

# Assessing the Knowledge and Practice of Solid Medical Waste Management among Private Hospitals in Port Harcourt, Nigeria: A Cross-Sectional Study

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### ABSTRACT

Effective medical waste management is essential for protecting public health and the environment. The study examined private hospitals in Port Harcourt metropolis and their medical waste management practices with special interest in their handling procedure and technique(s) used. World Health Organisation (WHO) standard procedures via segregation at source, using coloured coded containers, Storage for 24hours e, treatment and disposal through autoclaving or incineration were employed to ascertain their management practice. The study data were collected through questionnaire administration, interviews and field study. Twenty hospitals which provide services for low, middle and high income earners were randomly selected for this study in Port Harcourt City and Obio-Akpor local government areas, in Rivers State Nigeria. The results for the minimum and maximum wastes generated over 7 days as weighed from a facility in each LGA were 15.8kg/67.0kg (Obio-Akpor LGA) and 25.1kg/101.5kg (Port Harcourt City LGA) respectively. The mean waste generated for all the facilities was 40.1kg. Analysis showed a significant non-compliance to World Health Organization (WHO) standard procedures. The findings reveal that the procedure for medical waste management were inadequate with the use of a central waste collection method, thus indicates that these hospitals fell below the recommended waste management practices as prescribed by WHO. The high generation of medical waste in the study area is a proof that medical waste management is problematic. Based on the findings, it is recommended that an awareness sensitization be created to achieve better medical waste handling and forestall a sustainable environment.

**Keywords:** Healthcare Waste, Waste Management, Knowledge, Medical Waste Policy, WHO Compliance, Nigeria, Environmental Health.

### INTRODUCTION

Day to day activities in health institutions generate a lot of waste which is biological in nature and are potential sources of infection transmission. Medical waste management is of major concern due to the potentially high risks to both human health and the environment caused by inadequate waste management practices (Adnane et al., 2013; Ezeudu et al., 2022). The sustainable management of Medical Waste has continued to generate increasing public interest due to the health problems associated with exposure of human beings to potentially

hazardous wastes arising from healthcare (Chisholm *et al.*, 2021, Adnane *et al.*, 2013). Medical facilities generate waste, hazardous chemicals (disinfectants, laboratory solvents/reagents/fixatives, cytotoxic agents, x-ray developers, etc.) and radioactive materials (iodine-131, cobalt-60, radium-223, etc.), while such wastes are normally not infectious, they require proper disposal. Waste management entails the process of waste generation, collection, transportation, and disposal of wastes in facilities. Consequently, effective management



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of medical waste does not only involve the generation/collection and removal of wastes from hospital premises. It also includes the effective and environmentally safe manner of disposing these wastes (Phengxay *et al.*, 2005). Rivers State does not have a standalone medical waste act yet so the state leans on the federal framework where Rivers State Waste Management Agency (RIWAMA) tries to fill the gap: The National Environmental (Healthcare Waste Control) Regulations 2021 which gives the legal basis for classifying, storing, transporting and treating healthcare waste across the country and a National Healthcare Waste Management Policy adopted in 2013 which outlines segregation, treatment standards and the roles of agencies like NESREA. RIWAMA mandate includes regulating the generation, collection, treatment, recycling and disposal of all waste, including medical waste and it can set licensing terms and penalties.

World Health Organization (WHO) in 2007, noted that over the last few decades, progress in medical science and technology and expansion in the number of health institutions worldwide has been accompanied by increasing quantities of potentially hazardous medical waste. The risks include occupational exposure of health workers and waste-handlers and environmental exposure of the public caused directly by illegal or careless management and disposal practices or indirectly through emissions and ash handling from medical waste incinerators. In 2002 the World Health Organization (WHO) reported that underdeveloped countries suffer the greatest burden of risk from medical waste due to the high costs of proper disposal procedures.

The spread of blood borne pathogens in medical waste motivated the WHO in 2004 to call for the development of national policies, guidance and plans for medical waste management (Pruss *et al.*, 2013, Olaifa *et al.*, 2018). Majority of healthcare establishments in Port-Harcourt Metropolis particularly the public and private sector lacked functional and efficient waste management units and facilities, such as incinerators and vehicles for transportation of wastes to dumpsites (Stanley *et al.*, 2011, Abubakar *et al.*, 2022).

This study seeks to ascertain the current medical waste handling within the private hospitals since they are mostly proliferated within the study area, and to understand their status to forestall a sustainable environment. This objective will help stakeholders understand the need for waste management policies and guidelines that will streamline practices and encourage enforcement with punitive measures for defaulters.

## The Problem

With the rapid urbanization and ever increasing population growth in Port-Harcourt, there has been a tremendous proliferation of healthcare facilities to cater for the health issues of the populace. The high generation rate of medical waste in hospitals is a proof that medical waste

management is imperative. Research indicates that medical personnels and hospital management were totally irresponsible and unaware of basic methods of waste disposal (Pruss *et al.*, 2013, Santos *et al.*, 2018). A study revealed that a government hospital lacked proper on-site handling, segregation, transportation and disposal practices for healthcare waste (Homa *et al.*, 2025). Many hospitals simply dump all their wastes together from reception area trash to operating room waste without any form of segregation. Separation, collection, storage, carrying and disposal of medical waste are important and ignoring issues.

Chemical wastes that causes outdoor air pollution, emanates from two major sources: open burning and incineration. Inadequate incineration or open burning of medical waste produces toxic air pollutants such as acid gasses, nitrogen oxides, particulates, dioxins and heavy metals and distribute them over a wide area (Hasan & Rahman, 2018). These when inhaled can cause respiratory diseases. Certain organic gases, such as dioxins and furans, are carcinogenic whose effects have longer latency periods.

## Study objective

The overall objective of this study is to ascertain the management of medical waste in private hospitals in Port Harcourt metropolis. This will be achieved by identifying the current methods used in medical waste management handling. It will also ascertain the presence of a defined procedure for medical waste handling and management in healthcare facilities in Port Harcourt, determine the awareness of healthcare personnel regarding healthcare waste management, and assess the level of compliance with recommended best practices for the sustainable management of healthcare waste. The significance of this study is primarily to ensure our medical waste management practices are more efficient, reliable and environmentally friendly to avert public health and pollution issues. It will also serve as a useful tool for government, scholars, healthcare providers, the public as well as other researchers. The results will provide useful information to help medical waste management policy makers identify opportunities to enhance waste regulations and implementation to foster sustainable environment. This study will create the basis for better medical waste management enlightenment, identify gaps in current practices of medical waste in Nigeria when compared with WHO Standard and recommend ways of bridging this gap considering the current economic and technological realities in the country. Finally, it will also contribute to mitigate indiscriminate dumping of medical waste while promoting environmental protection.

## The Study Area

The study area is located in Port Harcourt metropolis which

**Table 1:** Geo coordinates for the sampled healthcare facilities

LGA	Code Number	Coordinates N/E	
Port Harcourt	PVHC – 1	4 52 27	7 0 50
	PVHC – 2	4 50 10	7 1 20
	PVHC – 3	4 50 14	7 1 20
	PVHC – 4	4 50 11	7 2 1
	PVHC – 5	4 50 6	7 2 1
	PVHC – 6	4 47 48	7 1 34
	PVHC – 7	4 45 44	7 0 49
	PVHC – 8	4 45 26	7 2 4
Obio-Akpor	PVHC – 9	4 50 55	6 55 59
	PVHC – 10	4 52 19	6 55 36
	PVHC – 11	4 52 10	6 58 42
	PVHC – 12	4 52 30	7 0 2
	PVHC – 13	4 48 47	6 57 0
	PVHC – 14	4 49 1	4 57 19
	PVHC – 15	4 50 4	6 59 9
	PVHC – 16	4 49 26	7 3 6
	PVHC – 17	4 49 54	6 59 43
	PVHC – 18	4 49 26	7 3 7
	PVHC – 19	4 49 45	6 58 32
	PVHC – 20	4 50 3	6 59 7

(Source: Author's Fieldwork, 2025)

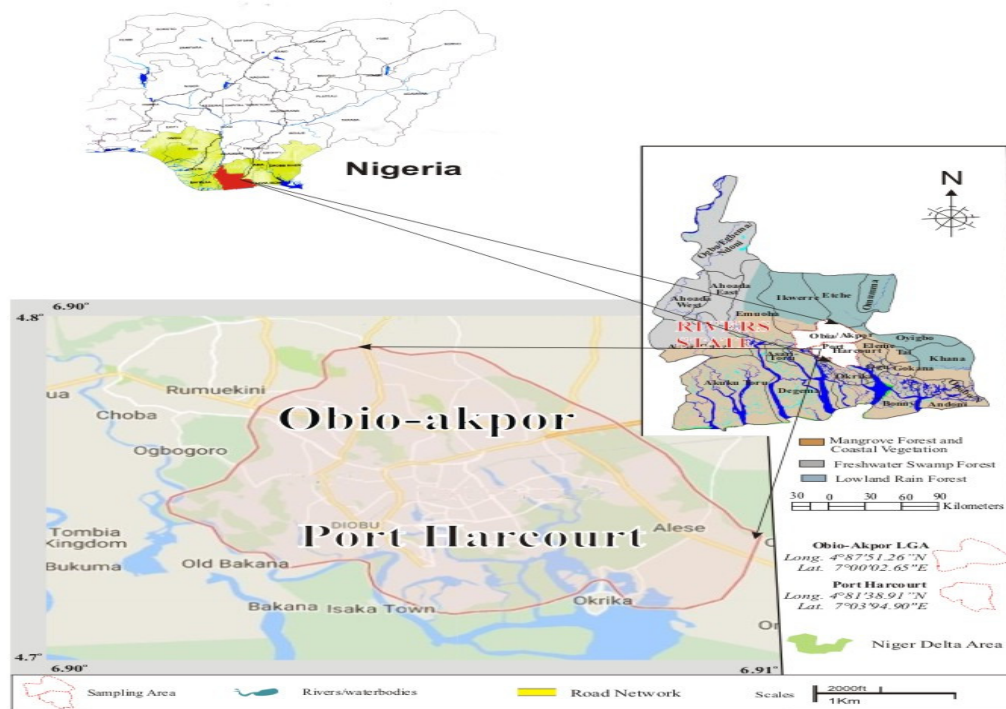


Figure 1: Map of Rivers State Showing Study Area

is the largest city in southern Nigeria after Lagos. Port-Harcourt is the capital of Rivers State, Nigeria with geographical coordinates: 4° 47' 21" N and 6° 59' 55" E, and an altitude of 463m (Table 1). It lies along Bonny River and is located in the Niger Delta, with Owerri-Imo to the North, Yenegoa-Bayelsa to the West, Uyo-Akwa Ibom to the East and the Atlantic Ocean to the South. It falls almost entirely within the lowland swamp forest ecological zone

and is flanked in the east, west and southern limits by mangrove swamp forest (Gobo, 2001) (Figure 1). Port Harcourt metropolis is considered as one of the fastest growing cities in Nigeria, the rate being estimated as 15%. As a city having the seat of crude oil and marketing prospecting companies in Nigeria, has led to the high population growth rate. The cost of living in Port Harcourt metropolis is also known to be relatively high,

most probably due to the rise in the demand for housing, social amenities, educational and medical healthcare by its large population Port Harcourt metropolis comprises of two Local Government Areas – Obio Akpo and Port Harcourt City Local Government Areas (LGAs). Port Harcourt City Local Government Area is located within latitudes  $4^{\circ} 45''$  -  $4^{\circ} 50''$  N and longitudes  $6^{\circ} 75''$  -  $7^{\circ} 05''$  E. It is largely drained by the Bonny River and lies at an altitude of 20m above sea level with tidal variation of 2.5m. It is a brackish peninsular with a network of creeks, water bodies and wet lands. Obio Akpo Local Government Area lies between latitudes  $5^{\circ} 00''$  S -  $5^{\circ} 48''$  E and longitudes  $6^{\circ} 45''$  -  $6^{\circ} 57''$  N. Port-Harcourt has an average temperature range of about  $28^{\circ}$  -  $30^{\circ}$  C with relative humidity variation from 91.0 – 92.0% and an average rainfall of 2,500cm<sup>3</sup>. Highest peak of rainfall recorded ranges from 177 - 200 days, (May - September) while the lowest amount is recorded between the months of October – April (Gobo, 2001). Port Harcourt features a tropical Monsoon Climate with lengthy heavy rainy seasons and very short dry seasons.

## Literature Review

Medical waste are all medical, liquid or gaseous wastes which are generated from hospitals, clinics, medical laboratories, research centers, pharmaceutical and veterinary factories, veterinary clinics, home nursing institutions eg. human and animal remnants, body fluids; blood and derivatives, human excreta, contaminated clothings, wipes, injectors, contaminated sharp tools, expired medicines and chemicals (Ezeudu et al., 2022).

### Hazardous medical waste

These are part of medical waste that can cause health risks. This waste is generated as a result of the following acts, such as diagnosis, processing, vaccination of humans or animals and may result from various scientific medical research, remnants of the tests such as vaccines, serums and antibodies. Hazardous medical waste is classified to the following:

**Infectious waste:** Waste containing, or believed to be containing microbes or organisms causing infectious diseases (bacteria), viruses and fungi.

**Anatomical waste (pathological):** Wastes that are competent and directly related to the human body or tissues as sick organs have been eradicated cut off limbs, dead embryos, or body fluids such as blood or such tissue that are sent for laboratory testing.

**Sharp waste:** These are tools used by medical staff and used for medical purposes or analytical and may cause cut or puncture of human body and any sharp tool may be used in surgical operations.

**Chemical waste:** Solid, liquid or gas waste resulting from diagnostics experimental, therapeutic, disinfection and cleaning.

### Pharmaceutical waste

Those expired or pharmaceutical products and non-complied with specifications, or different pharmaceutical and industrial remnants whether liquid or solid. It is reported that healthcare institutions dispose of all wastes to municipal dumpsites without pre-treatment, leading to an unhealthy and hazardous environment around the health institutions, affecting patients, staff and the community (Aung et al., 2019). These waste materials could cause serious hazards to health and the environment in cases of indiscriminate management. To avoid these hazards, a rigorous waste management system should be implemented. Medical waste is generated and discarded and is not intended for further use. It is of paramount importance that a number of key aspects of medical waste are addressed, these include efficient segregation of different types of medical waste, use of coded and coloured bags, and excellent handling and transfer. To address these requirements, adequate training and awareness programmes for medical and paramedical personnel are necessary.

Medical waste should be managed according to its type and characteristics. For waste management to be effective, the waste should be managed at every step, from acquisition to disposal. WHO (1999, 2005) gives the following as the elements of a comprehensive waste management system:

**Waste survey:** The survey should differentiate and quantify the waste generated. This helps to determine the method of disposal.

**Waste segregation:** This consists of placing different kinds of wastes in different containers or coded bags at the point of generation. It helps to reduce the bulk of infectious waste as well as treatment costs. Segregation also helps to contain the spread of infection and reduces the chances of infecting other healthcare workers.

**Waste accumulation and storage:** Waste accumulation and storage occurs between the point of waste generation and site of waste treatment and disposal.

**Waste transportation:** When medical waste is not treated on site, untreated waste must be transported from the generation facility to another site for treatment and disposal.

**Waste treatment:** Treatment is mainly required to disinfect or decontaminate the waste, right at source so that it is no longer the source of pathogenic organisms.

**Waste disposal:** The waste disposal methods vary in their capabilities, cost, availability to generation and impacts on the environment. The various disposal methods include incineration, autoclaving, chemical methods, thermal methods (low and high), ionizing radiation process, deep burial and microwaving. Thus, the hospital waste must be collected, segregated disposed off using proper method. Even if a small amount of infectious waste gets mixed with general waste it can contaminate the entire waste collected. A policy needs to be formulated based on reduce, reuse and recycle the biomedical waste. In medical waste management, healthcare wastes hold higher priority due to their hazardous nature. In 2014, according to World Health Organization (WHO) some part of healthcare wastes is considered most hazardous that can affect human health and pollute the environment badly. Management of medical wastes therefore work to eliminate the dangerous practice of incineration as well as to minimize the amount and toxicity of all waste streams generated by the hospitals. Despite the high level of waste generation from the hospital sources and the health implication, emphasis on waste generation and management have been on domestic sources (Phengxay et al., 2005, Aung et al., 2019).

## Materials/Methods

In this descriptive cross sectional study, probability sampling design was used in picking the sampled hospitals through the application of a simple random sampling method. The study population for this research was a total number of twenty private hospitals (20), seven (7) hospitals from Port Harcourt City and thirteen (13) hospitals from Obio-Akpor local government area.

A structured questionnaire as the instrument of information collection was designed to evaluate the awareness of medical waste management among these private healthcare establishments. The questionnaire contained questions based on the knowledge of existing medical waste management practices; knowledge and practice of waste handling, segregation, treatment and disposal (Zamparas *et al.*, 2005; WHO, 2014). It also recorded the degree of awareness of risks/hazards associated with medical waste handling and medical waste management policies, and the attitude of the various respondents towards the medical waste handling and management.

## Data Analysis Technique

Descriptive statistical tools were employed in the data analysis; the descriptive tools include tables, charts, frequency distribution. This involved analyzing the data generated from respondents to the structured questionnaires, direct observation and interviews made from the waste handling at each selected hospital

conducted by the researcher. Using the Statistical Program for Social Sciences (SPSS), SPSS 20.0 statistical software, the waste management handling of the hospitals was determined. The waste management performance of each hospital was assessed using a questionnaire addressing the main phases of the waste management process which includes waste handling/management process, policy/legislation and awareness/education was used to collect the data. To convert the data into a quantitative measure, score 1 was assigned to both YES and NO answers which were converted to percentage.

## Results

Table 2: Mode of Storage of Medical Waste in Private Hospitals in Port Harcourt

Mode of Storage	No. of Sampled Hospitals adopting the Method
Drums/Bulk bin	6
Plastic containers	4
Plastic bags	10
Marked/Colour Coded Bins	-

Source: Author's Fieldwork, 2025.

Sources of the waste were from operation theatre, intensive care, ward, dialysis unit, radiology, laboratory, and pharmacy. The components of the wastes were sharps, swabs, pathological wastes, chemical or pharmaceutical wastes, laboratory wastes, cultures and stock, waste water and general trash. The medical wastes generated from different departments in the sampled hospitals were not segregated except sharps and some major pathological wastes (from theaters) which were wrapped separately before disposal. There was also no treatment made before wastes were finally disposed. Most of the hospitals admitted to using municipal waste collectors of which drums, bulk bin, plastic containers and plastic bags were used to contain their wastes before disposal as shown in (Table 2).

Improper handling of medical waste causes both health and environmental hazards. None of the sampled hospitals treated its wastes before disposal; this proves the absence of defined procedure which shows very poor commitment to medical waste management, and this addresses Objective 2 of the study. Thus, the need for enlightenment on the handling and management of medical waste to encourage environmental sustainability.

Figure 2 shows that a greater percentage of the hospitals (60%) engaged in waste disposal by municipal waste collectors, while disposal by self-haul, onsite burning, self-haul/onsite, incineration/contractors were lower with 10% each. The greater percentage however poses a severe threat/risk to the environment.

Figure 3 shows that a greater portion of the respondents (65.21%) opined that their facility does not manage medical wastes according to WHO standard while 34.79%

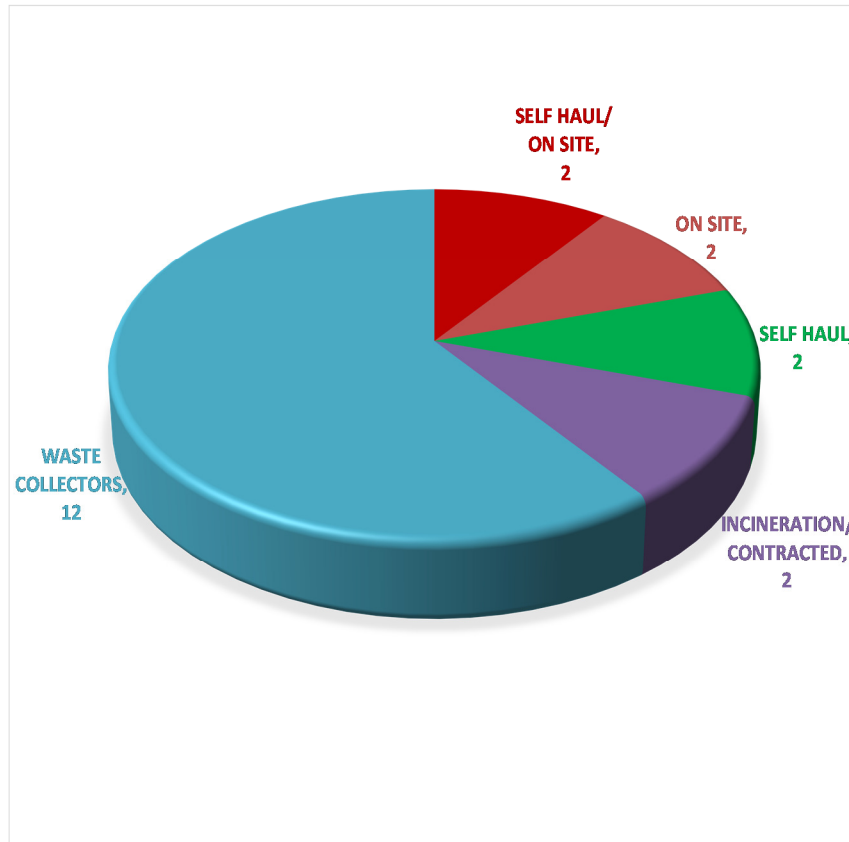


Figure 2: Waste Management Profile of the Study Area  
Source: Author's Field Work 2025

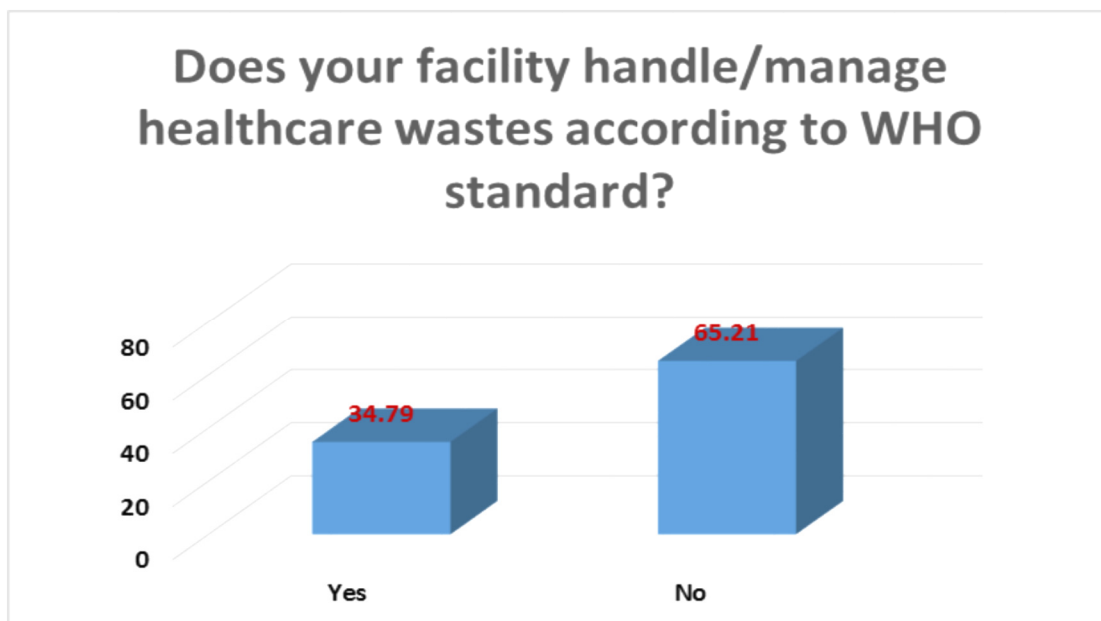


Figure 3: Percentage of Hospitals that managed their medical wastes according to WHO standard

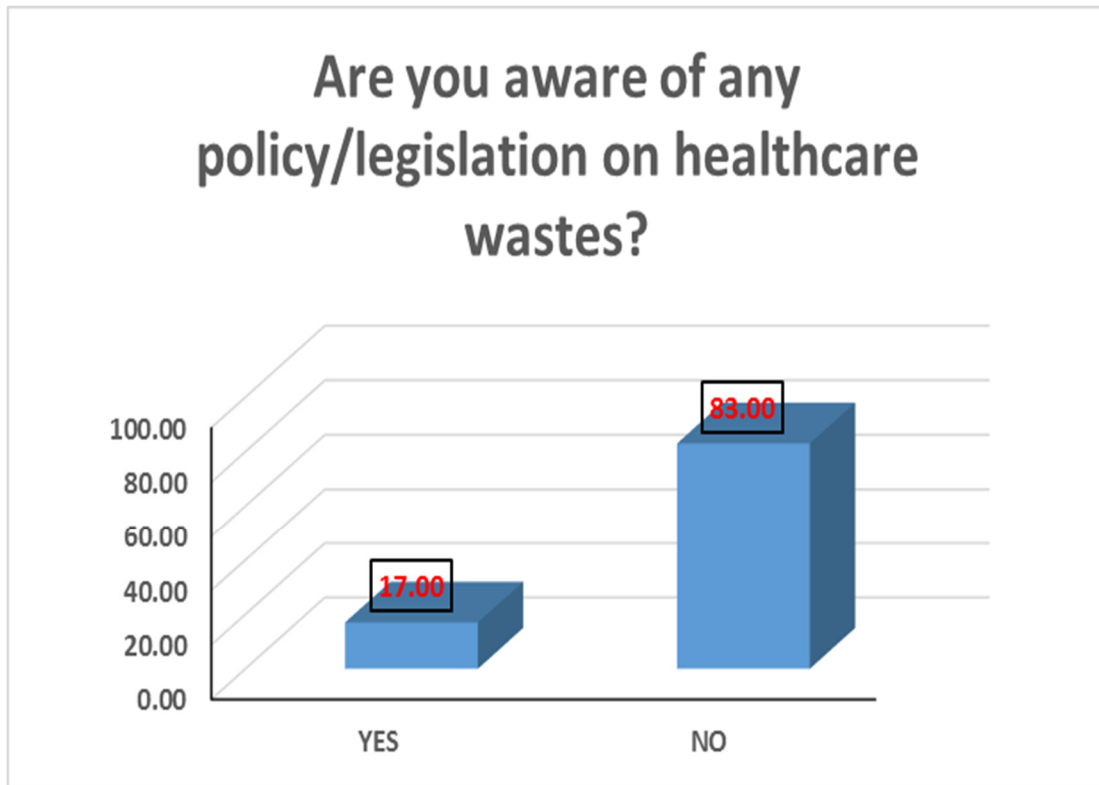


Figure 4: Percentage of hospitals with the awareness on Policy/Legislation of medical wastes

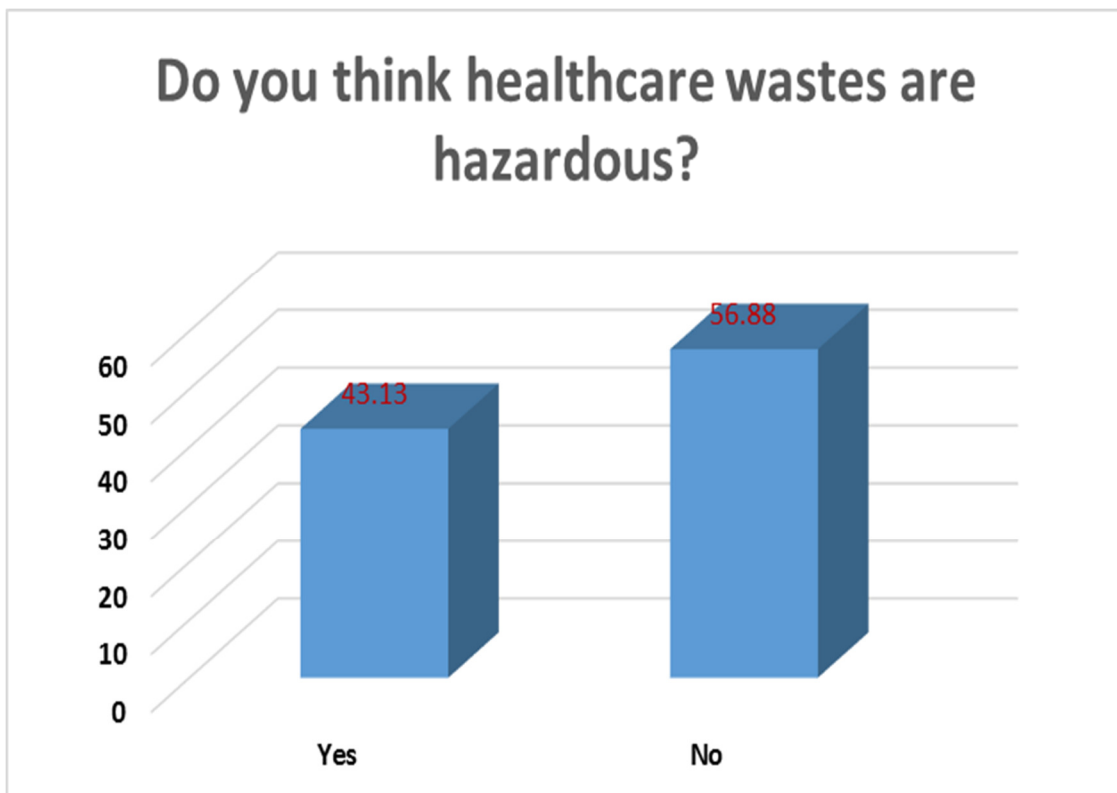


Figure 5: Percentage of hospitals with knowledge on Hazardous medical wastes

**Table 3:** Questionnaire Summary

Hospital Code	Waste Management		Knowledge on Policy/ Legislation		Awareness and Education		Summary	
	Yes	No	Yes	No	Yes	No	Yes	No
PH-1	33	14	1	4	5	3	39	21
PH-2	26	21	-	5	4	4	30	30
PH-3	18	29	2	3	5	3	25	35
PH-4	20	27	-	5	7	1	27	33
PH-5	10	37	1	4	4	4	15	45
PH-6	7	40	-	5	2	6	9	51
PH-7	9	38	1	4	2	6	12	48
OB-1	11	36	-	5	3	5	14	46
OB-2	31	16	2	3	6	2	39	21
OB-3	10	37	1	4	2	6	13	47
OB-4	12	35	1	4	4	4	17	43
OB-5	13	34	1	4	2	6	16	44
OB-6	9	38	1	4	2	6	12	48
OB-7	16	31	1	4	2	6	19	41
OB-8	26	21	-	5	1	7	27	33
OB-9	17	30	1	4	4	4	22	38
OB-10	19	28	-	5	3	5	22	38
OB-11	11	36	1	4	4	4	16	44
OB-12	11	36	2	3	4	4	17	43
OB-13	18	29	1	4	3	5	22	38
	327	613	17	83	69	91	413	787

Source: Author's Fieldwork, 2025.

**Table 4: Handling of Medical Waste in Private Hospitals in Port Harcourt**

Hospital Code	Weekly Waste Generated (kg)	Frequency of Collection	Frequency of Disposal	Method of Disposal
OB-1	30.2	Daily	Daily	Self haul/Site
OB-2	25.5	Daily	Once/week	Contracted
OB-3	33.3	Daily	Thrice/week	Self haul/Site
OB-4	15.8	Daily	Once/week	Site
OB-5	42.0	Daily	Twice/week	Self haul
OB-6	22.0	Daily	Once/week	Waste Collectors
OB-7	42.5	Daily	Once/week	Waste Collectors
OB-8	32.5	Daily	Once/week	Waste Collectors
OB-9	27.5	Daily	Once/week	Waste Collectors
OB-10	38.0	Daily	Once /week	Waste Collectors
OB-11	67.0	Daily	Twice/week	Waste Collectors
OB-12	38.6	Daily	Once/week	Waste Collectors
OB-13	26.0	Daily	Once /week	Site
PH-1	87.5	Daily	Once/week	Waste Collectors
PH-2	101.5	Daily	Daily/week	Site, Incineration
PH-3	49.0	Daily	Once/week	Waste Collectors
PH-4	35.0	Daily	Once/week	Waste Collectors
PH-5	35.0	Daily	Twice/week	Self haul
PH-6	28.0	Daily	Once/week	Site, Waste Collectors
PH-7	25.1	Daily	Once/week	Waste Collectors

Where OB- 1 to 13 represents the sampled private hospitals in Obio Akpor L.G.A and PH-1 to 7 represents the sampled private hospitals in Port-Harcourt L.G.A (Source: Author's Fieldwork, 2025)

said their facility manages medical wastes according to WHO standard. Figure 4 shows that a greater portion of the respondents (83.00%) opined that they are not aware of any policy/legislation on medical wastes while 17.00% opined they are not aware of a policy/legislation on medical wastes.

Figure 5 shows that a greater portion of the respondents (56.88%) opined that medical wastes are not hazardous while 43.13% opined that medical wastes are hazardous.

## DISCUSSION

This study reveals that majority of private hospitals in Port Harcourt metropolis lacked functional and efficient waste management units and facilities to cater for their wastes; this explains why of medical waste in the various hospitals (Table 1.2).

The implication of a large proportion of unawareness in private hospitals is predicated on the fact that majority of

the hospitals had their knowledge on proper procedure in managing their waste is lacking in Port Harcourt metropolis (Table 1.2). Furthermore, this study showed that knowledge of healthcare personnel on the health risks of inadequately managed waste did not automatically translate into efficient management no formal training so did not adopt the WHO standard operating procedures (Fig 5), also, these hospitals patronize waste disposal outfits and therefore has no trained staff on waste management process (Table 1.2). From Fig 2, on the spot assessment of some waste disposal agents of the hospitals showed that they treat the wastes they handle as normal domestic wastes and dispose them as such, thus confirming the findings of Chisholm *et al.* (2021) that solid waste workers are exposed to significant levels of physical, chemical and biological toxins. Research have shown that the practice of medical waste handling and management in the surveyed local government areas is poor, there was no safe disposal in most of the hospitals. Some of the surveyed hospitals used burning and burying as the methods of waste disposal. Most of the wastes were burnt in open areas and the wastes are not completely burnt (Fig. 2). In some facilities infectious wastes are buried in shallow pits in areas with shallow water table.

From the study (Fig. 3), it is obvious that the WHO guidelines have not been followed in the medical waste management in the hospitals.

## Conclusion

The current management practices for medical wastes generated at the surveyed facilities are unsustainable and cannot be relied upon to protect human health and environmental integrity. There was no existing policy or plan and no systems in place for sustainable management of medical waste. There is thus an urgent need to take practical steps aimed at ensuring the 'duty of care' and safeguarding the environment for current and future generations. The findings of the present study are important for the management of medical waste in Nigeria. This study indicates a high rate of medical waste generation per day, which sends a signal to healthcare administrators, health workers, environmental management experts and all other stakeholders to give special attention and priority in allocating adequate budgets for proper management of medical waste.

A mechanism to regulate and enforce sustainable management of wastes generated from healthcare as an integral part of the existing environmental protection framework should be considered (Olaifa *et al.*, 2018).

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