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Assessment of healthcare waste management practices among healthcare workers at two hospitals in Abuja, Nigeria

MK Aworh^{1*}, JKP Kwaga² & EC Okolocha²

1. Nigeria Field Epidemiology and Laboratory Training Programme, Asokoro, Abuja, Nigeria
2. Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria, Nigeria

*Correspondence: Tel.: +2348032377831; E-mail: mabelaworh@yahoo.com

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Abstract

Healthcare waste (HCW) is generated from hospitals or healthcare related facilities and is considered a major source of environmental contamination because it is made up of potentially harmful substances. In developing countries, especially Nigeria, management of HCW is becoming an issue of concern. The main objective of this study was to assess the current HCW management practices at two hospitals in Abuja, Nigeria. This cross-sectional study was conducted from June to July 2018 among randomly selected healthcare workers (HWs) practising at two hospitals in Abuja, Nigeria, using an electronic interviewer-administered questionnaire installed on a smartphone via an open data tool kit. We evaluated the waste segregation practices and assessed the knowledge of HWs regarding HCW in one public secondary and one private tertiary health facility. The status of waste management practice in the health facilities 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. Data gathered were analysed by performing descriptive statistics. Of the 105 health workers interviewed, 69 (65.7%) were females and mostly (44.8%) were within the age group 31-40 years. The proportion of respondents who had received specific training in the management of HCW was 17.1% (18/105). The level of HCW management practices in both facilities was found to be level 2: operating in a manner with some aspects that are considered sustainable. HCW management (HCWM) in Abuja is worth sustainable, especially in resource-limited settings. Hospital Management Board needs to ensure that measures needed to improve the HCWM at hospitals are provided.

Keywords: Environmental health, Healthcare waste, Medical waste, Sustainability, Waste segregation

Introduction

Healthcare waste (HCW) is the second most hazardous waste after radiation waste (Wafula *et al.*, 2019). Globally HCW requires proper management by healthcare workers (HWs)

because of its infectious nature and potential threats to cause diseases (Arab *et al.*, 2008). HCWs are biological or non-biological wastes that are discarded and not intended for further use,

including pathological, infectious and culture materials, etc (Oyeleke & Istifanus, 2009; Nwachukwu *et al.*, 2013) as well as chemicals, and infectious radioactive wastes (Giroletti & Lodola, 1993). Nine categories of HCW generated in hospital exist for easy identification of waste handling, treatment, and proper disposal (Pruss *et al.*, 1999; Hasan & Rahman, 2018). Healthcare facilities are often defined as public, private, and non-governmental facilities that contribute to the improvement of the health status of a person (Basu *et al.*, 2012).

Proper waste disposal, a component of environmental health is a major area of concern as HCW constitute health hazards with detrimental effects on the environment and public health (Da Silva *et al.*, 2005; Tudor *et al.*, 2005; Nwachukwu *et al.*, 2013). Gaps exist regarding HCW management (HCWM) practices in sub-Saharan Africa hence requiring the understanding of hospital personnel especially because of the dangers associated with this special type of waste. However, for proper HCWM, the HWs need to be properly trained and made aware of the associated risks (WHO, 2005). The nature of HCW as well as practices regarding sustainable HCWM methods like waste segregation and waste recycling, are often poorly examined and documented in several countries despite the health risks posed by the improper handling of these wastes (Oke, 2008; Farzadkia *et al.*, 2009). For example, in Nigeria, the level of awareness of HWs regarding HCWM has not been adequately documented (Abah & Ohimain, 2011; Anozie *et al.*, 2017).

HCW is a special category of waste that contributes to environmental hazards because they often contain materials that may be harmful and can cause ill health to those exposed to it. Evidence has shown that the inappropriate handling and disposal of HCW constitutes a health risk to HWs directly exposed to such hazards. Children and scavengers resident close to health facilities are also at risk and may become exposed to infectious wastes and a higher risk of diseases like HIV/AIDS (Coker *et al.*, 2009; Adedigba *et al.*, 2010). It is imperative that HWs are responsible for the proper disposal of these wastes hence the need for them to be knowledgeable on HCWM. Most HWs are very vulnerable and are at risk of contracting infections associated with improper handling of HCW, while patients and their visitors may be exposed to these health hazards (WHO, 2020). Several options are available for the proper disposal of bio-medical

waste. However, incineration is a better option for the final disposal of HCW (Hoenich & Pearce, 2002). Many hospitals in Nigeria may not practice incineration of HCW probably because the incinerator releases different pollutants into the atmosphere resulting in health deterioration and environmental pollution (Sharma *et al.*, 2013). Incineration of bio-medical wastes such as organs is the only accepted option to treat such HCW (UNEP/WHO, 2005). Untreated HCW in landfills is known to contaminate underground water resulting in environmental hazards (Jerie, 2016). HCW produced during the laboratory procedures used for diagnosis, treatment and immunization should be treated (Nwachukwu *et al.*, 2013). Reports are available on the management of household wastes; however, only a few studies have been conducted to assess the practices of HWs regarding HCWM in Nigeria (Abah & Ohimain, 2011; Nwachukwu *et al.*, 2013; Joshua *et al.*, 2014; Awodele *et al.*, 2016). Therefore, it is imperative to assess the current HCWM practices of HWs at both government and private hospitals in Abuja to generate baseline data for implementing the proper policy interventions.

Materials and Methods

Study design

This cross-sectional survey was conducted from June to July 2018 in two health care facilities in urban and rural areas.

Study setting

The study was carried out in a secondary facility located in a rural area and a tertiary facility in the urban city centre. The facilities were selected using simple random sampling method from a sampling frame of all the hospitals in Abuja Municipal Area Council (Figure 1). The secondary facility was a government-owned hospital with a 60-bed capacity and staff strength of 15 doctors and 88 nurses at the time of the study. The tertiary facility operated a public-private partnership with more than 150-bed capacity and that provided emergency, surgical, maternal, and child health services, amongst others.

Study participants

Using a table of random numbers, 105 HWs practising in the two hospitals were selected based on modified methods as previously described (UNEP/WHO, 2005). Only HWs aged 18 years and above who were staff of the two hospitals enrolled in the study after signing an informed consent form (Figure 2).

Data collection

Electronic questionnaires were physically administered to each HW by the interviewer at the hospital using an open data kit (ODK) collect app installed on a smartphone to determine their knowledge and practice regarding healthcare waste management. A key informant interview was conducted for the management staff of both hospitals by the investigator to assess the hospital's waste management strategy. The HWM systems were inspected. An inventory of the waste generated in each of the following sections of the hospital: Operation theatres, Pharmacy, Laboratories, In-patient wards, and Out-patient units, were obtained using an inventory form (UNEP/WHO, 2005). The wastes were classified according to the chart adopted from UNEP/WHO (2005) and presented in Figure 3.

The HCWM performance of the hospitals was assessed using a checklist consisting of six characteristic waste management descriptors and 27 indicators of HCWM, namely: General management strategy; Waste collection; Waste segregation; Waste recycling; Waste storage and Offsite disposal (Table 1). Using a set of criteria as previously described (Townend & Cheeseman, 2005) to assess the level of sustainable development associated with each of the facilities, an overall performance rating was assigned (Table 2).

Ethics approval and consent to participate

Permission was obtained from the management of each hospital where the study was conducted. Written informed consent was obtained from each eligible healthcare worker after explaining the purpose and importance of the survey before questionnaire administration. Confidentiality of information obtained was

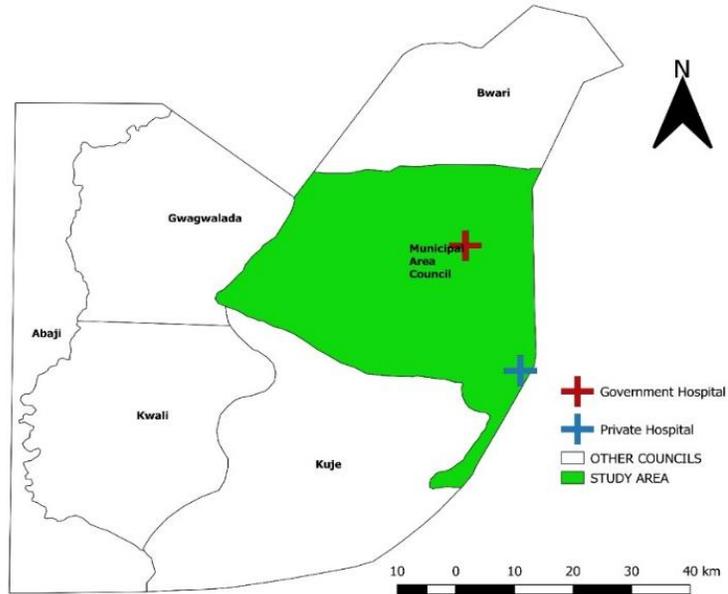


Figure 1: Map of FCT with the study area highlighted in green

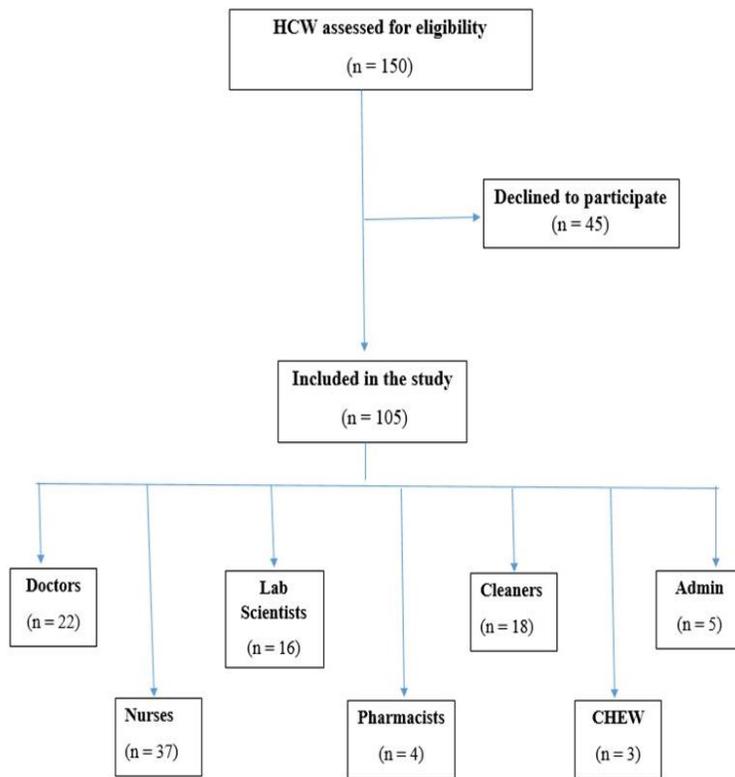
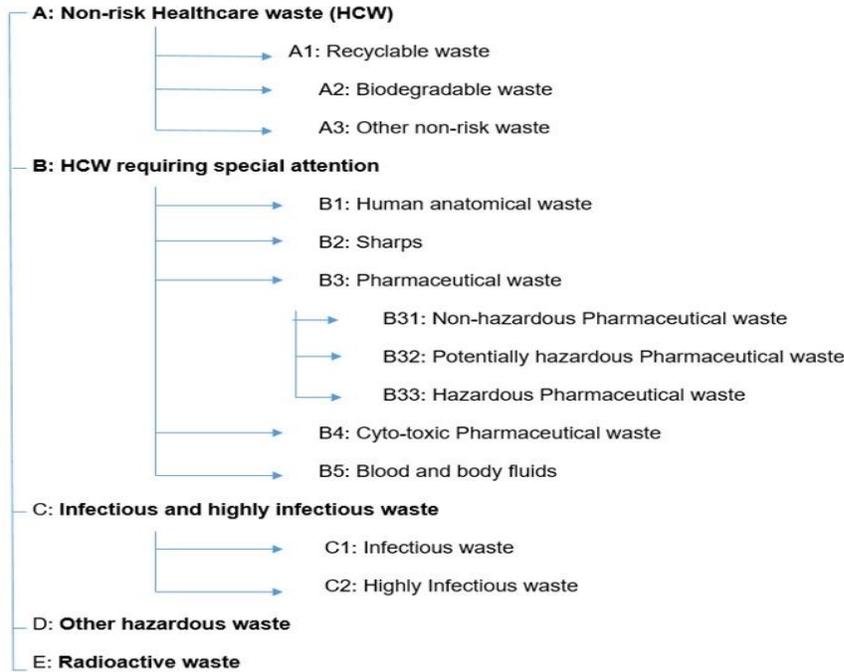


Figure 2: Flow chart for selection of study participants

maintained and assured by using unique identifiers for each study participant.



This Figure shows the five different classes of healthcare waste as described by the United Nations Environment Programme in collaboration with the World Health Organization. These include non-risk healthcare waste, healthcare waste requiring special attention, infectious and highly infectious waste, other hazardous waste as well as radioactive waste

Figure 3: Classification of Healthcare Waste (UNEP/WHO, 2005)

Table 1: HCW management description and the indicators used in the assessment of waste management performance at healthcare facilities

HCW management criteria	Indicators
1. General management strategy	Hospital waste management policy or strategy Special budget for waste management Operative staff for the management of waste Training on waste management Personal Protective Equipment is worn by operative staff
2. Waste collection and Segregation	Type of receptacles/storage containers (uniform or specific, varying types, sizes etc.) Colour coding of receptacles Number/adequacy of waste receptacles Are sharps or infectious materials collected separately Is segregation regulated or controlled
3. Waste recycling	Is there any form of recycling? What is recycled? Are syringes reused? What else is re-used?
4. Waste storage building?	Presence or absence of purpose-built waste handling facility Waste dumped outside the hospital Open waste disposal?
5. Waste treatment	None Autoclaving of lab wastes Crude incineration outside Encapsulation e.g. of sharps Waste burial within the healthcare facility Chemical disinfection of body fluids
6. Offsite disposal	Waste disposal contracted out? How are wastes transported (open vehicle or Enclosed compaction vehicle?) What is the final destination of the waste (open dump, level 1 landfill, hazardous waste engineered landfill, shredded + some other technology?)

Table 2: Guidelines for the assessment of level of sustainable waste management practice

Sustainable level of practice	Operating performance	Characteristics
Level 0	Operating in a totally unsustainable manner with reluctance to change	No waste management strategy, only limited segregation of wastes, storage containers are unspecific with no colour coding and waste is likely to be dumped outside the hospital building. In addition, waste is transported in open trucks, limited re-use of materials and no recycling at the facility; waste treatment is limited to the simplest technologies such as crude incineration while if off-site disposal exists it will be mainly to a dumpsite or level 1 landfill with the attendant environmental hazards
Level 1	Generally operating in an unsustainable manner, although there is some evidence of awareness and willingness to change	Although having no specific waste management strategy, will have separate collection of segregated wastes in enclosed vehicles, autoclave of infectious waste and use single cell incineration plant
Level 2	Operating in a manner with some aspects that are considered sustainable and others that are considered unsustainable	Waste management policy in place, segregation of wastes and colour coding, specified waste storage containers, waste transported with enclosed compaction vehicles and separate vehicles for hazardous waste, some recycling at facility (paper, cardboard etc), use of multi chamber incinerator plants and alternative modern technologies (such as microwave) to treat waste and disposal in level 2 landfill
Level 3	Generally operating in accordance with sustainable development, but some aspects not ideal	Local waste management policy and strategy in place, full colour coding, dangerous goods are stored in UN approved containers and packaging all waste in containers of approved standard and a dedicated waste handling facility. Re-use and re-cycling of materials (example, print cartridges, oil), incineration of hazardous materials to EU Directive emission standards plus use of alternative technology and offsite disposal at a level 3 engineered landfill site
Level 4	Operating in a way that displays all the characteristics normally associated with sustainable development	Waste management policy, full time waste manager, full segregation of materials, full colour coding, contracts with secondary raw materials industry, storage in UN approved containers, all wastes in containers or sacks to approved standard and a dedicated well secured waste facility. Waste is transported in enclosed compaction vehicles, Basel convention applied to waste transport. Recycling of paper, glass, plastic, metal, construction waste, food waste, textiles etc. incineration of hazardous materials to EU Directive emission standards plus use of alternative technology, hazardous waste to strictly controlled landfill sites and offsite disposal to level 4 engineered sanitary landfill

Source: Modified from Townend and Cheeseman (2005)

Data analyses

Data for analysis were extracted from the inventory form and questionnaires. The data collected were exported with ODK collect app to a computer as a Microsoft Excel spreadsheet using the ODK briefcase tool. Data analysis was done using Epi Info version-7 by computing frequencies and proportions.

Results

Out of 105 healthcare workers who participated in this survey, 69 (65.7%) were female and mostly (44.8%) were within the age group 31 - 40 years. Majority of the HWs (n= 95; 90.5%) had tertiary education. Among HCWs interviewed in both healthcare facilities, 37 (35.2%) were nurses; 22 (20.9%) were doctors; 16 (15.2%) were laboratory scientists while 18 (17.1%) were waste managers/cleaners (Table 3). The proportion of respondents who had received specific training on

HCWM was 17.1% (18/105). The proportion of HWs who understood the importance of using personal protective equipment (PPE) in HCWM while ensuring public safety was 79% (83/105). Only 68% (72/105) responded that their hospital practised segregation of HCW, and only 60% (63/105) had seen instructive posters on waste segregation using colour codes for different categories of HCW.

The key informant interviews showed that both hospitals had HWM strategies and protocols. However, observations revealed that there were no instructive posters on waste segregation on display around the hospitals. None of the respondents knew the focal persons responsible for HCW management in their respective units. Nearly half (49.5%) reported that the waste generated in their units were collected

Table 3: Socio-demographics of respondents at two hospitals in Abuja

Variables	Government Hospital n = 42 (%)	Private Hospital n = 63 (%)
Sex		
Male	18 (42.9)	18 (28.6)
Female	24 (57.1)	45 (71.4)
Age Group		
18 - 30	12 (28.6)	33 (52.4)
31 - 40	20 (47.6)	27 (42.9)
41 - 50	2 (4.8)	3 (4.8)
>50	8 (19.0)	0 (0.0)
Educational Level		
Primary	2 (4.8)	0 (0.0)
Secondary	2 (4.8)	6 (9.5)
Tertiary	38 (90.5)	57 (90.5)
Profession		
Doctor	10 (23.8)	12 (19.0)
Nurses	16 (38.1)	21 (33.3)
Lab scientist	4 (9.5)	12 (19.0)
Cleaners/Ward attendant	6 (14.3)	12 (19.0)
Pharmacist	4 (9.5)	0 (0.0)
Admin	2 (4.8)	3 (4.8)
CHEW	0	3 (4.8)

by cleaners/ward attendants and stored in temporary storage or dumpsite within the hospitals until municipal waste managers collect them. Waste categorization in both hospitals comprised generated sharps, infectious materials, and general pharmaceutical and pathological wastes. The nature of HCWs generated was assessed using the UNEP/WHO (2005) format (Table 4). The questionnaire administered to the HWs was used as a checklist for the examination of both hospitals' waste collection and disposal methods. There was no provision for weighing scales for measuring the weight of HCW generated at both hospitals, making it difficult to estimate the number of waste generated in the facilities. In both hospitals, wastes collected were stored temporarily in either a huge metal receptacle or a built

Table 4: Classification of healthcare waste generated at two hospitals in Abuja

Government Hospital		Private Hospital	
Type of Waste	Category of Waste	Type of Waste	Category of Waste
Used hand gloves	C1	Used hand gloves	C1
Swabs	C1	Swabs	C1
Needles/ syringes	B2	Needles/ syringes	B2
Empty bottles/ injections	B31	Empty bottles/ injections	B31
Waste paper	A	Waste paper	A
Food debris	A	Food debris	A
Drip set	B31	Drip set	B31
Intravenous giving set	C1	Intravenous giving set	C1
Body fluids	B5	Body fluids	B5
Soiled linen	C1	Soiled linen	C1
Excised tissue	C1	Excised tissue	C1
Blood testing strips	B2	Blood testing strips	B2
Rapid diagnostic test strips	B2	Rapid diagnostic test strips	B2
Wound dressing	C1	Wound dressing	C1
		Lab wastes from analyzers	B32

Categories of wastes: A - Non-risk waste; B2 - Contaminated sharps; B5 - Hazardous infectious waste; B31 - pharmaceutical waste; B32 – pharmaceutical waste to be discarded by authorized staff only; C1 - infectious waste

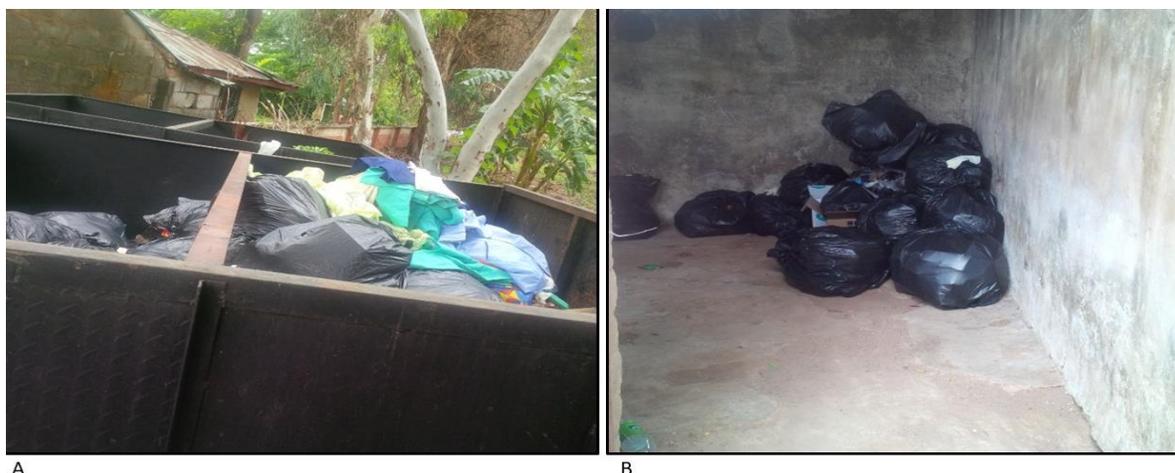


Plate I: Interim Waste storage at the two hospitals in Abuja, Nigeria

A shows the huge metal receptacle at Private Hospital used as interim storage for holding hospital-generated waste. B shows the concrete dumpsite at a Government Hospital used for interim storage of hospital-generated waste

dumpsite until they were picked up by the municipal waste collection vehicles to unspecified destinations (Plate I). At the various sections of both hospitals where HCWs were generated, the wastes were initially stored in the receiving receptacles, which are usually emptied weekly depending on the filling rate. Waste is collected daily by ward attendants and cleaners, neatly tied up in colour-coded bags – red for infectious, yellow for non-infectious and black for general wastes. Although these bags were not labelled, the red and yellow bags were decontaminated prior to disposal. Only black waste bags containing the non-infectious wastes are dumped directly into the dumpsite. Sharps are collected in sharp boxes and buried in a pit, while anatomical or pathological wastes are also buried in the premises or given to the patient's relative for disposal. Respondents reported that no form of waste re-cycling or re-use exists or is planned for the future at both hospitals visited (Figure 4).

Direct observation of waste management practices at the government hospital (GH) showed that waste was collected in different colour-coded bags, red – for infectious, yellow for non-infectious and black for general wastes. However, at the specialist hospital (PH), which is jointly managed by both the government and private sector, there was no form of colour coding for waste segregation.

At all the various sections where sharps were generated, safety boxes were observed to be used for the disposal of sharps at both hospitals. Most respondents (65%) disclosed that the safety boxes are disposed of when the boxes are two-third filled with sharps.

Most respondents at the GH (61.9%) and PH (71.4%) reported that they have existing waste management strategies. All respondents indicated that receptacles were available at the clinics, wards and laboratories in both hospitals for HCWM. Findings show that 76.2% (GH) and 42.9% (PH) of respondents indicated that there were colour coding practices for waste receptacles. Most respondents, 61.9% (GH) and 66.7% (PH), respectively, indicated that their facilities correctly segregated biohazard wastes into highly infectious, infectious and non-infectious wastes.

Wastes generated at both health facilities are usually collected at a central dumpsite which is either enclosed (GH) or opened (PH). Observations of the waste management practices showed that hospital waste generated at the GH was not treated prior to disposal. However, at the PH, some categories of infectious laboratory wastes are autoclaved prior to disposal. Used swabs, dressings and pharmaceutical wastes are disposed of along with the general wastes at both facilities. Sharps were collected separately in safety boxes and disposed in a sharps pit within the hospital premises.

The flow process for HCWM was the same for both hospitals (Figure 5). Based on the modified criteria (Townend & Cheeseman, 2005), both hospitals have HWM policy in place. The hospitals contract waste managers to dispose HCW in enclosed vehicles, and practice some form of recycling. However, only the GH uses colour-coded bags while the PH uses different types of receptacles for segregation of wastes; hence the level of HCWM practices in both facilities was found to be level 2 (Table 5).

Discussion

This is the first study in Abuja, to the best of our knowledge, to assess the knowledge and practices of healthcare workers regarding hospital waste management. Our study showed that the majority of the respondents were nurses. This is similar to the findings of Joshua *et al.* (2014) in a study which was carried out in some primary health care centres in Zaria – Nigeria. Awodele *et al.* (2016) in a Lagos study, reported that the majority (34.3%) of the respondents were domestic workers who handled waste disposal and management (Joshua *et al.*, 2014; Awodele *et al.*, 2016). Effective waste management practices depend largely on the source of waste generation, categorization, quantity and quality (Mbarki *et al.*, 2013). Direct observation from this study highlighted that some form of waste segregation is being practised at hospitals in FCT, similar to the findings of a related study (Abah & Ohimain, 2011). Findings from this study showed that nurses' respondents rightly identified items that constitute medical waste

compared to the other healthcare workers supporting available literature (Awodele *et al.*, 2016). This could be attributed to nurses having more training and exposure to waste management. Findings revealed that no form of waste re-cycling was practised in both hospitals assessed, violating the WHO recommendation, which advocates for recycling and re-use of materials (Prusset *al.*, 1999; WHO, 2006). A possible explanation for this violation could be the absence of government policies to ensure that

HCW is recycled into new products. However, in July 2020 the government of Nigeria developed the National Policy on Waste Management to promote the Reuse, Reduce, Recycle and Recovery Initiative (FME-FGN, 2020). Hopefully, the enforcement of this policy nationwide will improve HCW management in the country. Safety boxes are used for sharp collections and disposed of when two-thirds filled according to WHO regulation which ensures that the sharps are properly secured and do not fall

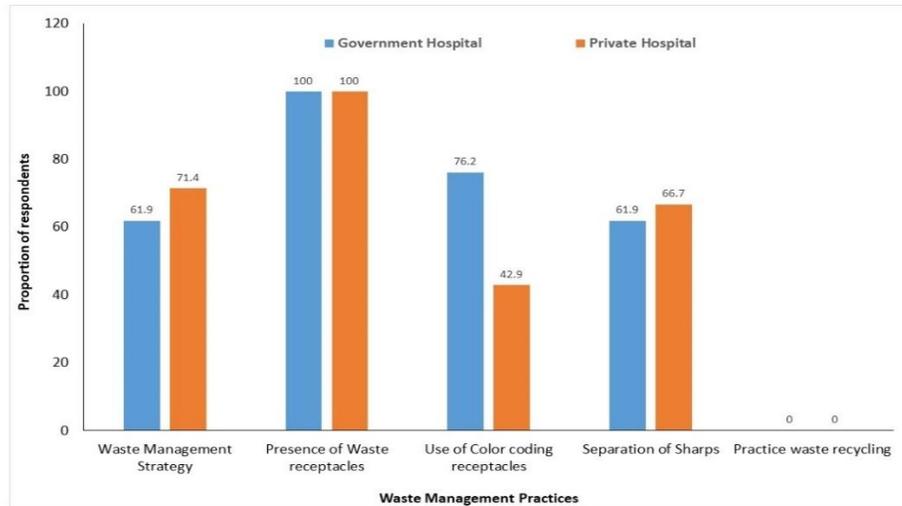


Figure 4: Healthcare Waste Management Practices at two Hospitals in Abuja, 2018. Each bar represents the different waste management practices reported by the healthcare workers at both hospitals. The orange bars represent responses of respondents from the private hospital while the blue bars represent the responses of respondents from the government hospital

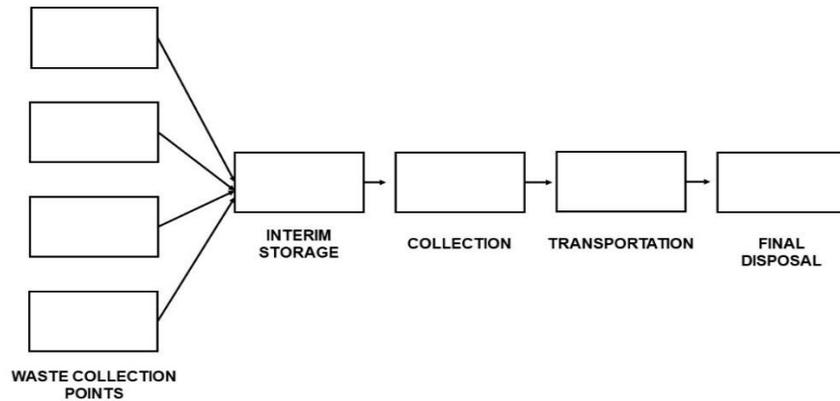


Figure 5: Flow Process for Hospital Waste Management. Healthcare waste is collected from different points at both hospitals and stored in interim storage. Thereafter the waste is collected by the municipal waste managers and transported to the final disposal sites

Table 5: Assessment of the level of compliance for Sustainable Management of Healthcare Waste at the two Hospitals

Level 1	Generally operating in an unsustainable manner, although there is some evidence of awareness and willingness to change	Although having no specific waste management strategy, it will have a separate collection of segregated wastes in enclosed vehicles, an autoclave of infectious waste and use single-cell incineration plant
Level 2	Operating in a manner with some aspects that are considered sustainable and others that are considered unsustainable	Waste management policy in place, segregation of wastes and colour coding, specified waste storage containers, waste transported with enclosed compaction vehicles and separate vehicles for hazardous waste, some recycling at facility (paper, cardboard etc), use of multi-chamber incinerator plants and alternative modern technologies (such as a microwave) to treat waste and disposal in level 2 landfill

out of the container (WHO, 2006). The reason for this correct practice observed in both hospitals could be because the HWs have good knowledge on the proper disposal of sharps (Awodele *et al.*, 2016; Ekanem *et al.*, 2021).

In both hospitals, ward attendants and cleaners were responsible for the collection of segregated medical wastes from the different wards and depositing the waste into the on-site storage center. Although personal protective equipment (PPE) is very important for the safety of anyone who handles medical wastes, it was observed that only heavy-duty gloves and boots were worn by some of the workers at both hospitals while others wore only rubber gloves. This was consistent with the findings of Awodele *et al.* (2016), who reported that domestic workers wore only heavy-duty gloves (Awodele *et al.*, 2016). This however, is not consistent with the recommended standards of WHO which require the use of heavy-duty gloves, boots, and apron in the management of healthcare waste (Pruss *et al.*, 1999). This observation is most likely because most ward attendants and cleaners lack regular on-the-job training, and such pieces of training on the importance of PPE should be conducted on a regular basis. Abah and Ohimain (2011), reported that 11.5% of respondents had received specific training in the management of HCW while 46% understood the importance of HCWM within the provision of safety to the public (Abah & Ohimain, 2011).

Waste treatment leads to a reduction in volume, weight, risk of infection, and organic compounds of the waste (Pruss *et al.*, 1999). However, the information provided by the respondents showed that no form of treatment is being carried out on infectious wastes before the disposal of such wastes. This is not consistent with the recommended standards of WHO, which requires that these

infectious wastes be treated before disposal (WHO, 2006). This is also not consistent with the UNEP criteria for sustainable waste management modified by Townend & Cheeseman (2005) which recommends the use of multi-chamber incinerator plants and alternative modern technologies (such as a microwave) to treat waste prior to disposal (Townend & Cheeseman, 2005).

Despite the challenges associated with HCW management, especially in low and middle-income countries like Nigeria, the Hospital Management Boards have taken the initiative to have well-organized systems of collecting and treating waste by providing waste management policies and strategies for hospitals in Abuja. The respective hospitals have also taken further steps by providing safety boxes for sharps disposal as well as different coloured-coded bags or different types of receptacles to encourage waste segregation. However, there were no instructive posters on waste segregation on display around the health facilities. This study shows that there is little progress in the management of medical waste in Abuja because of the following: medical waste is collected and segregated using the three colours coding system as recommended by WHO, then the wastes are transferred to the on-site storage and finally transported to the final disposal sites as practised by the Government hospital. We recommend that the Hospital Management Board ensure uniformity in HCWM practices in all hospitals, especially the private ones with practices different from the Government hospitals.

Overall, the level of sustainable waste management at the various health facilities is level 2 and needs to be improved upon. The current HCW management system can be improved significantly by developing a clear policy on medical waste management at national, state and local government levels. Training

and re-training of health workers, as well as the provision of colour coded receptacles and instructive posters, are essential in implementing a policy-based systematic protocol. It is also important that healthcare facilities make use of practical options such as waste segregation and recycling for effective HCW management.

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Conflict of interest

The authors declare that there is no conflict of interest.

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