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Research Article

Generation and Composition of Biomedical Waste in Selected Hospitals in Akure South Local Government Area, Nigeria

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ABSTRACT

This study analyses generation and composition of biomedical waste in selected hospitals in Akure local government area, Nigeria. Cross sectional survey research design was adopted in which both primary and secondary data were sourced. A multi-stage sampling technique was used. Of the 18 local government area in Ondo state, Akure South Local government Area was purposively selected. About 8 out of the entire 147 health care facilities (4 private and 4 public) identified were randomly selected representing 11% of the sample frame. Consequently, a structure questionnaire that captured the socio-economic characteristics, composition, generation and effects of biomedical waste for seven days (1 week) was administered to all (233) the waste handlers within the facilities identified within the selected health care facilities. Data were analyzed using both descriptive and inferential (ANOVA) statistics. The findings revealed that male accounted for 98.3% while 37.8% aged between 41 to 60 years. Healthcare facilities generate more of sharps and infectious waste, accounting for 338.1kg and 367kg respectively. All (100%) the facilities composed of sharp, infectious, non-risk forms of biomedical waste (12.5%) and chemical waste. In conclusion, there is variation in the biomedical waste generation, therefore effective waste management strategies should be adopted.

Keywords: *Biomedical waste, composition, generation, Ondo state*

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INTRODUCTION

Globally, medical waste represents a relatively small portion of the total waste generated in a community, yet, its significance can never be underestimated worldwide (Cheng *et al.,* 2009). This is because medical waste is highly infectious and hazardous. According to Becher and Lichtnecker (2002), biomedical waste due to indiscriminate organization bequests a high risk to doctors, technicians, sweepers, hospital visitors and patients working within the health sector, particularly medical facilities. It poses threats to environmental health and requires specific treatment and management prior to its final disposal (Hassan *et al*, 2008).

Biomedical wastes constitute a problem because of the epidemiological and political considerations associated with it. Increase in the incidences of exposure to blood, saliva, or other body fluids or aerosols that may carry infectious materials such as hepatitis C, HIV or other blood-borne or body fluid pathogens was linked to discarded syringes (Coker *et al* 2000). This is because stakeholders in the Hospital Waste Management sector did not see the subject matter as a component of hospital hygiene. Some of the waste management process that has been applied till now is summarized as being old (Acharya and Singh, 2000). Therefore, Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of biomedical waste in any establishment (Acharya and Singh, 2000).

The planning management of healthcare waste is a critical element of a healthcare facilities infection regulatory program, having direct link to occupational and environmental safety for healthcare workers. While roughly 80% of waste generated from the healthcare sector is classified as non-risk (non-infectious, non-hazardous) general waste, the remaining 20% is considered hazardous and needs specialized handling, treatment and disposal (Acharya and Singh, 2000). Fundamental to healthcare waste planning and management is their distinct categorizations, which often contain materials that may be harmful and capable of causing ill health if unnecessarily exposed to. A number of studies have indicated that the inappropriate handling and disposal of healthcare wastes pose health risks to health workers who may be directly exposed and to people near health facilities, particularly children and scavengers who may become exposed to infectious wastes and a higher risk of diseases like hepatitis and HIV/AIDS (WHO, 1999; 2002; Oke, 2008; Coker, 2009; PATH, 2009; Adegbite *et al*,2010).

Studies on Hospital solid waste have been carried out by different researchers. Longe and Williams (2006) surveyed medical waste management practices and their implications to

health and environment in metropolitan Lagos. The study assessed management practices in four hospitals ranging in capacity from 40 to 600 beds and established an average generation rate of medical waste of 0.562kg/bed/day to 0.670kg/bed/day; with infectious waste accounting for between 26 to 37% of the total volume. Only two of the hospitals investigated carried out treatment of their infectious and sharp waste types by incineration before final disposal. In a study on evaluation of health-care waste challenges in Hospitals within Ilorin metropolis", Ajimotokan and Aremu (2009) found that about 177.67Kg of waste was generated daily and the average waste generated per bed/per day was 1.56Kg. They further reported that the management of the waste was often poor, with a mixture of potentially infectious and non-infectious waste being a common sight in the hospital waste bins and hospital environment. With reference to this magnitude of generation,

While the aforementioned studies have focused more on generation, treatment of sharps and infectious waste, that which focuses on composition vis-a-vis the generation have not been given adequate attention in literature. This is because poor planning and management of biomedical waste contribute significantly to the negative consequences it has on the people's health care delivery. This study therefore is designed to analyze the composition and generation of bio-medical waste in selected hospitals in Akure South Local Government Area, Ondo State, Nigeria with the aim of determining its variation on across the facilities and the effects on people.

MATERIALS AND METHODS

Study Area: Akure SouthWest Local Government comprised one the LGAs in Ondo State central senatorial districts (Figure 2.2). Akure-South Local Government is an area surrounded by Idanre Local Government, Ifedore Local Government and Akure-North local Government areas .(Figure 2.3). The area is a Christian dominated area with few Muslims living there represent the study are which is Akure South Local Government Area of Ondo State.

It covers an area extent of about 340 km². The metropolis is located on a gently undulating terrain surrounded by isolated hills and Iselbergs. Topographic elevations vary between 260 and 470 m above sea level. The metropolis is drained by several streams and rivers. The nature of residual soils (excluding the very thin topmost layer) in Akure is determined by the underlying geology. There are three major soil associations in Ondo state, which are Iwo, Ondo and Itagunmodi Associations. The Iwo soil type is located on coarse grained granite and gneiss underlain area. The soil is composed of coarse textured, grayish brown to brown sandy to fairly clayey soils. The soil type occupies the central, northeastern/northwestern and southwestern part of Ondo state.

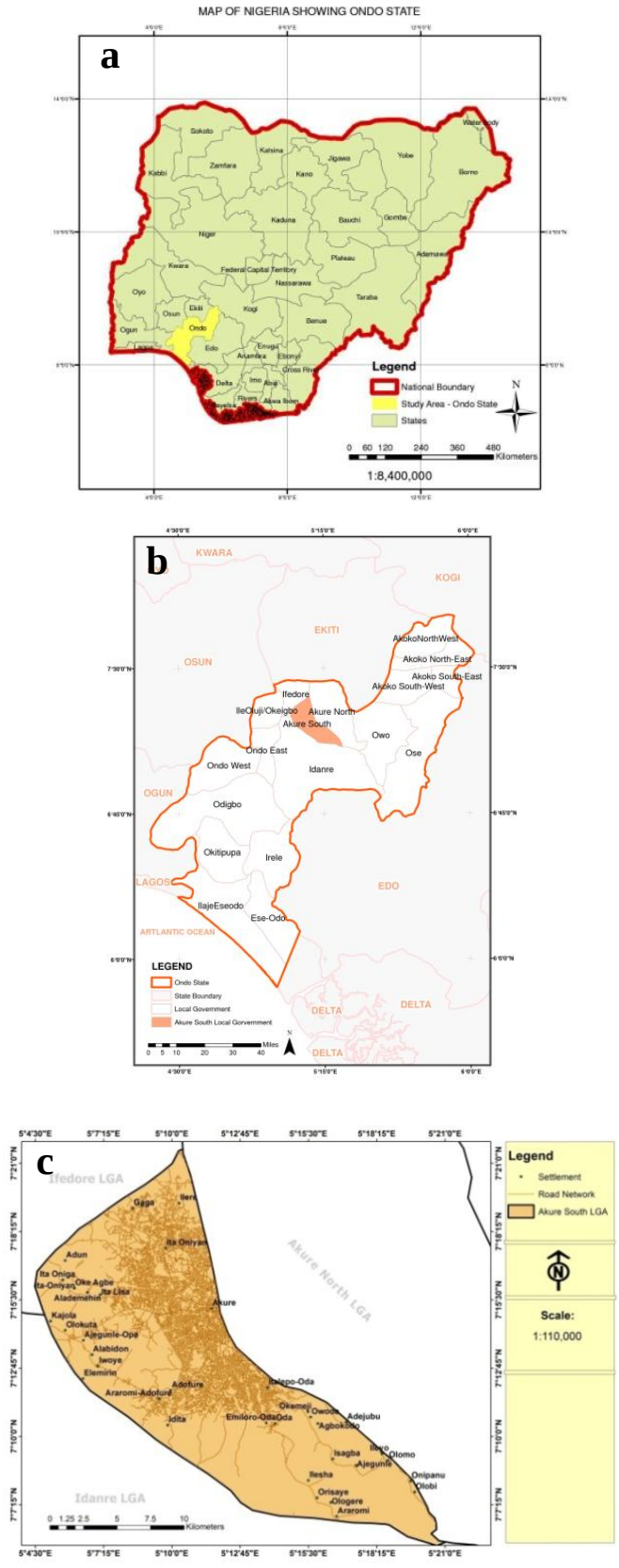

Figure 1:
(a) Map of Nigeria Showing the Position of Ondo State. (b). Map of Ondo State showing Akure South Local Government Area. (c). Map of Akure south local Government Area Showing some Settlements

Ondo State lies within the tropical climate with two distinct seasons of wet and dry. The dry weather is brought by the tropical continental air mass, blowing in from the Sahara desert between the months of November and March and the wet season comes from the tropical maritime air mass originating from the Atlantic Ocean between the month of April and October. The total rainfall in the area is 450mm with a mean monthly rainfall of 121mm, depicting a sharp fall in rainfall at a period between July and August (August Break). The temperature in the region is high throughout the year with a mean monthly temperature of about 27ºC and a range of 37ºc between the month of the highest temperature (February) and the month of lowest temperature (August). Overall, the study area is one the seven centers with the population in excess of 50,000. It also serves the dual purpose of being a commercial and administrative headquarter of both state of Ondo state and the Local government.

Methodology: Cross-sectional survey research design was adopted. Both primary and secondary data were sourced. A purposive sampling technique was used to select eight healthcare (four public and four private) facilities in Akure Local Government Area due to the high concentration of hospitals in the area. About 233 waste handlers within the healthcare facilities were identified (see Table 1) and a set of structured questionnaire containing: Socio-economic characteristic of the handlers, composition and characterization of biomedical waste (which was determined by taking the weight of biomedical waste generated per day for a period of seven days (1 week)), the rate of generation of biomedical waste and its effect on biomedical waste handlers were administered to all (100%) of them. This was done in order to make an objective inference. Consequently, hand held weigh balance were use in determining the weight of the waste *in accordance with Townend and Cheeseman guidelines (2005)*, while hospital records of the waste handlers was also accessed to determine its effect on them. Both descriptive and inferential statistics (regression model) were used to analyze the data at P > = 0.05%.

RESULTS

Socio economic Characteristics of the Respondents

This section presents the socioeconomic characteristics of the respondents in the study area. Variables considered were; gender, age, education and monthly income (Table 2). Investigations revealed that 1.7% of the respondents were male comprising of 0.4%, 0.9%, and o.4% in Nigeria Police Medical services, Igisogba Basic Health Centre and State Specialist Hospital Akure respectively (see table 2).

In terms of age distribution, investigation revealed that 24.5% of the respondents were aged between 21 and 40 years old, comprising of the highest (17.2%) in State Specialist Hospital, followed by FUTA Clinics (4.3%) and Igisogba Basic Health (2.1%). About 37.8% aged between 41 - 60 years old comprising of 1.3% in both Hope Hospital and Akure Mercy Specialist Hospital, 0.4% in Midas Hospital, 3.4% in FUTA Clinic, 3.9% in Nigerian Police Medical Service, 24.9% in State Specialist Hospital and 2.6% in Kajola Basic Health Centre. The proportion of respondents who aged above 60 years old accounted for 37.8%, comprising of 1.7%, 2.1%, 0.9%, 1.7%, 28.8% and 0.4% in Hope Specialist, Mercy Hospital, Midas Hospital, Nigeria Police Medical, State Specialist hospital and Kajola Basic Health respectively. (Table.2).

Investigation on the educational status of respondents revealed that 10.3% of the respondents had primary school certificate comprising of 0.4% in both Hope Hospital and FUTA Clinic and 9.4% in State Specialist Hospital. Almost three quarter (70.8%) of the respondents were secondary school certificate holders, comprising of 0.9% in Hope Hospital, 3.4% in Akure Mercy Specialist Hospital, 1.3 in Midas Hospital, 7.7% in FUTA Clinic, 5.6% in Nigeria police Medical Services, 1.3 in Igisogba Basic Health Centre, 48.1% in State Specialist Hospital Akure and 2.6 in Kajola Basic Health Centre. About 17.6% had technical school certificate, comprising of 1.7% in Hope Hospital, 0.9% in FUTA Clinic, Igisogba Basic Health Centre and Kajola Basic Health Centre, 0.4% in Nigeria Police Medical Services and 13.3% in State Specialist Hospital. Meanwhile, 1.3% of the respondents were degree holders comprising of 0.4% in Nigeria Police Medical Services and 0.9% in Igisogba Basic Health Centre (see table 2).

Analysis on the respondents' monthly income revealed that 1.3% of the respondents earn below ₦18, 000, particularly in State Specialist Hospital. Those who earned between ₦18, 000 and ₦36, 000 accounted for 56.3%, comprising of 0.9% in Hope Hospital, 2.1% in Akure Mercy Specialist Hospital, 1.3% in Midas Hospital, 8.2% in FUTA Clinic, 5.5% in Nigeria Police Medical Service, 1.3% in Igisogba Basic Health Centre, 34.8% in State Specialist Hospital and 2.1% in Kajola Basic Health Centre. Also, the proportion of the respondents that earned above ₦36,000 accounted for 42.5%, comprising of 2.1% in Hope Hospital, 1.3% in Akure Mercy Specialist Hospital, 0.9% in FUITA Clinic, Nigeria Police Medical Service and Kajola Basic Health Centre, 34,8% in State Specialist Hospital.

Table 1: Sample Frame, Sample Size and Questionnaire Distributed

S/No	Respondent	Hospital	Sample Frame	Sample Size	No of Questionnaire
1.	Waste Handlers within Healthcare Facility	Hope Hospital	7	7	7
		Akure Mercy Specialist Hospital	8	8	8
		FUTA Clinic	21	21	21
		Midas Hospital	3	3	3
		Nigeria Police medical services Akure	15	15	15
		Igisogba Basic Health Centre	7	7	7
		State Specialist Hospital Akure	165	165	165
		Kajola Basic Health Centre	7	7	7
Total			233	233	233

Table 2:
Socio- Economic Characteristics of the Respondents

Socio-Economic Characteristic	**Respondents**				**Total**	
Gender	Male		Female		**F**	**%**
	F	%	F	%		
Hope Hospital	0	0	7	3	7	3
Akure Mercy Specialist Hospital	0	0	8	3.4	8	3.4
Midas Hospital	0	0	3	1.3	3	1.3
FUTA Clinic	0	0	21	9.1	21	9.1
Nigeria Police Medical Services	1	0.4	14	6	15	6.4
Igisogba Basic Health Centre	2	0.9	5	2.1	7	3
State Specialist Hospital Akure	1	0.4	164	70.4	165	70.8
Kajola Basic Health Centre	0	0	7	3	7	3
Total	**4**	**1.7**	**229**	**98.3**	**233**	**100**

Age	21-40 years		41-60 years		61 and above		**F**	**%**
	F	%	F		%			
Hope Hospital	0	0	3	1.3	4	1.7	7	3
Akure Mercy Specialist Hospital	0	0	3	1.3	5	2.1	8	3.4
Midas Hospital	0	0	1	0.4	2	0.9	3	1.3
FUTA Clinic	10	4.3	8	3.4	3	1.3	21	9.1
Nigeria Police Medical Services	2	0.9	9	3.9	4	1.7	15	6.4
Igisogba Basic Health Centre	5	2.1	0	0	2	0.9	7	3
State Specialist Hospital Akure	40	17.2	58	24.9	67	28.8	165	70.8
Kajola Basic Health Centre	0	0	6	2.6	1	0.4	7	3
Total	**57**	**24.5**	**88**	**37.8**	**88**	**37.8**	**233**	**100**

Education Status	Primary		Secondary		Technical		Degree		**F**	**%**
	F	%	F	%			F	%		
Hope Hospital	1	0.4	2	0.9	4	1.7	0	0	7	3
Akure Mercy Specialist Hospital	0	0	8	3.4	0	0	0	0	8	3.4
Midas Hospital	0	0	3	1.3	0	0	0	0	3	1.3
FUTA Clinic	1	0.4	18	7.7	2	0.9	0	0	21	9.1
Nigeria Police Medical Services	0	0	13	5.6	1	0.4	1	0.4	15	6.4
Igisogba Basic Health Centre	0	0	3	1.3	2	0.9	2	0.9	7	3
State Specialist Hospital Akure	22	9.4	112	48.1	31	13.3	0	0	165	70.8
Kajola Basic Health Centre	0	0	6	2.6	1	0.4	0	0	7	3
Total	**24**	**10.3**	**165**	**70.8**	**41**	**17.6**	**3**	**1.3**	**233**	**100**

Income per month	Below ₦18,000		₦18,000-36,000		Above ₦36,000			
	F	%	F	%	F	%	F	%
Hope Hospital	0	0	2	0.9	5	2.1	7	3
Akure Mercy Specialist Hospital	0	0	5	2.1	3	1.3	8	3.4
Midas Hospital	0	0	3	1.3	0	0	3	1.3
FUTA Clinic	0	0	19	8.2	2	0.9	21	9.1
Nigeria Police Medical Services	0	0	13	5.5	2	0.9	15	6.4
Igisogba Basic Health Centre	0	0	3	1.3	4	1.7	7	3
State Specialist Hospital Akure	3	1.3	81	34.8	81	34.8	165	70.8
Kajola Basic Health Centre	0	0	5	2.1	2	0.9	7	3
Total	3	1.3	131	56.3	99	42.5	233	100

Composition/Characteristics of Biomedical Waste: Investigation carried out on the Composition/Characterization of biomedical waste from the sampled healthcare facilities revealed that all (100%) the facilities generate sharp waste. Infectious and non-risk forms of biomedical waste accounted for 12.5%. Apart from Igisogba Basic and Kajola basic healthcare, all other facilities generate chemical waste accounting for 12.5% each. Those facilities that do not generate chemical waste were mainly Primary Health Care where no serious operation that generates chemical waste is being carried out. Radioactive biomedical waste is the least (12.5%) generated waste across the sampled healthcare facilities, found only in the State Specialist Hospital. Also, investigation revealed that Hope Hospital, Mercy Specialist Hospital, Midas Hospital, Nigeria Police Medical Service and State Specialist Hospital were the facilities that involve in the generation of pathological waste, each accounting for 12.5%. However, FUTA Clinic, Igisogba and Kajola Basic healthcare did not generate pathological waste. Meanwhile, every facility apart from FUTA Clinic, Igisogba Basic Healthcare and Kajola Basic Healthcare were involved in the generation of infectious waste, each accounting for 12.5% (see Table 3).

Table 3:
Composition of Biomedical Waste from Healthcare Facilities

Composition of Biomedical Waste	**Respondents**													
	Sharps		Chemical		Radioactive		Pathological		Infectious		Non-risk		Highly infectious	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Hope Hospital	X	12.5	X	12.5	-	0	X	12.5	X	12.5	X	12.5	X	12.5
Akure Mercy Specialist Hospital	X	12.5	X	12.5	-	0	X	12.5	X	12.5	X	12.5	X	12.5
Midas Hospital	X	12.5	X	12.5	-	0	X	12.5	X	12.5	X	12.5	X	12.5
FUTA Clinic	X	12.5	X	12.5	-	0	-	0	X	12.5	X	12.5	-	0
Nigeria Police Medical Services	X	12.5	X	12.5	-	0	X	12.5	X	12.5	X	12.5	X	12.5
Igisogba Basic Health Centre	X	12.5	-	0	-	0	-	0	X	12.5	X	12.5	-	0
State Specialist Hospital Akure	X	12.5	X	12.5	X	12.5	X	12.5	X	12.5	X	12.5	X	12.5
Kajola Basic Health Centre	X	12.5	-	0	-	0	-	0	X	12.5	X	12.5	-	0
Total	**8**	**100**	**6**	**75**		**12.5**	**5**	**62.5**	**8**	**100**	**8**	**100**	**5**	**62.5**

Note: X=1 i.e Available -=0 i.e Not Available

Weight of Biomedical Waste Generated: Analysis on the rate of biomedical waste generation in the study area, revealed that sharp items which comprise of cut or punctures like needles, scalped blades, and infusion were 338.1kg, constituted one of the largest (26.7%) waste generated in the healthcare sampled. State Specialist Hospital had the largest (95.6kg) generation of sharps accounting for 7.5% of the total sharps generated, followed by Akure Mercy Specialist having 5.6% (71.2kg), Midas Hospital; 3.3% (41.9kg), Nigeria police Medical Service, 2.9% (36.4kg), FUTA Clinic 2.0% (25kg), Hope Specialist and Kajola basic Healthcare 1.8% (23kg) each . The least generator was Igisogba basic Health centre, which accounted for 22kg (1.7%).

Moreover, the total chemical generated across the various health cares sampled accounted for 140.1kg (11.1%) comprising of 1.2% (14.7kg) in Hope Hospital, 1.4% (17.4kg) in Akure Mercy Specialists Hospital, 1.5%(19.4kg) in Midas Hospital, 1.7% (21.3kg) in FUTA Clinic, 2.3% (29.5kg) in Nigeria Police Medical Service and 3.0% (38.0kg) in State Specialist Hospital. However, both Igisogba Basic Health and Kajola Basic Health do not have record of chemical waste generation. Also, the proportion of radioactive waste generated across the healthcare facilities accounted for 4kg (0.3%), all originating from State Specialist Hospital. Further investigation on Pathological waste generated revealed a total weight of 75.6kg (6%), cutting across many sampled hospitals with the highest (24.3kg) at Akure Mercy Hospital which accounted for 1.9%, followed by Nigeria Police Medical service 1.5% (18.6kg), Hope Specialist Hospital (2.0%)12.4kg and Midas Hospital both having (2.0%) 12.1kg each. The least was State Specialist Hospital having a volume of 8.0kg (0.6%). Igisogba Basic Health and Kajola Basic Health did not generate pathological waste.

In addition, the study revealed infectious waste to have the highest (367kg) rate of generation, accounting for 28.9%. This comprises of the State Specialist Hospitals also having the highest (110.7kg), and closely followed by Akure Mercy Hospital having 4.1% (51.5kg), Nigeria Police Medicals Service 4.0% (51.1kg), Hope Specialist Hospital 3.7% (47kg) and Igisogba Basic Health Centre 0.8% (10.5kg). This indicates that infectious items like cultures and stock agents from laboratory works, surgeries and autopsies, water and any other instruments that have been in contact with infected patients are the largest stream of infectious wastes. Non-risk waste also constitutes part of the waste generated across the healthcare having the highest weight of 68.3kg (5.4%) from the State Specialist Hospital. This was followed by Nigeria Police Medical Service 39kg (3.1%), Midas Hospital 24.7kg (1.9), Hope Hospital 23kg (1.8), Akure Mercy Specialist Hospital 22.8kg (1.8 %). FUTA Clinic alone generated 21kg (1.7%) in one week while Kajola Basic Health Centre generated the least 18.3kg (1.4%) rate of non-risk waste. With respect to Highly Infectious waste in the study area, all the facilities generated 105.2kg accounting for 18.7% with the exception of Kajola Basic Health. FUTA Clinic generated the highest accounting for 25kg (2.0%), Nigeria Police Medical Service 20.6kg (1.6%), State Specialist Hospital 20kg (1.6%), Hope Specialist had the least (4kg) generation of highly infectious waste accounting for 0.3%.

Trend in generation of biomedical waste in the study area: In order to determine the trend in generation of biomedical waste in the study area, trend analysis was carried out and the result revealed that the quantity of biomedical waste generated in the selected healthcare are as follows; there were weekly fluctuations in the number of kg per biomedical waste generation. For instance, in ascending order, Kajola Health Centre generated 10kg of biomedical waste on Day 1 and continues until it dropped from 10kg to 8kg on Day 5 and 6 and consequently dropped to 7.5 on Day 7. This was followed by Igisogba hospitals whose highest generation was 13kg and 14kg on day 3 and 4 respectively. Though, had the least which dropped as low as 6kg on day 7. FUTA Clinic generated 17kg on Day 1 and drop to 15kg on Day 2 and then pick up on day 3 to 17kg, thereafter, it rose slightly to 16kg on Day 6 and finally to 20kg on day 7.

Table 4:
Weight of Biomedical Waste Generated from Healthcare Facilities (kg)

Weight of Biomedical Waste (kg)	**Respondents**														**Total**		**Average Weight**
	Sharps		**Chemical**		**Radioactive**		**Pathological**		**Infectious**		**Non-risk**		**Highly infectious**				
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	
Hope Hospital	23	1.8	14.7	1.2	0	0	12.4	2	47	3.7	23	1.8	4	0.3	124.1	9.9	20.7
Akure Mercy Specialist Hospital	71.2	5.6	17.2	1.4	0	0	24.3	1.9	51.5	4.1	22.8	1.8	8	0.6	195	15.5	32.5
Midas Hospital	41.9	3.3	19.4	1.5	0	0	12.1	2	42.4	3.3	24.7	1.9	14.6	1.2	155.1	12.3	25.9
FUTA Clinic	25	2.0	21.3	1.7	0	0	0	0	31.8	2.5	21	1.7	25	2	99.1	8.2	24.8
Nigeria Police Medical Services	36.4	2.9	29.5	2.3	0	0	18.6	1.5	51.1	4	39	3.1	20.6	1.6	195.2	15.5	32.5
Igisogba Basic Health Centre	22	1.7	0	0	0	0	0	0	10.5	0.8	20	1.6	13	1	65.5	5.3	16.4
State Specialist Hospital Akure	95.6	7.5	38	3	4	0.3	8	0.6	110.7	8.7	68.3	5.4	20	1.6	344.6	28.2	49.2
Kajola Basic Health Centre	23	1.8	0	0	0	0	0	0	22	1.7	18.3	1.4	0	0	63.3	5.1	9.0
Total	**338.1**	26.7	**140.1**	11.1	**4**	0.3	**75.4**	6	**367**	28.9	**237.1**	18.7	**105.2**	8.3	**1266.9**	**100**	**211**

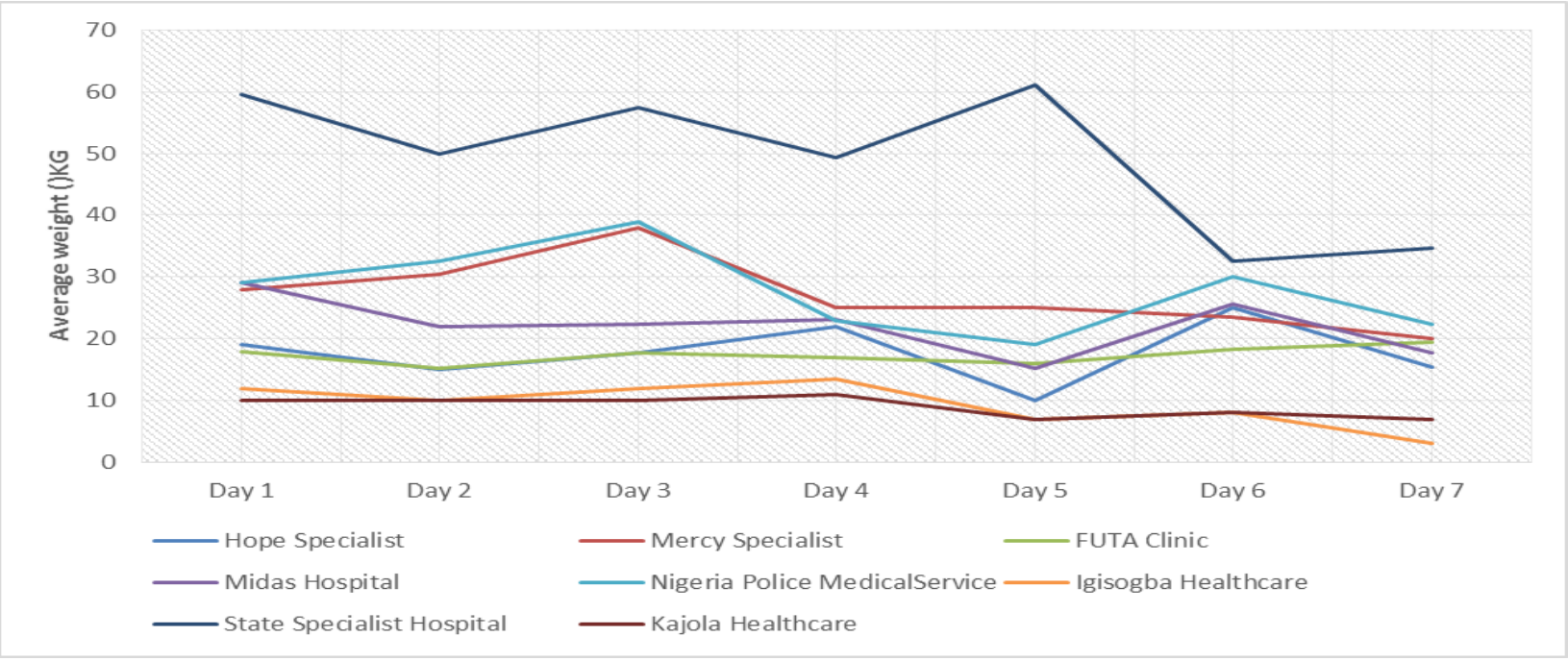

Figure 1:
Trend chart of waste generated per day across the healthcare

Table 5
Daily Generated Biomedical Waste from Sampled Healthcare Facilities (kg)

Weight of Biomedical Waste (kg)	Public Healthcare Respondents														Total		Average Weight
	Sharps		Chemical		Radioactive		Pathological		Infectious		Non-risk		Highly infectious				
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	
Nigeria Police Medical Service	36.4	5.4	29.5	4.4	0	0	18.6	2.8	51.1	7.6	39	5.8	20.6	3.1	195.2	29.1	32.5
Igisogba Basic Health centre	22	3.3	0	0	0	0	0	0	10.5	1.6	20	3.0	13	1.9	65.5	9.9	16.4
State Specialist Hospital	95.6	14.3	38	5.7	4	0.6	8	1.2	110.7	16.6	68.3	10.2	20	3.0	344.6	51.5	49.2
Kajola Basic Health centre	23	3.4	0	0	0	0	0	0	22	3.3	18.3	2.7	0	0	63.3	9.5	9.0
Total	**177**	26.4	**67.5**	10.1	**4**	0.6	**26.7**	4.0	**194.3**	29.1	**145.6**	21.7	**53.7**	8	**668.6**	100	**107.1**

	Private Healthcare Respondents														Total		Average Weight
	Sharps		Chemical		Radioactive		Pathological		Infectious		Non-risk		Highly infectious				
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	
Hope Hospital	23	3.8	14.7	2.5	0	0	12.4	2.1	47	7.9	23	3.8	4	0.7	124.1	20.7	20.7
Akure Mercy Specialist Hospital	71.2	11.9	17.2	2.9	0	0	24.3	4.1	51.5	8.6	22.8	3.8	8	1.3	195	32.6	32.5
Midas Hospital	41.9	7	19.4	3.2	0	0	12.1	2.0	42.4	7.1	24.7	4.1	14.6	2.4	155.1	26	25.9
FUTA Clinic	25	4.2	21.3	3.6	0	0	0	0	31.8	5.3	21	3.5	25	4.2	99.1	16.6	24.8
Total	**161.1**	26.9	**72.6**	12.2	**0**	0	**48.8**	8.2	**172.7**	28.9	**91.5**	15.2	**51.6**	8.6	**598.3**	100	**103**

Table 6
Correlation Matrix

Variables	Hospital-FUTA Clinic	Hospital-Hope Specialist	Hospital-Igisogba Basic Health	Hospital-Kajola Basic Health	Hospital-Mercy Hospital	Hospital-Midas Hospital	Hospital-Nigeria Police Medical Service	Hospital-State Specialist Hospital	Mean Weight
Hospital-FUTA Clinic	**1.0000**	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	**-0.1117**
Hospital-Hope Specialist	-0.1429	**1.0000**	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	**-0.0799**
Hospital-Igisogba Basic Health	-0.1429	-0.1429	**1.0000**	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	**-0.1945**
Hospital-Kajola Basic Health	-0.1429	-0.1429	-0.1429	**1.0000**	-0.1429	-0.1429	-0.1429	-0.1429	**-0.2490**
Hospital-Mercy Hospital	-0.1429	-0.1429	-0.1429	-0.1429	**1.0000**	-0.1429	-0.1429	-0.1429	**0.1000**
Hospital-Midas Hospital	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	**1.0000**	-0.1429	-0.1429	**-0.0112**
Hospital-Nigeria Police Medical Service	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	**1.0000**	-0.1429	**0.1308**
Hospital-State Specialist Hospital	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	-0.1429	**1.0000**	**0.4156**
Mean Weight	**-0.1117**	**-0.0799**	**-0.1945**	**-0.2490**	**0.1000**	**-0.0112**	**0.1308**	**0.4156**	**1.0000**

Meanwhile, Nigeria Police Medical Service generated 20kg on day 1 and drop to 15kg on day 2, then slightly rose to 21kg on Day 6 and subsequently soar–up to 23kg on Day 7. Also, Mercy Hospital generated 28kg of waste on Day 1, and rose to 29kg on Day 2 and then increases as high as 33kg on day 3. Midas Hospitals witnessed a generation of 29kg on Day 1, and dropped to 22kg on Day 2, then continue and fell to 15kg on Day 5, and thereby rose to its peak (23kg) on Day 6. Hope Specialist Hospital had the highest generation in the sampled facilities, although, equally fluctuated as the case with other facilities, having a gradual generation of 29kg on Day 1 and rose to 31kg on Day 2 and then increase to 38 on Day 3. It then suddenly, dropped to as low as 23kg on Day 4 and then decrease to 18kg on Day 5. Finally, State Specialist Hospital had a fluctuation case of as high as 60kg on Day 1, 50kg on Day 2 and moved to 58kg on Day 3 and later fell to 49kg on Day 4, then rose to the highest (61kg) on Day 5 and also fell to 32 on day 6 and lastly to 33kg on day 7.

Variation in the daily generation of biomedical waste in the study area: Furthermore, investigation was made on the variation of daily generated biomedical waste from sampled healthcare facilities in the study area. This was done by comparing the private and public health care facilities. The result revealed a remarkable variation. For instance, the proportion of sharp generated from public hospitals was 177 kg which accounted for 26.4% compare with private hospitals having 166kg (26.9 %). Chemical waste generated in public hospitals accounted for 67.5kg (10.1%) compare with 72.6kg (12.2%), generated in private hospitals. Regarding radioactive waste, public hospitals generated 4 kg (0.6%) while none was generated from private hospitals. On pathological waste, public hospitals generated 26, 7 kg (4.0%) as against 48.8kg (8.2%) generated in the private hospitals. Variations also exist in the generation of infectious and non-risk waste. While public hospitals daily generation accounted for 194.3kg (29.1%) and 145.6 kg (21.7%), private hospitals daily generation of infectious and non-risk constituted 172.7kg (28.9%) and 91.5kg (15.2%) respectively. For highly infectious waste, public hospitals had a daily generation of 53.7 kg (8.0%) as against the private hospitals that had 51.6kg which accounted for 8.6%) (See Table 5).

Table 6 shows the correlation matrix of the average weighted waste generated between the healthcare Centre, with -1 showing the least correlation and +1 showing the height correlation

DISCUSSION

The results of this study suggest that employment into the biomedical waste handling (particularly in waste clearance) within the healthcare facilities were female bias. This could be as a result of general believe that, cleaning is regarded more of a female's work than males in Nigeria. Generally, it could be adjudged that older people were more engaged in waste collection than the remaining age group in the study area. The observed dominance of secondary school certificate holders in the study area is not unconnected with the state government policy on free education up to secondary level. The implication of this is that, majority of the respondents had an average communication skill that was capable of making them understand, interpret and answer the questionnaire appropriately. Also, the disparity in the payment may not be far from different criteria employed in the payment of the respondents' wages by the employers. Prominent among which is educational qualification, implying in general, an earning above the United Nation minimum of $1 per day.

Furthermore, result of the weight of biomedical waste generated shows a serious implication on the health of the workers who had direct contact with the said facilities. This confirms the work of Cheng *et al*. (2009) on medical waste production in Taiwan, in which 92% of wastes generated were infectious, also constituting the major source of waste in the hospitals. In addition, Wahab and Adesanya (2011) specified that hazardous nature of hospital wastes can be attributed to their compositions with only 15% of hospital waste being hazardous in nature, but when hazardous waste is not segregated at the source of their generation and mixed with non-hazardous waste, then, 100% waste becomes hazardous. This was buttressed by some respondents' view that wastes generated in the hospitals are infectious.

The observed general increase in waste generation on the seventh day is not unconnected with the fact that majority of the people who patronized the facilities may probably be legitimately engaged with the weekly activities leaving aside weekend to health care facilities patronage. There was a variation in the daily generation of biomedical waste in the study area. The observed possible variation can largely be explained by the type of specialization each of the facilities is designated to handle. For instance, specialist hospital specializes in in high critical cases that other health care providers do not. This study agrees with study conducted by Tesfahun et al (2015) in Ethiopia where they observed that healthcare waste generation rate were dependent on the type and level of hospitals. It can also be said that the variation were dependent on many factors which were buttressed by individuals interviewed. This includes the location of the health care facilities, size of the health facilities. The test of hypothesis confirms an existing significant variation in the average weight of daily biomedical waste generated across the sampled healthcare facilities.

In conclusion, poor management of biomedical waste had negatively significant impact on the waste handlers within the facilities. Therefore, it is necessary that the authorities in charge should enforce the healthcare waste management plan so that the society can be free from risk associated with medical waste in order for the environment to be sustainable for human habitation.

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