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Full Length Research Paper

Trends in Healthcare Waste Management Practices: A Case Study of Health Professionals at Federal Medical Centre Umuahia, Abia State, Nigeria

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ABSTRACT: In comparison to municipal waste and the cost of proper management, the risks associated with poor healthcare waste management have the potential to have a significant impact on public and environmental health. The goal of this research was to investigate the healthcare waste management practices of health workers at the Federal Medical Centre Umuahia in Abia State. A cross-sectional survey of 319 participants was conducted using a structured questionnaire, yielding 313 responses. The result of the study shows that majority of health workers (85.90%) use colour coded containers and plastic bags for HCW collection of healthcare waste. Respondents frequently used lidder containers, storage houses, wheeled trolleys, wheeled bins, garbage trucks, and wheelbarrows for HCW transportation, according to the study. Incineration and chemical disinfection were the most commonly used infectious waste treatment methods at the Federal Medical Centre Umuahia in Abia State, while compositing, steam disinfection, gas disinfection, and other methods were rarely used. The majority of respondents preferred burning as their final disposal method, followed by open dumping, controlled incineration, burying, and others. Overall, the findings of the study suggest that more attention should be paid to waste management in the facility, as well as the need for hospital management to designate a waste management team and implement strict biomedical waste management rules.

Keywords: Healthcare waste, medical waste, healthcare waste management, waste management

INTRODUCTION

Although waste is an unavoidable by-product of all processes, proper waste management is a critical tool for any human society's long-term viability and development. Waste is typically defined as materials produced by human and animal activities that are discarded as undesirable (Environment Protection Authority EPA, 2019). Healthcare waste or medical waste, according to Chartier (2014) and the World Health Organization (2018), includes waste generated within healthcare facilities, blood banks and collection services, nursing homes for the elderly, research institutes, mortuary and autopsy centres, and laboratories related to medical procedures. It also includes the same types of waste that come from minor and dispersed sources, such as waste generated during home health care (e.g., home dialysis, self-administration of insulin, recuperative care). As a result, they pose a significant threat to the environment and public health, first to the healthcare worker, then to the waste handler, and finally to anyone who may come into contact with them as a result of improper or poor disposal. This threat cannot be overstated due to the wide range of diseases and injuries that exposure to them can cause (Adeoye *et al.*, 2018; Ronnie *et al.*, 2019). Some of these risks include the presence of potentially harmful microorganisms that can infect hospital patients, health workers, and the general public; drug-resistant microorganisms that can spread from health facilities to the environment; toxic substances that may be genotoxic and radioactive, as well as substances such as dioxins or mercury released during the handling or incineration of healthcare wastes; and (Awasthi *et al.*, 2019; WHO, 2018). Contamination of drinking, surface, and groundwater's as a result of the disposal of untreated healthcare wastes in landfills and open dumpsites; the

release of pollutants into the air and the generation of ash residue as a result of insufficient incineration or the incineration of unsuitable materials (Adeoye *et al*., 2018; WHO, 2018). The incineration of chlorine-containing or treated materials can result in the formation of dioxins and furans, which are carcinogenic to humans and have been linked to a variety of negative health effects. The incineration of heavy metals or high-metal-content materials (particularly lead, mercury, and cadmium) can result in the spread of toxic metals in the environment (Padmanabhan and Barik, 2018; WHO, 2018). Between 75 and 90% of total waste generated by healthcare providers is similar to household waste and thus is not more dangerous than household waste; this waste is commonly referred to as "non-hazardous" or "general healthcare waste." Waste generated primarily by administrative, kitchen, and housekeeping functions at healthcare facilities, but it may also include packaging waste and waste generated during healthcare building maintenance (Padmanabhan and Barik, 2018). The remaining 10–25 percent of healthcare waste is classified as “hazardous,” and includes wastes such as sharps, body parts, chemicals, or pharmaceuticals, among other things. Given Nigeria's growing population, which invariably leads to an increase in the generation of healthcare waste as more people seek health services for one reason or another, more attention must be paid to how this type of waste is managed and disposed of. Despite these concerns, healthcare waste in Nigeria, as in other developing countries, is frequently not separated into hazardous and non-hazardous wastes, nor is it properly treated before final disposal (Awasthi *et al*., 2019). As recommended by the World Health Organization (2017), proper healthcare waste management should include the steps of segregation, collection, transportation, treatment, and disposal to increase efficiency, lower the cost of service delivery, protect the health of health-care workers and patients, and protect the environment. During waste segregation, it is recommended to start with the healthcare provider and/or patient and caregiver who produces each waste item. It is also recommended to label waste containers during waste segregation to help identify the source, keep track of the types and quantities of waste produced in each area, and trace problems with waste segregation back to their source. Simplest method is to attach a label to each filled bag, on which are written the medical area's details, the date and time at which the bag was closed, and the name of the person who completed the label. In addition, the World Health Organization recommends that waste bags be labeled with an international hazard symbol and that infectious waste containers be placed out of reach of patients and visitors in order to prevent contact with infectious waste. Furthermore, infectious waste bags should ideally be labeled with the date, the type of waste, and the location of generation so that they can be tracked from the point of generation to the point of disposal (WHO, 2017).

Policy, regulations, and regulatory agencies with mandates on the proper management of healthcare waste are in place in Nigeria; however, their effectiveness is questionable. The most recent is the Healthcare Waste Management Policy and Strategic Plan, which was published in 2013. The Federal Ministry of the Environment and the National Environmental Standards and Regulation Enforcement Agency (NESREA) are the two regulatory agencies that are responsible for following up with hospitals, medical laboratories, pharmaceutical companies, and other health-related businesses on laboratory waste and industrial effluent treatment and disposal. Previous studies on healthcare waste management conducted across a variety of health facilities in a variety of locations throughout the country have revealed that enforcement of these regulations continues to be a major challenge, and that the majority of health facilities do not receive assistance in the management of their waste streams (Awodele *et al*., 2016). Abah and Ohimain (2011) estimated that waste generation ranged from 0.562 to 0.670 kg/bed/day, with a peak value of 1.68 kg/bed/day. Following the findings of the literature and the study of Chima *et al*., (2011), it appears that there may not be much difference between the ways waste generated in various health care institutions in Nigeria is managed. One example is the findings of Olubukola (2009) study in Lagos, which found that waste data and HCW management practices were similar in two general hospitals, even though they were conducted in different cities. These hospitals were characterized by a lack of waste minimization or waste reduction strategies, poor waste segregation practices, a lack of waste segregation instructional posters, and the disposal of hospital-generated waste with general waste (Olubukola, 2009).

Another study of Health Care Waste Management in the Jos Metropolitan Area of Nigeria revealed that the waste management options available in the hospitals did not meet the standards set by the country's waste regulatory bodies (Ngwuluka *et al*., 2009). The investigation conducted by Ngwuluka *et al*. (2009) revealed that open burning is practiced in healthcare institutions in Jos Metropolis, Plateau State, and that the release of dioxins, furans, and heavy metals into the environment occurs in the form of fumes and vapours. Open burning was also one of the most commonly used techniques for disposing of immunization waste generated in Kano State, according to the state's health department (Oke, 2008).

Another research conducted in Port-Harcourt, Nigeria, to assess hospitals' waste management practices (Ogbonna, 2011), enquired into waste generation rates and various waste disposal options by different categories of hospitals. Additionally, the findings of this study revealed that issues and problems with hospital waste management are not limited to the Port Harcourt

metropolis. Solid waste disposal methods revealed that open dumpsites are the most preferred, with incineration being non-existent in hospitals and clinics, according to the survey. In contrast to the majority of other hospitals, which do not separate waste into designated or color-coded containers for different waste streams, nor do they keep track of waste generation and disposal records (Ogbonna, 2011). As a result, according to the results of the survey, both hospitals and the companies that handle their waste regard hospital waste as normal domestic garbage (Ogbonna, 2011).

This is also supported by the findings of Adeoye *et al*. (2018), who conducted a study to assess waste management practices in different hospitals (primary health centres, private hospitals, and tertiary hospitals). Their findings revealed a poor record of waste, a low level of segregation practice, and a lack of recycling in nearly all of the health facilities. They also discovered that all of the facilities under investigation managed their waste entirely on their own, with no assistance from government agencies. According to Ezirim and Agbo (2018), less than half of the health facilities surveyed had designated persons or units handling waste, and only a quarter of those facilities had waste management plans that were adapted from the 2013 national policy, indicating that implementation of the 2013 healthcare waste management policy has not resulted in significant improvements. The purpose of this study was to assess the healthcare waste management practice among health workers in Federal Medical Centre Umuahia, Abia State.

MATERIALS AND METHODS

Description of the study area

Federal Medical Centre Umuahia in Abia State is in the South-eastern part of Nigeria and has a total land area of approximately 311,608 square meters of land bounded on the south by the Nigerian prisons, Umuahia; east by Ndume Ibeku; North by Umuahia urban and west by Afara clan (Federal Medical Centre Umuahia, 1991) (Figure 1). The Federal Medical Centre, Umuahia is one of the three tertiary health facilities in Abia State; it metamorphosed from the Queen Elizabeth Hospital, which was commissioned on March 24, 1956, by Sir Clement Pleas representing Queen Elizabeth the Second of England. The health facility started as a joint mission hospital administered by the Methodist, Anglican, and Presbyterian churches. Prior to being taken over by the Federal Government, it was taken over from the missions by the then-Imo State Government, led by then-Navy Captain Godwin Ndubuisi Kanu (now a retired rear Admiral), who renamed it Ramat Specialist Hospital in honour of the late slain Head of State, General Murtala Ramat Mohammed. During the first republic, it was renamed Queen Elizabeth Hospital under the administration of the late Chief Sam Mbakwe, Governor of the old Imo State. As a result, when it was taken over in November 1991, it was renamed the Federal Medical Centre (FMC) Umuahia. It is the first FMC to be so recognized (Federal Medical Centre Umuahia, 1991). The Ear, Nose and Throat (ENT) unit, Emergency unit, Maternity section, Oncology unit and medical laboratory unit are some of the departments found in the health facility.

Figure 1: Entrance view of the study area

Study design and data collection

This cross-sectional descriptive study quantitatively explored the healthcare waste management practices among health workers in FMC Umuahia of Abia State. Data was collected primarily using a structured questionnaire. Per data from the human resource department, the clinical staff strength is as follows: 518 nurses, 20 physiotherapists, 15 orthotists and prosthetists, 30 laboratory scientists/technicians, 30 record staff, 20 dieticians, 41 pharmacists, 18 environmental health officers, 60 hospital attendants and 413 doctors, making a total of 1,165. Assuming a confidence level of 95%, population proportion of 0.5 and an error margin of 0.05, the sample size was determined to be 290 using the Raosoft sample size calculator. A 10% attrition rate was factored in, resulting in a sample size of 319. Using the percentage representation of healthcare workers, the number of respondents to be sampled in each group was obtained as follows 113 doctors, 142 nurses, 11 pharmacists, 6 physiotherapists, 6 dieticians, 4 orthotists and prosthetists, 8 laboratory scientists, 5 environmental health officers, 16 hospital attendants and 8 record staff. The data collection tool employed in this study is a structured questionnaire. The questionnaire was developed from studying previous research (Coker *et al., 2009)* and the WHO's recommendation assessment tool (Basel Convention Secretariat and World Health Organization, 2005). It comprised of 2 parts, namely the socio-demographic section (Section A), and healthcare waste management practices (Section B to Section C). Copies of the questionnaire were distributed to health workers in order to collect primary data on existing health waste management practices, such as mode and frequency of waste collection, availability of resources for waste

management, and challenges of managing the final disposal of waste in the sampled hospital. The research instrument was self-administered to the respondents in the health facility and collected as agreed upon. Of the 319 copies of the questionnaire shared, 313 were retrieved. The simple random sampling by balloting with replacement was adopted in the sampling of respondents.

Data analysis and presentation

Data regarding the demographic information of respondents and the current situation of healthcare waste management practices were extracted from the questionnaire and analyzed using Microsoft Office Excel as well as the Statistical Package for Social Sciences (SPSS version 21.0) programmes. Presentation of the outputs was done using tables and charts.

RESULTS

Table 1 shows the socio-demographic description of the participants in the cross-sectional health survey. Of the 313 respondents, 218(69.6%) and 95(30.4%) were female and male, respectively. The results showed that most of the health workers (35.8%) sampled were between the age range of 30-39years, while the majority (51.4%) had less than ten years of experience as health workers.

Transportation method utilized in HCW management

The result in Table 2 shows the level of usage of different transportation means in HCW management. The study found that lidder container (3.93), storage house (3.79), wheeled trolley (3.95), wheeled bin (3.93), garbage truck (3.83), and wheelbarrow (4.13) were well utilized by the respondents with mean scores of 2.5 and above. On the other, the use of hand carts (1.73) and waste skip (1.52) was not well utilized among the health workers in the study hospital (Figure 2).

Treatment of infectious waste

Overall, only two treatments for infectious waste were found in the health facility, treatment of waste using incineration (2.85) and chemical disinfection (3.19) with a mean score greater than 2.5. Compositing (1.65), landfill (2.09), steam disinfection (1.87), gas disinfection (1.34) and recycling (1.35) had a mean score less than 2.5 and therefore, were not in the hospital as indicated by the health workers (Table 3 and Figure 3).

The practice of waste collection using colour coded containers and plastic bags for HCW collection

The result in (Figure 4) showed the distribution of respondents according to the use of colour-coded containers and plastic bags for HCW collection. The study found that most of the health workers (85.90%) used colour-coded containers and plastic bags for HCW collection than few (14.10%) that did not.

The practice of waste segregation into infectious and non-infectious waste

The availability and use of various recommended waste segregation methods are outlined in (Table 4). The 4-point Likert scale analysis of the level of use of segregation methods of HCW management as responded by the health workers in FMC showed puncture-proof container (3.90), and conveyor (3.58) as the main medium for the segregation of HCW while the use of coloured waste container (1.06), colour coded bag (2.08) and plastic bag (2.05) recorded mean less than 2.5 and therefore, insufficiently used (Figure 5).

Usage of PPE for waste management

The result on the level of usage of PPE for waste management among waste handlers in FMC was shown in (Table 5 and Figure 6). The result showed that all the PPE materials such as heavy-duty gloves (3.93), protection clothes (4.05), safety shoes (4.12), apron (3.84), face mask (3.98) and head cap (2.90) were in use and recorded mean score above 3.0 except goggles (2.36) that were rarely in use with a mean score below 2.5.

Final disposal for HCW

The final disposal measures used frequently were found to be burning, open dumping as indicated by 63.9%and 17.90% of the respondents, respectively. While controlled incineration (9.90%), burying (7.70%) and other methods (0.6%) were rarely used (Figure 7).

DISCUSSION

The study found that lidder containers, storage houses, wheeled trolleys, wheeled bins, garbage trucks, and wheelbarrows were frequently used as a means of transporting HCW on the job site. To avoid exposure and facilitate transportation, WHO (2017) recommends that containers for infectious waste collection and transportation be placed out of reach of patients and

Table 1: Socio-demographic characteristics of the health workers (N=313).

Variables	Characteristics	Frequency	Percentage (%)
Age range	Less than 30	43	13.7
	30-39	112	35.8
	40-49	82	26.2
	50 and above	76	24.3
	Total	313	100
Gender	Male	95	30.4
	Female	218	69.6
	Total	313	100
Designation	Doctors	90	28.7
	Nurses	127	40.6
	Lab technicians/scientists	8	2.6
	Environmental health officers	3	0.9
	Medical attendants	85	27.2
	Total	313	100
Years of experience	Less than 10 years	161	51.4
	10 years and above	152	48.6
	Total	313	100

Source: Field survey, 2020.

Table 2: Transportation Means utilized in HCW Management.

HCW Transportation means	AU	SU	RU	NU	Total	Mean
Lidder container	299(1196)	10(30)	0(0)	4(4)	1230	3.93
Storage house	282 (1128)	11 (33)	5(10)	15(15)	1186	3.79
Hand cart	66(264)	13(39)	4(8)	230(230)	541	1.73
Waste skip	41(164)	11(33)	17(34)	244(244)	475	1.52
Wheeled trolley	300(1200)	11(33)	0(0)	2(2)	1235	3.95
Wheeled bin	303(1212)	3(9)	2(4)	5(5)	1230	3.93
Garbage truck	281(1124)	21(63)	2(4)	9(9)	1200	3.83
Wheelbarrow	286(1225)	21(63)	0(0)	6(6)	1294	4.13

Source: Field survey, 2020
Acceptable mean (X) = 2.5,
Figures in parentheses are the Likert frequencies
AU= Always Used, SU = Sometimes Used, RU= Rarely Used and NU= Never Used

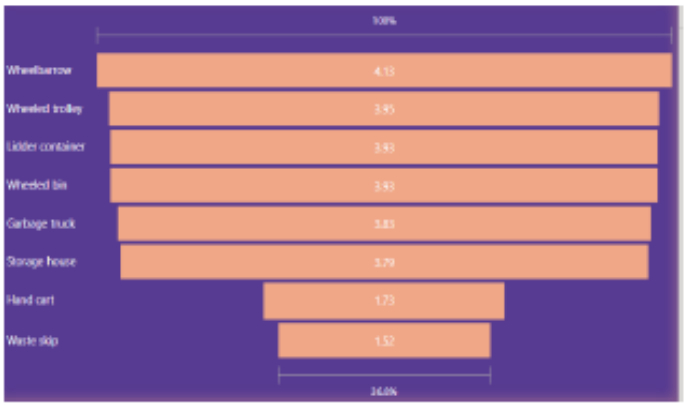

Figure 2: Level of the utilization of different transportation methods.
Source: Survey data, 2020.

visitors. The only treatments commonly used for infectious waste treatment in the study hospital were incineration (2.85) and chemical disinfection (3.19). According to Bujak (2010) and WHO (2017), incineration is an ideal method for most types of HCW, both hazardous and non-hazardous, because the combustion temperature during the process exceeds 1800°F, effectively destroying all hazardous and toxic elements.

Table 3: Method of treatment of infectious waste.

Treatment	AU	SU	RU	NU	Total	Mean
Compositing	39(156)	44(132)	7(14)	216(216)	518	1.65
Landfill	106(424)	9(27)	4(8)	194(194)	653	2.09
Incineration	160(640)	49(147)	2(4)	102(102)	893	2.85
Steam disinfection	82(328)	9(27)	9(18)	213(213)	586	1.87
Gas disinfection	24(96)	14(42)	6(12)	269(269)	419	1.34
Chemical disinfection	218(872)	12(36)	7(14)	76(76)	998	3.19
Recycling	32(128)	5(15)	2(4)	274(274)	421	1.35

Source: Field survey, 2020
Acceptable mean (X) = 2.5,
Figures in parentheses are the Likert frequencies
AU= Always Used, SU = Sometimes Used, RU= Rarely Used and NU= Never Used

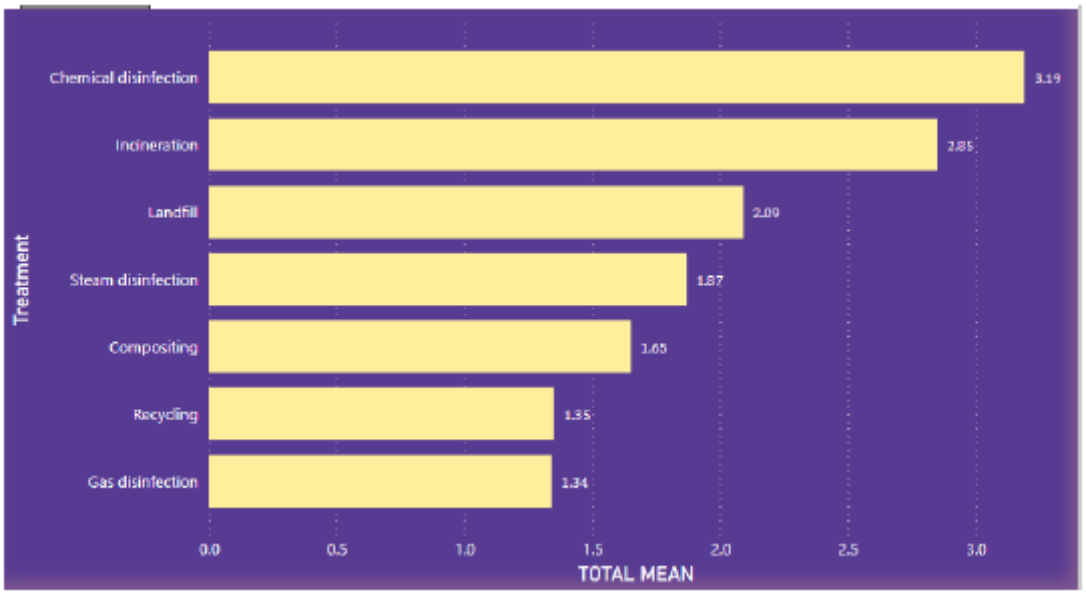

Figure 3: Method of treatment of infectious healthcare waste.
Source: Survey data, 2020.

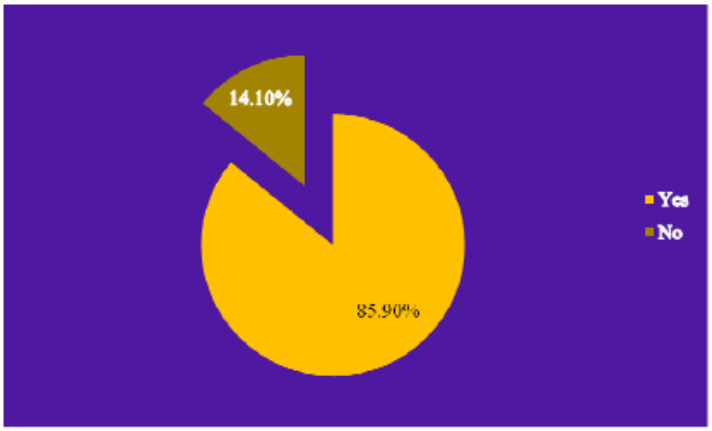

Figure 4: Distribution of respondent according to the use of colour coded container and plastic bags for HCW collection. Source: Survey data, 2020.

According to Krishnamoorthy (2017), the incineration method reduces waste volume by up to 95% of its original volume, which is the highest among all treatment methods. Although the level of use of chemical disinfection (3.19%) was higher when compared to incineration, this was most likely due to the availability

Table 4: Level of use of segregation methods in HCW management.

Segregation method	AU	SU	RU	NU	Total	Mean
Puncture-proof container	295(1180)	11(33)	2(4)	5(10)	1222	3.90
Coloured waste container	140(560)	10(30)	0(0)	163(163)	333	1.06
Conveyor	250(1000)	8(24)	43(86)	12(12)	1122	3.58
Plastic bag	151(453)	11(33)	2(6)	149(149)	641	2.05
Colour coded bag	109(436)	2(6)	8(16)	194(194)	652	2.08

Source: Field survey, 2020
Acceptable mean (X) = 2.5,
Figures in parentheses are the Likert frequencies
AU= Always Used, SU = Sometime Used, RU= Rarely Used and NU= Never Used.

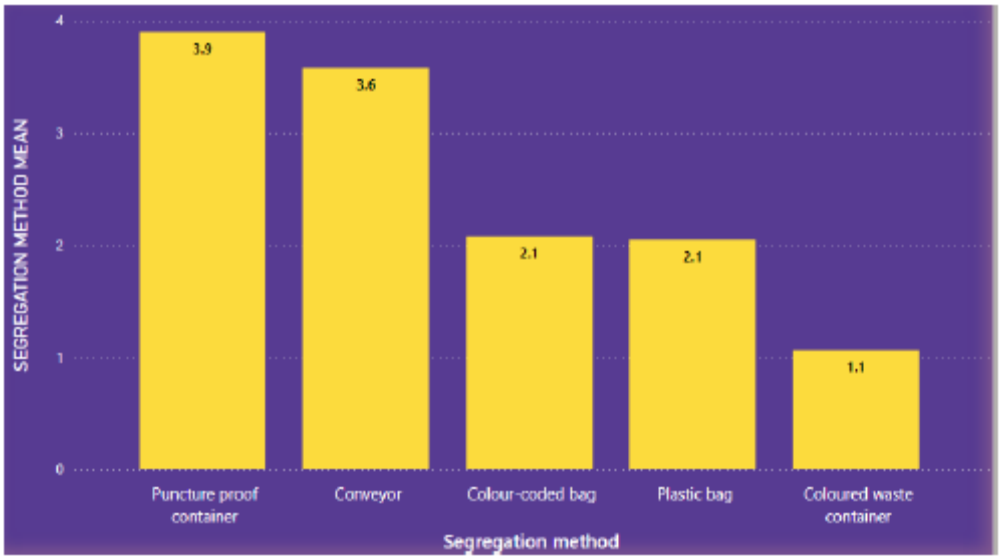

Figure 5: Use of various segregation methods in the health facility.
Source: Survey data, 2020.

Table 5: Level of usage of PPE for waste management among waste handlers.

Usage	AU	SU	RU	NU	Total	Mean
Heavy duty gloves	295(1180)	16(48)	0(0)	2(2)	1230	3.93
Protection clothes	298(1237)	7(21)	3(6)	5(5)	1269	4.05
Safety shoes	289(1228)	18(54)	2(4)	4(4)	1290	4.12
Goggles	55(220)	16(48)	230(460)	12(12)	740	2.36
Apron	286(1144)	16(48)	0(0)	11(11)	1203	3.84
Mask	307(1228)	6(8)	0(0)	0(0)	1246	3.98
Head cap	42(168)	237(711)	2(4)	32(32)	915	2.90

Source: Survey data, 2020
Acceptable mean (X) = 2.5
Figures in parenthesis are the Likert frequencies
AU= Always Used, SU = Sometime Used, Rarely Used and NU= Never Used

and cost of chemical disinfectants. Waste recycling, on the other hand, is never done in the study facility, which supports the findings of Adeoye *et al*., (2018). The results of a 4-point Likert scale analysis of the level of use of segregation methods in HCW management as reported by FMC health workers revealed the use of two major segregation methods. Because it allows for better handling of the infectious component of healthcare waste, segregation of healthcare waste at the point of generation is critical to achieving good HCWM (Onoh *et al*., 2019). Respondents indicated that puncture-proof containers and conveyors (3.58) were used as a medium for HCW segregation in hospitals. Nonetheless, this study discovered that coloured waste containers, plastic bags, and colour-coded bags were rarely used for segregation. Overall, medical waste segregation was discovered to be problematic, as mixing of different types of waste is unavoidable due to poor utilization of other waste segregation methods.

In terms of waste management practice, the study

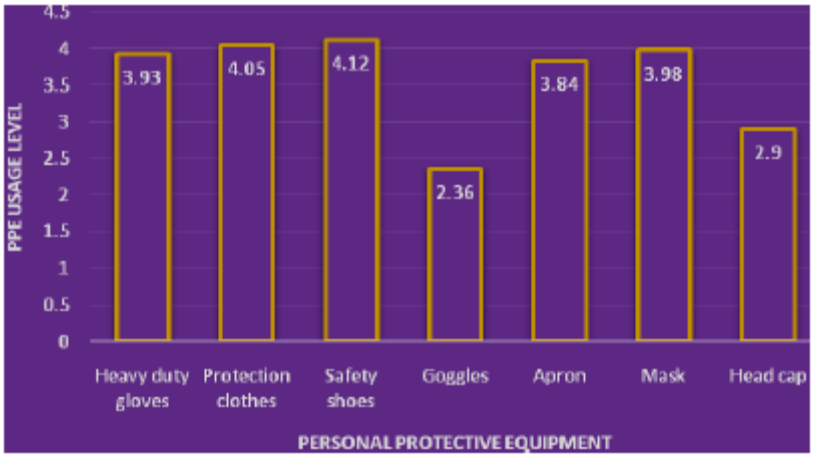

Figure 6: Level of usage of Personal Protective Equipment (PPE).

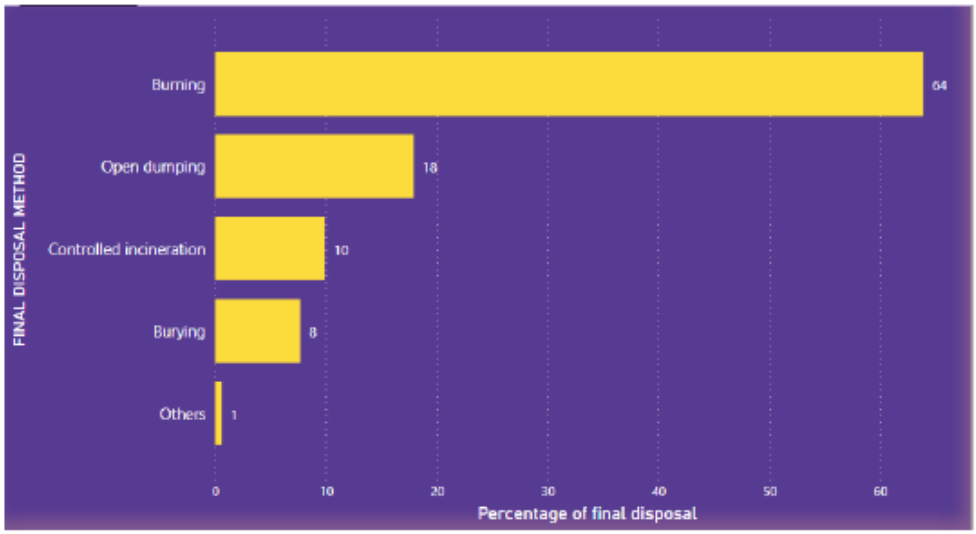

Figure 7: Distribution of Respondents according to final disposal of HCW

discovered a high level (85.90 percent) of use of colour-coded containers and plastic bags for HCW collection. This contradicts the findings of Ezirim and Agbo (2018) discovered that 96.7% of tertiary hospitals segregate waste using colour-coded containers. According to Adogu *et al.*, (2014); WHO, (2017), using different colour-coded bags for segregation is one of the most important parts of the healthcare waste management rules. Mugabi *et al.* (2018), Mane *et al.* (2016), and Ingle and Charania (2011) all observed and reported similar results, noting that all health facilities surveyed in their studies practiced waste segregation to a significant extent. According to the World Health Organization (2005), the use of a colour-coding system aims to ensure immediate and unequivocal identification of the hazards associated with the type of HCW handled or treated.

The findings of Wafula *et al.,* (2019) corroborate the results of this study on the use of Personal Protective Equipment (PPE). The practice of wearing PPEs such as gloves, masks, clinical coats, shoes help to minimize exposure to infections and injuries through contact with HCW waste. The study found high use of PPE materials such as heavy-duty gloves (3.93), protection clothes (4.05), safety shoes (4.12), apron (3.84), face mask (3.98) and head cap (2.90). However, the low usage of goggle (2.36) found in the study may be attributed to the fact that health workers were not provided with goggle as a protective gear by their employees.

The majority of respondents (63.90%) chose burning as the final disposal method. This was consistent with the findings of Adeoye *et al.* (2018), who found that burning was the most commonly used disposal method in all of the health facilities studied. Religious and cultural preferences should be considered in a few cases where waste contains recognizable body parts or foetal materials such as placentae, and such waste should be disposed of using acceptable and sensitive modalities (WHO, 2004). Burning is the least desirable method of

waste disposal because it emits vapours and greenhouse gases that can endanger human and environmental health. It is, however, recommended as a stopgap measure until a more secure alternative can be implemented. The few indications of open dumping (17.90%), controlled incineration (9.90%), burying (7.70%), and others (0.6%) observed by respondents were also consistent with the WHO (2011) report, which included incineration, landfill disposal, or deep burial as acceptable disposal measures. However, it is much lower than what was found in the study by Ezirim and Agbo (2018), which found that incinerators were used as the waste disposal method in most tertiary health facilities, while open burning and waste burying were found to be the most common disposal methods in secondary and primary health facilities. Similarly, Oyekale and Oyekale (2017) noted that burning of sharps and non-sharps HCW was practiced in the health facilities sampled in their study. This demonstrates a failure to use the most appropriate and safe disposal methods as specified by the type of waste generated (hazardous and non-hazardous).

Conclusion

The study provides empirical data on healthcare waste management practices among health workers at the Federal Medical Centre Umuahia in Abia State. The study discovered a high use of lidder containers, storage houses, wheeled trolleys, wheeled bins, garbage trucks, and wheelbarrows as HCW transportation mediums, as well as a high level of infectious waste treatment through incineration and chemical disinfection. The study also discovered that waste burning was the most commonly used final disposal measure. Waste burning is not the most recommended waste disposal method; therefore, it should be reconsidered. The use of puncture-proof containers and conveyors was a common medium for waste segregation. As a result, the study recommends that a healthcare waste management team/unit be established in the hospital, that responsible governmental bodies provide support and supervision, and that equipment and facilities be provided to ensure effective HCW management and sustainability.

Disclosure of conflict of interest

None.

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