http://dx.doi.org/10.22161/ijeab/2.6.52 *ISSN: 2456-1878*

Healthcare wastes management practices by public health facilities in Oshimili-South LGA of Delta State, South-South Nigeria

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Abstract— Background: *The sustainable management of Healthcare waste has continued to generate increasing public interest due to the health problems associated with exposure of human beings to potentially hazardous wastes arising from healthcare.*

Objectives: *To ascertain the healthcare wastes management practices by public health facilities in Oshimili-South LGA of Delta State.*

Methods: *A cross-sectional descriptive study. A multistage sampling technique was used in the selection of LGAs, healthcare facilities and respondents. There was Characterization and measurement (quantification) of waste. The study instrument was English language structured self administered questionnaire. The data obtained were analyzed using SPSS version 17.*

Results: *Practice of wastes reduction 92 (24.2%), wastes recycling 46(12.1%) and wastes weighing 72(18.4%). Fifty nine point four percent (59.4%) of respondents use personal protective equipments when handling wastes. Most 214 (62.2%) reported that burning was their final healthcare wastes disposal methods. The doctors, pharmacists and laboratory scientists all reported 100% use of protective gadgets. While the nurses (56.9%) and the wastes handlers (50.9%) use protective gadgets. On the average, 2.40kg/bed/day of waste was generated by the health facilities.*

Conclusion: *The study revealed that there was poor practice of waste segregation and recycling in all the facilities. There is need for more training.*

Keywords— *Healthcare, waste, management, practices.*

I. INTRODUCTION

In Nigeria, healthcare waste falls under the category of infectious waste.[1] These constitute a special category of waste because they contain potentially harmful materials like microbial culture and stock of infectious agents, pathological waste, waste from surgery or autopsy that were in contact with infectious agents, sharps (hypodermic needles, syringes, scalpel blades), waste from human blood and products of blood and laboratory waste. Other hazardous materials used by healthcare institutions that become part of their waste streams includes chemotherapeutic agents, antineoplastic chemicals, solvents, formaldehyde, photographic chemicals, radionuclides, mercury, anesthetic gases and toxic, corrosive and miscellaneous chemicals. Additional waste such as incinerator exhaust, laundry-related and kitchen waste are also Generated.[2]

HCWs management is a serious environmental impacting issue that must be addressed using series of management instruments that will help to alleviate the inherent havoc that these categories of waste have been causing and can cause to unsuspecting communities and inhabitants.[3] The sustainable management of Healthcare waste has continued to generate increasing public interest due to the health problems associated with exposure of human beings to potentially hazardous wastes arising from healthcare.[4,5]

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The problems in healthcare waste management stem from a failure of both practice and technology. Lack of waste segregation, unsafe waste handling, dumping of untreated wastes, preferential procurement of toxic products, extensive use of disposable materials, inadequate procedure for clean-ups and containment of spills, weak inventory controls of time-sensitive pharmaceuticals and reagents, and inappropriate classification of non-infectious waste as bio-hazard waste are examples of poor practices that lead to high rates of healthcare waste generation in health facilities.[6] The general options for management of solid waste range from prevention, minimization, reuse, recycling, energy recovery and disposal. That is integrated waste management. Methods of disposal of solid waste includes: sanitary landfills, incineration, composting, dumping, manure pits and burial.[7] The nature and quantity of healthcare waste generated, as well as institutional practices with regards to sustainable methods of healthcare waste management, including waste segregation and waste recycling are often poorly examined[8] and documented in several countries of the world despite the health risk posed by the improper handling of healthcare waste. It is also of serious concern that the level of awareness, particularly of health workers regarding healthcare waste has not been adequately documented.[8]

The Waste Management Authority in Lagos discovered that the specialized form of waste from hospitals and diagnostic laboratories was not being properly managed at any level in the state. The comingling of general or domestic waste with infectious waste (specialized waste) was very common[9], and healthcare waste being generated from healthcare facilities carries a higher potential of infection and injury than any other type of waste and poses danger if not properly managed. The authority saw the need for inter-sectoral collaboration and has been working with other state agencies including: the Ministry of Health; Ministry of Environment; Health Facility Monitoring and Accreditation Agency (HEFAMAA); the Environmental Protection Agency; John Snow Incorporated and AIDSTAR-ONE (NGO); in the development of consistent regulatory approach to ensure proper management of HCWs across the state. The authority medical waste management unit has also identified adaptations of various initiatives and "best practices". The introduction and free distribution of color coded bin liners and safety boxes to all accredited hospitals both (public and private) was one key strategy to jump-start the HCW management programme. Other efforts include participation of private service providers (PSP); annual HCW summit with stakeholders; training of hospital personnel and healthcare workers, emphasizing on waste segregation and containerization at source. They also organize training and workshops for waste handlers, effective monitoring and enforcement and strict legislation on infectious and hazardous waste management.[9]

The WHO Safe Healthcare Waste Management Policy Paper 2002[10] recommended that preventing the health risks associated with exposure to HCW for both workers and the public is achieved by promoting environmentally sound management policies for HCW; The Basel Convention is on management of hazardous and other wastes. It emphasizes the need to reduce exposure to toxic pollutants associated with the combustion process through the promotion of appropriate practices for high temperature incineration. Its strategies includes identification and development of recycling options wherever possible; research and promotion on new technology or alternative to small-scale incineration; risk assessment to compare the health risk associated with incineration and exposure to HCW; effective scale-up promotion of non-incineration technologies for the final disposal of HCW to prevent the disease burden from unsafe HCW management; promotion of the principles of environmentally sound management of HCW.[10]

In Nigeria, there is often the lack of manpower resource to properly manage huge amounts of medical waste generated.[21] Lack of relevant training and equipment for the waste handlers is a common feature particularly in public hospitals. They are highly exposed to risk of infection due to none provision of protective equipments.[27] It has also been found that health workers in Nigeria are unaware of relevant regulations and the existence of a hospital waste management policy.[11,12]

The study seeks to ascertain management practices of health facility wastes along with types and amount of wastes generated. This will bring to fore the gaps and lapses in HCWM.

Studies on healthcare wastes and healthcare wastes management practices have been conducted all over the world, amongst which is a study done in 2004 on healthcare waste management in the city of Ulaanbaatar, Mongolia.[13] In this study, information was obtained to describe the existing procedures practiced in handling and treatment of healthcare wastes produced. In addition, a cross-sectional study was conducted to characterize and quantify the healthcare wastes generated in Ulaanbaatar city of Mongolia.[13] A total of 56 healthcare facilities operating in the city were selected for the study: 15 large (13 public and 2 private). Results showed that an average total of about

2.65 tones were produced per day in public health facilities, in which 0.78 tons are medical and 1.87 tons were general waste. The medical waste per patient per day was 1.4-3.0 times higher in the inpatient sections than in the outpatient sections.[13]

A study carried out in Karachi, Pakistan[14] on healthcare waste management in hospitals in Karachi, reported that healthcare waste management practices in hospitals in Karachi was far below the desirable level due to lack of understanding about its significance by stakeholders, and absence of professional input and capability to deal with the issues. Also reported, was general slackness on the part of facility managers, inadequately trained staffs, inappropriate tools and equipments, and limited awareness about the contagious nature of the waste. The healthcare waste is collected and disposed with municipal solid waste, which is dangerous to the health of the public.[14]

A critical analysis of healthcare waste management in a developed and developing Country, comparing England to India was done. The study employed a range of methods such as, audits and questionnaire surveys to examine healthcare waste management practices in the Andhra Pradesh State India. Compliance with the regulatory notifications for biomedical waste management and handling rules 1998, under the environmental protection act (1986) of the government of India was used as the standard.[15] Whilst in King George Hospital, England, the published practices of a case study organization in compliance with policies such as the hazardous waste regulations 2006 were utilized. The study reported that the management of healthcare waste in India was far below recommended practice and standard, despite the introduction of rules and regulations, wastes generated by government hospitals were still largely being dumped in the open, waiting for collection along with the general waste. Unlike India, the management of healthcare waste is very stringent in England.[15]

Another study carried out in Irrua specialist teaching hospital, Irrua, Edo State, Nigeria, on healthcare waste management, revealed that the average amount of healthcare waste was 0.62 kg/person/day at the out-patient units and 0.81 kg/bed/day in the in-patient wards. The proportion of respondents (healthcare workers including waste handlers) who had received specific training in the management of healthcare waste was 11.5% (6/52). The number who understood the importance of healthcare waste management practice was found to be 0. This study highlighted the pitfalls of healthcare waste management practices in Nigeria.[16] A similar study on healthcare waste disposal practices of 432 private dental practitioners in the city of Bangalore, India was carried out. Results revealed that Dentist in Bangalore were poorly aware regarding healthcare waste disposal methods and the existence of legislation governing healthcare waste disposal. These practitioners were not motivated enough to comply with the guidelines.[17]

A study in Lagos State Nigeria, to determine the variations and similarities in the healthcare waste disposal practices within two General Hospitals (Orile-Agege General Hospital and General Hospital, Lagos) located in separate Local Government Areas of Lagos State was done. The study used physical observation, waste quantification or estimation and documented information provided in the hospital records. Primary and secondary data were gathered, the primary were collated through the field survey over a month each, where oral interviews, field video and photography, discussion with workers, quantification of various sectional waste using two scales, one with +1/-0.1 accuracy with a minimum range of 0.02 and capacity of 3.0kg and the second with +1/-0.5 accuracy with minimum of 1kg to a maximum capacity of 120kg. The study revealed similarities in many areas.[3] Total waste segregation was not practiced on the two sites, no waste reduction or minimization measures exist either. Many sections do not keep proper records on the quantities of the materials used for treating patients; neither do they normally quantify their generated waste daily. Co-disposal of domestic and healthcare wastes like highly infectious wastes (like from DOTS and VCT) is the normal practice existing in the hospitals and co-collection of the generated wastes by wastes collectors was observed to be the norm and non observance of most colour codes recommended for keeping waste was the practice.[3]

A cross-sectional study in Nigeria Federal Capital Territory (FCT), Abuja in 2006 on characterization and management of solid medical wastes in five selected hospitals, showed that the average waste generation rate per bed/day was 2.78kg of solid waste, 26.5% of the total waste was hazardous in nature. Waste segregation was not practiced by any of the hospitals surveyed, 18.3% of the hospitals incinerated waste in a locally built brick incinerator; 9.1% bury; 36.3% burn waste in open pits while 36.3% dispose of a waste into municipal dumpsites. It was also found that waste management officers do not have formal training in waste management techniques; and hospital administrators pay very little attention to appropriate management of medical waste.[18]

http://dx.doi.org/10.22161/ijeab/2.6.52 *ISSN: 2456-1878*

A similar study was done in four (2 private and two public) hospitals with capacity ranging from 40 to 600 beds in metropolitan Lagos. Results showed that medical waste management practices in all hospitals indicate absence of full compliance with the protocol for handling medical wastes as stipulated in the relevant sections of the guidelines and standards for environmental pollution control in Nigeria. Three hospitals demonstrated high priority for segregation of infectious medical wastes. Average generation rate of medical wastes in the investigated hospitals range from 0.562kg/bed/day to 0.670kg/bed/day. Infectious waste accounts for between 26 to 37% of this volume. Only two of the hospitals investigated carry out treatment of their infectious and sharp wastes by incineration before final disposal. Burning and burial of medical waste is an unusual but common practice among the hospitals. All hospitals employ the services LAWMA for final collection and disposal of their medical wastes at Government approved sites.[19]

II. METHODS

The study was carried out in Oshimili-South Local Government Area (LGA) of Delta North Senatorial District of Delta State; it is a semi-urban area with headquarters in Asaba. It has an area of 603 square kilometers and a population of 149, 603 at the 2006 census.[20] It consists of ten towns or communities namely Asaba, Oko, Cable point, Central core area, Isieke, Ezenei, Umuagu, Umueze, Umuonaje and Zappa.[21] This LGA has good access roads and pipe borne water supply. Located in this LGA is the Federal Medical Center, Asaba, the Delta State University, Anwai Campus, the Federal College of Education (Technical). This area is connected to the National grid of the Power Holding Company of Nigeria. The main religion in this area is Christianity and the language spoken by the people are Igbo, English language and Pidgin English. There are eleven (11) public health facilities in the LGA. There are nine primary health care centers, one general hospital at Okwe and one tertiary health care facility (Federal Medical Centre, Asaba) in Oshimili-South LGA. The PHCs include PHC Umuagu, Okwe, Awai, Anala, Ogbele, Amakoma, Akwaebune, Umueze and West-End. The Federal Medical Centre (FMC) has 175 doctors, 42 pharmacist, 43 laboratory scientist and technicians, 400 nurses, 19 workers in radiology, 7 in physiotherapy, 7 in pathology and 132 health/ward assistance/health care wastes handlers. This make a total of eight hundred and fifty (855) health staff in the FMC. The general hospital has a total of 120 health staff, amongst whom, are doctors, nurses, laboratory staffs, pharmacist, ward assistants and waste handlers. The nine PHCs have a total of 248 medical and environmental health staff.

The study was a cross-sectional descriptive study among healthcare workers in public health facilities and they included medical doctors, pharmacists, nurses, midwives, laboratory scientists, laboratory technicians and healthcare waste handlers/ward orderlies. Non medical workers such as the administration and accounting staffs were excluded. Also excluded from this study are private health facilities and those who refused to give consent to participate in this study.

Characterization and measurement (quantification) of waste:

Waste items from the FMC, the General Hospital and the nine PHCs were categorized according to wastes types. The cooperation of staff of each shift was sought to place all the wastes generated inside the labeled colour coded polythene bags that were provided by the researcher as appropriate by repeatedly reminding them. Red coloured bags were used for highly infectious waste like body parts, placenta, body fluids, blood bags, culture plates etc. Yellow bags for waste moderately infectious but hazardous waste like swabs, wound dressings not too soaked, infusion sets, catheters etc. Black bags labeled 'general waste' for general (non-hazardous) waste like paper, food debris, cans etc and other labeled black bags for chemicals and drugs.

After twenty four (24) hours, the bags were collected by the research team members. In the renal unit, theatre and labour rooms, wastes were weighed per shift because the nature of the waste required immediate disposal. Wastes were collected on alternate days for a week per hospital and per PHCs. The wastes were sorted and weighed in polythene bags using a top loader scale Camry Emperors 100kg with a capacity of 100kg and intervals of 100gm. Smaller amounts of wastes were weighed using same make of scale but with a capacity of 20kg and intervals of 50gm. Scales were standardized everyday by a known weight. The characterization was done according to the categories stated above. Total waste per bed per day at each of the study sites was calculated by division of the total waste generated per day by the total number of occupied beds of each site.

Ethical approval for this study was given by the Ethical Committee of the University of Benin Teaching Hospital, Benin City, Edo State. Consent to participate in this study was sought from the respondents after detailed explanations to them about what the study entails, as well as assuring

http://dx.doi.org/10.22161/ijeab/2.6.52 *ISSN: 2456-1878*

them of confidentiality of information to be given. The questionnaires were them self administered.

The sample size was calculated based on one proportion sampling with population greater than 10,000;

$n = Z^2 pq/d^2$

Where

n = the minimum sample size

z = standard normal deviate, set at 1.96 corresponding to 95% significance level.

P = 50% proportion of characteristics (attributes) in the population because there are no reports of previous studies on this in this area.

q = 1 – p

q = 1 – 0.5 = 0.5

d = precision or degree of accuracy i.e. acceptable margin of sample error set at 5% or 0.05.

Substituting the above figures in the formula, the desired sample size, n, for the study will be

$n = (1.96)^2 \times 0.5 \times 0.5 / 0.05^2 = 385$. This therefore means that a minimum sample size of 385 is required for the study to be valid.

Adjusting by 10% for non-response

n = 424 as now the sample size for the study.

A multistage sampling technique was used in the selection of LGA and participants in this study. There were nine primary health care centers, one general hospital at Okwe and one tertiary health care facility (Federal Medical Centre, Asaba) in Oshimili-South LGA. An English language structured self-administered questionnaire with open and closed ended questions with sections on social demographic data and wastes management practices was used for this study. The data obtained were analyzed using SPSS version 17. Test of associations were done using chi square statistics at 95% confidence levels.

III. RESULTS

In all, eleven health care facilities participated in this study. The FMC, General Hospital and nine PHCs.

Table.1: Socio-demographic characteristics of respondents: (N= 402)

Characteristics	Frequency	Percentages (%)
Age (years)		
10 – 19	7	1.9
20 – 29	82	22.1
30 – 39	138	37.2
40 – 49	106	28.6
50 – 59	38	10.2
Marital status		
Single	110	27.7
Married	245	60.9
Separated	20	5.0
Divorced	16	4.0
Widowed	11	2.7
Designation		
Doctors	46	11.4
Nurses	130	32.3
Pharmacists	20	5.0
Lab. Scientists	20	5.0
Wastes handlers/Health assist.	120	29.8
Others e.g. labourers etc	66	16.4
Religion		
Christianity	398	99.7
Islam	1	0.3

A total of 402 health workers from the two hospitals and the nine PHCs participated in the study giving a response rate of 95%. The age group 30-39 years constituted 138 (37.2%) of respondents. The mean age of respondents was 36.8± 10years with standard deviation of 9.1 years. The age of respondents ranged from 18 – 55 years. Majority 245 (60.9%) of respondents were

http://dx.doi.org/10.22161/ijeab/2.6.52 *ISSN: 2456-1878*

married, while 110 (27.7%) of the respondents were single. Nurses constituted the highest proportion of respondents in the study with a frequency of 130 (32.2%), followed closely by Healthcare Waste Management Workers (health/ward assistants/environmental health workers) who were 120 (28.9%) of the respondents. Majority 398 (99.7%) of the respondents were Christians.

Table.2: Hospital policy regarding healthcare waste management

Variables	Frequency (%)		Total
	Yes	No	
Awareness of HCWM policy	294(77.4)	86(22.6)	380(94.5)
Availability of focal person	233(72.1)	90(27.9)	323(80.3)
Employees information on policy	301(88.5)	39(11.5)	340(84.6)
Employees practice of policy	283(85.8)	47(14.2)	330(82.1)
Awareness of other hospital safety policies	233(57.5)	165(42.5)	388(96.5)
Penalty for not following policy	263(59.9)	136(40.1)	339(84.3)

The study revealed that 294(77.4%) of respondents are aware of a HCWM policy in their health facility; 233(72.1%) respondents know people in charge of the policy; 283(85.8%) of respondents practice this policy. Awareness of other policies like policy on universal precaution was 233(57.5%), and if there are penalties if the policies are not obeyed were 263(59.9%).

Table.3: Practices before final disposal

Variable	Frequency (%)		Total
	Yes	No	
Practices before final disposal			
Wastes reduction	92(24.2)	286(75.8)	380(94.5)
Wastes recycling	46(12.1)	333(87.9)	379(94.3)
Daily weighing of wastes	72(18.4)	320(81.6)	392(97.5)
Use of personal protective equipments	233(59.4)	159(40.6)	392(97.5)

Practice of wastes reduction 92(24.2%), wastes recycling 46(12.1%) and wastes weighing 72(18.4%) before final wastes disposal. It also revealed that only 233(59.4%) of respondents use personal protective equipments when handling wastes.

Table.4: Hospital waste disposal methods

Variable	Health facilities (%)			Total
	FMC	GH	PHC	
Final HCW disposal methods				
Incineration	10(2.9)	1(0.3)	19(5.5)	30(8.7)
Burying	29(8.4)	3(0.9)	49(14.2)	81(23.5)
Open dumping	4(1.2)	1(0.3)	3(0.9)	8(2.3)
Burning	53(15.4)	9(2.6)	152(44.2)	214(62.2)
Dumping into the river	0(0)	0(0)	11(3.2)	11(3.2)
Total	96(27.9)	14(4.1)	234(68.0)	344(100)

Most 214(62.2%) of the total respondents believe that the final healthcare wastes disposal methods of their health care facility is by burning. Fifty three (15.4%) of the FMC respondents; 9(2.6%) of the General hospital respondents; and 152(44.2%) of the PHCs respondents indicated burning as their final wastes disposal methods. This is closely followed by burying as a final wastes disposal method with FMC 29(8.4%); General hospital 3(0.9%); and the PHCs 81(23.5%) indicating burying as final disposal method.

http://dx.doi.org/10.22161/ijeab/2.6.52 *ISSN: 2456-1878*

Table.5: Training on healthcare waste management (HCWM): (N=365)

Variable	Training on HCWM		Total	Test/p-value
	Yes (%)	No (%)		
Designation of respondents				
Doctors	17(41.5)	24(58.5)	41(11.2)	
Nurses	68(58.1)	49(41.9)	117(32.1)	$X^2 = 17.304$
Pharmacists	3(27.3)	8(72.7)	11(3.0)	df = 5 p= 0.004
Lab. Scientists	11(78.6)	3(21.4)	14(3.8)	
Waste handlers/Health assist	61(59.8)	41(40.2)	102(27.9)	
Others e.g. Labourers etc.	32(40.0)	48(60.0)	80(21,9)	
Total	**192(52.6)**	**173(47.4)**	**365(100.0)**	
Health facilities				
FMC	58(55.2)	47(44.8)	105(28.8)	$X^2 = 1.309$
General hospital	19(59.4)	13(40.6)	32(8.8)	df = 2 p= 0.520
PHCs	115(50.4)	113(49.6)	228(62.5)	
Total	192(52.6)	173(47.4)	365(100.0)	

Indicates that laboratory scientists were found to have had more training on HCWM (78.6%), followed by wastes handlers/health assistants (59.8%), nurses (58.1%), and doctors (41.5%). The General Hospital had more training on HCWM for their health staff (59.4%), followed by the FMC (55.2%), and the PHCs (50.4%).

But however, statistically, designation of respondents, and difference in healthcare facilities were both not found to be significantly associated with training on HCWM. In other words, there was no difference in training on HCWM in the different designation and also in the different healthcare facilities.

Table.6: Use of protective gadgets and equipments

N = 392

Variable	Use of protective gadgets		Total	Test/p-value
	Yes (%)	No (%)		
Designation				
Doctors	46(100.0)	0(0)	46(11.7)	
Nurses	74(56.9)	56(43.1)	130(33.2)	$X^2 = 73.549$
Pharmacists	15(100.0)	0(0)	15(3.8)	df = 5
Lab. Scientists	15(100.0)	0(0)	15(3.8)	p= 0.0001
Wastes handlers/Health assist.	56(50.9)	54(49.1)	110(28.1)	
Others e.g. Labourers etc.	27(35.5)	49(64.5)	76(19.4)	
Use of protective gadgets/ equipments				
FMC	106(89.8)	12(11.2)	118(30.1)	$X^2 = 92.920$
General Hospital	30(88.2)	4(11.8)	34(8.7)	df= 2
PHC	97(40.4)	143(59.6)	240(61.2)	p=0.001

There is a statistically significant difference in the use of protective gadgets and equipments among the different designations of health staffs and also among the different healthcare facilities. In other words, there is a statistically significant association between the designation of respondents, healthcare facilities of respondents and the use of protective gadgets.

The doctors (100.0%), pharmacists (100.0%), and laboratory scientists (100.0%), use protective gadgets all the time, while the nurses (56.9%) and the wastes handlers/health assistants (50.9%) use protective gadgets less often.

The respondents of the FMC (89.8%) and those of the General hospital (88.2%), use protective gadgets and equipments while respondents of the PHCs (40.4%) use these gadgets less often.

http://dx.doi.org/10.22161/ijeab/2.6.52 *ISSN: 2456-1878*

Table.7: HCWM practices before final disposal

Variable	Practices before final disposal		Total	Test/p-value
	Yes (%)	No (%)		
Weighing of waste before disposal				N = 392
FMC	32(27.1)	86(72.9)	118(30.1)	$X^2 = 52.75$
General Hospital	19(55.9)	15(44.1)	34(8.7)	df = 2
PHC	21(8.7)	219(91.3)	240(62.2)	p=0.0000
Practice of waste reduction				N = 380
FMC	40(36.4)	70(63.6)	110(28.9)	$X^2 = 18.46$
General Hospital	12(36.4)	21(63.6)	33(8.7)	df =2 p= 0.0000
PHC	40(16.9)	197(83.1)	237(62.4)	
Wastes recycling				N = 379
FMC	7(6.4)	103(93.6)	110(29.0)	$X^2 = 7.356$
General Hospital	2(6.1)	31(93.9)	33(8.7)	df=2 p=0.025
PHC	37(15.7)	199(84.3)	236(62.3)	
Disposal of all waste medical and Non-medical in same container				N = 391
FMC	48(41.7)	67(58.3)	115(29.4)	$X^2 = 30.32$
General Hospital	12(38.7)	19(62.3)	31(7.9)	df=2 p=0.0000
PHC	170(69.4)	75(30.6)	245(62.7)	
Use of special wastes containers for sharps				N = 360
FMC	94(79.7)	24(20.3)	118(30.1)	$X^2 = 1.38$
General Hospital	23(67.6)	11(32.4)	34(8.7)	df = 2
PHC	37(15.7)	199(84.3)	236(62.3)	p=0.0000

There is a statistically significant difference among those that weigh their wastes before disposal and those that do not in the different healthcare facilities. Weighing of wastes before disposal is most commonly practiced by respondents of the General hospital (55.9%), and least practiced by respondents of the PHCs (8.7%) and FMC (27.1%).

There is a statistically significant difference among those that practice wastes reduction before disposal and those that do not in the different healthcare facilities. Though, there is poor practice of wastes reduction in all the health facilities, it is worst with the PHCs (16.9%).

There is no statistically significant difference among those that practice wastes recycling, or use of special wastes containers for sharps and those that do not in the different healthcare facilities. The practice of wastes recycling is generally poor in all the health facilities studied. Though, no statistically significant difference, the use of special wastes containers for sharps is higher in the FMC (79.7%) and the General hospital (67.6%) as compared to the PHCs (15.7%).

Table.8: Final wastes disposal methods of Health Facilities *N = 344*

Variable	Health Facilities			Total	Test/p-value
	FMC (%)	GH (%)	PHC (%)		
Final wastes disposal methods					
Incineration	10(33.3)	1(3.3)	19(63.3)	30(8.7)	
Burying	29(35.8)	3(3.7)	49(60.5)	81(23.5)	$X^2 = 13.078$
Open dumping	4(50.0)	1(12.5)	3(37.5)	8(2.3)	df = 8
Burning	53(24.8)	9(4.2)	152(71.0)	214(62.2)	p= 0.109
Dumping into the river	0(0)	0(0)	11(100.0)	11(3.2)	

http://dx.doi.org/10.22161/ijeab/2.6.52 *ISSN: 2456-1878*

Indicates that 214(62.2%) of the respondents from the different healthcare facilities believe that their facilities final wastes disposal methods is by burning.

Though, there was no statistically significant difference between the final HCW disposal methods in the different healthcare facilities.

Table.9: Characterization and quantification of waste Amount of various categories of waste generated from hospitals per day

	General (kg)	Sharps (kg)	Infectious (kg)	Pathological (kg)	Radiological (kg)	Pharmaceuticals (kg)	Total (kg)
Health facilities							
FMC	132.2	1.6	12.2	7.5	0.0	2.4	155.9
General hospital	23.7	0.7	10.2	2.3	0.0	1.2	38.1
PHCs	332.2	12.3	4.5	0.5	0.0	2.6	352.1
Total	488.1	14.6	26.9	10.3	0.0	6.2	546.1

Shows that the amount of various categories of waste differed. General waste had the highest quantity followed by infectious waste in all the health facilities.

Table.10: Mean waste generated per bed daily

	Mean number of Occupied beds/day (N)	Mean total waste generated (kg)/day (kg)	Estimated waste/bed/day (kg)
Health facilities			
FMC	86	155.9	1.81
General hospital	17	38.1	2.24
PHC	112	352.1	3.14
Total	**201**	**546.1**	**7.19**

Reveals that total amount of waste generated per facility increased with total number of occupied beds. However, the PHCs generated more wastes per bed/day (3.14kg/bed/day), while the FMC generated the least amount of waste/bed/day (1.81kg/bed/day). On the average, 2.40kg/bed/day of waste was generated by the health facilities.

Table.11: Composition of waste from the health facilities.

	Percentage composition of waste categories generated per day			
	General (non Hazardous) Kg(%)	Hazardous infectious Kg(%)	Hazardous non infectious Kg(%)	Total Kg(%)
Health facilities				
FMC	132.2(84.8)	21.3(13.7)	2.4(1.5)	155.9(100.0)
General hospital	23.7(62.2)	13.2(34.6)	1.2(3.1)	38.1(100.0)
PHCs	332.2(94.3)	17.3(4.9)	2.6(0.7)	352.1(100.0)
Total	**488.1(89.3)**	**51.8(9.5)**	**6.2(1.1)**	**546.1(100.0)**

http://dx.doi.org/10.22161/ijeab/2.6.52 *ISSN: 2456-1878*

This shows that the waste generated consisted of 89.3% general waste, 9.5% of hazardous infectious waste (sharps, infectious and pathological waste) and 1.1% of hazardous non infectious waste (pharmaceutical and radiological waste). Waste composition did not vary with hospital type.

IV. DISCUSSION

Segregation is the essence of waste management and together with waste identification, the key to minimization and effective management of healthcare waste. The most appropriate way of identifying the categories of healthcare waste is by sorting the waste into colour-coded plastic bags or containers.[22] In this study, only 43.3% of the respondents practiced waste segregation by disposing waste into colour coded plastic bags or containers, while 58.8% of the respondents deposit both medical and non-medical waste into same plastic or containers. Segregation of medical waste from non-medical waste was almost completely lacking in this study except from segregation of sharps, and this is in keeping with several studies like the study in two general hospitals in Lagos, Nigeria,[3] Another study in the Federal Capital Territory (FCT), Nigeria[18]; studies in the Fars Province of Iran[23] and the University Hospital in Fars, Iran[24]; other studies in Jos[25] and PortHarcourt,[26] Nigeria, that all reported poor segregation of medical from general wastes. Contrary to findings in this study, are reports of high priority segregation of infectious medical waste from general waste as reported in studies done in Lagos, Nigeria in two private and two public hospitals with bed capacity of 40 to 600 beds.[19] Similarly, a study in the United States (US) of America, reported a 95.4% rate of segregation of medical from general waste among US hospitals. Also reported in this study, is that 96.1% of US hospitals use labeled or colour-coded bags or both.[27]

Most (77.4%) of the healthcare workers are aware of HCWM policy in their healthcare facility. This is not in keeping with the study in Johannesburg, South Africa[22], the study in Bangalore, India[45] and the study in Egypt[28] where awareness of wastes management policy were either non-existent or very low. In this study, awareness of HCWM policy in the different health facilities; awareness of policy by the different designation of respondents (doctors, pharmacist, nurses, laboratory scientist and waste handlers/ward orderlies); abiding by the policy when aware of it; and if respondents participate in policy implementation, were all found not to be significantly associated with healthcare wastes management policy implementation. Awareness of respondents of HCWM policy was highest among the FMC respondents (81.3%). This could be attributed to the fact that the FMC is a tertiary healthcare facility with more highly educated healthcare workers as compared to the general hospital and PHCs. Awareness of HCWM policy was also highest among doctors (78.6%) as compared to nurses (72.7%), pharmacist (71.4%), laboratory scientist (64.3%), and wastes handlers/health assistants (62.4). Though, there was no statistically significant difference in awareness of HCWM policy among the different designations.

This study revealed that there is poor practice by healthcare workers regarding waste reduction (24.2%), waste recycling (12.1%), and weighing of waste (18.4) before final disposal. This shows a higher level of practice of waste reduction, recycling and weighing of waste than that of the study in two general hospitals in Lagos[3] that reported 0% practice of waste reduction, recycling and weighing of waste before final disposal. Most (62.2%) of the total respondents reported that the final healthcare wastes disposal methods of their health care facility is by burning. This is of a higher level of than that of the study in the FCT, Nigeria where 36.3% was reported.

Only 52.6% of the healthcare workers had a form training on HCWM. The study revealed that there was no statistically significant difference in training on HCWM in the different designation and also in the different healthcare facilities studied. These findings are not in keeping with the study in Karachi, Pakistan,[14] FCT, Nigeria,[18] Fars University Hospital, Iran[24] and the study in Rawalpindi, Pakistan[29] that all reported poor knowledge of HCW due poor training of healthcare workers.

Proper training and management of healthcare workers with regard to HCWM is necessary, observance of standard precaution together with use of Personal Protective Equipments (PPEs) is also required. The minimum PPEs consist of overalls, waterproof long boots, heavy industrial gloves and facemasks. HIV, hepatitis B and C infections are some of the deadly hazards healthcare workers are exposed to. These are risk not only to the workers but also to their family members.[24] In this study, use of PPEs was best among the doctors (100.0%), pharmacists (100.0%), and laboratory scientists (100.0%). Poor practice was observed among the nurses (56.9%) and the wastes handlers/health assistants (50.9%). This may be explained by the fact that the doctors and laboratory scientist are in direct contact with patients and their specimens and therefore are more cautious. The pharmacy staff probably may not be that exposed to these hazards, but in this study, they seem to be

aware and very cautious of their safety. The poor usage amongst the nurses may be due carelessness on their part since knowledge of risk of HCW is high in this study. Poor usage amongst the waste handlers and ward assistants may be due to poor literacy, poor level of knowledge and poor risk perception. This seemingly poor usage of PPEs among sanitation staffs was also found among sanitation staff of in the study in Rawalpindi, Pakistan[29] and also lack of knowledge of use of PPEs in the study at the Fars University, hospital in Iran.[24]

Average waste generation per bed was 2.40kg/bed/day and this was similar to what was obtained in the FCT, Abuja, Nigeria where it was stated to 2.78kg/bed/day.[18] Lower values have been reported from Lagos,[19] Ilorin,[20] and Irrua,[16] However, per capital waste generation was much higher in Iran and the United States where it was 4.45kg and 6.93kg/bed/day respectively.[27,23] This varying amount of waste generated per bed daily between countries may be due to differences in economic status and development and the probability of using more disposable items and more consumables with higher economic status. The proportion of wastes constituents in this study (general waste made up of 89.3%, hazardous infectious 9.5% and hazardous non-infectious 1.1%; of the infectious, sharps consisted of 2.7%) were within the range reported from previous studies in Nigeria; Abuja[18] and Akure.[31]

V. CONCLUSION

The study showed that there is poor practice of waste segregation in all the facilities. None of the facilities segregated their wastes into different categories; wastes were not properly handled and were collected and disposed in mixed form. Also found was poor practice of waste reduction, recycling and waste weighing before final disposal. Practice was not influence by duration of work experience but was found in the case of use of personal protection equipments to be influenced by designation of the health worker.

A daily waste generation per bed was 2.40kg/bed/day. Waste composition was 89.3% general waste, 9.5% of hazardous infectious waste (sharps, infectious and pathological waste) and 1.1% hazardous non-infectious waste (pharmaceutical, chemical and radiological waste).

Most of the healthcare facilities did not have waste management plan, nor do they have waste management teams or clear defined procedures for waste management.

REFERENCES

[1] Federal Environmental Protection Agency (FEPA). Guidelines and standard for industrial Effluents, Gaseous emissions and hazardous waste management in Nigeria.1991. Accessed at www.vertic.org/media/.../Nigeria/NG_Environment_Agency_Act.pdf. On 11/06/2012.

[2] United States Environmental Protection Agency. Guides to Environmental Pollution Prevention: Selected Hospital Wastes streams. 1990. USEPA/625/7-90/009.

[3] Olubukola BO. Comparative Analysis of Healthcare waste management practice in two General hospitals in Nigeria.2009. Accessed at http://www.eco-web.com/edi/index.htm on 06/06/2011 at 10:21pm.

[4] Tudor TL, Noonan CL, Jenkin LET. Healthcare waste management; A case study from the Cornwall NHS, UK Waste Manage 2005; 25: 606-615.

[5] Ferreira AP, Veiga MM. Hospital waste operational procedures: A Case study in Brazil. Waste manage 2003; 21:377-382.

[6] UN/GEF. Global healthcare waste project. Accessed at www.gefmedwaste.org/ on 23/10/2012.

[7] Park K. Park's textbook of preventive and social medicine. m/s Bnarside bhant publishers 2009; 20 ed (13), 659-661.

[8] Farzadika M, Moradi A, Mohammadi MS. Hospital waste management statusin Iran: A case study in the teaching hospitals of Iran university of medical sciences. Waste Manage Res 2009; 27:384-389.

[9] Lagos Waste Management Authority 2011. Accessed at www.lawma.gov.ng/ on 14/01/2012.

[10] WHO. Safe healthcare waste management: policy paper, 2002. Accessed at www.who.int/water_sanitation_health/medicalwaste/hcwmpolicy/en/ on 02/12/2011.

[11] Townend WK, Cheeseman CR. Guidelines for the evaluation and assessment of the sustainable use of resources and waste management at healthcare facilities. Waste Manage Res. 2005; 23: 398-408.

[12] Adegbita MA, Nwafor SO, Afon A, Abegunde AA, Bamise CT. Assessment of Dental Waste Management in a Nigerian tertiary hospital. Waste Manage. Res. 2010; 28:769-777.

[13] Shinee S, Gombojav E, Nishimura A, Hamgjima N, Ito K. Healthcare waste management in the Capital city of Mongolia. Waste management 2007; 12: 22.

[14] Ahmed R, Ahmed N. Healthcare waste Management in Karachi, Pakistan.2008. Waste Management, 2004;

20(4): 34-52.Accessed at http//:www.waste.nl on 16/06/2011.

[15] Ijaya KG, Kavita D, Vidya KB. A critical Analysis of healthcare waste management in developed and developing Countries: Case study from India and England.2007. Accessed at www.swif.ait.ac.th/intlconf/ on 16/06/2011.

[16] Abah SO, Ohimain EI. Health care waste management in Nigeria: A case study. JPHE 2011; 3(3). 99-110.

[17] Sudhaka V, Chandrashekar J. Dental Healthcare Waste disposal among private Dental Practices in Bangalore City, India. Waste manage 2008; Accessed at www.ncbi.nlm.nih.gov/pubmed/18356854 on 17/06/2011.

[18] Bassey BE, Benka-Coker, MO, Aluyi SA. Characterization and management of solid Medical Waste in the Federal Capital Territory, Abuja Nigeria 2006. Accessed at www.ncbi.nlm.nih.gov/pmc/articles/pmc1831969 on 17/06/2011.

[19] Longe EO, Williams A. A preliminary study of medical waste management in Lagos metropolis, Nigeria. Iran.J. Environ. Health. Sci. Eng., 2006; 3(2):133-139.

[20] Mokuolu O. Improving the management of solid hospital waste in a Nigerian tertiary hospital. Free online files, September 2009. Available at http://www.thefreelibrary.com/health+general+community/2009/September/25- p5384

[21] Kane A, Lloyd J, Zaffran M, Simonsen L, Kane M. Transmission of hepatitis B, hepatitis C and human immunodeficiency viruses through unsafe injections in the developing world: model-based regional estimates. Bull needle stick accidents. World Health Org 1999; 41: 151-4.

[22] Cocchiarella L, Scott D, Deitchman SD, Young DC. Biohazardous waste management: What a the physician needs to know. Report of the council on scientific affairs. Arch Fam Med. 2000; 9: 26-9.

[23] Askarian M, Vakili M, Kabir G. Results of a hospital waste survey in private hospitals in Fars province, Iran. Waste Management, 2004; 24(4): 347-52.

[24] Askarian M, Vakili M, Kabir G. Hospital waste management status in university hospitals of the Fars province, Iran. Int. J. Environ. Health Res, 2004; 14(4): 295-305.

[25] Ngwuluka N, Ochekpe N, Odumosu P, John SA. Waste management in health care establishment within Jos metropolis, Nigeria. Afr J of Env Sc and Tech 2009; 3(12): 459-465.

[26] Ogbonna DN, Chindah A, Ubani N. Waste management options for healthcare wastes in Nigeria: A case study of Port Harcourt hospitals. Journal of Public Health Epidemiology 2012; 4(6): 156-169.

[27] Rutala WA, Odette RL, Samsa GP. Management of infectious wastes by US hospitals. JAMA, 1989; 262: 1635-40.

[28] Ramokate T, Basu D. Health care waste management at academic hospital: knowledge and practice of doctors and nurses. SAMJ, 2009; 99(6): 444-5.

[29] Chaudhry MA, Hyat A, Qureshi SM, Najmi SAA. Health hazards of hospital waste to sanitary workers at combined military hospital, Rawalpindi. Pakistan armed forces medical journal, 2004; 2(11).

[30] Coker AO, Sikiru KA, Sridhar MKC, Sangodoyin AY. Characterization and management of hospital solid wastes in Nigeria: Sanitation and water for all, proc. of the 25th WEDC Conf, Addis Ababa Ethiopia. 1999; 331-4.

[31] Babatola JO. A study of hospital waste generation and management practices in Akure, Nigeria. African Research Review 2008; 2(3): 292-305.