Assessment of Staff Nurses' Knowledge and Attitude toward Biomedical Waste Product Management

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ABSTRACT

Background: Biomedical Waste Product Management (BMWM) is a critical component of healthcare because improper management possess significant risks to public health and environment. **Aim:** to assess staff nurses' knowledge and attitudes regarding biomedical waste management. **Research design:** A descriptive correlational design was utilized in this study. **Setting**: The study was conducted at Cardiothoracic Minia University Hospital. **Subjects:** All available staff nurses (N=256), employed at the hospital during the data collection period participated in the study. **Tools:** two instruments were used: tool (I) A questionnaire comprising personal data, and the Bio-Medical Waste management Structure Questionnaire. Tool (II) Bio-Medical Waste Structured Knowledge Questionnaire. **Results:** More than half (59.8%) of staff nurses had poor knowledge and a negative attitude toward biomedical waste management. **Conclusion:** A highly statistically significant correlation was observed between staff nurses' overall knowledge and their attitude regarding toward BMWM at Cardiothoracic Minia University Hospital. **Recommendation:** Its recommended to enhancing in-service training programs, enforcing compliance, with waste management protocols, allocating necessary resources, conducting periodic assessments, and promote awareness of to ensure safer healthcare and environmental practices.

Keywords: Biomedical Waste Product Management, Knowledge, attitudes, staff Nurses

Introduction

Biomedical waste (BMW) includes all waste generated by healthcare facilities, such as hospitals, pharmacies, and medical research centers, and is categorized into general trash and hazardous waste. The latter poses significant health risks, including the transmission of viruses like HIV and Hepatitis B (**Faisal et al., 2024**). Healthcare workers are particularly at risk from sharps, biological fluids, and airborne pathogens like COVID-19, making effective waste management essential to mitigate disease transmission (**Khan et al., 2024**).

In low- and middle-income countries, improper BMW disposal exacerbates health and environmental challenges, endangering healthcare workers, patients, and waste handlers. Exposure to infectious, chemical, and radioactive hazards leads to diseases and injuries, while improper disposal can contaminate air, water, and land, posing serious health risks. Effective BMWM is essential to prevent pathogen transmission and minimize environmental pollution (**Omo & Hassan, 2024**;

Janik-Karpinska et al., 2023; **Sonkar et al., 2023**).

BMWM is a systematic process that encompasses the generation, segregation, storage, transportation, and disposal of healthcare waste, with the goal of minimizing health and environmental risks. Proper BMWM reduces hospital-acquired infections, prevents pollution, and protects healthcare workers and communities. This includes methods such as modern incineration, autoclaving, and non-incineration technologies, which help control infectious disease spread, reduce operational costs, and improve healthcare quality and public health outcomes (**Ghali et al., 2023**; **Miamiliotis et al., 2024**; **Nwosu et al., 2024**).

Effective BMWM requires strict protocols, including waste minimization, segregation at the point of generation, and secure storage and transportation to prevent contamination. Dedicated trolleys and specialized vehicles are used for safe transport, while waste treatment technologies such as shredding, grinding, pelletization, incineration,

and autoclaving further reduce volume and prepare waste for disposal (**Tawonezvi et al., 2023**). Adherence to safety measures, including universal precautions, proper personal protective equipment (PPE), and training programs, is essential to reduce occupational exposure to biological, chemical, and physical hazards (**Ketema et al., 2023**). Public health campaigns and education initiatives are critical to promoting responsible waste disposal and segregation practices (**Ben Jmaa et al., 2023**). The knowledge and attitudes of healthcare workers, particularly nurses, are pivotal in the effective management of BMW. Adequate knowledge about waste management practices correlates with positive attitudes, which, in turn, lead to better adherence to safety protocols and waste segregation. Regular training programs significantly improve both knowledge and attitudes, ensuring safe and effective BMWM practices (**Pravinraj et al., 2023**; **Thirunavukkarasu et al., 2022**).

Nurses play a central role in BMWM by ensuring proper waste segregation, minimizing waste generation, and advocating for environmentally sustainable practices. They educate patients and healthcare staff on the impacts of waste, promote recycling, and collaborate with professionals to implement safe disposal mechanisms. By applying their clinical expertise, nurses improve waste management practices, enhancing patient safety, healthcare quality, and environmental sustainability (**Schenk et al., 2023**; **Gaudreau et al., 2024**).

Significance of the study:

Egypt faces considerable challenges in hospital waste management despite existing legislation (e.g. Environmental Law No. 4 of 1994 and Waste Management Regulation Law No. 202 of 2020). Ineffective segregation, collection, and treatment of biomedical waste often result from inadequate enforcement, lack of awareness, and poor compliance with guidelines. Studies have shown that many healthcare professionals, especially nurses, possess insufficient knowledge of BMW management, which negatively affects them leading to poor practices. Continuous training and education are therefore crucial to improve both knowledge and attitudes toward safe waste management (**Khashaba et al., 2023; Dwivedi et al., 2023**).

Internationally, research (e.g., **Chipepera et al., 2021; Thirunavukkarasu et al., 2022**) revealed inadequate knowledge of bio-medical waste management, with 42.7% of the participants scoring 'poor' overall. Also, the study revealed that less than half of the participants had insufficient knowledge scores, while one-third had low and medium attitude scores. Furthermore, it concluded that good bio-medical waste management knowledge may lead to a positive attitude. Nationally, the study of **El Ella et al., (2018)** "showed statistically significant associations between nurses' total knowledge of hospital waste management and their commitment in different areas.

During rounds at the Cardiothoracic Minia University Hospital, the researcher observed that while the number of staff nurses is substantial, their knowledge of biomedical waste management policies is insufficient. Many do not actively seek training programs to enhance their understanding of this critical topic, perceiving such programs as time-consuming rather than essential, thus the researcher conducted this study to assess staff nurses' knowledge and attitudes toward biomedical waste product management.

Aim of the study

The current study aimed to assess staff nurses' knowledge and attitudes toward biomedical waste management.

Research Questions:
- What is the level of knowledge and attitude among staff nurses regarding biomedical waste management?
- Is there a relation between staff nurses' knowledge and their attitudes toward bio-medical waste management?

Research Design

A descriptive correlational research design was employed to achieve the aim of the present study.

Setting

The study was conducted at Cardiothoracic Minia University Hospital, affiliated with Minia University Hospital in Egypt.

Study Subjects

A convenience sample of all nursing staff (N = 256) working at Cardiothoracic Minia University Hospital during the data collection period was included in the study.

Data Collection Tools:

Two instruments were used:

Tool I: Bio-Medical Waste Structure Questionnaire: Consisted of two parts:

• **Part I: Staff Nurses' Personal Data: -**

It was used to collect data about staff nurses encompassing items such as age, gender, marital status, educational qualifications, residence, years of experience, department name, and in-service training program.

• **Part II: Bio-Medical Waste Structured Knowledge Questionnaire:**

It was adopted by **Ali et al., (2022)** to assess healthcare providers' knowledge about biomedical waste management. It consists of 24 MCQ questions divided into three sub-sections; (I) general knowledge of biomedical waste management (9 items), (II) knowledge of biomedical waste segregation (8 items). and (III) knowledge of waste disposal (7 items).

Scoring system: The correct answer was given one score, the incorrect or didn't know the answer was given zero scores:

- • High level of knowledge about biomedical waste management: Scores between 19 and 24 (> 75%),
- • Moderate level of knowledge about biomedical waste management: Scores between 15 and 18 (60% – 75%),
- • Low level of knowledge about biomedical waste management: Scores between 0 and 14 (< 60%).

• **Tool (II) Staff Nurses' Attitude toward Biomedical Waste Management Scale:**

Developed by **Rudraswamy, (2012),** and was modified by the researcher to assess Staff Nurses' Attitudes about Biomedical Waste Management. It contained (24) items.

Scoring system: the items of the scale were measured by a 5-point Likert scale, with the responses being: "Strongly disagree =1" "Disagree =2" and "Neutral=3" "Agree =4" " Strongly agree =5", total score, ranged from 24 to120 and divided into two levels:

- • **Positive Attitude**: Total score 24-72 (≥ 60),
- • **Negative Attitude**: Total score 73-120 (< 60).

Validity of the tool:

The scales were tested for face validity by a jury of 5 experts 'in the field of Nursing Administration and education from the faculty of nursing at Minia University. Each of the expert

panels was asked to examine the instruments for content coverage, clarity, wording, length, format, and overall appearance. And necessary modification was done by the jury panel.

Reliability of the tool:

Reliability of the scales was performed to confirm the consistency of the scales. The internal consistency was measured to identify the extent to which the items of the scales measured what it was intended to measure. Also, the scales were tested for their reliability by using the Cronbach alpha test which revealed good internal reliability for tool I and tool II were 0.788, 0.84, and 0.817.

Pilot study:

A pilot study was carried out before starting data collection on 10% (25) of the studied sample, who work at the Cardiothoracic Department of Minia University Hospital. This pilot study aimed to test the clarity, comprehensiveness, accessibility, and applicability of the tools and to estimate the appropriate time required for filling out the questionnaire. Tools did not need modification based on the findings of the pilot study. So, participants of the pilot study were included in the study sample.

Data collection procedure:

The research process was initiated with official approvals from the Dean of the Nursing Faculty at Minia University, the Ethical Committee, and the Nursing Faculty. The research scales were adopted, translated into Arabic, and approved by a jury for data collection. Written consent was obtained from the director of the Cardiothoracic Department at Minia University Hospital after explaining the purpose of the study.

Upon receiving permission, the researcher introduced herself to the head nurse and nursing staff, explaining the nature and objectives of the study and providing instructions on completing the scales. A pilot study was conducted to ensure the clarity and applicability of the scales, followed by an assessment of their reliability.

The researcher then distributed the scales to all nursing staff, ensuring that the process was directly supervised, with the assistance of the head nurse in each unit. The scales were administered during working hours, with individual sheets given to each nurse. Nurses were allotted 20 to 25 minutes to complete the scales, and the researcher was available to address any questions.

Fieldwork commenced in April 2024 and continued through July 2024. Nurses were

instructed to complete the scales based on their personal experiences. The researcher remained outside the units for the majority of the data collection period, returning after 15 minutes to provide any needed clarifications. Visits to each department were scheduled according to the nurses' work shifts.

Ethical Considerations:

- Ethical approval for this study was granted through an official letter from the Research Ethics Committee of the Faculty of Nursing, Minia University. Permission to conduct the research was also obtained from the Dean of the Faculty of Nursing at Minia University. Additionally, consent was secured from the director and nursing managers of the Cardiothoracic Department at Minia University Hospital, as well as from the head of the department and the head nurse.
- Before conducting both the pilot study and the main study, oral consent was obtained from the participants who were willing to participate, after a thorough explanation of the nature and objectives of the research. Participants were informed of their right to refuse participation or withdraw from the study at any point without providing a rationale. Throughout the data collection process, participant privacy was prioritized.

The study ensured confidentiality by assigning identification numbers to participants instead of using names, thus protecting their anonymity.

Statistical Design:

The collected data was tabulated, computerized, analyzed, and summarized by using descriptive statistical tests to test research questions using the SPSS version (25). Qualitative data were expressed as frequency and percentage. Probability (P-value) is the degree of significance, less than 0.05 was considered significant. The smaller the P-value obtained, the more significant the result (*), and less than 0.001 was considered highly significant (**). T-test and ANOVA test were used for qualitative data test used to detect the relation between sociodemographic data of nursing staff and their study variables.

The statistical method of correlation is used to determine the type and degree of a link between two numerical variables. The co-sign efficient indicates the type of the relationship (positive/negative), while the value indicates its strength, as follows: Rho values below 0.25 indicate a weak correlation, 0.25-0.499 indicate a fair connection, 0.50-0.74 indicate a moderate correlation and values above 0.74 indicate a strong correlation.

Results

Table (1): Frequency distribution of the staff nurses' personal data (no=256)

Staff nurses' personal data	(no.=256)	%
Age		
• 20 – less than 30 years old	162	63.3
• 30 – less than 40 years old	75	29.3
• ≥ 40 years old years old	19	7.4
Mean±SD = 28.83±2.184		
Marital status		
• Single	95	37.1
• Married	159	62.1
• Divorced	2	0.8
• Widow	0	0.0
Academic Qualification		
• Diploma degree of nursing	20	7.8
• Technical institution of nursing	119	46.5
• Bacaloria degree of nursing	116	45.3
• Others	1	0.4
Residence		
• Urban	155	60.5
• Rural	101	39.5
Years of experience		
• < 5 years	131	51.2

Staff nurses' personal data	(no.=256)	%
• 5-10 years	92	35.9
• >10 years	33	12.9
Mean+SD = 4.2136±1.327		

Table (1): Indicates that more than three-fifths (63.3%) of the studied staff nurses are aged between 20 and 29 years, with a mean age of (28.83 ± 2.18) years. Additionally, over three-fifths (62.1%) of the participants are married. Regarding their academic qualification, nearly half (46.5%) of the staff nurses have completed a technical nursing institution, followed closely by those holding a bacaloria degree in nursing (45.3%). Approximately three-fifths (60.5%) of the staff nurses reside in urban areas. In terms of work experience, slightly more than half (51.2%) have less than five years of experience, with a mean score of (4.21 ± 1.33) years.
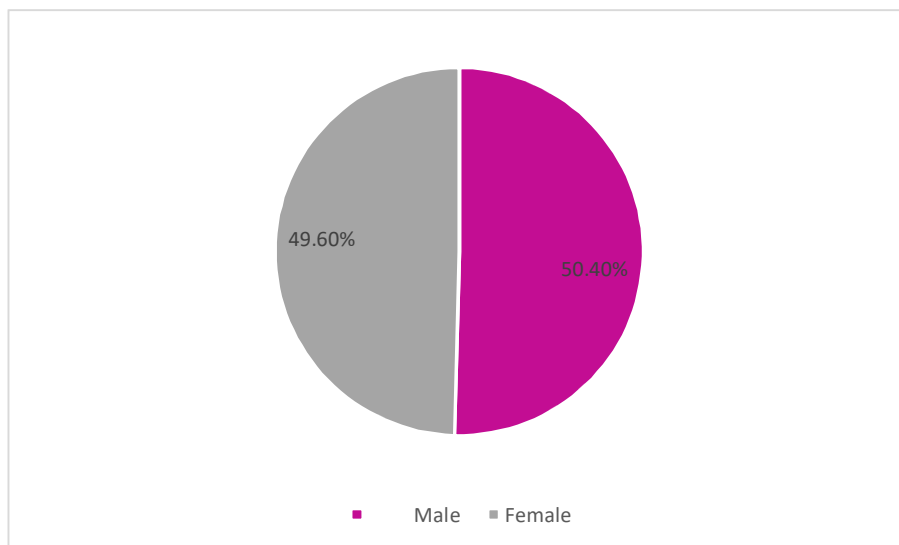

Figure (1): Frequency distribution of the staff nurses' sex (no=256)

Figure (1): Mentions that slightly more than half (50.4%) of the studied staff nurses are males.
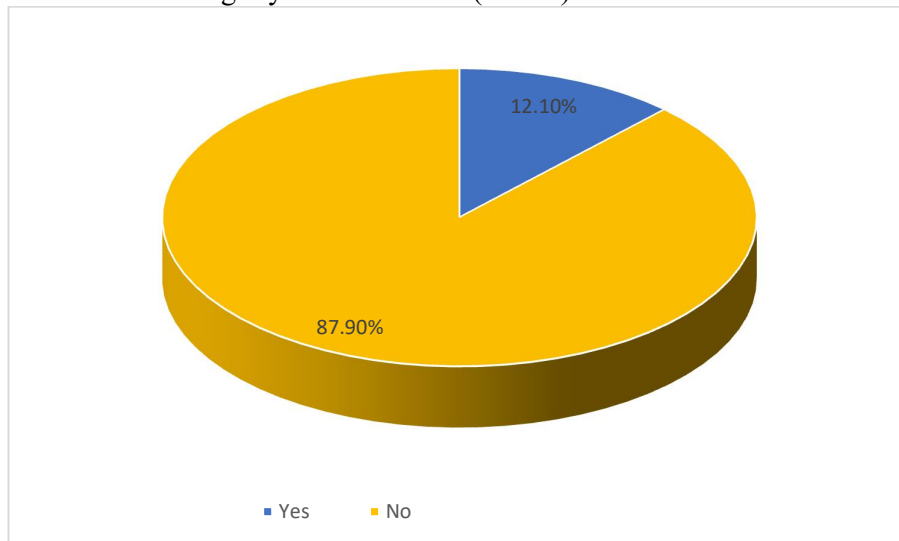

Figure (2): Frequency distribution of the staff nurses' attended in-service education programs about waste management (no=256).

Figure (2): Demonstrates that the majority (87.9%) of the studied staff nurses have not participated in in-service education programs on waste management, while the minority (12%) attended the waste management program.

Table (2): Frequency distribution of the staff nurses' department (no=256)

Nurses' department	(no.=256)	%

Nurses' department	(no.=256)	%
• Blood Bank Department	4	1.6
• Cardiac & Thoracic Intensive Care Units	72	28.1
• Cardiac & Thoracic Medical	30	11.7
• Cardiac & Thoracic Surgical	20	7.8
• Cardiac catheterization	18	7.0
• Economic Department	6	2.3
• Emergency Intensive Care Unit	20	7.8
• Emergency Department, Endoscopy Department, Radiology Departments	30	11.7
• Emergency department	4	1.6
• Operations Department	19	7.4
• Outpatient Clinics	5	2.0
• Physiotherapy Department	4	1.6
• Surgical Intensive Care Unit	24	9.4

Table (2): Shows that the highest-ranking departments, comprising more than one-quarter (28.1%) of the studied nurses are cardiac & thoracic intensive care units, then the cardiac thoracic medical unit and emergency department.
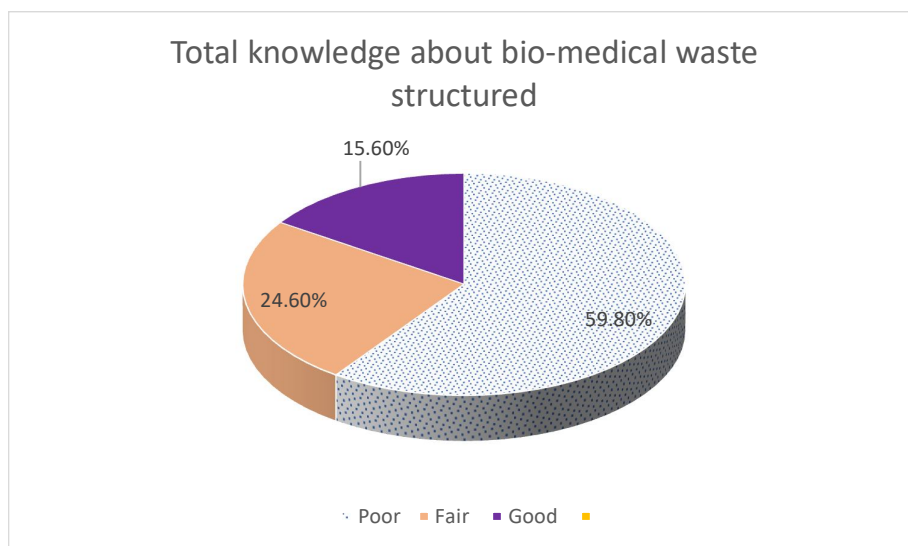

Figure (3): Staff nurses' total knowledge about bio-medical waste product management (no=256)

Figure (3): reveals staff nurses' total knowledge about bio-medical waste product management, more than half (59.8%) of them demonstrated poor knowledge, while slightly less than one quarter (24.6%) of them exhibited fair knowledge, and only one-sixth (15.6%) of them achieved a good level of total knowledge about bio-medical waste product management.

Figure (4): Staff nurses' total attitude toward biomedical waste management (no=256)

Figure (4): indicates that more than half (55.1%) of the staff nurses exhibit a negative attitude toward biomedical waste management, while (44.9%) display a positive attitude.

Table (3): Correlation between staff nurses' total knowledge and attitude about bio-medical waste product management (no.= 256)

Items		Staff nurse's total knowledge about bio-medical waste product management	Staff nurse's total attitude about bio-medical waste product management
Staff nurse's total knowledge about bio-medical waste product management	r P- value	1	.566** .001
Staff nurse's total attitude about bio-medical waste product management	r P- value	.566** .001	1

*=p≤0.05 (significant), NS= No Significant difference * * highly Statistically significant difference

Table (3): demonstrates a highly statistically significant positive correlation between staff nurses' total knowledge and their attitude toward biomedical waste management (r = 0.566, p = 0.001).

Discussion

Effective biomedical waste (BMW) management is essential for preventing environmental contamination and protecting public health. Nurses, as frontline healthcare providers, play a critical role in handling and disposing of BMW. However, disparities in their knowledge and attitudes highlight the need for continuous training. A positive attitude toward BMW management is linked to better adherence to protocols. Institutional support, ongoing education, and strict enforcement of guidelines are crucial for improving nurses' compliance and minimizing the risks associated with improper waste disposal (**Khalil et al., 2024; Krishnamurthy et al., 2024; Reddy et al., 2024**).

In many developing countries, improper BMW disposal, such as open burning and dumping, remains common due to limited resources, creating severe health and environmental hazards. The increasing volume of healthcare waste requires immediate attention. Raising awareness among healthcare workers about waste types and their harmful effects is essential for effective management. Strengthening nurses' knowledge and attitudes through targeted interventions can enhance workplace safety and reduce the environmental impact of poor BMW practices (**Patel et al., 2023; Siimane & Nts'ihlele, 2024; Udayanga et al., 2024**). So, we conducted this study about the assessment of staff nurses' knowledge and attitude toward biomedical waste product management.

Regarding the studied staff nurses' Personal data, the current study indicated that more than three-fifths of them were aged between 20 and 29 years old. This finding aligned with **Dwivedi et al. (2023)** who reported that more than

three-fifths of participants were aged 20 and 30 years old. Also, this finding was in line with the study by **Priya et al. (2023)** which found that three-fifths of participant nurses were aged 20 and 30 years old. In the same vein, this finding was consistent with **Ali et al., (2022)** who found that more than half of the studied nurses were aged between 20 – 30 years. However, in contrast to the present finding, **Shekoohiyan et al. (2022)** found that a smaller proportion of the participants were under 30 years old.

Concerning the studied staff nurses' marital status, the current study indicated that the highest percentage (more than three-fifths) of them were married. This finding was in agreement with **Khalil et al. (2024)** who reported that the highest percentage of studied nurses were married. This finding was supported by the study by **Mahmoud & Elsayed, (2022)** which reported that a higher percentage of their study participants were married.

Regarding the studied staff nurses' academic qualifications, the current study revealed that nearly half of the staff nurses have completed a technical nursing institution, followed closely by those holding a bachelor's degree in nursing. This finding was supported by the study of **Khashaba et al. (2023)** which found that more than half of their participants had technical nursing education. Also, the current finding was in contrast with the study conducted by **Thirunavukkarasu et al., (2022)** who found that the highest education qualification was a bachelor's degree.

Concerning the residence of the studied staff nurses, it was noted that approximately three-fifths of them resided in urban areas, this finding was contrary to the study conducted by **Mahmoud and Elsayed, (2022)** found that more than half of their study participants were from rural areas.

Regarding the studied staff nurses' years of experience, the current study showed that slightly more than half of the studied staff nurses had less than five years of experience. This finding was similar to the study of **Shekoohiyan et al. (2022)** in which more than half of the study participants had 1–5 years of experience. Also, this finding was consistent with the study of **Patel & Patel (2023)** which reported that more than half of the studied nursing staff had work experience of 0 to 5 years. In contrast to the present findings, the study of **Ali et al., (2022)** found that more than one-third of them their year of experience ranged between six to ten years.

Concerning the studied staff nurses' sex, the current study showed that slightly more than half of the studied staff nurses were males, this finding was in the same vein as the study of **Thirunavukkarasu et al., (2022)** who reported that more than half of the study participants were males. This study finding also was consistent with **Faisal et al., (2023)** who reported that more than half of the studied nurses were males. Contrary to the current study finding, the study by **Ali et al., (2022)** revealed that most of the studied nurses were females.

Regarding the staff nurses who attended in-service education programs about waste management, the current study demonstrated that the majority of the studied staff nurses had not participated in in-service education programs on waste management, while the minority attended the waste management program. This finding aligned with the study conducted by **Tulay et al., (2024)** which found that the highest percentage of respondents responded that have not received any training about medical waste management.

This finding was also in line with the study by **Mohamed et al., (2021)** who found that found minority of the study participants received training about waste management. On the other side, this finding was in disagreement with **Khalil et al. (2024)** who reported a high rate of attendance in in-service training programs about waste management. Also, this finding was inconsistent with the study of **Ali et al., (2022)** who indicated that more than two-thirds of participants had a previous in-service training program about waste management.

Concerning the frequency distribution of the staff nurses' department, the present study indicated that the highest-ranking departments, comprising more than one-quarter of the studied nurses are the cardiac & thoracic intensive care units, then the cardiac thoracic medical unit and emergency department. This finding was in disagreement with **Akbor et al., (2024)** who revealed that the highest-ranking departments were general wards, followed by intensive care units.

Regarding the Staff nurses' total knowledge of bio-medical waste product management, the current study revealed that more than half of them demonstrated poor knowledge, followed by slightly less than one-quarter of them exhibiting fair knowledge, and only one-sixth of them achieved a good level of total knowledge about bio-medical waste product management.

From a researcher's perspective, heavy workloads and understaffing limit nurses' participation in biomedical waste management training, leading to persistent knowledge gaps. Lack

of awareness of regulatory guidelines and inadequate refresher courses further increase the risk of improper disposal. Hospital failure to prioritize continuous education exacerbates non-compliance, highlighting the need for structured training programs.

This finding was consistent with **Khalil et al., (2024)** who revealed that more than two-fifths of the studied nurses had low knowledge regarding biomedical waste management, while slightly more than one-third of them had a moderate level of knowledge, and nearly about one-fifth had high level of knowledge. Also, these results were in the same vein with **Hassan et al., (2024),** who revealed that all respondents had unsatisfactory knowledge about bio-medical waste product management. In the same line with this finding, the study by **Chitroda & Purohit, (2024**) found that there were significant gaps in knowledge about BMW.

This result was inconsistent with the study by **Ali et al., (2022)** which indicated that more than three-quarters of the studied nurses had good/ average knowledge regarding waste management. This result differed with **Mahmoud & Elsayed, (2022)** who found that more than half of nurses had a good total knowledge level about bio-medical waste product management. This finding disagreed with **Pravinraj et al., (2023)** who assessed the knowledge, attitude, and practices of biomedical waste management among doctors and nurses in a private tertiary care center in Puducherry and revealed that more than one-third of studied nurses exhibited excellent knowledge, and around two-fifths demonstrated good knowledge about BMW.

Also, this result was inconsistent with **Shaik et al., (2023)** who evaluated the knowledge of staff nurses on health hazards related to biomedical waste and found that the majority of nurses possessed adequate knowledge of biomedical waste management. The current findings were not in the same line with **Ali, (2022)** who found that more than three-quarters of the nurses had good knowledge. Additionally, these findings contrasted by **Bizuneh et al., (2024)** who reported that slightly more than two-thirds of respondents had good knowledge. Also, the present study's results differed from those of the study by **Salmira & Amalia (2024)** which illustrated that more than half of respondents had good knowledge.

Concerning staff nurses' total attitude toward biomedical waste management, the present study indicated that more than half of the staff nurses exhibited a negative attitude toward biomedical waste management, while less than half of them displayed a positive attitude. This result was consistent with the finding of **Salmira & Amalia, (2024)** who stated that more than half of the staff nurses had negative attitudes. Also, this finding came in the same line with **Millanzi et al., (2023)** who reported that more than two-thirds of sanitary personnel had a negative attitude.

From the investigator's point of view, the lack of adequate training, institutional support, and perceived inefficiencies in the waste management system are consistent factors that might contributed to negative attitudes toward BMWM among staff nurses in this hospital. Addressing these issues through comprehensive training programs, institutional support, and clear waste management protocols is essential to improve staff nurses' attitudes regarding biomedical waste management.

While this result was contradicted with the findings of the study by **Ali, (2022)** and of the study by **Bizuneh et al., (2024)** both found that the majority of participants had a good attitude toward BMWM. Also, this finding was in contradiction with the study by **Dey et al., (2022)** which observed that three-quarters of nurses held a positive attitude. This result was not consistent with the finding of **Thirunavukkarasu et al., (2022)** who reported that approximately two-thirds of studied nurses exhibited a high attitude.

The results of **Ali et al., (2022)** did not align with these findings as they found that the majority of the studied nurses had a positive attitude toward waste management. Furthermore, this outcome contradicted the findings of **Dewi et al., (2024)** who reported that more than two-thirds of health workers demonstrated a positive attitude.

Regarding the Correlation between staff nurses' total knowledge and attitude about bio-medical waste product management, the current study demonstrated a highly Statistically significant difference between staff nurses' total knowledge and their attitude toward biomedical waste management ($r = 0.566$, $p = 0.001$). From the researcher's perspective, this relationship highlights the critical role of education and training in shaping nurses' attitudes toward BMW management, this correlation indicates that knowledge serves as a foundational determinant of attitude, supporting the argument that well-informed nurses are more likely to recognize the importance of proper waste disposal and exhibit a proactive approach in their practices, educational interventions reinforce positive attitudes and commitment to safe waste management practices.

From the researcher's perspective, this relationship highlights the critical role of education and training in shaping nurses' attitudes toward BMW management, this correlation indicates that knowledge serves as a foundational determinant of attitude, supporting the argument that well-informed nurses are more likely to recognize the importance of proper waste disposal and exhibit a proactive approach in their practices, educational interventions reinforce positive attitudes and commitment to safe waste management practices.

This result aligned with **Salmira & Amalia, (2024)** who reinforced a highly Statistically significant difference between staff nurses' total knowledge and their attitude toward biomedical waste management. Also, the current finding was consistent with **Subrahmanyan et al., (2023)** who reported a moderate positive correlation, while **Thirunavukkarasu et al., (2022)** found a weaker correlation (rho = 0.249, p = 0.001).

Additionally, the study by **Elsayed & Rashad, (2019)** revealed a statistically significant correlation between nurse knowledge and attitude scores. In addition, a study by **Khashaba et al., (2023)** reported that nurses' attitudes had a significant relation to their knowledge, and the post-knowledge and attitude scores were significantly better in nurses after the educational program.

Conclusion

The study found that more than half of the staff nurses demonstrated poor knowledge of biomedical waste management (BMWM), while slightly less than one-quarter exhibited fair knowledge, and only one-sixth achieved a good level of knowledge. Regarding their attitude, more than half displayed a negative attitude toward BMWM, whereas less than half had a positive attitude. A highly statistically significant correlation was observed between staff nurses' total knowledge and their attitude toward BMWM, indicating that better knowledge is associated with a more positive attitude.

Recommendations

Based on the findings, the following recommendations are suggested:
- Implement continuous and mandatory in-service training programs on biomedical waste management (BMWM) for all nursing staff.
- Strengthen hospital policies to ensure strict adherence to biomedical waste management guidelines.
- Conduct periodic assessments of nurses' knowledge and attitudes

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