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The Influence of Biomedical Waste Disposal Methods, Knowledge and Influence on Health of Health Workers in Public Hospitals in Calabar Education Zone, Nigeria			
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Keywords		Abstract	
Biomedical waste, knowledge, health workers, public hospitals		The purpose of this study was to ascertain biomedical waste disposal methods, knowledge and influence on health of health workers in public hospitals in Calabar Education Zone, Nigeria. To achieve the purpose of this study, a null hypothesis was formulated to guide the study. Conceptual and empirical literatures were reviewed in accordance with the variables of the study. Survey research design was utilized for the study. The population of this study comprised registered laboratory scientists, pharmacists, nurses/midwives and waste management personnel in selected public health care facilities or hospitals in Calabar Education Zone of Cross River State. Proportionate stratified random sampling and simple random sampling techniques were adopted in selecting the 484 respondents sampled for the study. A validated 20 item four-point modified Likert scale questionnaire Open Dumping Disposal Method and Health of Workers Questionnaire (ODDMHWQ) was the instrument utilized for data collection. The reliability estimates of the instrument ranged from 0.82-0.83 using Cronbach Alpha method. To test the hypotheses formulated for the study simple linear regression statistical tool was used at 0.05 level of significance. The findings revealed that there was a significant positive influence of incineration of biomedical wastes on health of health workers in Calabar Education Zone. It was recommended among others that Government and hospital management should enforce proper biomedical waste management protocols, especially in discouraging open dumping and uncontrolled landfills.	
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INTRODUCTION

Every day, relatively large number of wastes are generated in hospitals and facilities around the world. Hospital waste generally consists of medical waste and non-medical waste. Based on its nature, the concentration and amount of hospital waste can be detrimental to health and can pollute the environment. Hospital waste also contains toxic chemicals and sharp objects causing hospital waste to be infectious, toxic, and/or

radioactive. Biomedical waste has recently emerged as a major concern not only to hospitals but to all conventional medical units where treatment of patient (human or animals) is provided such as clinics, dental offices, dialysis facilities, analytical laboratories, pharmacies, university laboratories and nursing home environment.

Biomedical waste scattered in and around the health care facilities invite flies, insect, rodent, cats and dogs that are responsible for the spread of communicable diseases like plaque, rabies, typhoid, cholera, etc. It has been found by Habibullah and Afsar (2023) in Mexico that 21% of the injuries occurred during the disposal process. Out of 69 interviewed waste handlers, 34% (13) reported 22 needle prick injuries between them during the first 12 month, and 96% had seen needles and syringes in waste. Regularly, the cleaning and sewage channeled into the drain generate unpleasant smell or odour and multiplication of vectors that leads to transmission of diseases like cholera epidemic and pollutes the entire environment.

Similarly, World Health Organization (2019) reported that among the 35 million healthcare workers worldwide, the estimation shows that each year about 3 million workers receive hard exposure to blood borne pathogens, 2 million of those to hepatitis B virus (HBV), 0.9 million to hepatitis C virus (HCV), and 170,000 to human immunodeficiency (HIV). Also, hospital associated infections (HAI) affect approximately 5% of hospitalized patients. This shows that the complexity of infectious healthcare waste problems has given rise to incidence of diseases as a result of injuries from syringes causing AIDs, and Hepatitis virus.

However, improper hospital waste methods and disposal system has been observed by the researcher in the study area to have resulted to many significant health problems for both staff and patients. Among such problems resulting from biomedical waste are skin allergies, eyes irritation, diarrhea, cholera and even injuries from sharp object (Rinhardt & Gorden, 2021; Trim & Elliott, 2023). There are numerous diseases resulting from medical wastes which can be transmitted among groups of people such as health workers, scavengers, patients and hospital visitors who are highly at health risks like acquired immunodeficiency syndrome (AIDs) and hepatitis B and C viruses. In addition, medical waste can have both direct and indirect health risks to workers. Direct risks are in the form of handling the waste physically where injury may occur during diagnosis or disposal process, while indirect harm are as a result of toxic substances from inadequate burning of medical waste and exposure to blood born viruses.

In healthcare facilities in Cross River State, biomedical wastes are generated during diagnosis, treatment immunization, research activities or production, or testing of biological and medical resources such as discarded blood and body fluids along with soiled linen, cotton, body part, organs, bandage and plaster, tissues from surgery or birth, gloves, syringes, needles and blades can cause health risks to healthcare workers. Exposure to hazardous biomedical waste ranging from chemical or reagents, liquid waste, discharged foul odour, and toxic emissions inhalation can result in diseases; while cuts in the skin, injury or injection are the common ways that pathogenic organisms enter the human body, creating the link between the transmission of acquired immunodeficiency syndrome (AIDs) and viral hepatitis B (HBV) infections (Dan, Imam, Ukpata & Akpa, 2023).

In addition, infections caused by exposure to biomedical waste includes skin infections, meningitis, gastro enteric infections, genital and ocular infection, respiratory infections, hemorrhagic fevers, etc. Infections can also spread via; sewage systems or resilient agents such as rats, which feed on them, and may cause health risks to the general public. The World Health Organization (2018) classified waste into eight (8) categories: general waste, pathological, radioactive, chemical, infections to potentially infectious waste, sharps, pharmaceuticals and pressurized containers. Biomedical wastes are mainly generated from government hospitals, private hospitals, nursing homes, dispensaries, primary health centers, medical colleges/research centers, paramedic services outfits, veterinary colleges, blood banks, mortuary, autopsy centers among others. While minor waste are generated from physicians/dentist clinic, animal houses, blood donation camps, and vaccination centers. Types of waste generated, segregation/storage, collection/transportation, handling/treatment as well as methods of waste disposal in every facility plays an important role concerning health risks.

Main purposes of waste management and disposal are to clean up the surrounding environment and to identify the appropriate systems for waste neutralization, recycling and disposal. Within waste disposal, the health care waste management (HCWM) is a process that helps to ensure proper hospital hygiene and safety of health care workers and communities. Health care workers and patients are concerned about planning and procurement, staff training and behavior, proper use of tools, machines and pharmaceuticals, proper methods applied for segregation, reduction in volume, treatment and disposal of biomedical waste. Studies have demonstrated that there is not a single method of biomedical waste treatment or disposal that completely eliminates all risks to humans or to environment (World Health Organization, 2018).

Biomedical waste disposal methods usually relate to all kinds of planned activities concerned with the proper handling and disposal of wastes from the point of generation to the point of final disposal. Wastes disposal methods are comprehensive, integrated, rational and systematic approach towards the achievement and maintenance of acceptable human health. Modern methods of wastes disposal have emerged in response to the recognition of health influence (Kumar & Singh, 2018).

Basically, there are various methods of wastes disposal among workers and patients in the health sector, these include but not limited to incineration. According to Gouveia and Prado (2019), incineration is a common waste disposal method. It is where ignitable wastes are burnt at hot temperature to devour every flammable material. Manyele and Lyasenga (2020) conveyed that pathogens from open dumps of medical waste, human excreta, and decomposing organic matter can cause infections, respiratory diseases, and gastrointestinal illnesses. Dust from the dump can cause respiratory issues such as chronic obstructive pulmonary disease (COPD), asthma, and bronchitis. Open burning of waste releases toxic fumes, including dioxins and furans, which can cause serious respiratory and cardiovascular problems.

The waste management departments are statutorily charged with the primary responsibility of biomedical wastes disposal. However, the present state of our hospitals has shown that cleaners in this departments lack the capacity and capability to fulfill this obligation. Several efforts have been made by governments across Nigeria, and intervention projects have been put in place over the years to ensure proper disposal of biomedical wastes. It is also very worrisome to note that most health care facilities do not even have waste management experts or departments and so on.

In Cross River State, there are poor systems of wastes disposal in hospitals. This raises several questions that need answers. What are the biomedical wastes generated by health centers? How are these wastes disposed? How does the disposal systems relate to human health? Hence this study investigated biomedical wastes disposal methods and influence on health of health workers in Public Hospitals of Calabar Education Zone, Cross River State, Nigeria.

Statement of the problem

Healthcare workers are frequently exposed to numerous occupational hazards, including biological, chemical, and physical risks. Their constant contact with patients and infectious materials makes them particularly vulnerable to diseases, injuries, and toxic exposures. One of the most serious threats faced by health workers and the general public

is improper biomedical waste disposal. Biomedical wastes, which include syringes, blood-soaked materials, contaminated dressings, sharps, and pathological waste, are often found in open bins around hospitals in Calabar Education Zone. Such poor disposal practices lead to environmental contamination, foul odour, toxic emissions, and water pollution, posing significant health risks to hospital staff, waste handlers, and nearby residents.

The World Health Organization (WHO) has reported that out of about 35 million healthcare workers worldwide, approximately 3 million are exposed annually to bloodborne pathogens; 2 million to hepatitis B and C viruses, and 170,000 to HIV/AIDS infection. Many of these exposures are directly linked to improper waste handling, such as the lack of needle cutters, unsafe sharps disposal, and unprotected contact with infectious materials. In Nigeria, despite existing national and international guidelines on biomedical waste management, many public health institutions still struggle to adhere to standard protocols due to inadequate infrastructure, insufficient funding, and lack of trained personnel.

In Calabar Education Zone, the problem is exacerbated by poor waste segregation, inadequate protective gear, irregular waste collection, and limited knowledge among health workers. Although health professionals may possess theoretical knowledge about safe waste disposal, it often does not translate into proper practice due to high workload, weak institutional enforcement, and inadequate motivation. Previous interventions, such as short-term training programs and awareness campaigns, have been introduced in some hospitals. However, these efforts have produced limited and unsustainable outcomes, as compliance remains inconsistent, and behavioural change among staff is minimal.

Given these challenges, it becomes necessary to investigate the influence of biomedical waste disposal methods, knowledge, and influence on health of health workers in public hospitals in Calabar Education Zone, Nigeria. Understanding these relationships would provide evidence-based insights that can guide the development of sustainable biomedical waste management systems, strengthen policy enforcement, and safeguard both public health and the environment.

Purpose of the study

The purpose of this study was to ascertain the influence of biomedical waste disposal methods, knowledge and influence on health of health workers in public hospitals in Calabar Education Zone, Nigeria. Specifically, the study sought to:

1. Examine the influence of incineration of biomedical wastes on health of health workers in Calabar Education Zone.

Research questions

The following research questions were posed to guide the study:

1. What is the influence of incineration of biomedical wastes on health of workers in Calabar Education Zone?

Statement of hypotheses

The following hypotheses guided the study:

1. There is no significant influence of incineration of biomedical wastes on health of workers in Calabar Education Zone.

LITERATURE REVIEW

Incineration of biomedical waste and influence on health of workers

The perceptions of health workers (HWs) on medical waste management (MWM) issues in Tanzanian hospitals was examined by Ignasio and Samwel (2016). The perceived total waste generation rates were lower than the actual measurements. A total of 210 respondents were planned to be involved in the study, whereby, 105 were from Amana (35.5% of total staff) and the other 105 were from Ligula hospital (45.1% of total staff). Out of these, 206 (98%) responded and 4 (2%) were unable to participate due to various reasons. Secondary data were collected from various documentary sources such as facility quarterly and annual reports, health management information system, evaluation reports, supervision reports and from different studies associated with MWM practices including technology performance. Primary data were collected via structured questionnaire with both open and close ended questions. This study has organized information and statistics on MWM practices in hospitals from generation to final disposal. The perceptions of HWs on MWM have been properly analysed to give information that forms the basis for realistic planning, budgeting and implementation of MWM in economical, effective and efficient way. The study covered workers' perceptions in the following issues: medical waste generation; medical waste segregation; segregation practices, areas where medical waste segregation takes place; types of containers used for medical waste segregation and container colouring and labelling; medical waste collection, storage and transportation; impact of medical waste disposal technology on the environment; problems facing MWM in hospitals; awareness of diseases associated with poor MWM; knowledge and skills of HWs on MWM, training need assessment, PPE availability/utilization, and knowledge of HWs on administrative issues.

When the HWs perceptions on utilization of disposal technologies were analysed, it was observed that open burning on the ground is not practiced in both hospitals. Open

burning in a hole is practiced (Amana 8% and Ligula 19%) and is mainly used to burn papers and packaging materials. High temperature and low temperature incinerators are not used in these facilities, while the medium temperature incinerators were the main onsite treatment method utilized with the temperatures ranging from 500°C to 600°C for Amana and 400°C to 500°C for Ligula. The irritating smell and smoke coming out of those incinerators was a concern in the surrounding communities. At Ligula hospital, the situation was much worse as the smoke was heavy, black and pungent. About 33% of medical waste in Ligula hospital was being buried under the ground while the practice is not exercised at all in Amana hospital, as most of its waste (about 54%) is transported off-site. The perceived total waste generation rates are lower than the actual measured medical waste generation in both hospitals. Moreover, administrators perceive lower rates than implementers of MWM, leading to poor resource allocation.

Likewise, Edith, Azuka and Sunday (2023) carried out a study on the assessment of knowledge and perception among health workers towards proper biomedical wastes management in selected hospitals in Abuja. Data were collected by structured questionnaire and on- the-spot observation. Six hospitals that provided health care services to the increasing population of Abuja residents were surveyed. Descriptive and inferential statistical analysis were used in the analysis of the data. Chi-square (χ^2) test was used to determine the level of significance set at $p < 0.05$. The years of work experience of the respondents showed that 98 (24.50%) have spent 1-5 years on the job, 80 (20.00%) of the respondents have spent 5-10 years on the job, 88 (22.00%) of the respondents have spent 10-15 years on the job while majority 134 (33.50%) of the respondents had spent more than 15 years on the job. The study showed that there was a significance difference in the knowledge and perceptions of health workers to the biomedical waste management ($p < 0.05$). High level of knowledge and perception among the health workers was observed. There is still need for training and retraining of the health workers, hospital visitors and the general public, sensitization on the risks and benefits associated with proper biomedical waste management.

A survey research design was utilized by Bassey (2024) to assessed the perceived health implications of solid waste disposal systems among health workers in government hospitals in Edo South Senatorial District, Nigeria. 400 respondents were selected using the stratified random sampling technique. Data was collected using a validated 25-item four-point modified Likert scale questionnaire, which demonstrated good reliability with a 0.80 estimate established through the test-retest method. The analysis, conducted using

multiple linear regression, revealed a significant influence of waste disposal methods (waste disposal into water bodies, landfill, open dumping, incineration, and recycling) among Health Workers in Government Hospitals in the district. The findings suggest the need for proper disposal of biomedical waste through incineration, approved dumpsites, or recycling. This study contributes to the understanding of the health implications of solid waste disposal systems and recommends specific measures for waste management in healthcare facilities.

Again, Edith, Azuka, Sunday and Jeffrey (2024) carried out a related study on the incineration practice among health workers in selected hospitals in Abuja towards achieving effective waste management. A descriptive and cross-sectional study was conducted among 430 participants from six hospitals in Abuja. Data were collected using a pretested, structured questionnaire and on-the-spot observation. Reliability analysis and descriptive statistics were employed for the analysis of data. Most of the respondents agreed to the segregation at the point of generation 366 (91.5%), majority of the respondents supported the use of color-coded bins for segregation. The Cronbach's $\alpha = 0.830$, loading factor (0.601- 0.949) which indicates that the measuring tool was reliable and the items on the questionnaire showed co-relatedness and consistency. The study revealed that most of the respondents were sensitized and practiced the process of segregation. Although these practices were observed on the spot, they could later change thus, sustenance of these practices is expedient to maintain a lasting and workable waste management framework. Government and hospital waste management team to prioritize the segregation process through an adequate budget for supplies of segregation materials.

Also, Agunwamba, Emenike and Tenebe (2023) conducted a study on a cross sectional descriptive study of Medical Waste Management (MWM) practice and their implication to health and environment was carried out between August and September 2022 in Calabar Metropolis, Cross River State, Nigeria with the aim of assessing the current practices and commitment to sustainable HCW management in three (1 tertiary, 1 General and 1 Private) hospitals ranging in capacity from 30 to 500 beds. The study approach involved the estimation of the quantity of HCW generated, evaluation of the waste segregation practices and determination of the knowledge of healthcare workers regarding HCW management. Daily waste inventory of each ward was carried out. An evaluation of the status of the waste management practice in the health facility was carried out using the following criteria: waste management (responsibility, segregation, storage and packaging); waste transport; waste recycling and reuse; waste treatment and final

disposal. The result obtained from the study showed wastes generation at the rate of 1.31, 1.16 and 0.78 kg/day/patient for large, medium and small sized hospitals, respectively. Comparing the results gotten from the tertiary hospital and results gotten from developed countries, Analysis of Variance (ANOVA) was used which showed a less non-significant value. Out of the 189 people that participated in the survey of medical waste management, 19% of the people were highly concerned. 38% of the people were slightly concerned and 33% of them were neutral in their approach. The remaining people were not at all concerned with the MWM. Profession and age seemed to have an effect on the result.

RESEARCH METHODOLOGY

This study adopted the survey research design. According to Isangedighi (2012) survey research is a method of having a systematic, intense, accurate and purposeful observation of behaviour, trait or opinion and describing existing phenomenon as precise as possible. It is a design that is directed towards determining the nature of a situation as it exists at the time of investigation. The design is chosen because it will allow the researcher to collect data from a given population who have the same characteristics, using a well-designed variety of instrument concerning participants responses on fact and opinion attitude to objectively describe existing situation without modification. It also gave opportunity to study large and small population to discover relative incidence by selecting and studying the sample of the study.

The area of this study was Calabar Education Zone of Cross River State, Nigeria. It comprises seven Local Government Areas namely Akamkpa, Akpabuyo, Bakassi, Biase, Calabar Municipality, Calabar South and Odukpani Local Government Areas. The area lies within latitude $4^{\circ}27'N$ and $5^{\circ}32'N$ and longitude $7^{\circ}.50'$ and $9^{\circ}.30'E$ of the equator. It has a landmass of 9980 square kilometers, and is bounded by Akwa Ibom State and Abia to the West, Yakurr Local Government Areas to the North, Atlantic Ocean to the South and the Republic of Cameroon to the East. The area lie within the mangrove swamp and tropical rainforest regions thereby having both wet and dry seasons. The area is characterized with a maximum temperature of about $27^{\circ}C$ with a peak of $35^{\circ}C$ during January and February (Weatherbase, 2011).

Administratively, the area has 75 political wards with Odukpani Local Government Areas (13), Calabar South Local Government Areas (12), while all the other five Local Government Areas have 10 wards each. Administrative headquarter of the Local Government Areas are Akamkpa-Oban, Akpabuyo-Ikot Nakanda, Bakassi-Abana, Biase-Akpet Central, Calabar Municipality-Akim Qua, Calabar South-Anantigha and Odukpani-

Odukpani town respectively. The languages within each of the Local Government Area are Efik, Ejagham, Korop, Ukwa, Ito and devop for Akamkpa; Efik for each of Akpabuyo and Bakassi, Nne, Mehu, Ubaghara, Umon, Isanginyoinyo and Iyonyong for Biase, Efiok and Ejagham for Calabar municipality; Efik and Efut for Calabar South and Ejagham, Efik, Ofot and Kiong for Odukpani Local Government Area.

The population of this study comprised registered laboratory scientists, pharmacists, nurses/midwives and waste management personnel in selected public health care facilities or hospitals in Calabar Education Zone of Cross River State, Nigeria. According to the Cross River State Health System Restructuring Data (2025), the population of healthcare providers is 1,363 in government healthcare facilities in Calabar Education Zone. The population distribution is shown in Table 1.

TABLE 1
Population distribution of government healthcare facilities in Calabar Education Zone of Cross River State

S/N	Name of health care facilities	LGA	Healthcare workers	Population	Total
1.	University of Calabar Teaching Hospital	Calabar Municipality	Nurses/midwives	438	707
			Lab. Scientists	40	
			Pharmacist	61	
			Waste managers	168	
2.	University of Calabar Medical Centre	Calabar Municipality	Nurses/Midwives	26	61
			Lab. Scientists	12	
			Pharmacists	9	
			Waste managers	14	
3.	Federal Neuro Psychiatry Hospital, Calabar	Calabar South	Nurses	20	82
			Lab. Scientists	2	
			Pharmacist	18	
			Waste managers	41	
4.	General Hospital, Calabar	Calabar South	Nurses	26	130
			Lab. Scientists	19	
			Pharmacist	21	
			Waste managers	64	
5.	Cottage Hospital Oban, Akamkpa	Akamkpa	Nurses	19	38
			Lab. Scientists	3	
			Pharmacist	4	
			Waste managers	12	
6.	General Hospital UkemOdukpani	Odukpani	Nurses	21	41
			Lab. Scientists	3	
			Pharmacist	4	
			Waste managers	13	
7.	Navy Reference Hospital Calabar	Calabar Municipality	Nurses	31	56
			Lab. Scientists	5	
			Pharmacist	5	
			Waste managers	15	
8.	General Hospital, Akpabuyo	Akpabuyo	Nurses	36	59
			Lab. Scientists	4	

			Pharmacist	5	
			Waste managers	14	
			Nurses	39	
9.	General Hospital, Akamkpa	Akamkpa	Lab. Scientists	4	66
			Pharmacist	5	
			Waste managers	18	
			Nurses	24	
10.	Police Hospital 1BB, Calabar	Calabar Municipality	Lab. Scientists	6	52
			Pharmacist	8	
			Waste managers	14	
			Nurses	41	
11.	Cottage Hospital, Akpet	Biase	Lab. Scientists	3	71
			Pharmacist	6	
			Waste managers	21	
			Total		1,363

Source: Cross River State Health System Restructuring Data (2025)

The sampling techniques used for this study was proportionate stratified random sampling and simple random sampling techniques. Using stratified sampling technique, all the government health care facilities in Calabar Education Zone were stratified into seven local government areas while simple random sampling was used to select four health care facilities. Here, the method adopted was hat and draw process where all the names of the various health care facilities were written on slips of paper, folded into a container, mixed thoroughly and then picked one after the other with replacement. The healthcare facilities whose names appeared on the picked slips were selected for the study. Proportionate stratified random sampling technique was also adopted in selecting fifty percent of respondents from the entire study population which is not the same in each of the selected health facility used for the study.

The sample for this study consisted four hundred and eighty-four respondents randomly selected from four public care facilities in Calabar Education Zone of Cross River State. This number represented 50% of the population of the four (4) facilities that were selected for the study. They comprised both males and females including nurses, laboratory scientists, pharmacists and waste managers/sanitation workers. The sample distribution is presented in Table 2.

The instrument used for data collection in the study was a questionnaire titled: Biomedical Waste Disposal Methods and Influence on Health of Workers Questionnaire (BWDMIHQ). The questionnaire was constructed by the researcher. It was divided into three sections, Section A, B and C. Section A dealt with demographic data of the respondents, section B contained items measuring the sub-independent variables of the

study, while section C measured the dependent variable – health influence. The respondents were required to express their opinion based on each item in the instrument.

TABLE 2

Sample distribution of respondents in health care facilities in Calabar Education Zone

S/N	Healthcare facilities	Nurses	Lab scientists	Pharmacists	Waste managers	Total
1.	University of Calabar Teaching hospital	219	20	31	84	354
2.	General Hospital, Calabar	13	10	11	32	66
3.	General Hospital, Akpabuyo	18	2	3	7	30
4.	General Hospital, Akamkpa	20	2	3	9	34
	Total	270	34	48	139	484

Source: Field survey, 2026

The researcher personally visited all the selected health care facilities in Calabar Education Zone and sought the consent of the head of surgery, accident and emergency department by explaining the purpose and intention of conducting a study in their establishment. The researcher administered the questionnaire with the help of a trained research assistant. At the end of the exercise copies of the questionnaire were returned to the researcher for data analysis.

A coding guide was developed containing information in the questionnaire with four-point Likert scale option adopted. The positively worded items were assigned in an increasing (SA – 4 points, A – 3 points, D – 2 points and SD – 1 point) order while the negative worded items were in decreasing (SA – 1 point, A – 2 points, D – 3 points and SD – 4 points) order. However, a key is developed for each item in the instrument with a coding schedule. The coding schedule is presented in Table 4.

RESULTS AND DISCUSSION

In this section, the researcher presents the findings of the study, which are derived from the results of the data analyses. The statistical significance level of 0.05 was utilized to ensure the validity of the findings. The hypothesis formulated for this study was examined through the analysis of the collected data related to the variable under investigation.

Hypothesis

There is no significant influence of incineration of biomedical wastes on health of workers. The independent variable of this hypothesis is incineration of biomedical wastes while the dependent variable is influence on health of workers. Simple linear regression statistics was used in testing the hypothesis and the results are presented in Table 3.

The regression model revealed a statistically significant relationship between the incineration of biomedical wastes and the influence on health of workers in the Calabar Education Zone. The R value of 0.091 indicates a very weak positive correlation between the two variables. However, the R-Square value of 0.053 implies that incineration of biomedical wastes explains approximately 5.3% of the variance in the influence on health of workers. Although this proportion is modest, it suggests that incineration contributes in a statistically significant way to how health workers perceive the impact of waste disposal practices on health. The F-ratio of 42.179 and p-value (.000) indicate that the model is statistically significant at the 0.05 level. This means that the relationship between incineration of biomedical wastes and influence on health is unlikely to be due to chance. The standard error of the estimate (10.001) suggests the typical distance between the actual data points and the regression line, reflecting moderate dispersion in the responses.

Overall, this analysis showed that incineration as a disposal method does have a significant, though relatively small influence on health workers' perceptions of health risks associated with biomedical waste. This supports the argument for further attention to waste incineration protocols and health education on emission risks in hospital waste management systems.

The result of hypothesis revealed a statistically significant but weak positive relationship between incineration of biomedical wastes and impact on health as perceived by health workers, suggesting that incineration practices explain the variance in how health workers perceive the health implications of biomedical waste disposal.

These findings are consistent with those of Ita (2018), who reported a significant negative influence of incineration of biomedical wastes on health as perceived by health workers in the same Calabar Education Zone. Ita's study emphasized that poorly managed incineration processes release toxic emissions that threaten the health of hospital workers and nearby residents. Similarly, Ignasio and Samwel (2016), in their assessment of medical waste management practices in Tanzanian hospitals, found that medium-temperature incinerators (400°C–600°C) generated irritating smoke and pungent odour, posing respiratory health concerns to both hospital workers and surrounding communities. Their

findings highlight that improper incineration processes can result in incomplete combustion, leading to the release of harmful gases and particulate matter.

In line with this, Edith, Azuka, and Sunday (2023) reported significant variations in the knowledge and perceptions of health workers towards biomedical waste management in Abuja hospitals. Their study showed that while many health workers had a high level of awareness of biomedical waste risks, continuous training and retraining were necessary to improve practices and mitigate the health risks associated with waste incineration and other disposal methods. Similarly, Edith, Azuka, Sunday, and Jeffrey (2024) emphasized that sustainable waste management requires consistent sensitization and the provision of proper segregation equipment, as this reduces the health risks associated with exposure to improperly incinerated waste.

Again, Bassey (2024) further confirmed the significance of incineration and other biomedical waste disposal methods in influencing health workers' perceptions of health impacts in Edo South Senatorial District. The study found that inappropriate waste disposal methods such as open dumping or burning directly correlate with increased health risks, including respiratory complications and infection spread. Bassey's conclusion aligns with the current finding, suggesting that while incineration may serve as a more controlled disposal method, improper operation or maintenance can still pose health threats.

Moreover, Dzekashu, Akoachere and Mbacham (2017) observed that in Cameroon, incinerators in health facilities were substandard and lacked proper air scrubbers, leading to the release of harmful smoke and exposure to workers and nearby populations. They recommended regular supervision and enforcement of medical waste management policies to ensure compliance with environmental health standards. This finding corroborates the present study's result, as it indicates that health workers' perceptions of risk may stem from direct or indirect exposure to the adverse effects of incineration practices.

The results of this study reinforce the notion that biomedical waste incineration, when improperly managed, contributes to negative health perceptions and outcomes among health workers. Although incineration remains a necessary waste treatment method, poor maintenance of incinerators, lack of emission control devices, and insufficient worker protection increase health risks. The modest R^2 value (5.3%) indicates that while incineration significantly influences health, other factors – such as training, awareness, waste segregation, and protective measures – also play crucial roles. Therefore, consistent with Agunwamba, Emenike and Tenebe (2023), effective management of biomedical waste requires a comprehensive approach involving worker education, proper

segregation, and technological upgrades in waste treatment systems. This will not only enhance compliance with waste management standards but also improve health workers' perceptions and overall workplace safety.

TABLE 3

Summary of data and simple regression analysis on the influence of incineration of biomedical wastes and influence on health of workers

Biomedical wastes and influence on health of workers					
R	R-square	Adjusted R-square	Std. Error of the Estimate		
.091	.053	.049	10.001		
Model	Sum of squares	df	Mean Square	F	Sig
Regression	217.999	1	217.999	42.179	.000
Residual	82119.730	482	100.024		
Total	82337.729	484			

a. Predictors: (Constant): Incineration of biomedical wastes

b. Dependent Variable: Influence on health of workers

CONCLUSION AND RECOMMENDATIONS

Conclusion

The study concludes that biomedical waste disposal methods and knowledge of biomedical waste disposal methods significantly affect health workers' perception of health risks in public hospitals. Incineration is considered safer, though still requiring stringent regulation. The knowledge of biomedical waste management was found to be a crucial factor in shaping health workers' perceptions, underscoring the need for targeted training and educational interventions. In essence, improving biomedical waste disposal practices and investing in knowledge development among health professionals are essential steps in reducing occupational and public health risks within the healthcare system.

Implication of the findings

These findings imply the need for the Cross River State Ministry of Health and hospital management boards to strengthen regulatory frameworks guiding biomedical waste disposal in public hospitals. This may involve revising existing waste management policies, introducing stricter enforcement measures, and ensuring compliance with international best practices for biomedical waste handling. The positive perception of incineration as safer waste disposal methods suggests that hospital administrators must prioritize investment in modern and environmentally friendly waste treatment facilities.

Poor infrastructure and outdated disposal systems currently in place could be exacerbating health risks among healthcare workers and surrounding communities. Therefore, hospital management teams should establish effective internal waste management units and develop protocols for waste segregation, transportation, and treatment to safeguard both staff and patients.

The influence of knowledge on health perceptions highlights the importance of continuous training and retraining of health workers on proper biomedical waste management practices. This points to the need for integrating waste management education into healthcare training programs and providing regular professional development opportunities through workshops, seminars, and certifications. Enhanced knowledge will not only improve compliance but also reduce occupational health risks and promote safety in healthcare environments.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Regular and mandatory training workshops should be organized to improve health workers' knowledge of biomedical waste handling and health safety practices.
2. Investment in safe disposal technologies: Public hospitals should be equipped with functional, eco-friendly incinerators and facilities that support safe recycling practices.
3. Public health education: Awareness campaigns should be extended to auxiliary hospital staff and communities near healthcare facilities to prevent exposure to improperly disposed waste.
4. Monitoring and evaluation units: Establish institutional monitoring teams to ensure compliance with biomedical waste segregation, labeling, transportation, and final disposal.

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