of the study

This study focuses on assessing the knowledge, attitudes, and practices of healthcare waste management among undergraduate nursing students in selected tertiary educational institutions in Benin City. It is limited to final-year nursing students who have undergone clinical training and are expected to have practical exposure to healthcare waste handling. The study covers only educational institutions within Benin City and does not include students from other healthcare disciplines or geographical locations.

1.8 Operational Definition of terms

Knowledge: Refers to the level of awareness and understanding that undergraduate nursing students have regarding healthcare waste management practices, including types of healthcare waste, segregation methods, and proper disposal techniques.

Attitudes: Refers to the feelings, perceptions, beliefs, and disposition of undergraduate nursing students toward the importance and necessity of proper healthcare waste management in clinical and educational settings.

Practices: Refers to the actual behaviours, actions, and adherence of undergraduate nursing students to recommended healthcare waste management procedures during clinical postings and other healthcare-related activities.

Healthcare Waste Management: Refers to the systematic process of handling, segregation, collection, transportation, treatment, and disposal of waste generated from healthcare activities to minimize health and environmental risks.

Undergraduate Nursing Students: Refers to individuals enrolled in a bachelor's degree program in Nursing Science at selected tertiary educational institutions in Benin City who have received both theoretical and clinical training.

CHAPTER TWO

LITERATURE REVIEW

This chapter focuses on the review of related literature under the following headings; conceptual review, theoretical review and empirical review. Necessary literature would be gotten from published and unpublished works, articles and journals in this study.

2.1 Conceptual review

2.1.1 Concept of Healthcare Waste

Healthcare waste, often referred to as biomedical waste, encompasses all waste generated within healthcare facilities such as hospitals, clinics, dental practices, blood banks, veterinary hospitals, and laboratories. According to several studies, healthcare waste includes a diverse range of materials, some of which pose serious health and environmental risks if not managed properly (Abinaya et al., 2024). It is broadly defined as any waste produced through the diagnosis, treatment, or immunization of humans or animals, as well as in related research activities and the production or testing of biological materials (Ferreira et al., 2024).

A significant portion of healthcare waste is non-hazardous and similar in nature to household waste. However, about 15–25% of it is considered hazardous, meaning it may be infectious, toxic, or radioactive (Dalui et al., 2021). Effective management of this waste is essential not only to prevent health hazards to healthcare workers, patients, and the general public but also to minimize its impact on the environment (Bhandari et al., 2024).

2.1.2 Types of Healthcare Waste

Healthcare waste can be categorized into several types, each requiring specific methods of handling and disposal to ensure safety and environmental protection:

1.Infectious Waste: Infectious waste are referred to as waste that are capable of causing disease to susceptible hosts as a result of pathogens they're suspected to contain, examples of these pathogens could be bacteria, viruses, parasites or fungi. This includes items such as blood-soaked bandages, surgical gloves, culture dishes, and laboratory waste (Dalui et al., 2021).

2.Pathological Waste: Pathological waste consists of tissues, organs, body parts, human fetuses, blood, and other bodily fluids. This type of waste requires special handling because of the high risk of infection and emotional sensitivity surrounding its disposal (Hashish et al., 2020).

3.Sharps Waste: Sharps are items that can cause cuts or puncture wounds and include needles, scalpels, blades, and broken glass. Sharps are capable of causing infection, particularly from blood-borne viruses such as HIV, hepatitis B, and hepatitis C (Chilate, 2023).

4.Chemical Waste: Chemical waste includes discarded solid, liquid, and gaseous chemicals used in diagnostic and experimental work, cleaning, housekeeping, and disinfection processes. Examples are solvents, laboratory reagents, and disinfectants that are outdated, spilled, or no longer needed (Ferreira et al., 2024).

5.Pharmaceutical Waste: Pharmaceutical waste includes expired, unused, or contaminated drugs and vaccines. Improper disposal of pharmaceuticals can lead to environmental pollution and the development of drug-resistant pathogens (Hategekimana et al., 2025).

6.Cytotoxic Waste: Cytotoxic waste contains substances with genotoxic properties such as carcinogenic, mutagenic, and teratogenic properties. It includes drugs used in cancer treatment

(chemotherapy), and its improper handling can pose serious health risks (Álvarez-Nieto et al., 2022).

7.Radioactive Waste: This type of waste contains radioactive substances and is generated from activities such as cancer radiotherapy, nuclear medicine, and medical research. Proper containment and disposal are crucial to prevent radiation exposure (Thirunavukkarasu et al., 2022).

8.Non-hazardous or General Waste: Non-hazardous waste includes materials that are not capable of causing hazards (biological, chemical, radioactive, or physical). Examples are office paper, kitchen waste, and packaging materials (Heiskanen, 2022).

2.1.3 Importance of Proper Healthcare Waste Management

Proper healthcare waste management is a critical component of public health and environmental safety. The healthcare sector, while dedicated to healing, inevitably generates significant quantities of waste, some of which are hazardous and pose serious health risks if not managed appropriately (Abinaya et al., 2024). Managing healthcare waste properly is vital to safeguarding healthcare workers, patients, the general community, and the environment from potentially harmful exposures.

One of the primary reasons for emphasizing proper healthcare waste management is to prevent the spread of infectious diseases. Infectious waste, including contaminated sharps, body fluids, and microbiological cultures, carries a high potential for transmitting diseases such as HIV, hepatitis B and C, and other blood-borne infections (Dalui, Banerjee, & Roy, 2021). Healthcare workers are particularly at risk through needlestick injuries or improper handling of contaminated materials. Studies highlight that effective waste segregation and the use of personal

protective equipment (PPE) can significantly reduce occupational exposure (Kanaparty et al., 2024).

Moreover, the community at large is also at risk when healthcare waste is not disposed of properly. Scavenging at open dumpsites can expose individuals to dangerous infections and toxic chemicals, contributing to broader public health issues (Hashish et al., 2020). Proper disposal systems, including secure landfill practices and incineration of hazardous materials, are essential strategies recommended by international health bodies to minimize these risks (Hossain et al., 2022).

Environmental protection represents another crucial aspect of healthcare waste management. Hazardous substances such as pharmaceuticals, heavy metals from medical equipment, and radioactive materials can seep into soil and water sources if not contained properly, leading to environmental contamination and affecting ecosystems (Ferreira et al., 2024). For example, improper disposal of expired medicines has been linked to the development of antimicrobial resistance (AMR), posing a significant long-term threat to global health (Hategekimana et al., 2025).

Healthcare waste management also has legal and ethical dimensions. Many countries have strict regulations regarding the handling, transportation, and disposal of healthcare waste, with penalties for non-compliance (Thirunavukkarasu et al., 2022). Compliance with these laws is not just a legal obligation but also a moral one, as it demonstrates a healthcare institution's commitment to the safety and well-being of the broader community (Pawar & A, 2024).

Beyond the prevention of harm, effective waste management practices promote operational efficiency within healthcare facilities. Proper segregation reduces the volume of hazardous waste requiring expensive treatment, thereby lowering operational costs (McCauley et al., 2024). When

healthcare waste is managed correctly from the point of generation, there is less need for secondary handling, which in turn reduces the risk of accidents and enhances overall workplace safety.

Additionally,Training and education are essential for enhancing health care waste management procedures. Structured educational programs have been shown to significantly improve healthcare workers' knowledge and attitudes toward waste management (Chauhan et al., 2022). Integrating environmental sustainability concepts into healthcare education can also empower future healthcare professionals to adopt and advocate for eco-friendly waste disposal practices (Badawy et al., 2025).

In the context of global sustainability efforts, healthcare waste management also aligns with broader environmental goals. The Sustainable Development Goals (SDGs), especially those pertaining to health, clean water and sustainable communities are supported by initiatives to reduce, reuse and recycle medical waste(Heiskanen et al.,2022).

2.1.4 Risks Associated with Poor Waste Management (to Health, Environment, and Society)

The health of the people, the environment and society at large are all at danger from inadequate health care waste management. The failure to properly manage healthcare waste can lead to devastating consequences, including the spread of infectious diseases, environmental pollution, and broader social and economic challenges (Abinaya et al., 2024).

Risks to Health

One of the most immediate and severe risks of poor healthcare waste management is its impact on human health. Improper disposal and handling of infectious waste expose patients, trash managers, health care professionals, and the general public to a high risk of infections, particularly blood-borne diseases such as hepatitis B, hepatitis C, and HIV (Dalui et al., 2023).

For example, needlestick injuries caused by improperly discarded sharps are a well-documented hazard that can transmit these serious infections.

In addition to infections, exposure to drugs polluted by pharmaceutical waste can lead to antimicrobial resistance and toxicity(Hategekimana et al., 2025). Waste handlers and health care professionals who are not adequately trained or equipped may suffer acute injuries, chronic illnesses, or long-term health conditions due to repeated exposure to hazardous substances (Kanaparty et al., 2024).

Moreover, communities living near poorly managed healthcare waste sites face heightened risks of respiratory illnesses, skin diseases, and gastrointestinal infections, as pathogens from waste can contaminate air, soil, and water sources (Hashish et al., 2020).

Risks to the Environment

Environmental degradation is another critical consequence of poor healthcare waste management. Hazardous contaminants are released into the air, land, and water via improper waste disposal techniques such as open dumping and uncontrolled burning. Airborne contaminants like dioxins and furans, produced from the incineration of plastics and other hazardous materials, are known carcinogens and can cause respiratory problems and other severe health conditions (Ferreira et al., 2024).

Water bodies near healthcare facilities often become dumping grounds for untreated waste, leading to contamination of drinking water sources with pathogens and toxic chemicals (Hossain et al., 2022). This can result in serious outbreaks of waterborne diseases like cholera and dysentery. Furthermore, toxic heavy metals such as mercury from broken thermometers and cadmium from batteries accumulate in ecosystems, causing long-term harm to wildlife and entering the food chain of humans through bioaccumulation (Álvarez-Nieto et al., 2022).

Additionally, the improper disposal of radioactive healthcare waste, though less common, can have catastrophic effects on the environment, contaminating land for generations and posing a significant threat to human and animal life (Thirunavukkarasu et al., 2022).

Risks to Society

The societal impacts of poor healthcare waste management are far-reaching and complex. Economically, the costs associated with managing outbreaks of diseases caused by poor waste practices can be enormous, placing additional strain on already overburdened healthcare systems (McCauley et al., 2024).

Socially, there is a significant stigma attached to communities living near healthcare waste disposal sites. These communities often suffer from discrimination, reduced property values, and limited opportunities for development due to health and environmental concerns (Pawar & A, 2024).

Children and marginalized groups, who often scavenge at waste sites for reusable materials, are disproportionately affected, facing exposure to hazardous waste without any protective measures (Chauhan et al., 2022). This exacerbates existing social inequalities and hinders efforts toward achieving broader goals of health equity and social justice.

From a governance perspective, poor waste management practices reflect weak regulatory systems and can erode public trust in health institutions and government agencies (Sürme & Maraş, 2022). In the long term, failure to address healthcare waste challenges undermines public health initiatives and compromises the credibility of health policies designed to protect communities.

2.1.5 Factors Influencing Knowledge Acquisition (Curriculum, Clinical Exposure, Workshops, etc.)

Healthcare waste management (HCWM) is a crucial component of infection prevention and control, particularly within healthcare settings where the risk of exposure to hazardous materials is high. Among future healthcare professionals, particularly nursing students, the acquisition of adequate knowledge and skills in healthcare waste management is vital for ensuring safe practices that protect themselves, their patients, and the environment. Several key factors influence the extent and depth of nursing students' knowledge on healthcare waste management, including formal curriculum content, clinical exposure, participation in workshops, and other informal learning opportunities.

Curriculum Content

The structure and content of the nursing curriculum play a foundational role in shaping students' knowledge of healthcare waste management. When comprehensive instruction on HCWM is integrated into nursing education programs, students are better equipped to understand waste categorization, safe handling practices, segregation protocols, and legal and environmental implications (Álvarez-Nieto et al., 2022). Studies have shown that curricula which incorporate dedicated modules or courses on waste management significantly enhance students' theoretical understanding and practical competence (McCauley et al., 2024).

However, when HCWM is treated only as a minor topic within broader infection control or public health courses, students may not develop the depth of knowledge required for effective waste handling in real-world settings (Pawar & A, 2024). Therefore, integrating comprehensive and detailed training on HCWM into the core nursing curriculum is crucial for promoting safe and sustainable healthcare practices.

Clinical Exposure

Clinical placements and real-world exposure to healthcare settings are another powerful influence on nursing students' knowledge of healthcare waste management. In clinical environments, students observe, participate in, and practice waste management activities under the supervision of experienced nurses and infection control teams. This hands-on experience bridges the gap between theoretical knowledge and practical application (Hategekimana et al., 2025).

The extent at which the pupils are exposed to proper waste management practices during their clinical rotations can greatly impact their learning. Facilities that prioritize and strictly enforce waste segregation protocols, use color-coded bins, and emphasize safety measures help students internalize these practices and develop lifelong habits (Hashish et al., 2020). Conversely, in facilities where waste management practices are poor or inconsistent, students may adopt unsafe practices, highlighting the need for clinical mentors to model proper behaviors consistently.

Workshops and Training Programs

Participation in workshops, seminars, and specialized training sessions significantly enhances nursing students' understanding and skills related to healthcare waste management. Workshops often provide focused, practical, and interactive learning experiences that reinforce formal education and clinical exposure (Dalui et al., 2021).

Interactive methods such as role-playing, simulations, case studies, and group discussions help students to actively engage with the material and practice decision-making in waste management scenarios (Chilate et al., 2023). Training sessions often update students on new guidelines, innovations in waste handling technologies, and the environmental and public health consequences of poor waste management. Regular participation in such programs ensures that

students' knowledge remains current and that they are prepared to adapt to evolving healthcare standards (Bhandari et al., 2024).

Influence of Institutional Policies and Support

Institutional culture and policies also play an important role in shaping nursing students' knowledge and attitudes toward healthcare waste management. Hospitals and training institutions that emphasize sustainable healthcare practices, enforce strict waste management protocols, and invest in continuous staff education foster a learning environment that encourages students to value and prioritize safe waste practices (Ferreira et al., 2024).

Moreover, support from academic institutions in the form of accessible educational materials, mentorship programs, and assessments related to HCWM ensures that students consistently engage with and apply their knowledge (Balay-Odao et al., 2024).

2.1.6 Factors Influencing Knowledge, Attitudes, and Practices

The knowledge, attitudes, and practices (KAP) of nursing students regarding healthcare waste management (HCWM) are influenced by multiple interconnected factors. These factors not only shape the theoretical understanding of waste management but also determine how effectively and consistently students apply correct practices during clinical settings. Key among these factors are educational background, clinical training and exposure, availability of resources and facilities, and the strength of institutional policies and supervision.

Educational Background

Educational background plays a foundational role in influencing students' knowledge and attitudes towards healthcare waste management. Nursing curricula that integrate comprehensive modules on infection control and environmental health provide students with a strong theoretical base regarding HCWM (Álvarez-Nieto et al., 2022). Courses that offer detailed instruction on

types of healthcare waste, segregation methods, disposal protocols, and the dangers of inadequate waste management enhance students' cognitive readiness to manage waste appropriately.

Conversely, where educational programs give minimal attention to HCWM or treat it as a peripheral topic, students often graduate with significant knowledge gaps (Bhandari et al., 2024). The depth, frequency, and method of instruction — whether through lectures, simulations, or problem-based learning — significantly affect how deeply students internalize HCWM principles (Hossain et al., 2022). Thus, a well-structured and practical education in waste management is vital for developing strong foundational knowledge and fostering positive attitudes.

Clinical Training and Exposure

Clinical training and real-world exposure are critical in putting theoretical understanding into action. Students studying nursing who are exposed to well-organized clinical environments where waste management is strictly monitored are more likely to develop proper disposal habits and positive attitudes toward waste handling (Dalui et al., 2021). During clinical postings, students not only practice skills but also observe the behaviors of nurses, physicians, and housekeeping staff, whose adherence (or lack thereof) to waste management standards strongly influences students' practices (Ferreira et al., 2024).

Positive clinical experiences where best practices are consistently demonstrated reinforce proper waste management behavior. On the other hand, exposure to settings where waste is improperly handled — such as mixed disposal of sharps and general waste or overfilled biohazard containers — can normalize unsafe practices among students (McCauley et al., 2024). Furthermore, hands-on workshops and in-service training sessions during clinical rotations strengthen students'

ability to recognize different waste categories and apply safe handling procedures (Kanaparty et al., 2024).

Availability of Resources and Facilities

The presence (or absence) of appropriate resources and facilities is a practical determinant of healthcare waste management practices among nursing students. Proper segregation bins, color-coded disposal bags, sharps containers, gloves, and other personal protective equipment (PPE) are essential tools that facilitate correct waste handling (Balay-Odao et al., 2024). When these resources are readily available and accessible, students are more likely to follow the recommended protocols for waste segregation and disposal.

In contrast, shortages or unavailability of waste management supplies can compromise even the most well-intentioned students. Lack of proper bins, inadequate PPE, or irregular collection of biomedical waste forces students and staff alike to improvise, often resulting in improper disposal practices (Hategekimana et al., 2025). The quality of the clinical environment — including the availability of clean, well-labeled disposal stations — therefore plays a pivotal role in shaping students' compliance and attitudes toward HCWM.

Institutional Policies and Supervision

Institutional policies and the level of active supervision greatly influence how nursing students engage with healthcare waste management protocols. Clear policies that mandate strict adherence to waste segregation guidelines, regular training, and auditing of waste management practices create an environment where compliance is expected and deviations are promptly corrected (Badawy et al., 2025). Institutions that embed waste management practices into their organizational culture make it easier for students to view these practices as non-negotiable aspects of professional nursing behavior.

Supervision by clinical instructors and ward managers is equally important. Effective supervisors not only model correct practices but also monitor student compliance, provide real-time feedback, and encourage accountability (Chitroda et al., 2024). In environments with poor supervision or lax enforcement of HCWM protocols, students may either neglect proper practices or adopt incorrect habits observed among senior staff.

Moreover, institutions that regularly update their policies based on national or international waste management guidelines, and involve students in workshops, seminars, and continuous professional development activities related to HCWM, foster a culture of continuous improvement and safety consciousness (Sundberg et al., 2024).

2.2 Theoretical Framework

The study adopted the Knowledge, Attitude, and Practice (KAP) model. It is a widely utilized theoretical framework in public health and behavioral research to assess and understand human behaviors, especially those related to health and environmental practices. The model is based on the premise that individuals' actions are directly influenced by their knowledge and attitudes towards a particular subject.

Knowledge refers to the awareness and understanding individuals have about a specific topic, acquired through education, experience, or exposure. In the context of healthcare waste management (HCWM), knowledge encompasses awareness of different types of medical waste, risks associated with improper disposal, and proper waste segregation and disposal techniques. Knowledge serves as the foundational step because, without adequate understanding, individuals are less likely to adopt appropriate behaviors.

Attitude involves a person's feelings, beliefs, and perceptions about the knowledge they possess. It reflects how individuals value or prioritize a particular behavior. A positive attitude towards

healthcare waste management, for instance, would mean that nursing students not only recognize the importance of proper waste handling but also feel a personal and professional responsibility to practice it. Conversely, negative or indifferent attitudes could hinder the adoption of safe practices even when knowledge exists.

Practice represents the observable actions or behaviors of individuals based on their knowledge and attitudes. In healthcare settings, practice would include the actual segregation, handling, and disposal of medical waste according to established standards and guidelines. Proper practice indicates a successful transition from knowledge and positive attitude into action.

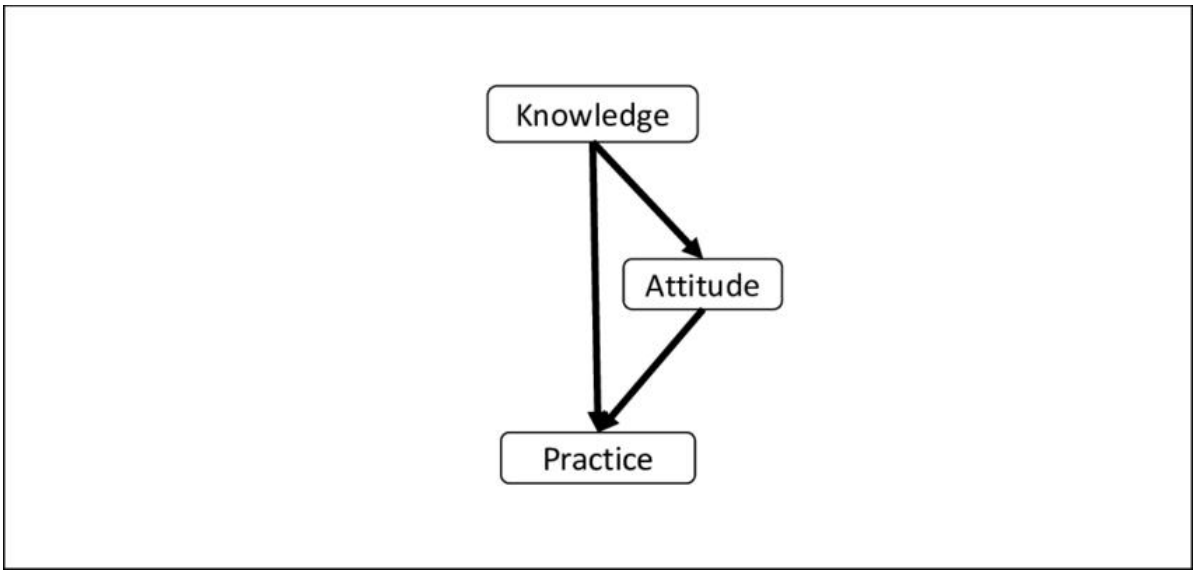

Fig 1: Diagrammatic Representation of Knowledge, Attitude, and Practice (KAP) model

2.2.2 Application of the Knowledge, Attitude, and Practice (KAP)

In this study, the Knowledge, Attitude, and Practice (KAP) Model provides a structured framework for understanding the behaviors of undergraduate nursing students regarding healthcare waste management. The KAP model posits that knowledge acquisition is the

foundation for shaping attitudes, which in turn influence practices. Applying this model to the study's specific objectives allows for a comprehensive examination of how knowledge, attitudes, and practices interact to determine the effectiveness of healthcare waste management among future nursing professionals.

The "knowledge" component of the KPA model is directly related to the first objective, which is to assess understand undergraduate nursing students knowledge of healthcare waste management. Knowledge encompasses the information, awareness, and understanding students have about the types of healthcare waste, proper disposal techniques, associated risks, and regulations. According to the model, sufficient and accurate knowledge is essential, as it forms the basis upon which students develop their attitudes toward waste management.

The second objective, to assess the attitudes of undergraduate nursing students towards the relevance of proper healthcare waste management, aligns with the "Attitude" component of the model. Attitudes reflect the students' feelings, beliefs, and values regarding the significance of managing healthcare waste responsibly. A positive attitude is crucial for motivating behavior change and compliance with proper waste management protocols. The KAP model suggests that knowledge alone is not enough; students must also hold favorable attitudes toward the importance of healthcare waste management to influence their behavior.

The third objective, to evaluate the practices of undergraduate nursing students in the handling and disposal of healthcare waste, corresponds to the "Practice" component of the KAP model. Practices refer to the actual application of knowledge and attitudes in real-world settings, particularly during clinical postings. This includes actions such as segregation of waste at the source, proper usage of color-coded containers, wearing personal protection equipment and adherence to institutional waste disposal guidelines. The KAP model underscores that while

knowledge and attitudes are precursors, actual practices are the ultimate indicators of effective learning and internalization.

Finally, the fourth objective, to identify factors associated with knowledge, attitudes, and practices of healthcare waste management among undergraduate nursing students, recognizes that external factors also play a significant role in shaping behaviors. In the context of the KAP model, factors such as educational background, clinical training and exposure, availability of resources, institutional policies, supervision, and personal experiences can influence each stage — knowledge acquisition, attitude formation, and the translation of these into practical actions. Understanding these factors is vital to designing interventions that enhance knowledge, foster positive attitudes, and improve practices among nursing students.

2.3.1 Knowledge about Health Care Waste Management

In a study conducted by Pal et al. (2023) "To Ascertain the Level Of Awareness And Adherence To Proper Disposal Methods For Leftover And Expired Medication Among Nursing And Dental Students", the researchers aimed to determine the level of awareness and adherence to proper disposal methods among nursing and dental students. The study adopted a cross-sectional survey design and utilized convenience sampling to select senior-level nursing and dental students (2nd, 3rd, and 4th year). Information was gathered using a structured 10-item questionnaire divided into two sections: demographic characteristics and questions assessing knowledge and habits regarding unused and expired medications. The findings revealed that 60% of nursing students reported checking the expiry date of medications before purchase, indicating a moderate level of knowledge, while 17.5% admitted to not checking at all. Moreover, 22.2% of nursing students indicated they were unaware of expiry date checks, pointing to significant gaps in knowledge. The study concluded that although a proportion of students demonstrated awareness regarding

medication use and disposal, there remains a substantial need to improve the knowledge and practices of health care students to prevent environmental contamination and public health risks associated with improper medication disposal.

Similarly, Abinaya et al. (2024) conducted a study on "Knowledge and Awareness about Biomedical Waste Segregation and Disposal among Medical and Paramedical Students at a Tertiary Care Hospital in Chennai", aiming to assess knowledge and awareness levels regarding biomedical waste (BMW) segregation and disposal. Additionally, the study used a cross-sectional design and gave a structured questionnaire to a sample of 632 participants who were third and fourth year medical and paramedical students. Descriptive statistics and appropriate inferential tests were used to analyze the data.

The results demonstrated that medical students had significantly better knowledge regarding BMW segregation, disposal methods, and associated health risks compared to paramedical students. This suggests a disparity in educational exposure or curriculum emphasis between the two groups. The authors concluded that although a reasonable level of knowledge was evident among medical students, there is a critical need for targeted educational interventions, especially for paramedical students, to enhance understanding and promote safe biomedical waste management practices.

In a study by Chauhan et al. (2022), A Study to Assess the Effectiveness of Structured Teaching Programme on Knowledge Regarding Biomedical Waste Management among Nursing Students of Selected Nursing College Rudrapur, Uttarakhand, the researchers assessed the knowledge of nursing students on biomedical waste management. A pre-experimental, one-group pre-test post-test design was employed, and non-probability purposive sampling was used to select 30 nursing students from a nursing college in Rudrapur, U.S. Nagar. Data were collected using a structured

knowledge questionnaire. The findings revealed a significant improvement in the knowledge scores of students after the intervention. The mean post-test knowledge score (15.5) was significantly higher than the pre-test score (11.1), with a t-value of 6.98 and a p-value less than 0.00001. There was also a significant association between students' knowledge levels and selected socio-demographic variables. The study concluded that structured teaching programs effectively improve the knowledge of nursing students regarding biomedical waste management, highlighting the need for ongoing education and training to promote safe practices.

In another study by Chilate (2023), The Effectiveness of Structured Teaching Programme (STP) on Knowledge Regarding Bio-Medical Waste Management among B.Sc. Nursing Students, the researcher evaluated the knowledge levels of second- and third-year B.Sc. nursing students at the Government College of Nursing, Durg. A pre-experimental research design was adopted, and a structured knowledge assessment tool was used for data collection. The results showed that a majority of the students (74%) were aged between 21 and 24 years, and all participants were female. Most students (78%) reported acquiring knowledge about biomedical waste management primarily through hospital experience, rather than from books or workshops. The study found that the majority of students demonstrated a good level of knowledge regarding biomedical waste management. Although associations between knowledge and variables such as living arrangements and hospital of practice were examined, these were not statistically significant. The study concluded that structured teaching programs and clinical exposure contribute positively to students' knowledge of biomedical waste management.

In a study carried out by Hashish et al. (2020), Knowledge, Attitude and Practice of Undergraduate and Intern Saudi Nursing Students Regarding Biomedical Waste Management and Influencing Factors, the researchers assessed the level of knowledge, attitudes, and practices

regarding biomedical waste management among undergraduate and intern nursing students. A cross-sectional design was employed, and the study was conducted at the College of Nursing-Jeddah, King Saud bin Abdul-Aziz University for Health Sciences, Saudi Arabia. The researchers used a structured KAP questionnaire administered to all eligible undergraduate nursing students enrolled in academic levels 5 to 8 (N=229) and all intern nurses (N=86) during the 2018/2019 academic year. The results revealed that participants had inadequate knowledge regarding biomedical waste management and colour coding systems. However, their attitudes towards waste management were generally positive, and their practice levels were rated as moderate. Several facilitators and barriers influencing their knowledge and practice were identified. The study concluded that periodic, comprehensive training and in-service educational programs are essential to enhance the awareness and improve the biomedical waste management practices of nursing students, interns, and healthcare staff.

Similarly, Najotra et al. (2020) conducted a study, Knowledge, Attitude and Practices of Biomedical Waste Management among Medical and Nursing Students in a Teaching Hospital of J & K, India, to evaluate and compare the knowledge, attitude, and practices regarding biomedical waste management between medical and nursing students. The study adopted a cross-sectional design, using a self-administered, predesigned, and pretested questionnaire distributed to 140 participants. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 21. The findings showed that 80% of medical students were aware of biomedical waste management rules, compared to only 40% of nursing students. A statistically significant difference in knowledge levels between the two groups was noted. Although both groups demonstrated an overall positive attitude towards biomedical waste management, their actual practices were relatively poor, and no significant difference in attitudes between the groups was

found. The study emphasized the need for strict implementation of biomedical waste management rules and recommended the development of targeted training programs for undergraduate medical and nursing students to translate knowledge into effective practice.

2.2.2 The attitudes of undergraduate nursing students towards health care waste

In a study carried out by Silambarasan (2023), Biomedical Waste Management among Nursing Students, the researcher explored the knowledge, attitudes, and practices of biological waste management among nursing students. Using a descriptive research design and a non-probability volunteer sampling technique, a sample of 100 nursing students who met the inclusion criteria was selected. A structured questionnaire assessed participants' knowledge, attitudes, and practices through a pre-test and post-test format.

The findings revealed a moderate pre-test mean score of 56.51, with a standard deviation of 20.5229. Chi-square analysis indicated no significant association between most demographic variables and students' knowledge, attitude, or practice, except for education and training. The results highlighted the need for regular and systematic training programs to improve not only the technical skills but also the attitudes of nursing students towards biomedical waste management. The study emphasized that continuous education plays a critical role in shaping a more positive and proactive attitude toward safe waste handling.

Similarly, Tiwari et al. (2021) conducted a study, Knowledge, Attitude and Practices Regarding Biomedical Waste Management as Per 2019 Rules among Nursing Students, to assess nursing students' attitudes along with their knowledge and practices concerning updated biomedical waste management guidelines. A descriptive cross-sectional design was employed, and the total enumeration method was used to include 163 nursing students who had more than six months of clinical exposure. Students in their first academic year were excluded from the study. The

findings showed that although a significant proportion of the participants demonstrated poor knowledge in various aspects of biomedical waste management—such as color coding (84.7%) and disposal methods (92.6%)—their attitudes were notably positive, with 76.1% of students showing a favorable disposition toward biomedical waste management practices. Furthermore, 74.2% of the participants adhered to safe practice patterns. The study concluded that despite deficiencies in knowledge, the students maintained a positive attitude, suggesting that targeted educational interventions could effectively bridge the gap between attitude and technical competence.

In a study carried out by Toluk et al. (2021), Evaluation of Nursing Students' Medical Waste Knowledge Level, the researchers aimed to assess the knowledge levels related to medical waste among nursing students and to highlight implications for public health and environmental safety. A descriptive cross-sectional design was adopted, and a sample of 100 nursing students from different academic years was selected. Data were collected using a researcher-developed questionnaire, and the reliability of the instrument was confirmed with a Kuder Richardson 20 coefficient of 0.744. Statistical analysis involved Chi-Square tests and Fisher's exact tests, with a significance level set at $\alpha=0.05$. The results indicated that 70% of the students had received some form of education regarding medical waste. Findings showed significant differences in understanding certain aspects of waste management, such as the correct filling of medical waste bags and the classification of expired drugs as pharmaceutical waste, particularly when analyzed by gender. The study concluded that as students advance academically and attend more courses related to waste management, their knowledge and attitudes towards managing medical waste responsibly improve. Emphasis was placed on the critical role of continuous education in

strengthening nursing students' commitment to effective medical waste practices, thereby enhancing public, personnel, and environmental health.

Similarly, Vasamreddy et al. (2023) conducted a study, Knowledge, Attitude, and Practices Regarding Biomedical Waste Management Among Nursing Students: A Cross-Sectional Analysis, to examine how nursing students across different years of study perceived and practiced biomedical waste management. Using a descriptive cross-sectional design and the total enumeration method, 180 nursing students (90 first-year and 90 fourth-year) from Sri Padmavathamma Government College of Nursing were surveyed with a structured questionnaire developed through expert consultation. The findings revealed that fourth-year students demonstrated a more positive attitude towards biomedical waste management compared to first-year students. The study emphasized that educational progression significantly enhanced students' attitudes and awareness regarding proper waste management. The authors suggested that reinforcing attitudes through regular educational interventions would be essential to fostering responsible healthcare waste management practices among nursing students, ultimately safeguarding environmental and public health.

In another related study, Vijay et al. (2025) explored the Knowledge, Attitude, and Practices on Biomedical Waste Management Among Nursing Students through a cross-sectional design. A self-administered, pretested questionnaire was used to collect data from 140 participants, comprising both medical and nursing students, at a tertiary care teaching hospital. Although medical students demonstrated superior knowledge about biomedical waste rules compared to nursing students (80% vs 40%), both groups exhibited an overall positive attitude towards biomedical waste management. However, the differences in attitudes between medical and nursing students were not statistically significant. Despite good attitudes, the study found that

actual practices were relatively poor, prompting the recommendation that proper training programs be instituted to convert positive attitudes into safe and effective biomedical waste management behaviors.

2.2.3 The practices of undergraduate nursing students in the handling and disposal of health care waste.

In a study conducted by López-Medina et al. (2022) titled Perceptions and Concerns about Sustainable Healthcare of Nursing Students Trained in Sustainability and Health, a cohort design with an inductive content analysis approach was used to explore the perceptions and concerns of nursing students regarding sustainable healthcare practices. The study was carried out among undergraduate nursing students across their four-year academic program, where they were exposed to scenario-based learning and augmented reality interventions focusing on sustainability, climate change, and health. Students completed surveys containing open-ended questions after each intervention.

The results revealed that students acknowledged content related to climate change, health, and hospital waste segregation within their curriculum. However, as clinical exposure increased, students demanded more training on low environmental impact healthcare practices. They expressed concerns about the excessive and unnecessary use of materials in healthcare, poor waste segregation practices, absence of recycling initiatives, and the environmental pollution caused by improper disposal methods. Students recognized that climate change would increasingly affect nursing practice, emphasizing the need for environmental leadership within the nursing profession. The study concluded that sustainable healthcare education enhances environmental awareness among future nurses and empowers them to lead climate-smart healthcare practices.

Similarly, Shuleta-Qehaja & Kelmendi (2022) carried out a descriptive cross-sectional study titled Pharmacy and Nursing Students' Knowledge and Practices Concerning the Disposal of Unused and Expired Medicines in Kosovo to assess the disposal practices of nursing and pharmacy students. A self-administered questionnaire was distributed among 500 randomly selected students, yielding a response rate of 67.2% (336 students). The findings showed that although a majority of students (over 80%) checked medication expiration dates, disposal practices were poor, with more than half discarding unused and expired medicines into regular trash. Only a small proportion returned medicines to pharmacies. Although students were aware of the environmental and public health risks associated with improper disposal, knowledge on safe return mechanisms was lacking. The study concluded that introducing additional lectures on safe disposal and organizing stakeholder-led workshops would be crucial in promoting better pharmaceutical waste management practices among nursing students.

In another related study by Nakiganda et al. (2023) titled Safe Disposal of Unused Medicine Among Health Professions Students at Makerere University: Knowledge, Practices and Barriers, a cross-sectional design was used to investigate the knowledge, practices, and barriers to safe medicine disposal among undergraduate health professions students. Data were collected via an online questionnaire distributed through WhatsApp and email. Among the 205 participants, although 76% demonstrated good knowledge, actual disposal practices were suboptimal. About half of the participants admitted to storing unused medicines at home, primarily antibiotics and analgesics. The most common method of disposal reported was dumping into household garbage (50.2%), with only 18% utilizing take-back programs. Major barriers to proper disposal included insufficient advice from medicine dispensers and inadequate knowledge regarding safe disposal methods. The study concluded that despite reasonable knowledge levels, there was a clear gap

between knowledge and practice, suggesting the need for targeted interventions to promote safe disposal behaviors and reduce the risk of environmental contamination and antimicrobial resistance.

In a study conducted by Mlouki et al. (2023) titled Hand Hygiene and Biomedical Waste Management among Medical Students: A Quasi-Experimental Study Evaluating Two Training Methods, a quasi-experimental design was used to assess the effectiveness of two different training methods on hand hygiene (HH) and biomedical waste management (BMWM) among medical students. The study was carried out between September 2021 and May 2022 at the Faculty of Medicine of Monastir, Tunisia, and involved fifth-year medical students. Participants were divided into two groups: one received conventional training (teacher-led presentations and simulations), while the other underwent student-centred training (student-prepared courses and simulated exercises). Data were collected using the WHO HH Knowledge Questionnaire and the "BMWM audit" tool validated by the Nosocomial Infection Control Committee in France.

The study included 203 students, with 105 in the control group and 98 in the experimental group. Results showed that both training methods significantly improved post-test scores related to HH and BMWM. However, the student-centred training method yielded higher post-test mean scores for both hand hygiene (14.1 ± 1.9 compared to 13.9 ± 2.3) and hazardous waste management (25 ± 3.3 compared to 23.6 ± 5.5). Moreover, the proportion of students with good HH knowledge increased more substantially after the student-centred training (40.5%) than after the conventional training (25%). The study concluded that combining student-centred teaching with continuous supervision can enhance knowledge and practices in both hand hygiene and biomedical waste management among medical students, promoting better waste management behaviours early in professional training.

Similarly, Gubae et al. (2023) carried out a descriptive cross-sectional study titled Ecopharmacology: Knowledge, Attitude, and Medication Disposal Practice among Pharmacy Students to assess the knowledge, attitude, and practices related to the environmental disposal of medicines among pharmacy students in Northwestern Ethiopia. Data were collected through a self-administered questionnaire between May 1 and June 15, 2023, involving 445 participants. Findings revealed significant gaps in knowledge and practice. Only 20% of the students were familiar with the concept of ecopharmacology, 27% understood that excretion from humans or animals is a major route by which pharmaceuticals enter the environment, and 42% were aware of the risk of increased antimicrobial resistance from antibiotic residues. Despite a generally positive attitude toward environmental protection, 61.8% of students reported disposing of leftover or expired medicines by throwing them into household trash. Only 27% had received any prior information regarding proper pharmaceutical disposal. The study concluded that while pharmacy students demonstrated positive attitudes, their knowledge and practices concerning pharmaceutical waste disposal were inadequate. It recommended integrating more structured education on ecopharmacology and environmental pharmaceutical pollution into the pharmacy curriculum to foster responsible waste management behaviours among future healthcare professionals.

In a study conducted by Revankar et al. (2023), titled Knowledge of Biomedical Waste Management amidst the Clinical Students of Dental College, Tamilnadu State, India – A Cross-Sectional Observational Study, a cross-sectional observational design was employed to assess the knowledge and awareness regarding biomedical waste (BMW) management among undergraduate dental students in Tamilnadu, India. A pre-designed questionnaire was distributed among the students to evaluate their expertise and awareness on the subject. A total of 180

students participated, with a male-to-female ratio of 1:2 and an average age of 19.76 ± 1.03 years. The findings showed that 60.33% of students correctly answered questions about BMW management, while 81.35% demonstrated a correct overall knowledge of biomedical waste principles. The study concluded that the dental students possessed a relatively high level of knowledge and understanding concerning biomedical waste management, although there remains a margin for improving practical application.

Similarly, Kamran et al. (2022) conducted a study titled Awareness of Dental Undergraduates, Post Graduates and Dental Practitioners about Dental and Biomedical Waste Management using a cross-sectional design with convenience sampling. Conducted between January and June 2019 across private and public dental colleges in Karachi, Pakistan, the study recruited 273 participants, including undergraduate and postgraduate students as well as dental practitioners. Participants completed a detailed questionnaire covering aspects such as biomedical waste rules, waste disposal measures, dental waste types, and associated environmental hazards. The results showed that 64.4% of respondents were unaware of dental waste management rules, and while 75% agreed that hospital waste should be treated by qualified professionals, only 67.7% recognized the different categories of dental waste. Notably, postgraduate students demonstrated significantly better knowledge compared to undergraduates, although the overall level of awareness about environmentally friendly waste disposal practices remained insufficient. The authors recommended the incorporation of workshops and continuous medical education seminars to bridge the "know-do gap" in biomedical waste management practices.

Furthermore, Ali et al. (2021) carried out a cross-sectional study titled Assessment of Knowledge of Biomedical Waste Management in Third and Final Year BDS Students at Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan. The study aimed to evaluate the knowledge

of third- and final-year dental students regarding proper biomedical waste (BMW) disposal methods. Using a questionnaire-based survey, the study included 107 students (56 from third year and 51 from final year). The analysis revealed that a majority of students were unaware whether their institution followed official BMW guidelines, and many also lacked clear knowledge about waste segregation categories. Statistical analysis using the Chi-square test indicated a significant gap in knowledge ($p < 0.05$). The study concluded that the lack of understanding about correct biomedical waste disposal methods among dental students is alarming and underscored the need for integrating BMW management education into undergraduate curricula to ensure safe disposal practices among future healthcare providers

2.4.4 Factors associated with knowledge, attitudes, and practices of health care waste management among undergraduate nursing students.

In a study conducted by E et al. (2022) titled Knowledge, Attitudes, and Practices Associated with Biomedical Waste Management among Students in an Indian Teaching Hospital, a cross-sectional survey design was employed to assess the levels of knowledge, attitudes, and practices regarding biomedical waste management among students from nursing, physiotherapy, pharmacy, and allied health disciplines at a private teaching hospital in Tamil Nadu, India. Data were collected using a structured questionnaire, and the sampling included 237 respondents, with 59.4% being female and 40.5% male, predominantly aged between 21 and 30 years. Statistical analysis compared knowledge, attitude, and practice levels across study groups. The results revealed that while PhD scholars in allied health sciences and nursing students demonstrated excellent knowledge (>90%) concerning needle-stick injuries, other groups showed lower levels of awareness. Notably, a significant proportion of students reported experiencing needle-stick injuries within the past 24 months: 84% of nursing undergraduates, 80% of pharmacy students,

26% of allied health students, and 70% of physiotherapy students. The study concluded that there remains a concerning lack of knowledge and awareness about biomedical waste management risks, laws, and practices among students in the allied health fields, highlighting the need for more rigorous training and education to promote safer healthcare environments.

Similarly, Chilate (2023) investigated The Effectiveness of a Structured Teaching Programme (STP) on Knowledge Regarding Bio-Medical Waste Management among B.Sc. Nursing Students at the Government College of Nursing, Durg. The study utilized a pre-experimental research design to evaluate the impact of structured educational intervention on second- and third-year B.Sc. nursing students' knowledge. All participants were female students, with the majority (74%) aged between 21–24 years. Data collection involved a structured knowledge assessment tool, and the primary sources of students' prior knowledge were identified as hospital experience (78%), followed by books (14%) and conferences/workshops (8%). The results showed that before the intervention, students already exhibited a generally good understanding and positive attitude toward biomedical waste management, attributed largely to their clinical training at the Government District Hospital, Durg. Statistical analysis indicated a significant improvement in knowledge levels post-intervention ($p \leq 0.05$), although factors such as gender, living pattern, and specific hospital affiliation were not significantly associated with knowledge levels. The study concluded that structured teaching programs can effectively enhance nursing students' knowledge and awareness of biomedical waste management, ultimately leading to improved healthcare practices and safer environmental management.

In a study conducted by Vasamreddy et al. (2023), titled Knowledge, Attitude, and Practices Regarding Biomedical Waste Management Among Nursing Students: A Cross-Sectional Analysis, the researchers employed a non-experimental, descriptive cross-sectional design to assess the

knowledge, attitudes, and practices (KAP) related to biomedical waste management among first- and fourth-year nursing students. Using the total enumeration method, all eligible students at Sri Padmavathamma Government College of Nursing were included in the study during October and November 2022. Data were collected through a structured questionnaire developed from an extensive literature review and expert consultation, covering 31 items (12 for knowledge, 10 for attitude, and 9 for practice). A total of 180 students participated, equally divided between the first and fourth years. Analysis with SPSS version 20 and the Chi-square test revealed that fourth-year students demonstrated significantly better knowledge, more positive attitudes, and stronger practices regarding biomedical waste management compared to first-year students. The study concluded that continuous educational interventions are necessary to further enhance the knowledge and practices of biomedical waste management among nursing students, for the betterment of environmental and public health.

Similarly, Silambarasan (2023) conducted a study titled Biomedical Waste Management among Nursing Students, using a descriptive research design with a non-probability volunteer sampling technique. The study recruited 100 nursing students who met the inclusion criteria. Data were gathered using a standardized questionnaire to evaluate pre-test and post-test knowledge, attitudes, and practices (KAP) related to biomedical waste management. The pre-test results showed a mean score of 56.51 with a standard deviation of 20.5229, indicating moderate baseline knowledge. Chi-square analysis found no significant association between demographic variables and KAP scores, except for education and training, which had a significant effect. The study concluded that regular training programs are critical to improving nursing students' knowledge and practical skills in biomedical waste management, emphasizing that educational interventions are key to enhancing sustainable and safe healthcare practices.

Additionally, E et al. (2022), in their study Knowledge, Attitudes, and Practices Associated with Biomedical Waste Management among Students in an Indian Teaching Hospital, employed a cross-sectional survey design with data collected from students of nursing, physiotherapy, pharmacy, and allied health sciences through a structured questionnaire. A total of 237 students participated, with most falling within the 21–30 year age range. Statistical analyses demonstrated that knowledge regarding biomedical waste management was particularly strong among PhD scholars and nursing students, while undergraduate students from other disciplines showed lower awareness levels. Furthermore, a significant proportion of students had experienced needle-stick injuries in the preceding two years, underlining the practical implications of insufficient waste management knowledge. The study concluded that there is a substantial gap in knowledge, attitudes, and practices regarding biomedical waste management among allied health students, necessitating more comprehensive training programs.

2.4 Summary of the Literature Review

This study explores the knowledge, attitudes, and practices (KAP) of undergraduate nursing students concerning healthcare waste management, as well as the factors influencing these dimensions. The conceptual review highlights several key areas essential for understanding the topic. Firstly, healthcare waste is defined as any waste generated by healthcare activities, with types ranging from infectious, pathological, and sharps waste to pharmaceutical, chemical, and general non-hazardous waste. Proper healthcare waste management is crucial for protecting human health, preserving the environment, and maintaining public safety. The review underscores that failure to manage healthcare waste appropriately poses serious risks, including the spread of infections, environmental contamination, and social stigmatization.

Furthermore, the literature emphasizes the current knowledge levels among nursing students about healthcare waste management, revealing that knowledge acquisition is influenced by factors such as curriculum design, clinical exposure, and participation in workshops and seminars. In terms of attitudes, the review notes that personal values, cultural beliefs, and institutional policies shape how students perceive and prioritize waste management. Practices are often assessed through direct observation in clinical settings, highlighting varying degrees of compliance with standard procedures, and are affected by barriers such as inadequate training, resource constraints, and lack of supervision. The review also examines factors influencing knowledge, attitudes, and practices, which include educational background, clinical training, availability of facilities, institutional policies, and the level of supervision provided during clinical practice. These factors contribute significantly to how effectively nursing students engage in safe and sustainable healthcare waste management practices.

The theoretical foundation of the study is based on the Knowledge, Attitude, and Practice (KAP) Model. This model provides a sequential framework where knowledge is seen as the initial step leading to the development of attitudes, which then influence actual practices. According to the KAP model, improving knowledge is critical for fostering positive attitudes and, ultimately, correct practices. It also recognizes the role of external factors such as institutional support and resource availability in shaping these outcomes. The application of the KAP model to the study's specific objectives ensures a comprehensive exploration of how knowledge, attitudes, and practices among nursing students are interconnected and influenced by various contextual factors. By utilizing this framework, the study aims to identify gaps and propose strategies for strengthening healthcare waste management education and practice among future healthcare professionals.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This chapter described the research methodology that the researcher intends to adopt in conducting this study. The various components of research methodology was discussed under their respective headings, including research design, study setting, target population, sample and sampling technique, instruments of data collection, validity and reliability of instruments, method of data collection, method of data analysis, and ethical considerations.

3.1 Research design

This study employed a descriptive-correlational cross-sectional design. The descriptive aspect aimed to determine the levels of knowledge, attitudes, and practices of undergraduate nursing students regarding health care waste management. At the same time, the correlational component would seek to identify factors associated with these variables. A cross-sectional approach was used to gather data at a single point in time without manipulating any variables. This design was considered appropriate because it enabled the researchers to provide a comprehensive overview of the students' knowledge, attitudes, and practices, and to explore possible relationships among influencing factors in an efficient and practical manner.

3.2 Research Setting

The study was carried out in the Faculty of Nursing science at the University of Benin, located in Ovia North-East Local Government Area of Edo State, Nigeria. The University of Benin was founded in 1970, starting as the Institute of Technology and later changing to the University of Benin by the National University Commission (NUC). The University of Benin is one of the largest and most prestigious universities in Nigeria, with a reputation for academic excellence.

The university has over 40,000 students enrolled every year, both full-time and part-time, shared among its 13 faculties, which include Law, Engineering, Agriculture, Management Sciences, Arts, Physical Sciences, Environmental Sciences, Social Sciences, Pharmacy, Life Sciences, College of Medical Sciences, and Education. The university has approximately 73 departments organized within these faculties. The faculty of Nursing are housed within the College of Medical Sciences at the University of Benin. The faculty offer undergraduate and postgraduate programs in nursing, preparing students for careers in healthcare. The faculty have state-of-the-art facilities, including nursing skills laboratories, simulation centers, and clinical placement opportunities in affiliated hospitals and healthcare facilities. The faculty of Nursing have a strong focus on evidence-based practice, research, and community engagement, making them an ideal setting for the proposed study.

3.3 Target Population

The target population for the study was nursing students from 200 level to 500 level at the University of Benin.

Table 3.1 Number of Nursing students in each Academic level

Level	Number of students
200	177
300	190
400	174
500	160
Total	**701**

Source: Nursing Department (April, 2025)

3.4 Sample Size Determination

The sample size was calculated as indicated below:

Using Taro Yamane's Formula

$$n = \frac{N}{1+N(e)^2}$$

Where

N= Population under study

E= Constant 0.05%) margin error

$$n = \frac{701}{1+701\ (0.05)^2}$$

$$n = \frac{701}{1+701\ (0.0025)}$$

$$n = \frac{701}{1+1.7525}$$

$$n = \frac{701}{2.7525}$$

n=255

Therefore, the sample size was 255.

3.5 Sampling Technique

A stratified random sampling was used for this study. Stratified random sampling is a probability sampling technique where the population is divided into distinct subgroups or strata that share common characteristics such as gender, age, income, education level (Ahmed 2024). After creating these strata, participants were randomly selected from each group. The key advantage of this approach is that it ensures each subgroup is adequately represented in the sample, which improves the precision and reliability of my findings.

Proportional sampling calculation

Table 3.1: Distribution of sample size across all levels

Academic level	Determination of sample size in each level	Sample size per level
200	177/701 x 255	64
300	190/701 x 255	69
400	174/701 x 255	63
500	160/701 x 255	58

3.6 Instrument for Data Collection

The instrument for data collection in this study was a self-structured questionnaire. This was developed based on the objectives of the study. The questionnaire were made up of four sections with. Questions which were carefully drafted, sequenced and constructed in a bid to get in-depth information that is useful and relevant to the study was used.

Section A: consist of the demographic data of the participants (Age, Marital Status, Current Educational Level, Ethnicity).

Section B: The level of knowledge of undergraduate nursing students about health care waste management.

Section C: The attitudes of undergraduate nursing students towards health care waste management.

Section D: The practices of undergraduate nursing students in the handling and disposal of health care waste.

Section E: The factors associated with knowledge, attitudes, and practices of health care waste management among undergraduate nursing students.

3.7 Validity of the Instrument

The instrument's validity pertained to its capability to accurately measure the intended construct or concept (Surucu & Maslakci, 2020). Researchers assessed various validity types such as content, construct, criterion, and face to evaluate the instrument's accuracy. For this research, face and content validity were utilized to validate the research tool. The questionnaire undergone

validation by both the project supervisor and a field expert, and necessary adjustments were implemented by the researcher before starting the main study.

3.8 Reliability of the Instrument

The reliability of an instrument referred to its stability and consistency in delivering uniform outcomes when assessing the same criteria under identical circumstances (Surucu & Maslakci, 2020). It essentially gauged how consistently the instrument produced similar results across multiple trials. A reliable instrument is one that could produce the same results if the behaviour was measured again by the same scale. The Cronbach's alpha reliability technique was employed in this study. This researcher conducted reliability testing on the instrument by distributing 26 questionnaires, which constituted 10% of the total sample size of 255, to nursing undergraduates of Igbenedion University (which are outside the sampled population). A coefficient of 0.71 was obtained, so the instrument was considered reliable.

3.9 Method of Data Collection

A well-structured questionnaire was administered to the undergraduate nursing students from 200 level to 500 level until the required sample size of 255 was achieved. The undergraduate students were approached at the faculty of Nursing University of Benin. The purpose of the study was explained to them, and the instrument for data collection was administered. Data collection was conducted by the researchers. The data collection took place during break periods, and on-the-spot retrieval of the administered copies of the questionnaire were all collected on the same day. Data collection lasted for about two weeks.

3.10 Method of Data Analysis

Ethical approval was obtained from the ethics and research committee of the College of Medical Sciences, University of Benin. Permission was obtained from the Dean of Nursing Science,

University of Benin, to proceed with the research. Before data collection began, participants received detailed explanations about the research's purpose, content, and implications. They were assured of confidentiality, ensuring the protection of their personal and private information. Throughout the research, ethical guidelines were strictly adhered to, including the following considerations:

Confidentiality: Respondents' information were treated confidentially, with no request for names or addresses in the questionnaire. Participants understood that their responses are confidential and solely used for research purposes. No personal identifiers were used in any document or questionnaire to maintain anonymity.

Voluntary Participation: Participants were informed of their right to voluntary participation without facing penalties or bias. They could choose to withdraw or decline to provide information at any point if they feel uncomfortable or unsure.

Avoidance of Plagiarism: Proper citation of all authors used in the study was ensured, both within the content and in the reference page.

CHAPTER FOUR

RESULT OF FINDINGS

This chapter deals with the representation of data collected from respondents on the knowledge, attitudes and practices of health care waste management among undergraduates nursing students in a Tertiary Educational Institution in Benin City. A total of 255 questionnaires were distributed to nursing students in the selected tertiary health institution, out of which 247 were properly filled and valid for data analysis, giving a response rate of 97%.

Table 4.1: Socio-demographic characteristics of respondents

Variable	Frequency	Percentage (%)
Age		
Below 18 years	18	7.3
18 - 21 years	76	30.8
22 - 25 years	91	36.8
26 – 29 years	42	17.0
30 and above	20	8.1
Sex Male		
	33	13.4
Female	214	86.6
Level of Study 200		
Level	59	23.9
300 Level	67	27.1
400 Level	61	24.7
500 Level	60	24.3
Marital Status Single		
	187	75.7
Married	48	19.4
Divorced	7	2.8
Widowed	5	2.0
Religion		
Christianity	171	69.2
Islam	48	19.4
Traditional	15	6.1
Others	13	5.3
Place of Residence Hostel		
	138	55.9
Off-campus	109	44.1

Table 4.1 cont'd

Variable	Frequency	Percentage (%)
Previous Training on Health Care Waste Management Yes	104	42.1
No	143	57.9
Clinical Exposure/Experience		
Yes	189	76.5
No	58	23.5
Number of Clinical Rotations Completed	47	19.0
0-2		
3-5	124	50.2
6 and above	76	30.8
Attendance at Seminars/Workshops on Waste Management	88	35.6
Yes		
No	159	64.4
Knowledge of Institutional Waste Management Policy Yes	101	40.9
No	146	59.1

Table 4.1 presents the socio-demographic characteristics of the respondents. The age distribution shows that the largest group falls within the 22–25 years category, accounting for 36.8% of the respondents. This is followed by those aged 18–21 years at 30.8%, while 17.0% are between 26–29 years. A smaller proportion, 8.1%, are 30 years and above, and 7.3% are below 18 years of age. The majority of respondents

are female, comprising 86.6%, while males represent 13.4%. In terms of level of study, the respondents are fairly distributed, with 300level students forming the largest group at 27.1%, followed by 400-level (24.7%), 500-level

(24.3%), and 200-level (23.9%). Marital status data indicate that most respondents are single

(75.7%), while 19.4% are married, 2.8% divorced, and 2.0% widowed. Religiously, Christianity is the dominant faith among respondents (69.2%), followed by Islam (19.4%), traditional religion (6.1%), and other religions (5.3%). Regarding residence, 55.9% live in hostels, while 44.1% reside off-campus. When asked about prior training on health care waste management, 57.9% reported no previous training, while 42.1% had received some form of training. Clinical exposure is common among the respondents, with 76.5% indicating they have had such experience, compared to 23.5% who have not. In terms of the number of clinical rotations completed, half of the respondents (50.2%) had completed between 3 to 5 rotations,

30.8% had completed 6 or more, and 19.0% had completed between 0 to 2 rotations. Attendance at seminars or workshops on waste management was relatively low, with only 35.6% having attended, while 64.4% had not. Lastly, 40.9% of respondents were aware of their institution's waste management policy, while the majority (59.1%) were not

.

Answering research question

Research question 1: What is the level of knowledge of undergraduate nursing students about health care waste management?

Table 4.2: Showing the level of knowledge of undergraduate nursing students about health care waste management.

Items	Frequency(%)	Correct(%)	Wrong(%)	Mean	Remark
Which of the following is classified as infectious waste? Used syringes	203 (82.2)	203 (82.2)	44 (17.8)	1.8	Good
Office paper	26 (10.5)				
Food leftovers	18 (7.3)				
What colour code is commonly used for disposing sharps in health care facilities? Yellow container	34 (13.8)	171 (69.2)	76 (30.8)	1.7	Good
Red container	171 (69.2)				
Blue container	42 (17.0)				
What is the first step in health care waste management? Transportation	37 (15.0)	158 (64.0)	89 (36.0)	1.6	Good
Disposal	52 (21.1)				
Segregation at the point of generation	158 (64.0)				
Which of the following wastes should be disposed of in a biohazard bag? Clean gauze	31 (12.6)	174 (70.5)	73 (29.5)	1.7	Good
Blood-soaked bandages	174 (70.5)				
Unused medicine	42 (17.0)				
Which method is most appropriate for the final disposal of pathological waste? Open dumping	34 (13.8)	146 (59.1)	101 (40.9)	1.6	Good
Incineration	146 (59.1)				
Composting	67 (27.1)				

Sharps containers should be filled up to what level before disposal?					
Completely full	71 (28.7)	109 (44.1)	138 (55.9)	1.4	Poor
Three-quarters full	109 (44.1)				
Half full	67 (27.1)				
What type of personal protective equipment (PPE) is essential when handling health care waste?					
Surgical mask only	45 (18.2)	181 (73.3)	66 (26.7)	1.7	Good
Gloves	181 (73.3)				
ID badge	21 (8.5)				
Which regulatory body provides guidelines for health care waste management in many countries?					
World Bank	36 (14.6)	167 (67.6)	80 (32.4)	1.7	Good
World Health Organization (WHO)	167 (67.6)				
United Nations Children's Fund (UNICEF)	44 (17.8)				
Which of the following is not considered hazardous health care waste?					
Expired medications	34 (13.8)	189 (76.5)	58 (23.5)	1.8	Good
Fruit peels	189 (76.5)				
Laboratory reagents	24 (9.7)				
Why is proper segregation of health care waste important?					
It increases the volume of waste	18 (7.3)	195 (78.9)	52 (21.1)	1.8	Good
It reduces risks to health workers and the public	195 (78.9)				
It delays waste disposal	34 (13.8)				
		Grand Mean		**1.7**	**Good**

Cut off mean = 1.5

Table 4.2 presents the level of knowledge of undergraduate nursing students about health care waste management. The highest mean score of 1.8 was recorded for the items identifying infectious waste, recognizing non-hazardous health care waste, and understanding the importance of proper segregation of health care waste, all indicating good knowledge. This was followed by a mean score of 1.7 for questions on the correct colour code for disposing sharps, the appropriate disposal of waste in biohazard bags, the use of personal protective equipment when handling health care waste, and the regulatory body providing guidelines for health care waste management, each reflecting good knowledge. A mean score of 1.6 was observed for knowledge about the first step in health care waste management and the most appropriate method for final disposal of pathological waste, also indicating good knowledge. The lowest mean score of 1.4 was found in the item assessing knowledge on the correct level to which sharps containers should be filled before disposal, which was rated as poor. The grand mean of 1.7 indicates an overall good level of knowledge of health care waste management among the respondents.

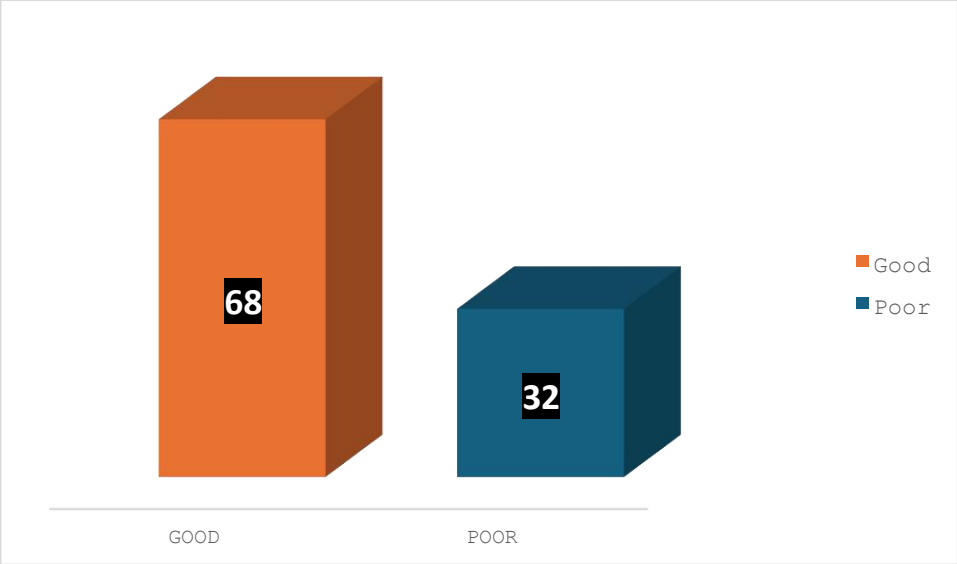

Figure 4.1: Bar Chart Showing the level of knowledge of undergraduate nursing students about health care waste management

The bar chart shows that 169 (68%) of the respondents demonstrated good knowledge of health care waste management, while 78 (32%) exhibited poor knowledge.

Research question 2: What are the attitudes of undergraduate nursing students towards health care waste management?

Table 4.3: showing the attitudes of undergraduate nursing students towards health care waste management

Items	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean	Remark
Proper health care waste management is essential for infection control.	139 (56.3)	84 (34.0)	15 (6.1)	9 (3.6)	3.4	Positive
Managing health care waste correctly is the responsibility of every health worker, including students.	121 (49.0)	88 (35.6)	26 (10.5)	12 (4.9)	3.3	Positive
Training on health care waste management should be mandatory for all nursing students.	132 (53.4)	91 (36.8)	18 (7.3)	6 (2.4)	3.4	Positive
I believe improper disposal of health care waste can endanger patients and the environment.	128 (51.8)	86 (34.8)	20 (8.1)	13 (5.3)	3.3	Positive
Segregating waste into different categories is unnecessary and timeconsuming.	23 (9.3)	31 (12.6)	109 (44.1)	84 (34.0)	2	Negative
I feel motivated to follow health care waste management protocols during clinical practice.	107 (43.3)	91 (36.8)	30 (12.1)	19 (7.7)	3.2	Positive
I am confident that following proper waste management practices helps protect my health.	115 (46.6)	89 (36.0)	24 (9.7)	19 (7.7)	3.2	Positive
Health care waste management should only be the concern of hospital cleaning staff, not nursing students.	18 (7.3)	26 (10.5)	106 (42.9)	97 (39.3)	1.9	Negative
Regular supervision and monitoring encourage better compliance with waste management practices.	119 (48.2)	93 (37.7)	23 (9.3)	12 (4.9)	3.3	Positive
			Grand Mean		**2.7**	Positive

Cut off mean = 2.5

Table 4.3 illustrates the attitudes of undergraduate nursing students towards health care waste management, with a grand mean of 2.7, reflecting a generally positive disposition among the respondents. The highest mean score of 3.4 was recorded for both the belief that proper health care waste management is essential for infection control and the opinion that training on health care waste management should be mandatory for all nursing students, indicating strong agreement and prioritization of these aspects. This is closely followed by a mean of 3.3 for the statements that managing health care waste is the responsibility of every health worker, including students, that improper disposal can endanger patients and the environment, and that regular supervision and monitoring encourage better compliance, all demonstrating a high level of responsibility and awareness. The statements "I feel motivated to follow health care waste management protocols during clinical practice" and "I am confident that following proper waste management practices helps protect my health" each had a mean of 3.2, suggesting that personal motivation and perceived self-protection are also significant drivers of positive attitudes. Conversely, the lowest mean scores were observed for the statements "Segregating waste into different categories is unnecessary and time-consuming" (mean 2.0) and "Health care waste management should only be the concern of hospital cleaning staff, not nursing students" (mean 1.9), indicating strong disagreement and a clear rejection of these negative or dismissive attitudes. Overall, the results reveal that undergraduate nursing students hold predominantly positive attitudes towards health care waste management, recognizing its importance, their own responsibility, and the need for mandatory training, while rejecting misconceptions and demonstrating motivation to comply with best practices.

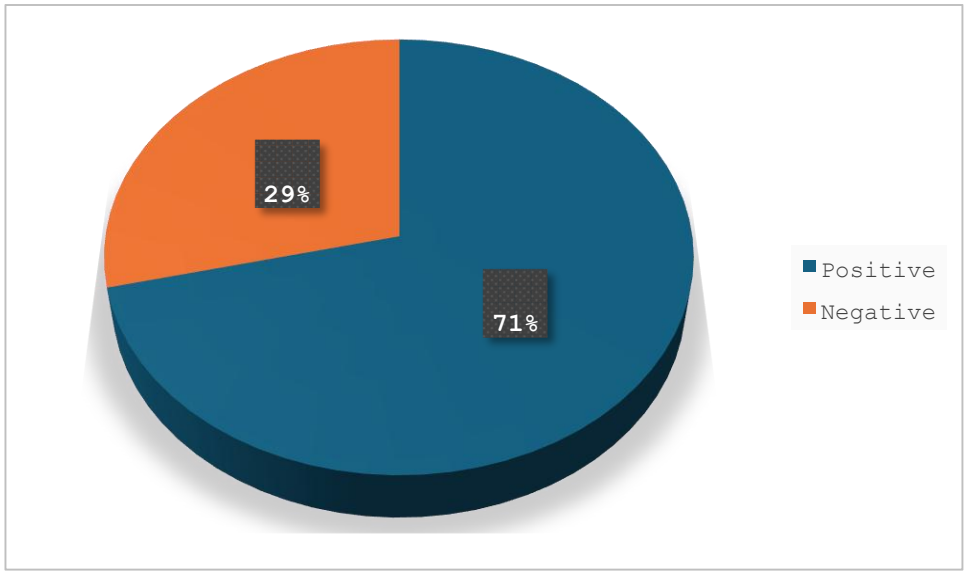

Figure 4.2: Pie chart showing the attitudes of undergraduate nursing students towards health care waste management

The pie chart shows that 176 (71%) of the undergraduate nursing students had a positive attitude towards health care waste management, while 71 (29%) had a negative attitude.

Research questions 3: What are the practices of undergraduate nursing students in the handling and disposal of health care waste?

Table 4.4 Showing the practices of undergraduate nursing students in the handling and disposal of health care waste

Statement	Always	Sometimes	Rarely	Never	Mean	Remark
I properly segregate health care waste according to color-coded bins.	108 (43.7)	87 (35.2)	31 (12.6)	21 (8.5)	3.1	High
I wear personal protective equipment (PPE) when handling health care waste.	117 (47.4)	81 (32.8)	28 (11.3)	21 (8.5)	3.2	High
I wash my hands after disposing of health care waste.	126 (51.0)	74 (30.0)	29 (11.7)	18 (7.3)	3.2	High
I correctly label hazardous health care waste before disposal.	98 (39.7)	83 (33.6)	42 (17.0)	24 (9.7)	3	High
I dispose of sharps (needles, blades) in puncture-proof containers.	131 (53.0)	77 (31.2)	25 (10.1)	14 (5.7)	3.3	High
I attend trainings or seminars on health care waste management when available.	102 (41.3)	79 (32.0)	36 (14.6)	30 (12.1)	3	High
I report incidents of improper health care waste disposal to the appropriate authorities.	87 (35.2)	76 (30.8)	45 (18.2)	39 (15.8)	2.9	High
I educate my peers on proper health care waste handling during clinical rotations.	93 (37.7)	81 (32.8)	41 (16.6)	32 (13.0)	3	High
I separate infectious waste from non-infectious waste during disposal.	109 (44.1)	86 (34.8)	29 (11.7)	23 (9.3)	3.1	High
I follow hospital or clinical guidelines strictly when managing health care waste.	115 (46.6)	84 (34.0)	28 (11.3)	20 (8.1)	3.2	High
			Grand Mean		**3.1**	High

Cut off mean = 2.5

Table 4.4 demonstrates generally high compliance among undergraduate nursing students in health care waste management practices, with a grand mean of 3.1 (above the 2.5 cutoff). The highest mean scores are observed for sharps disposal (3.3), PPE usage (3.2), handwashing (3.2), and adherence to clinical guidelines (3.2), reflecting rigorous safety protocols. Proper segregation (3.1), infectious waste separation (3.1), and peer education (3.0) also scored well, while incident reporting (2.9) showed slightly lower but still high compliance. These findings align with studies emphasizing training needs but contrast with reports of moderate knowledge, suggesting practical adherence may outpace theoretical understanding in structured clinical environments.

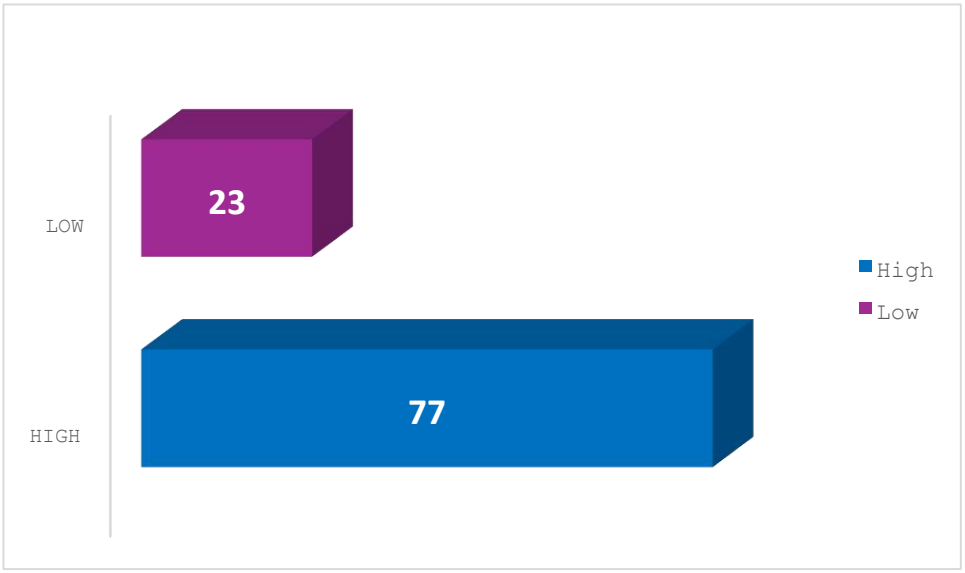

Figure 4.3: Bar Chart showing the practices of undergraduate nursing students in the handling and disposal of health care waste

The Bar chart shows that 189 (77%) of the undergraduate nursing students demonstrated high levels of proper practices in the handling and disposal of health care waste, while 58 (23%)

exhibited low levels of such practices.

Research questions 4: What are the factors associated with knowledge, attitudes, and practices of health care waste management among undergraduate nursing students?

Table 4.5 Showing the factors associated with knowledge, attitudes, and practices of health care waste management among undergraduate nursing students

Items	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean	Remarks
Adequate training programs improve my knowledge of health care waste management.	113 (45.7)	91 (36.8)	28 (11.3)	15 (6.1)	3.2	Influential
Access to clear hospital guidelines encourages proper health care waste handling.	105 (42.5)	89 (36.0)	35 (14.2)	18 (7.3)	3.1	Influential
Supervision by clinical instructors positively influences my waste management practices.	97 (39.3)	93 (37.7)	36 (14.6)	21 (8.5)	3.1	Influential
Availability of proper waste disposal facilities motivates me to practice correct disposal.	110 (44.5)	90 (36.4)	28 (11.3)	19 (7.7)	3.2	Influential
Time constraints during clinical duties affect my ability to properly manage health care waste.	88 (35.6)	94 (38.1)	40 (16.2)	25 (10.1)	3	Influential
Lack of awareness among staff and students leads to improper waste disposal practices.	101 (40.9)	87 (35.2)	38 (15.4)	21 (8.5)	3.1	Influential
My level of education affects how well I manage health care waste.	95 (38.5)	84 (34.0)	42 (17.0)	26 (10.5)	3	Influential
Peer influence plays a role in how seriously I take health care waste management.	91 (36.8)	88 (35.6)	41 (16.6)	27 (10.9)	3	Influential
Regular monitoring and evaluation by supervisors improve adherence to waste management protocols.	108 (43.7)	92 (37.2)	31 (12.6)	16 (6.5)	3.2	Influential
Personal interest and commitment strongly determine how I handle health care waste.	111 (44.9)	85 (34.4)	29 (11.7)	22 (8.9)	3.2	Influential
			Grand Mean		**3.1**	**Influential**

Cut off mean = 2.5

Table 4.5 identifies key factors influencing health care waste management among undergraduate nursing students, with a grand mean of 3.1 (above the 2.5 cutoff), indicating strong agreement on their impact. The highest mean scores (3.2) are attributed to adequate training programs, availability of proper disposal facilities, regular monitoring by supervisors, and personal interest, underscoring their critical role in improving knowledge, practices, and adherence. Clear hospital guidelines (3.1), supervision by clinical instructors (3.1), and lack of awareness (3.1) also emerge as significant factors, aligning with studies emphasizing institutional support and education gaps. Time constraints (3.0), education level (3.0), and peer influence (3.0) further highlight operational and social challenges, corroborating research on workload and training deficiencies. These findings collectively stress the interplay of structured training, resource availability, and individual accountability in effective waste management practices.

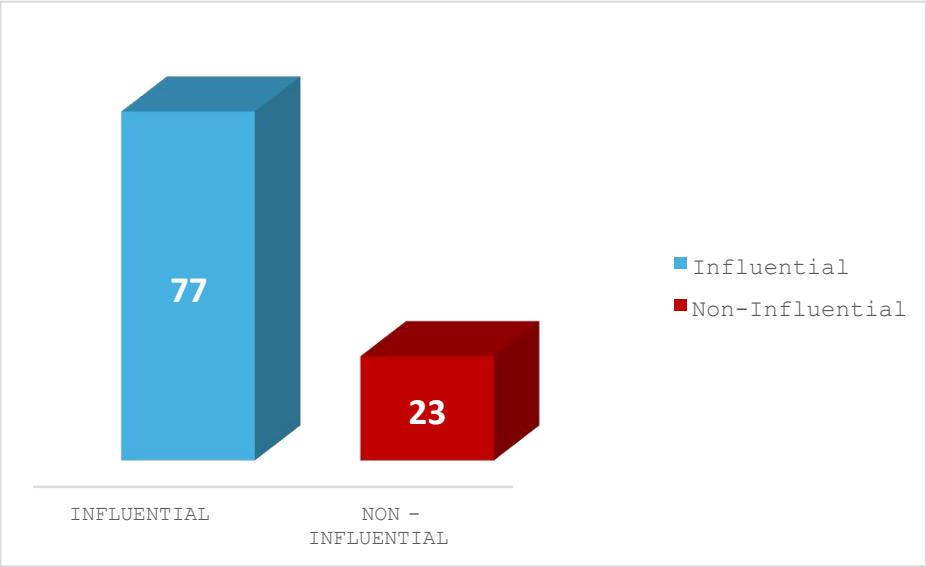

Figure 4.4: Bar Chart showing the factors associated with knowledge, attitudes, and practices of health care waste management among undergraduate nursing students

The bar chart shows that 191 (77%) of the respondents identified factors as influential in shaping their knowledge, attitudes, and practices of health care waste management, while 56 (23%) considered these factors non-influential.

Hypothesis

Ho1: There is no significant relationship between knowledge of healthcare waste management and the practice of healthcare waste management among undergraduate nursing students in tertiary educational institutions in Benin City

Table 4.6: Relationship between knowledge of healthcare waste management and the practice of healthcare waste management among undergraduate nursing students in tertiary educational institutions in Benin City

Knowledge	**practice of healthcare waste management**		**Test Statistics (χ^2)**	**df**	**P value**	**Decision**
	High	**Low**				
Good	132 (53.4)	103 (46.6)	2.101	1	0.07	Accepted
Poor	126 (58.6)	103(43.4)				

Table 4.6 shows that there was no statistically significant relationship between the level of knowledge and the practice of health care waste management among undergraduate nursing students in tertiary institutions in Benin City ($\chi^2 = 2.101$, $p = 0.07$). Although students with

good knowledge practiced health care waste management more than those with poor knowledge, the difference was not significant at the 0.05 level. Therefore, the null hypothesis was accepted.

CHAPTER FIVE

DISCUSSION OF FINDINGS

This chapter discusses the major findings of the research compared with the literature reviewed, the implication for nursing, summary, conclusion, Recommendations and Suggestions for further Studies.

5.1. Discussion of major Findings

The study assessed the knowledge, attitudes and practices of health care waste management among undergraduates nursing students in a Tertiary Educational Institution in Benin City. The socio-demographic data of the respondents reveals important characteristics of nursing students that align with findings from previous studies. The sample predominantly comprises females (86.6%), which is consistent with the gender distribution observed in nursing education studies such as Chilate (2023), where all participants were female. The majority of respondents fall within the 22-25 years age range (36.8%), similar to the age profile reported by Silambarasan (2023) and Chilate (2023), where most nursing students were between 21-24 years. The findings show that 57.9% of respondents have no previous training in healthcare waste management, which parallels the knowledge gaps identified by Najotra et al. (2020) and Hashish et al. (2020). Despite this lack of formal training, 76.5% report having clinical exposure, supporting Chilate's (2023) observation that hospital experience (78%) serves as the primary source of knowledge about biomedical waste management for most nursing students. Only 35.6% of respondents have attended seminars or workshops on waste management, reflecting the limited educational interventions highlighted by Tiwari et al. (2021) and Gubae et al. (2023). Similarly, only 40.9% are aware of institutional waste management policies, which aligns with Najotra et al.'s (2020) finding that only 40% of nursing students were aware of biomedical waste management rules.

The relatively balanced distribution across study levels (200-500) enables comparison of knowledge progression throughout academic years, similar to the approach taken by Vasamreddy et al. (2023) and Toluk et al. (2021), who found significant improvements in knowledge and attitudes as students advanced academically. The fact that half of the respondents (50.2%) have completed 3-5 clinical rotations suggests moderate clinical exposure, which López-Medina et al. (2022) associated with increased awareness of waste management challenges.

level of knowledge of undergraduate nursing students about health care waste management.

The findings reveal that a majority of undergraduate nursing students (68%) demonstrated good knowledge about health care waste management, with only 32% exhibiting poor knowledge. This favourable knowledge level aligns with several previous studies, including Chilate (2023), who reported that nursing students generally showed good understanding of biomedical waste management principles. Similarly, Revankar et al. (2023) found that 60.33% of dental students correctly answered questions about biomedical waste management, comparable to our findings. Analysis of specific knowledge items indicates that students possess good knowledge in most areas of health care waste management, with a grand mean of 1.7. Students demonstrated particularly strong knowledge in identifying infectious waste (82.2% correct responses), recognizing non-hazardous waste (76.5% correct responses), and understanding the importance of proper segregation (78.9% correct responses). This reflects the findings of E et al. (2022), who noted that nursing students demonstrated excellent knowledge (>90%) concerning aspects like needle-stick injuries compared to students from other health disciplines.

However, notable knowledge gaps exist in certain areas. Only 44.1% of students correctly identified the appropriate filling level for sharps containers before disposal, indicating a critical safety knowledge gap. This specific deficit corresponds with Hashish et al. (2020), who reported

inadequate knowledge regarding specific aspects of biomedical waste management protocols among nursing students despite generally positive attitudes. The relatively good knowledge of colour coding for sharps disposal (69.2% correct responses) contrasts with Tiwari et al. (2021), who found that 84.7% of nursing students demonstrated poor knowledge of colour coding systems. This difference might be attributed to variations in educational emphasis across institutions or the influence of clinical exposure, as our study shows 76.5% of respondents had clinical experience.

Understanding of waste segregation as the first step in waste management (64% correct responses) aligns with López-Medina et al.'s (2022) observation that nursing students increasingly recognize proper waste segregation as a critical component of sustainable healthcare practices. However, this still leaves a substantial percentage (36%) unaware of this fundamental principle, suggesting room for improvement in foundational waste management education. The findings regarding knowledge of regulatory guidelines (67.6% correctly identifying WHO) are higher than those reported by Najotra et al. (2020), who found only 40% of nursing students were aware of biomedical waste management rules. This difference might reflect varying emphasis on regulatory frameworks across different nursing curricula or improved awareness over time.

The attitudes of undergraduate nursing students towards health care waste management

The study findings reveal that a significant majority (71%) of undergraduate nursing students demonstrated a positive attitude towards health care waste management, with only 29% exhibiting negative attitudes. This overwhelmingly positive orientation, with an overall grand mean of 2.7, aligns closely with previous research findings and underscores the generally favourable disposition nursing students have toward proper waste management practices. The

strongly positive response to statements regarding the essential nature of waste management for infection control (90.3% agreeing or strongly agreeing) corresponds with findings from Tiwari et al. (2021), who reported that 76.1% of nursing students showed favourable dispositions toward biomedical waste management practices. Similarly, both Hashish et al. (2020) and Vijay et al. (2025) documented generally positive attitudes among nursing students despite knowledge deficiencies in certain areas.

Particularly noteworthy is the high level of agreement (90.2%) with the statement that "Training on health care waste management should be mandatory for all nursing students," indicating students' recognition of the importance of formal education in this area. This finding supports López-Medina et al.'s (2022) observation that as clinical exposure increases, nursing students demand more training on environmentally sound healthcare practices, demonstrating their awareness of the significance of proper preparation. The strong agreement (86.6%) that health care waste management is the responsibility of every health worker, including students, rather than solely the concern of cleaning staff (82.2% disagreed with relegating this responsibility), reflects the professional accountability noted by Silambarasan (2023). This researcher emphasized that continuous education plays a critical role in shaping a more positive and proactive attitude toward safe waste handling among nursing students.

Students' motivation to follow waste management protocols during clinical practice (80.1% agreement) aligns with Toluk et al.'s (2021) conclusion that as students advance academically and attend more courses related to waste management, their commitment to responsible medical waste practices improves. Similarly, confidence in the protective value of proper waste management practices (82.6% agreement) reflects the positive association between knowledge and attitudes documented by Vasamreddy et al. (2023). The predominantly positive response

(85.9% agreement) to the value of supervision and monitoring in encouraging compliance with waste management practices supports Mlouki et al.'s (2023) finding that combining studentcentered teaching with continuous supervision enhances knowledge and practices in biomedical waste management.

Interestingly, while most attitudes were positive, 21.9% of students still considered waste segregation unnecessary and time-consuming, revealing a subset with potentially problematic views. This finding parallels Nakiganda et al.'s (2023) observation of a knowledge-practice gap despite overall positive attitudes. The strong agreement (86.6%) that improper disposal endangers patients and the environment aligns with Shuleta-Qehaja & Kelmendi's (2022) finding that students were generally aware of environmental and public health risks associated with improper disposal, even when their actual practices were suboptimal. These findings suggest that undergraduate nursing students generally possess the attitudinal foundation necessary for proper healthcare waste management. As Vasamreddy et al. (2023) concluded, reinforcing these positive attitudes through regular educational interventions would be essential to fostering responsible healthcare waste management practices, ultimately safeguarding environmental and public health.

Practices of undergraduate nursing students in the handling and disposal of health care waste

The findings reveal that a substantial majority (77%) of undergraduate nursing students demonstrated high levels of proper practices in the handling and disposal of health care waste, with only 23% exhibiting low levels. This positive practice profile, indicated by a grand mean of 3.1, presents an encouraging picture of nursing students' waste management behaviours, though it raises interesting comparisons with previous research findings.

The high level of proper practices observed in this study contrasts somewhat with several previous studies that identified significant gaps between knowledge, attitudes, and actual

practices. For instance, Nakiganda et al. (2023) found that despite 76% of health profession students demonstrating good knowledge, their actual disposal practices remained suboptimal, with approximately half disposing of unused medicines in household garbage. Similarly, Shuleta-Qehaja & Kelmendi (2022) reported that over half of their student participants discarded unused medicines in regular trash despite awareness of environmental risks. The finding that 84.2% of students always or sometimes properly segregate waste according to color-coded bins is notably higher than what might be expected based on López-Medina et al.'s (2022) study, which highlighted nursing students' concerns about poor waste segregation practices they observed during clinical rotations. This suggests either improved training at the study institution or possible self-reporting bias.

The high compliance with personal protective equipment use (80.2% always or sometimes wearing PPE) and hand hygiene practices (81% always or sometimes washing hands after waste disposal) aligns with Mlouki et al.'s (2023) findings regarding improved hand hygiene and biomedical waste management practices following training interventions. This supports their conclusion that proper education enhances both knowledge and practice behaviors. Particularly noteworthy is the high percentage (84.2%) of students who always or sometimes dispose of sharps in puncture-proof containers, which contrasts positively with E et al.'s (2022) concerning finding that a significant proportion of students reported experiencing needle-stick injuries (84% of nursing undergraduates) within a 24-month period. This suggests either effective teaching of this critical safety practice or heightened awareness of sharps disposal among the study population.

The finding that 73.3% of students always or sometimes attend available training on waste management differs from the broader trend noted by Gubae et al. (2023), who found only 27% of

pharmacy students had received prior information regarding proper pharmaceutical disposal. This variance may reflect institutional differences in training availability or student engagement.

Although 66% of students reported always or sometimes reporting improper waste disposal incidents to authorities, this still leaves a substantial portion who rarely or never report such incidents, suggesting room for improvement in fostering a safety culture. This aligns with Kamran et al.'s (2022) observation of a significant "know-do gap" in biomedical waste management practices among healthcare students. The practice of educating peers on proper waste handling (70.5% always or sometimes) indicates a positive peer influence culture, which could be leveraged for broader improvements, as suggested by Silambarasan's (2023) emphasis on systematic training to improve both technical skills and attitudes. The finding that 80.6% always or sometimes follow hospital guidelines strictly when managing healthcare waste is encouraging but slightly at odds with Ali et al.'s (2021) finding that many students were unaware whether their institutions followed official biomedical waste guidelines, suggesting a potential disconnect between institutional policies and student awareness.

These generally positive practice findings, while encouraging, should be interpreted cautiously given the well-documented knowledge-practice gaps identified in previous research. As Tiwari et al. (2021) noted, despite favourable attitudes, actual practices often remain suboptimal, suggesting the need for continued monitoring and reinforcement of proper waste management behaviours among nursing students. The findings nevertheless indicate that with proper education and institutional support, high levels of appropriate waste management practices can be achieved among nursing students

Factors associated with knowledge, attitudes, and practices of health care waste management among undergraduate nursing students

The findings reveal that a substantial majority (77%) of undergraduate nursing students identified various factors as influential in shaping their knowledge, attitudes, and practices regarding health care waste management, while only 23% considered these factors noninfluential. With a grand mean of 3.1, these results underscore the multifaceted nature of influences on nursing students' waste management behaviours and align with numerous previous studies on this topic. Training emerges as a particularly significant factor, with 82.5% of students agreeing or strongly agreeing that adequate training programs improve their knowledge of health care waste management. This finding strongly corresponds with Chauhan et al.'s (2022) study, which demonstrated that structured teaching programs significantly improved nursing students' knowledge scores regarding biomedical waste management (from 11.1 pre-test to 15.5 post-test). Similarly, Chilate (2023) confirmed a significant improvement in knowledge levels post-intervention ($p \leq 0.05$), supporting the critical role of educational interventions. The influence of clear hospital guidelines (78.5% agreement) and supervision by clinical instructors (77% agreement) aligns with Mlouki et al.'s (2023) conclusion that combining student-centered teaching with continuous supervision can enhance knowledge and practices in both hand hygiene and biomedical waste management. This supervisory component is further supported by the strong agreement (80.9%) that regular monitoring and evaluation improve adherence to protocols, echoing Silambarasan's (2023) emphasis on systematic training and supervision.

The availability of proper waste disposal facilities as a motivating factor (80.9% agreement) reflects López-Medina et al.'s (2022) finding that nursing students expressed concerns about poor waste segregation infrastructure and the absence of recycling initiatives in healthcare facilities.

This practical barrier to proper waste management practices was similarly noted by Nakiganda et al. (2023), who identified insufficient infrastructure as a key barrier to safe medicine disposal. Time constraints during clinical duties emerged as an influential factor (73.7% agreement), aligning with the observation by Tiwari et al. (2021) that despite positive attitudes, practical barriers often hinder optimal practices. This practical challenge highlights the importance of streamlining waste management systems to accommodate the busy clinical environment.

The influence of awareness levels (76.1% agreement that lack of awareness leads to improper practices) corresponds with E et al.'s (2022) finding of concerning gaps in knowledge about biomedical waste management risks among allied health students. Similarly, Najotra et al. (2020) emphasized that knowledge deficits directly impact practice quality. Educational level as an influential factor (72.5% agreement) strongly aligns with Vasamreddy et al.'s (2023) finding that fourth-year students demonstrated significantly better knowledge, more positive attitudes, and stronger practices compared to first-year students. Similarly, Toluk et al. (2021) confirmed that as students advance academically, their commitment to waste management improves. Peer influence (72.4% agreement about its role) relates to Silambarasan's (2023) finding that educational interventions work partly through creating peer cultures that value proper waste management. The high agreement (79.3%) regarding personal interest and commitment as determinants of waste handling practices reflects Hashish et al.'s (2020) observation that attitudes significantly influence practice quality, even when knowledge levels are moderate.

These findings highlight the interplay of educational, institutional, personal, and social factors in shaping nursing students' waste management behaviors. As Chilate (2023) concluded, continuous educational interventions are necessary but insufficient; they must be complemented by appropriate infrastructural support, clear guidelines, effective supervision, and a supportive peer

culture. This multifaceted approach is essential for translating knowledge into consistent practice and fostering a culture of responsible healthcare waste management among nursing students, as emphasized by multiple previous studies (Mlouki et al., 2023;
Vasamreddy et al., 2023; Toluk et al., 2021).

5.2 Implication to nurses

The findings of this study carry significant implications for nursing education, professional practice, and health policy, particularly in the area of health care waste management (HCWM). Although the results showed that most nursing students possessed good knowledge and demonstrated positive attitudes toward HCWM, certain gaps were evident, especially in technical aspects such as the correct disposal of sharps and awareness of institutional policies and procedures. This indicates a need for the nursing curriculum to be strengthened, with more emphasis placed on structured learning around HCWM, including global best practices and national guidelines. Integrating practical demonstrations, simulations, and case-based learning into nursing education could greatly enhance students' understanding and application of HCWM principles. Nurses, being at the forefront of patient care, have a crucial role in promoting infection prevention and control through proper waste handling. Their attitudes, as reflected in this study, show a commendable awareness of the importance of safe HCWM not only for their own safety but also for the safety of patients, other health workers, and the environment. This places nurses in a strategic position to serve as role models and advocates for best practices in waste management within healthcare settings. Furthermore, the findings suggest a growing sense of ethical and professional responsibility among nursing students. The fact that many students disagreed with the notion that waste disposal is solely the responsibility of cleaning staff indicates an understanding of the shared nature of healthcare responsibilities. This reflects a shift

toward greater accountability, which is essential in fostering a culture of safety and responsibility in healthcare institutions. However, the study also revealed that a significant number of students had not participated in any formal training, seminars, or workshops related to HCWM. This points to the need for regular in-service training and continuing education to reinforce and update nurses' knowledge and skills. Healthcare facilities should prioritize such training as part of their quality assurance and safety programs.

Additionally, the study highlighted that only a portion of the students consistently reported improper waste disposal practices. This raises concerns about the existing culture of reporting and the possible barriers that may discourage it. Creating an enabling environment that supports open communication, provides protection for whistleblowers, and encourages active participation in safety protocols is essential. Nurses must be empowered to speak up and take initiative when they observe unsafe practices, knowing that their actions contribute to a safer workplace and improved patient outcomes.

5.3 Summary

This study explored the knowledge, attitudes, and practices of health care waste management among undergraduate nursing students in a tertiary institution in Benin City. The findings revealed that while a majority of the students demonstrated a good level of knowledge and generally positive attitudes toward health care waste management, there were noticeable gaps in their practical application and participation in formal training programs.

The students showed a reasonable understanding of the importance of proper waste segregation, the health risks associated with poor waste management, and the role of nurses in ensuring a safe healthcare environment. Many also exhibited positive attitudes, such as acknowledging their shared responsibility in managing health care waste, rather than relegating the task solely to

cleaning staff. This suggests a growing awareness of professional accountability among future nurses. However, the study also identified areas of concern. Not all students had attended formal workshops or training on health care waste management, and a considerable number did not consistently report improper disposal practices. These findings highlight the need for enhanced education, institutional support, and the creation of a safety culture that encourages active participation in proper waste management.

Overall, the study emphasized the critical role nurses play in maintaining environmental and occupational safety through effective waste management practices. By addressing the identified gaps through improved education, practical training, and policy support, nursing students can be better equipped to uphold safe and sustainable healthcare practices in their future careers.

5.4 Conclusion

This study examined the knowledge, attitudes, and practices of health care waste management among undergraduate nursing students in a tertiary educational institution in Benin City. The findings revealed that while most students possess a foundational understanding of the principles of health care waste management and exhibit positive attitudes toward its importance, there remains a significant gap in the consistent and proper application of these practices.

It became evident that knowledge alone does not always translate into action. Although students are aware of the risks associated with poor waste disposal and recognize their responsibilities in ensuring a safe healthcare environment, many have not received formal training or are not actively involved in institutional waste management protocols. This suggests the need for a more structured and practical approach to embedding waste management into nursing education.

The study underscores the vital role that nurses play in promoting a safe and hygienic healthcare system through proper waste management. As future front-line healthcare providers, nursing

students must be adequately trained and supported to not only understand but also implement effective waste management practices. Strengthening this aspect of their education will contribute to better health outcomes, reduce environmental hazards, and promote a culture of safety within the healthcare system.

5.5 Limitations of study

This study was limited by its focus on a single tertiary institution in Benin City, which may affect the generalizability of the findings to nursing students in other regions or institutions. Additionally, the reliance on self-reported data may have introduced bias, as respondents might have provided socially desirable answers rather than reflecting their actual knowledge, attitudes, or practices. Time constraints and limited access to institutional records also restricted the depth of observation and validation of reported practices.

5.6 Recommendation

Based on the findings of this study, several recommendations are proposed to enhance knowledge, attitudes, and practices of health care waste management among undergraduate nursing students:

1. Nursing training institutions should strengthen the integration of health care waste management into their curriculum, ensuring that both theoretical knowledge and practical skills are adequately emphasized.
2. Institutions should organize periodic workshops, seminars, and hands-on training sessions on waste segregation, handling, and disposal to reinforce students' competencies and correct misconceptions.

3. Health care training centers and affiliated hospitals should ensure the availability of color-coded bins, protective equipment, and other necessary materials to encourage proper waste disposal practices.
4. Nursing students should be sensitized to national and institutional policies on health care waste management to align their practices with established standards and legal frameworks.
5. Clinical instructors and hospital staff should closely monitor students' waste handling practices during clinical rotations and provide immediate corrective feedback where necessary.

5.7 Suggestion for Further study

- Future studies should investigate the long-term effects of educational interventions on healthcare waste management practices among nursing students and professionals. Understanding how different training approaches such as workshops, practical sessions, and curriculum integration influence waste handling behaviour could offer valuable insights for designing more effective instructional methods.
- Research should also explore the role of institutional support, including policy enforcement, availability of waste disposal infrastructure, and administrative involvement, in shaping proper waste management practices. Comparative studies across multiple tertiary institutions and geographic regions could help reveal institutional and regional variations that influence behaviour.

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APPENDIX

FACULTY OF NURSING SCIENCES

COLLEGE OF BASIC MEDICAL SCIENCES

UNVERSITY OF BENIN, BENIN CITY

Dear Respondent,

I am a 500 level student of the faculty of nursing in the above-named institution. I am carrying out a research study on the topic; **Knowledge, Attitudes And Practices Of Health Care Waste Management Among Undergraduates Nursing Students In A Tertiary Educational Institution In Benin City.** Please kindly assist me by indicating your opinion where necessary

Yours faithfully,

Instruction: please do not write your name, provide and tick the appropriate answer.

SECTION A: Socio-Demographic Data

1. **Age**: Below 18 ( ) 18 – 21 ( ) 22 – 25 ( ) 26 – 29 ( ) 30 and above ( )
2. **Sex**: Male ( ) Female ( )
3. **Level of Study**: 200 Level ( ) 300 Level ( ) 400 Level ( ) 500 level ( )
4. **Marital Status**: Single ( ) Married ( ) Divorced ( ) Widowed ( )
5. **Religion**: Christianity ( ) Islam ( ) Traditional ( ) Others ( )
6. **Place of Residence**: Hostel ( ) Off-campus ( )
7. **Previous Training on Health Care Waste Management**: Yes ( ) No ( )
8. **Clinical Exposure/Experience**: Yes ( ) No ( )
9. **Number of Clinical Rotations Completed**: 0–2 ( ) 3–5 ( ) 6 and above ( )
10. **Attendance at Seminars/Workshops on Waste Management**: Yes ( ) No ( )
11. **Knowledge of Institutional Waste Management Policy**: Yes ( ) No ( )

Section B: The level of knowledge of undergraduate nursing students about health care waste management.

1. Which of the following is classified as infectious waste? A) Used syringes ( ) B) Office paper ( )C) Food leftovers ( )
2. What colour code is commonly used for disposing sharps in health care facilities? A) Yellow container ( )B) Red container ( ) C) Blue container ( )
3. What is the first step in health care waste management? A) Transportation ( ) B) Disposal ( )C) Segregation at the point of generation ( )
4. Which of the following wastes should be disposed of in a biohazard bag? A) Clean gauze ( ) B) Blood-soaked bandages ( ) C) Unused medicine ( )
5. Which method is most appropriate for the final disposal of pathological waste? A) Open dumping ( ) B) Incineration ( ) C) Composting ( )
6. Sharps containers should be filled up to what level before disposal? A) Completely full ( ) B) Three-quarters full ( ) C) Half full ( )
7. What type of personal protective equipment (PPE) is essential when handling health care waste? A) Surgical mask only ( ) B) Gloves ( )C) ID badge ( )
8. Which regulatory body provides guidelines for health care waste management in many countries? A) World Bank ( ) B) World Health Organization (WHO) ( ) C) United Nations Children's Fund (UNICEF) ( )
9. Which of the following is not considered hazardous health care waste? A) Expired medications ( ) B) Fruit peels ( ) C) Laboratory reagents ( )
10. Why is proper segregation of health care waste important? A) It increases the volume of waste ( ) B) It reduces risks to health workers and the public ( ) C) It delays waste disposal ( )

Section C: The attitudes of undergraduate nursing students towards health care waste management.

Please indicate your level of agreement with the following statements: (Strongly Agree, Agree, Disagree, Strongly Disagree)

Statement	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
Proper health care waste management is essential for infection control.				
Managing health care waste correctly is the responsibility of every health worker, including students.				
Training on health care waste management should be mandatory for all nursing students.				
I believe improper disposal of health care waste can endanger patients and the environment.				
Segregating waste into different categories is unnecessary and time-consuming.				
I feel motivated to follow health care waste management protocols during clinical practice.				
I am confident that following proper waste management practices helps protect my health.				
Health care waste management should only be the concern of hospital cleaning staff, not nursing students.				
Regular supervision and monitoring encourage better compliance with waste management practices.				

Section D: The practices of undergraduate nursing students in the handling and disposal of health care waste.

Please indicate how often you engage in the following practices: (Always, Sometimes, Rarely, Never)

Statement	Always	Sometimes	Rarely	Never
I properly segregate health care waste according to color-coded bins.				
I wear personal protective equipment (PPE) when handling health care waste.				
I wash my hands after disposing of health care waste.				
I correctly label hazardous health care waste before disposal				
I dispose of sharps (needles, blades) in puncture-proof containers.				
I attend trainings or seminars on health care waste management when available.				
I report incidents of improper health care waste disposal to the appropriate authorities.				
I educate my peers on proper health care waste handling during clinical rotations.				
I separate infectious waste from non-infectious waste during disposal.				
I follow hospital or clinical guidelines strictly when managing health care waste.				

Section E: The factors associated with knowledge, attitudes, and practices of health care waste management among undergraduate nursing students.

Please indicate your level of agreement with the following statements: (Strongly Agree, Agree, Disagree, Strongly Disagree)

Statement	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
Adequate training programs improve my knowledge of health care waste management.				
Access to clear hospital guidelines encourages proper health care waste handling.				
Supervision by clinical instructors positively influences my waste management practices.				
Availability of proper waste disposal facilities motivates me to practice correct disposal.				
Time constraints during clinical duties affect my ability to properly manage health care waste.				
Lack of awareness among staff and students leads to improper waste disposal practices.				
My level of education affects how well I manage health care waste.				
Peer influence plays a role in how seriously I take health care waste management.				
Regular monitoring and evaluation by supervisors improve adherence to waste management protocols.				
Personal interest and commitment strongly determine how I handle health care waste.				