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Assessment of Knowledge and Practice of Waste Management among Healthcare Workers in Nasarawa State, Nigeria

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Abstract

Background: The risk of exposure to harmful agents by healthcare workers, patients, and the surrounding communities, as well as environmental contamination due to the improper disposal of medical waste, remains a global challenge.
Aim: This study was conducted to assess the knowledge and practices of healthcare workers regarding medical waste management in Nasarawa State, Nigeria, focusing on issues such as categories, problems related to medical waste, and procedures for handling and disposal.
Study Design and Duration: The study was a descriptive cross-sectional questionnaire-based study conducted on healthcare workers between September 2024 to October2024.
Methodology: A questionnaire-based study involving 422 healthcare workers was designed having both open-ended and closed-ended items that were divided into three parts as follows: part A: sociodemographic characteristics of the respondents; part B: knowledge of respondents about medical waste management; part C practice of respondents regarding medical waste management. Data obtained from this study were analysed using the chi-square test and the Fisher's Exact test.
Results: The study revealed a good level of knowledge of waste management (95.0%) among the 422 healthcare workers studied. Chi-square analysis revealed that age group ($\chi^2 = 86.95$, $P < 0.05$), staff category ($\chi^2 = 81.57$, $P < 0.05$), level of education ($\chi^2 = 197.68$, $P< 0.05$), years in practice ($\chi^2 = 90.87$, $P < 0.05$) and prior training on healthcare waste management ($\chi^2 = 195.54$, $P < 0.05$) were all significantly associated with knowledge levels. In contrast, gender was not statistically associated with knowledge ($\chi^2 = 0.78$, $P > 0.05$).
Conclusion: Although this study revealed a good knowledge of waste management among participants, there are discrepancies in the training, practice of waste management and the absence of waste management and disposal systems in some facilities. There is a need for adequate awareness and training for healthcare workers, especially health attendants and waste handlers. Furthermore, sufficient funding and strict regulations are needed to mitigate the health hazards related to improper healthcare waste management.

Keywords: Healthcare waste; Healthcare workers; Knowledge; Nasarawa; Practice

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Introduction

The World Health Organization (WHO) reported that 15% of medical waste generated is considered hazardous material that may be infectious or cause other forms of harm to humans, animals and the environment. An estimated 16 billion injections are administered worldwide annually; however, not all the needles and syringes are properly disposed of after use (WHO, 2024; Cirstea *et al*., 2025). Waste can be defined as any substance, material, or object that is no longer in use and is disposed of or is intended to be disposed of (National Environmental Standards and Regulations Enforcement Agency [NESREA], 2021). Medical waste, on the other hand, is the term used to describe waste produced from healthcare and similar activities that may pose a risk of infection or may prove hazardous as a large amount of these wastes are generated during diagnosis, treatment or immunization (Padmanabhan & Barik, 2019; Dwivedi *et al*., 2021; Janik-Karpinska *et al*., 2023). The World Health Organization (WHO) has classified medical waste into eight categories based on their physical and chemical properties as thus: General waste (Non-hazardous), infectious waste,

pathological waste, sharps, chemical waste, pharmaceutical waste, cytotoxic waste, radioactive waste (WHO, 2024). Globally, waste continues to be a growing challenge. This problem is amplified by growing trends in consumption, production patterns, and modernisation (Agamuthu & Babel, 2023). Roland (2020) reported that about 19,864.03 kg/day of waste is generated in Nigeria, with the North Central and North East accounting for the highest rates. Handling of waste in landfills, the operation of defective incinerators and indiscriminate dumping usually leads to the contamination of the soil, air, and water, leading to local, regional, and global pollution (Abubakar *et al*., 2022). Medical care plays an important role in the life and well-being of society; this critical care eventually leads to the generation of waste that poses a great challenge (Aworh *et al*., 2022). Waste generated from these health facilities, if not properly managed, may pose a risk to the healthcare workers, waste handlers, the community, and to a large extent the environment. Therefore, waste requires specific treatment and management before its final disposal (Mathur *et al.*, 2012). In many developing countries, including Nigeria, the actual amount of healthcare waste, its composition, segregation, and disposal are not properly defined and documented by practitioners, even though guidelines on the safe handling and disposal of healthcare waste exist (Desta & Abera, 2017; Oyekale & Oyekale, 2017). In Nigeria, the National Environmental Standards and Regulations Enforcement Agency (NESREA) is saddled with the responsibility for the protection of the environment, biodiversity conservation, and sustainable development. The agency also sees to matters of enforcement of environmental standards, regulations, rules, laws, policies, and guidelines (NESREA, 2021). Medical waste poses significant health risks to hospital workers, patients, and the general public. Workers who handle medical waste without proper knowledge and practices are at risk of exposure to infectious diseases, needle injuries, and chemical hazards. These wastes can adversely affect the environment if improperly handled and disposed of. Proper knowledge and practices of medical waste management can help prevent water and soil contamination, reduce greenhouse gas emissions and protect local wildlife. Furthermore, improper handling and disposal of medical waste can be costly to hospitals.

Proper knowledge and practices of medical waste management could help reduce costs associated with waste management, including storage, transportation, and disposal.

Methods

Study Area, Sites and Population

Nasarawa State is located in the North Central region of Nigeria. It is situated along coordinates 8°32′ N and 8°18′ E with a total area of 27,1117 km^2 (10,470 sq km) comprising 13 local Government Areas. The State's estimated population stands at 2.8 million based on projections by the National Population Commission [NPC] (NPC, 2006; NBS, 2016). It is bounded in the North by Kaduna State, in the West by Abuja (FCT), in the South by Kogi and Benue, and in the East by Taraba and Plateau states (Figure 1). It lies within the Guinea Savannah region and has a tropical climate (Akwa *et al.*, 2007; Sufiyan *et al*., 2020). The study sites were five hospitals within the state, while the sample population were healthcare workers in the selected hospitals within the state who were willing to participate

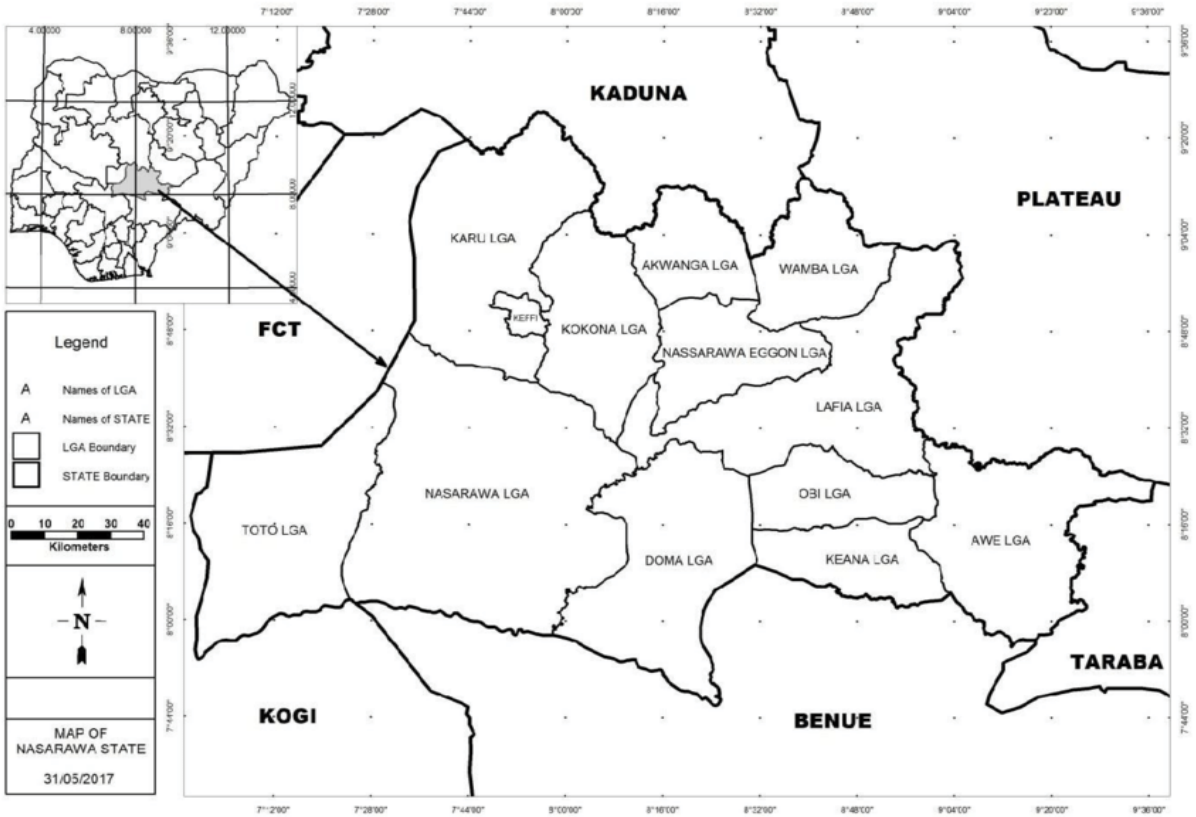

Figure 1: Map of Nasarawa State (Agidi *et al*., 2018).

Study Design and Duration

The study was a cross-sectional questionnaire-based study conducted on healthcare workers between September 2024 to October 2024. The questionnaire contained both open-ended and closed-ended items that were divided into three parts as follows: part A: sociodemographic characteristics of the respondents; part B: knowledge of respondents about medical waste management and part C: practice of respondents in respect of medical waste management. The knowledge score was determined by evaluating nine questions that assessed knowledge. Each correct response was awarded 1 point and 0 point for incorrect response. The maximum total score was 8 points while the minimum was 0. Scores of 0-4 (noted to be less than or equal to 50%) were regarded as poor level of knowledge while 5-8 (above 50%) was regarded as good level of knowledge.

Inclusion criteria

Healthcare workers (clinical) in the selected health facilities who were willing to participate in the study during the study period were included.

Exclusion Criteria

Non-clinical staff and clinical staff who did not agree to participate were excluded

Sample Size and Sampling Method

A sample size of 422 was determined to be sufficient for this study. This calculation was based on a previous report that 57.8% of the hospital workers possess a good knowledge towards medical waste management (Musa *et al*., 2023) using the formula described by Sapra (2022) as follows;

$N = Z^2pq/ d^2$

Where,

N= Sample size

Z= Statistics for a level of 95% confidence interval= 1.96

P = prevalence rate of 57.8%. (Musa *et al*., 2023).

d = level of significance (allowable error) = 5% or 0.05

q= 1-p

Thus,

$N= (1.96)^2 \times 0.578 \times (1-0.578)/(0.05)^2$

$N = 3.8416 \times 0.578 \times 0.422/0.0025$

$N = 0.937027706/0.0025$

$N = 374.8 \approx 375$

However, actual sample size = Calculated sample size + 10% attrition rate. But a 10% Attrition rate = 37.5

Therefore, the actual sample size = 375 + 37.5 = 412.

This was rounded up to 422

N = 422

A convenience sampling method was used to collect data from various healthcare healthcare workers.

Data Analysis

The data obtained was analyzed using Statistical Package for Social Sciences (SPSS) version 27. Statistical significance association between qualitative variables was assessed using the Chi-square and Fisher's exact test at 95%.

Results

Sociodemographics of the respondents

The frequency and percentage of respondents for each variable are represented in Table 1. Regarding age, 128(30.3%) were aged 30-39 years representing the highest age group for respondents followed by 110 (26.1%) for those aged 20-29, 108(25.6%) for those aged 40-49 years with the least being 76(18.0%) for those aged 50-59 years. The gender variable shows that 265(62.8%) of the respondents were male, while 157(37.2%) were female. On the category of healthcare workers, 165(39.0%) were Medical Laboratory Scientists, 81(19.2%) were Nurses, 69(16.4%) were Pharmacists, 48(11.4%) were Physicians, 34(8.1%) were Health attendants and 25(5.9%) were Cleaners. Regarding the educational status of the respondents, 305(72.3%) had tertiary education qualifications, 65(15.4%) were secondary school holders, 32(7.6%) were primary school certificate holders, while 20(4.7%) didn't possess any formal educational certificate. The years of working experience of respondents shows that the majority of respondents 245(58.1%) had been working for 2 to 10 years, while 152(36.0%) had been working for more than 10 years and 25(5.9%) had been working for less than 2 years. Finally, 350(82.9%) had training on waste management while 72(17.1%) did not have any form of training on waste management.

Table 1. Sociodemographic characteristics of respondents

Variables	Perimeter	Frequency (n=422)	Percentage (%)
Age	20-29	110	26.1
	30-39	128	30.3
	40-49	108	25.6
	50-59	76	18.0
Gender	Male	265	62.8
	Female	157	37.2
Staff Category	Physician	48	11.4
	Nurse	81	19.2
	Medical Laboratory Scientist	165	39.0
	Pharmacist	69	16.4
	Health Attendant	34	8.1
	Cleaners	25	5.9
Level of Education	Primary	32	7.6
	Secondary	65	15.4
	Tertiary	305	72.3
	Non-formal	20	4.7
Years in Practice	<2	25	5.9
	2-10	245	58.1
	>10	152	36.0
Training on Healthcare Waste Management	Yes	350	82.9
	No	72	17.1

Assessment of knowledge of participants regarding healthcare waste management

Concerning the knowledge of participants in relation to waste management, 48.3% had knowledge of the national healthcare waste management policy in Nigeria, 62.8% had a waste management plan in their facility, 58.3% had instructive posters placed on walls in their facility, 91.0% disagreed with collecting all waste types in the same receptacle, 97.9% disagreed with discarding healthcare waste alongside municipal waste, 87.7% had proper knowledge on disposal of infectious waste, while 95.7% had knowledge on the disposal of general waste. Finally, 98.3% were knowledgeable on the harmful effects of indiscriminate disposal of hospital waste (Table 2).

Table 2: Knowledge of participants on healthcare waste management

Variables	Response	Frequency (n=422)	Percentage (%)
Is there a national healthcare waste management policy in Nigeria	Yes	204	48.3
	No	27	6.4
	Not sure	191	45.3
Is there a waste Management Plan in your Facility?	Yes	265	62.8
	No	50	11.8
	Not sure	107	25.4
Is there Instructive Posters on Healthcare Waste Management?	Yes	246	58.3
	No	67	15.9
	Not sure	109	25.8
All types of waste should be collected in one receptacle?	Yes	38	9.0
	No	384	91.0
Healthcare waste should be discarded in same bin with municipal waste?	Yes	9	2.1
	No	413	97.9
Appropriate PPE should be used when handling waste?	Yes	419	99.3
	No	3	0.7
Infectious waste should be stored in black waste bin?	Yes	52	12.3
	No	370	87.7
General waste should be stored in yellow bins?	Yes	18	4.3
	No	404	95.7
Indiscriminate disposal of hospital waste could be harmful	Yes	415	98.3
	No	7	1.7
Overall good knowledge			95.0%*

*The overall good knowledge, was determined by classifying each knowledge-based question as having a correct or incorrect response and then taking the mean percentage of all the correct responses across the knowledge items.

Assessment of healthcare waste management practices by respondents

The participants were assessed on their level of practice of waste management revealing that 53.1% had instructive posters in their facility, 75.1% disposed waste in specified containers, 70.6% disposed sharps in puncture-proof containers, majority 84.8% used PPE while working and handling waste. Furthermore, 56.4% used wheelbarrow, 41.7% used plastic/metal drums, while a few 9.0% used plastic bags as the means of transporting waste. Regarding the methods of waste treatment, 72.0% used autoclaving, 19.0% used chemical methods while 9.0% were not sure of the methods used in their facility. In addition, 59.2% used incinerator as means of final waste disposal, 34.6% used landfill and 6.2% used open dumping. Also, 39.6% of the respondents reported having a needle prick or broken glassware injury. Finally, a majority 97.6% of respondents reported incidence regarding waste when they occur (Table 3).

The association between the sociodemographic variables of participants and knowledge of waste management was assessed revealing that 62.6% of respondents demonstrated good knowledge of healthcare waste management, while 37.4% had poor knowledge. The Chi-square analysis revealed that age group ($\chi^2 = 86.95$, $P < 0.05$), staff category ($\chi^2 = 81.57$, $P < 0.05$), level of education ($\chi^2 = 197.68$, $P < 0.05$), years in practice ($\chi^2 = 90.87$, $P < 0.05$) and prior training on healthcare waste management ($\chi^2 = 195.54$, $P < 0.05$) were all significantly associated with knowledge levels. In contrast, gender was not statistically associated with knowledge ($\chi^2 = 0.78$, $P > 0.05$). This is represented by Figures 2, 3, 4, 5 and 6 respectively.

Table 3. Healthcare waste management practices by respondents

Variable	Practice	Frequency	Percentage (%)
Are there instructive posters in your facility?	Yes	224	53.1
	No	198	46.9
Dispose waste in specified containers always	Yes	317	75.1
	No	105	24.9
Sharp wastes are disposed in puncture-proof containers	Always	298	70.6
	Sometimes	82	19.4
	Never	42	10.0
Wearing of appropriate PPE while handling waste	Always	358	84.8
	Sometimes	59	14.0
	Never	5	1.2
Modes of waste transportation	Wheelbarrow	238	56.4
	Plastic/metal drums	176	41.7
	Plastic bags	8	1.9
Waste treatment methods	Autoclaving	304	72.0
	Chemical	80	19.0
	Not sure	38	9.0
Method of final waste disposal	Incinerator	250	59.2
	Landfill	146	34.6
	Open dumping	26	6.2
Have you had a needle-prick/broken glassware injury before?	Yes	167	39.6
	No	225	60.4
Do you report incidence regarding waste when they occur?	Yes	412	97.6
	No	10	2.4

Personal protective equipment (PPE).

Bivariate analysis on the association between participants sociodemorgraphic characteristic and knowledge of healthcare waste management

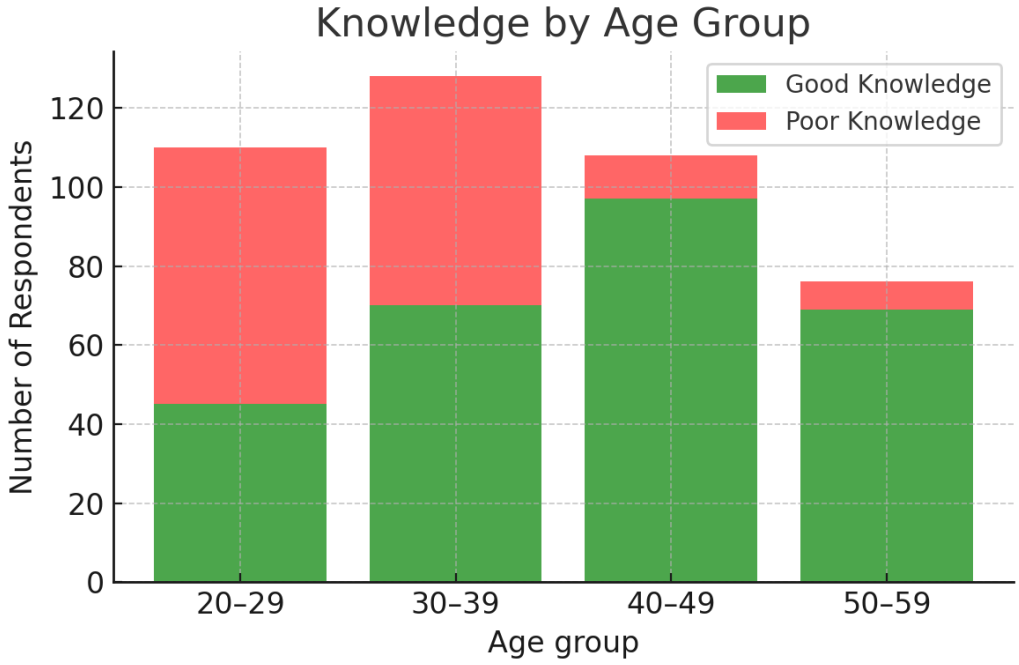

Figure 2. Association between knowledge of waste management and age group of participants

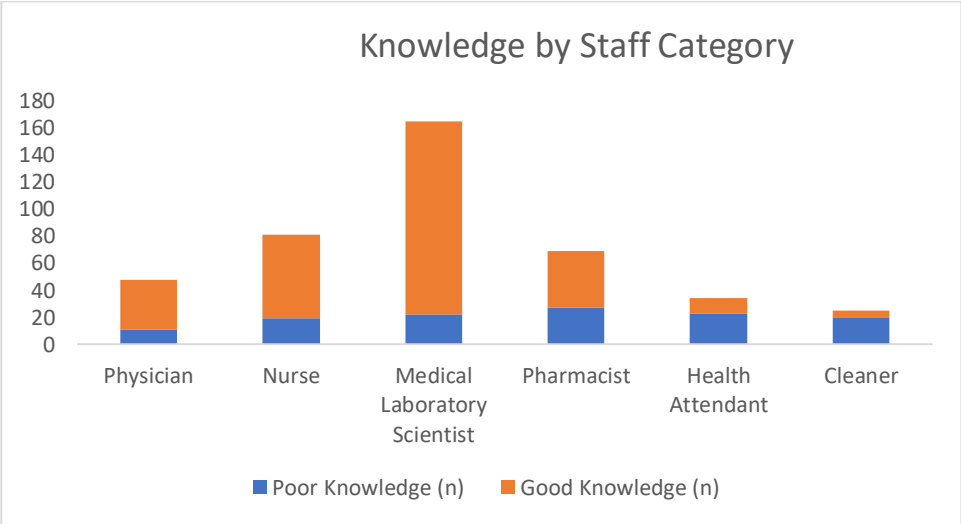

Figure 3. Association between knowledge of waste management and staff category

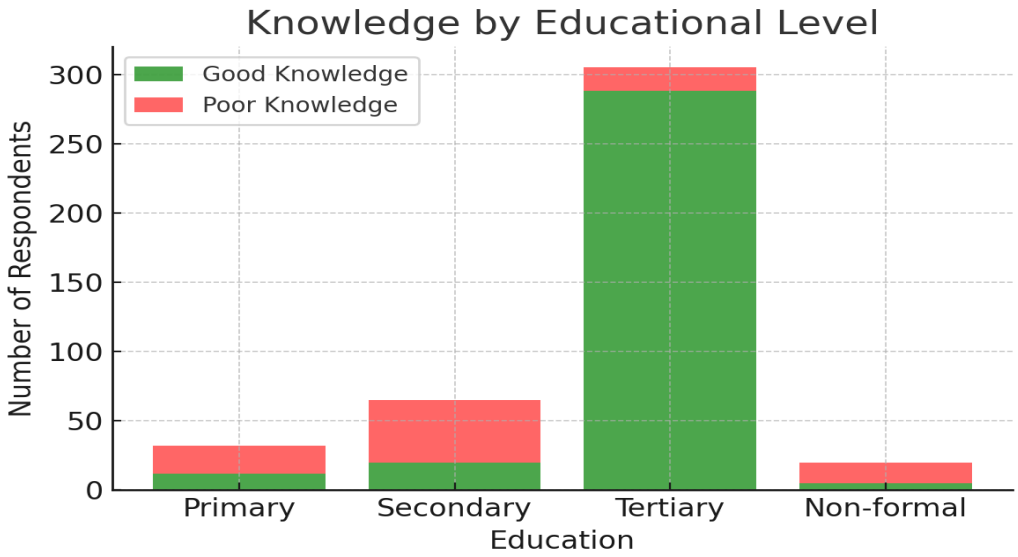

Figure 4. Association between knowledge waste management and level of education

Figure 5. Association between knowledge of waste management and years of experience

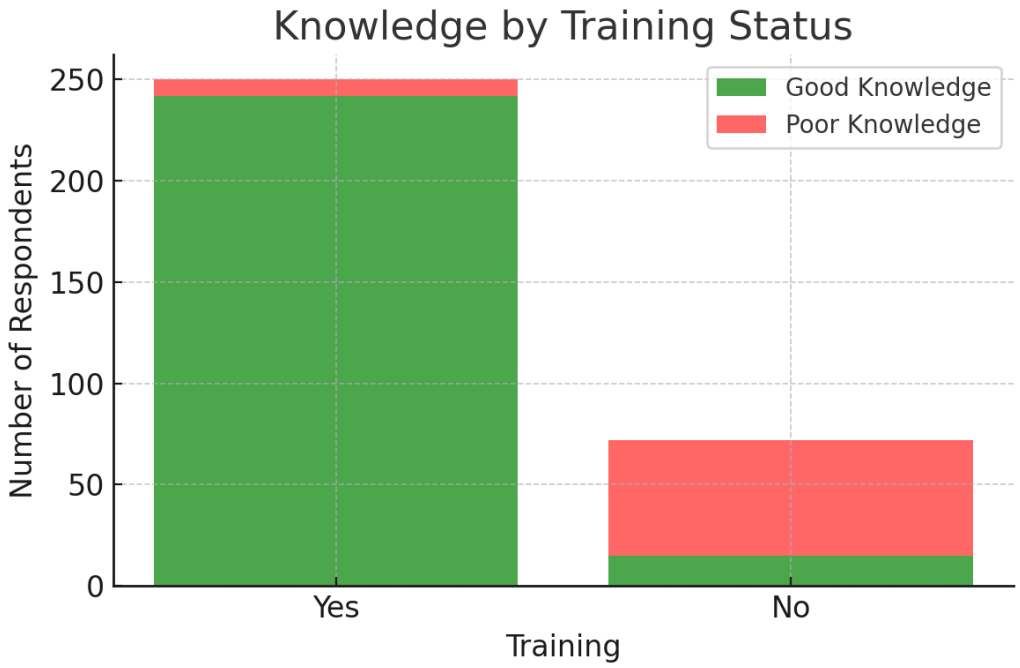

Figure 6. Association between knowledge of waste management and training.

Discussion

Sociodemographics of the respondents

The current study revealed that majority of the respondents knew about healthcare waste management. Out of the 422 respondents 128(30.3%) were aged 30-39 years representing the highest age group for respondents followed by 110 (26.1%) for those aged 20-29, 108(25.6%) for those aged 40-49 years with the least being 76(18.0%) for those aged 50-59 years. Interestingly, knowledge of healthcare waste management increased markedly with age, with respondents aged 40 years and above demonstrating the highest levels of awareness. Similar trends have been reported within and outside Nigeria (Ekanem *et al*., 2021; Uloma *et al*., 2022; Musa *et al*., 2023; Udayanga *et al*., 2023; Woromogo *et al*., 2020).

The gender variable shows that 265(62.8%) of the respondents were male, while 157(37.2%) were female. This is similar to reports by Amaike *et al*. (2025), Mboi *et al.* (2024), in Nigeria and Afesi-Dei *et al*. (2023) in Ghana. Furthermore, Sahiledengle (2019) reported males to be higher compared to females and Bizuneh *et al*. (2024) among operation room personnel in a tertiary hospital in Ethiopia.

On the contrary, females dominated the healthcare workforce interviewed in Port Harcourt, Nigeria (Abah & Ogbonna, 2024) with a percentage of 64.9% against the male 35.1%, and 78.6% against 21.4% reported by Elizabeth *et al*. (2025) in Enugu, Nigeria. In a similar study, 67% female was reported against males in Yaoundé (Woromogo *et al*., 2020); Also 73.3% females against 26.7% males were recorded in Sweden, and 89.5% females against 10.5% males in Hungary (Uloma *et al*., 2022). Similarly, Udayanga *et al*. (2023) in Siri Lanka reported that women accounted for 58.6% of respondents, while Khaled & Ali (2022) reported a higher percentage of females (73.7%) compared to males (26.3%) among respondents in Iraq. These findings concur with the World Health Organisation (WHO, 2020) report which stated that women account for 67% of the global health and social care workforce. However, the disparity in our study could be because more males participated compared to females.

On the category of healthcare workers, 165(39.0%) were Medical Laboratory Scientists, 81(19.2%) were Nurses, 69(16.4%) were Pharmacists, 48(11.4%) were Physicians, 34(8.1%) were Health attendants and 25(5.9%) were Cleaners. Interestingly, Haifete *et al*., 2016 reported a higher 80.0% number of respondents among the ward assistants and 100% among cleaners.

The number of respondents with respect to their professional cadre depends largely on the type of health facility, availability and willingness to participate in the study. This trend has been reported by several authors (Gupta *et al*., 2016; Mugabi, *et al*., 2018; Musa *et al*., 2023; Abah & Ogbonna, 2024; Elizabeth *et al*., 2025).

Regarding the educational status of the respondents, 305(72.3%) had tertiary education qualifications, 65(15.4%) were secondary school holders, 32(7.6%) were primary school certificate holders, while 20(4.7%) didn't possess any formal educational certificate. This is in tandem with report by Abah *et al*. (2023) where 75.3% of participants possed a tertiary certificate.

Similarly, Uchechukwu *et al*. (2017) reported tertiary certificate holders to be 71.3%, while Ekanem *et al*. (2021) reported 88%.

The years of working experience of respondents shows that the majority of respondents 245(58.1%) had been working for 2 to 10 years, while 152(36.0%) had been working for more than 10 years and 25(5.9%) had been working for less than 2 years. This is in conformity to the reports by Ekanem *et al*. (2021), Udayanga *et al*. (2023) and Akkajit *et al*. (2023). Conversely,

Uloma *et al*. (2022), Musa *et al*. (2023) and Abah & Ogbonna (2024) reported that majority of respondents in their study were less than 5 years in service.

Majority 350(82.9%) of respondents in this study had training on waste management while 72(17.1%) did not have any form of training on waste management. There is a high probability for health facilities that train their staff on healthcare waste management to handle waste safer, prevent occupational hazards and help infectious disease control compared to those without training (Oyekale & Oyekale, 2017; Afesi-Dei *et al*., 2023; Bannour *et al*., 2024). In Kenya, Njagi *et al*. (2012) opined that health and safety in healthcare waste management was not included in most of the curricula for training health professionals that participated in their study, but that most of them acquired this through on the job training from seminars and informally through organized talks at their place of work. Training has been proven to be a major determinant of knowledge and practice of healthcare waste management, as trained respondents are more knowledgeable than their untrained counterparts (Ekanem *et al*., 2021; Bannour *et al*., 2024).

Knowledge of the respondents regarding healthcare waste management

The outcome of the study revealed that 95.0% of respondents demonstrated good knowledge of healthcare waste management. Professional category significantly influenced knowledge in this study. Medical laboratory scientists (86.7%), physicians (77.1%), nurses (76.5%) and pharmacists (60.9%) recorded the highest levels of good knowledge, while health attendants (32.4%) and cleaners (20.0%) had the lowest. Overall, 48.3% had knowledge of the national healthcare waste management policy in Nigeria, 62.8% of the respondents had a waste management plan in their facility, 58.3% reported having instructive posters on healthcare waste management in their facility, 94.1% had a good knowledge on waste segregation. This is in agreement with reports by Haifete *et al*. (2016), Ekanem *et al*. (2021), Musa *et al*. (2023) and Abah & Ogbonna (2024). In general, the knowledge of healthcare waste management is affected by several factors, these include inadequate or complete absence of training and awareness, the professional category of healthcare staff (such as medical laboratory scientist/technicians, nurses and doctors compared to attendants and waste disposers). Also, the availability of resources like proper segregation tools, use of technology and the presence and effectiveness of facility level management systems and policies have been shown to influence waste practices (Salubi *et al*., 2022; Musa *et al.*, 2023; Udayanga *et al*., 2023).

Practice of the respondents regarding healthcare waste management

On the aspect of practice, 75.1% disposed waste in specified containers always, 70.6% disposed sharps in puncture-proof containers, 84.8% of respondents wore appropriate personal protective equipment (PPE) while handling waste always. Furthermore, on the method of final waste disposal, 59.2% used incinerator, 34.6% used landfill while 6.1% used open dumping.

Only 39.6% of respondents have had a needle-prick/broken glassware injury before. Instructively, 97.6% report incidence regarding waste when they occur. In variance to the current study, Abah & Ogbonna (2024) reported that 35.1% of the respondents know about the correct waste disposal practice which is lower than that obtained in our study. Also, Kenny & Priyadarshini (2021), in their review demonstrated a heavy reliance on basic, low tech healthcare waste disposal techniques, their negative impacts and that the lack of clear knowledge and practices has led to toxic and sometimes hazardous waste exposed to the general public.

Limitations

We could not carry out on the spot assessment to ascertain correctness of some of the response gotten in this study.

Conclusion

Healthcare waste remains a global challenge. The risks of exposure to hazardous substances and environmental contamination are higher in low income areas. The WHO declares that several reasons exist for inadequate health care waste services. These include limited legal frameworks (e.g. policies, regulations, guidelines), lack of awareness about the health hazards related to healthcare waste, inadequate training in proper waste management, absence of waste management and disposal systems, insufficient financial and human resources and low priority. Many countries either do not have appropriate regulations or do not monitor and enforce them. Although this study revealed a statistically significant association between good knowledge and practice of waste management among participants with regards to level of education, prior training and years of practice, there are discrepancies in the training, practice of waste management and the absence of waste management and disposal systems in some facilities. There is a need for adequate awareness and training for healthcare workers, especially health attendants and waste handlers. Furthermore, sufficient funding and strict regulations are needed to mitigate the health hazards related to improper healthcare waste management.

Ethical Approval

Ethical clearance for this research was obtained from the Nasarawa State Ministry of Health (NHREC Protocol number: 18/06/2017) in line with the Declaration of Helsinki on the conduct of biomedical research involving human subjects.

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Competing Interests

The authors have declared that there are no existing competing interests.

Authors' Contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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