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Research Paper

Healthcare Waste Generation and its management in Delta State

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ABSTRACT

This study accessed waste generation in the healthcare sector and its management in Delta State, Nigeria. To achieve data on healthcare waste (HCW) generated was collected from the various wards in the government hospital on a weekly basis for a period of four months. The data generated was analysed using ANOVA. The study revealed 51% of the total HCW in Delta state is produced from Medical, Maternity and Surgical wards in Warri government hospital. In Delta State, an average of 5kg/patient/day HCW is generated. HCW generated in Warri and Asaba hospitals varies significantly from other hospitals in Delta State. The study recommends incineration and energy recovery as the best HCW management practice.
Keywords: *Healthcare, Waste, Delta State*

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I. INTRODUCTION

The rapid population growth has resulted in a demand led growth in hospitals, clinics, and medical services. The increasing number of hospitals, clinics, and medical centres has also led to increasing resources to improve their practice, thus creating an increase in waste (Toyobo, Baba, & Oyeniyi, 2012). Hospital, like any other centre of man's activities, is a source for waste generation (Wahab & Adesanya, 2011). Some of the waste generated in hospitals are similar in many respects to that produced by hotels and restaurants. However, hazardous waste is generated from hospital waste and they are harmful to health workers, the public and the environment (Akter, 2000). Most health care waste contain materials such as syringes, soiled dressings, chemicals and radioactive materials. These wastes are generated in different treatment process, which includes diagnosis, monitoring and preventive, curative or palliative activities in field of the veterinary and human medicine (Akter & Tränkler, 2003).

Recent studies in Nigeria has estimated waste generation of between 0.562 to 0.670kg/bed/day (Longe & Williams, 2006) and as high as 1.68kg/bed/day. Any waste management design ought to be constructed upon a unswerving evaluation of the volume of waste generated (Karamouz et al., 2007). Our environment is directly or indirectly affected the impact of healthcare waste. Healthcare waste contains highly toxic materials which contains viruses and bacteria which could lead to dysfunction of the human body (Toyobo, Baba, & Oyeniyi, 2012). Prior to poor management and disposal, healthcare waste poses threats to environmental. The mishandling of medical waste stances as a risk to the wellbeing of individuals and the surrounding areas by polluting the water resources, air and soil.

In Delta State, healthcare waste is poorly segregated, handled and disposed in many of many health facilities. They do so by disposing all wastes to city dumpsites short of pre-treatment, prompting an undesirable and dangerous surrounding from place to place in the various health centres and hospitals, influencing, affecting patients, staff and the community. Again, workers in the health centres and hospitals, people that hands waste, people that pick wastes, people that handle sharps can are been infected with diseases like hepatitis B, C and HIV/AIDS viruses through the injuries sustained from the handling of on safe objects or reuse of syringes/needles. Most of the hospital in Delta State simply dump all their wastes together from reception area trash to operating room waste without any form of segregation while, a few use incinerators. Most of the waste handlers still collects HCW with bare hands.

In Delta State, there are weak policies on management of hospital waste and that is the reason it is not remarkable to discover different parts of hospital waste like utilized needles, disposed of blood vials, syringes, already used description bottles and so forth inappropriately arranged and left untreated. Consequently, this paper examines healthcare waste generation and its health effect on workers in Delta State. This research is geared to proffer possible suggestion towards management policies implementation to reduce the healthcare waste generation.

II. STUDY AREA

Delta State is situated in southern piece of Nigeria, limited by South by Gulf of Guinea, toward the West by Ondo State, South-North by Edo State, South-East by Bayelsa State, and East by Anambra State. The area is characterised by hydromorphic soils, which is a combination of abrasive sedimentary and colluvial deposits comprising essentially of thick friable sands with intercalation of clay beds, residues and abrasive to fine grained granites (Anomohanran, 2011). In this manner, the muds are inadequately depleted and aggregated with water since it is close to the Atlantic coast, having a high-water table near the surface.

The significant waterways in Delta State are Ethiope, Escravos, Niger, Forcados, Jameson, Warri, Ase, Benin, and Ossisa. Thus, prompting a need to manage health care waste which contaminate water. The average annual rainfall in the coastal area is about 266.5cm and 190.5cm in the Northern fringes of the State. Delta State has a high temperature ranging between 39^{o}c and 44^{o}C with an average of 30^{o}C (Kingsley, 2012). The vegetation varies from the mangrove swamps along the coast through rain forest in the middle to derived Savannah in the north. The population of Delta State is estimated to be 6,629,103 in 2012. The State Population is projected to be 9,529,403 in 2025. The growing affluence and increasing population have increased the demand for more healthcare facilities increases, there is also an increase in medical waste generation.

III. CONCEPTUAL ISSUES

This study is premised on the concepts of zero waste. Zero waste is established to maximize our existing recycling and reuse efforts, while ensuring to turn the outputs to inputs. Zero Waste is a concept geared towards change in policies, technologies, through creating an eco-design, industrial ecology, cleaner production through waste minimization and resource recovery at the end of the pipe (Staniškis, 2005).

The Zero waste concept has been applied in many studies in various urban communities focusing on zero waste, Clay, Gibson and Ward (2006) has applied this concept in their work in Australia, Malamakis et al. (2008) in Greece, Nader (2009) in Masdar City, Snyman and Vorster (2010) in Tshwane, Young, Ni and Fan (2010) in Taiwan, and Phillips et al. (2011) in England. Notwithstanding, there have been not very many examinations on an all-encompassing way to deal with zero waste. All these aspects create a complex cluster in our society (Zaman & Lehmann, 2011). Fig 1 shows the intricacy in planning zero waste, where the ecological circle functions as an edge for any remaining circles like political, economic, social, and mechanical, and that these circles are dynamic in nature.

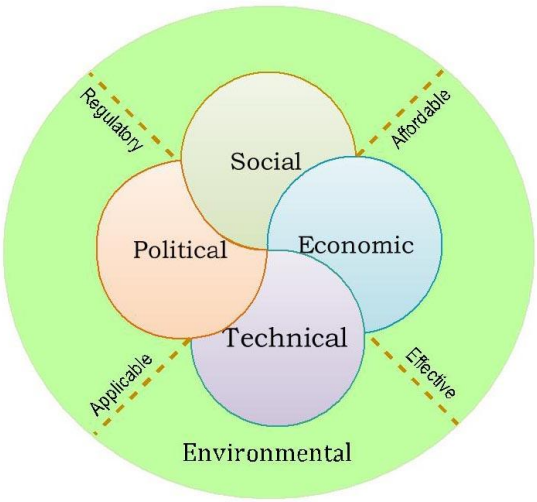

Fig. 1: Spheres in zero waste
Source: Zaman and Lehmann (2011)

Zaman and Lehmann (2011) recognized five centre viewpoints that are generally significant in changing urban communities into zero waste urban areas. This is a way of thinking that expects to direct individuals in the upgrade of their asset use framework determined to diminish waste to nothing.

IV. MATERIALS AND METHOD

The data utilized for this study was generated from measurements of health-care waste volumes in Delta State. Health-care waste was measured and categorized to ascertain the volume of waste generated and waste characteristics. Data on waste volume were collected from two (2) government general hospitals in each of the three zones. A total of 6 health-care centres in Delta State were evaluated (see Table 1). The HCW data were collected for a period of (4) months (August-November) from government hospitals in Delta State. These hospitals were chosen based on the specialization, availability and consistencies of data, and long existence, spreading across the already existing senatorial seats. In harmony with the research guidelines, oral permission from heads of each hospitals were obtained. A transient walk-through check-up from one healthcare to another healthcare centre were carried out to ascertained the type of waste generated.

Table 1: Distribution of Hospitals

Zones	**Health-care centres**
Delta North	Government hospital Kwale, Federal medical centre Asaba,
Delta Central	Central hospital Sapele, and Central hospital Ughelli
Delta South	Government hospital Burutu, Central hospital Warri

Source: Field work, 2019

This was useful to ensure data quality follow up at the time of data collection. All health service delivery sections were included for the transient observation: OPD (out-patient department), maternity, surgical, paediatric, gynaecological, diagnostic, treatment room, and accident/emergency. The researcher physically weighed generated waste quantities in each hospital using a weighting scale. The collected waste was and measured on daily basis to determine the volume of waste generated.

Waste weighing and recording station were arranged in convenient site within the vicinity of the health-care centre. Empty plastic buckets of standard colours: blue colour for general waste, green colour for pharmaceutical waste and red colour used for infectious waste and pathological waste were daily distributed to different section of the health centre. Plastic bags with different colours (blue strip plastic bags for general waste and red strip plastic bags for infectious waste and pathological waste) were kept inside the individual pails. The containers and plastic packs were named to demonstrate the various classifications of hospital waste, the location of the waste generated, date the waste was generated and number of samples. The wastes bin was emptied in the standard spot that the hospitals utilized for removal of wastes after its weight were estimated and recorded with recording log design sheet each day at 8:00am. Before this was done, the weight of the trash bin was measured on a spring balance instrument, so as to get the weight of the bin. Thereafter, the weight of the trash bin was subtracted, so as to get the net weight of the health-care waste. The health-care waste was further segregated to identify the various health-care waste categories using alphabetical notation such as follows: A=sharps, B=infectious, C=pathological, D=Pharmaceutical, E=non-hazardous waste.

The data on difference in volume of waste generated from the healthcare sector in Delta State was investigated using ANOVA. These data were key into the IBM SPSS version 21 and double checked before analysis.

V. RESULTS AND DISCUSSION

Table 2 shows the volume of HCW generated in government hospitals in Delta State. It revealed that Warri hospital produced the most (28.6%), Asaba produced 20%, with Kwale and Burutu producing 12% and 10% respectively. Over half (51%) of the total HCW produced in the delta State is generated from Medical, Maternity and Surgical wards, and the remaining 49% of HCW is generated from paediatric, gynaecological, treatment and accident wards. The maternity units in government hospitals in Delta state generates more volume of HCW, while the least HCW generation is from gynaecological Unit of the hospitals. The increase in the HCW in the maternity ward could be attributed to both waste of mothers and babies.

Table 2: HCW in Kg per unit in government hospitals in Delta State

	Medical	Maternity	Surgical	Paediatric	Gynaecological	Treatment	accident/ Emergency	Total	%
Warri	3246	8721	3252	3436	3286	2954	4126	**29021**	28.6
Asaba	2897	4672	3611	2100	2728	2212	2334	**20554**	20.2
Sapele	1893	2527	2762	1926	1965	1963	2132	**15168**	14.9
Ughelli	1457	2397	1952	2408	2414	1770	1308	**13706**	13.6
Kwale	1619	3553	1639	1659	1338	1279	1323	**12410**	12.2
Burutu	1347	2938	2083	1260	1259	1001	813	**10701**	10.5
Total	12459	24808	15299	12789	12990	11179	12036	**101560**	100
%	12.3	24.4	15	12.6	**12.8**	11	11.9	100	

Source: Field work 2019

Table 3 shows HCW generated per person per day in the different units in government hospitals in Delta State. The rate of waste generation in the healthcare sector was computed to be an average of 6.7kg/patient/day at Warri, 4.0kg/patient/day at Asaba, 6.8 kg/patient/day at Sapele, and 4.6kg/patient/day, 4.3kg/patient/day, and 3.7kg/patient/day at Ughelli, Kwale and Burutu respectively. This resulted in an average of 5kg per day for the six healthcare facilities. This could be attributed to facility size and diversity of services. administrative personnel in each sampled hospital.

Table 3: Departmental Healthcare Waste generated in Kg/person/day

	Medical	Maternity	Surgical	Paediatric	Gynaecological	Treatment	accident/Emergency	Average
Warri	2.5	1.2	3.5	18.3	11.1	5.0	5.3	**6.7**
Asaba	3.7	0.8	4.2	3.1	6.8	3.6	5.6	4.0
Sapele	4.2	0.8	8.8	3.7	6.0	13.0	11.0	6.8
Ughelli	3.7	1.2	2.3	5.8	8.5	6.4	4.6	4.6
Kwale	4.3	2.6	2.3	4.4	5.1	5.2	6.2	4.3
Burutu	4.2	2.4	3.1	3.7	5.4	3.3	4.0	3.7
Average	3.8	1.5	4.0	6.5	7.2	6.1	6.1	5.0

Source: Field work 2019

Fig 2 shows the monthly heath care waste generation in Delta State. The total volume of waste generated from August to November during the period of study was 141,125kg. More HCW were generated in the month of August and September. This could be attributed to increased birth rate and increased population of people that needed medical care.

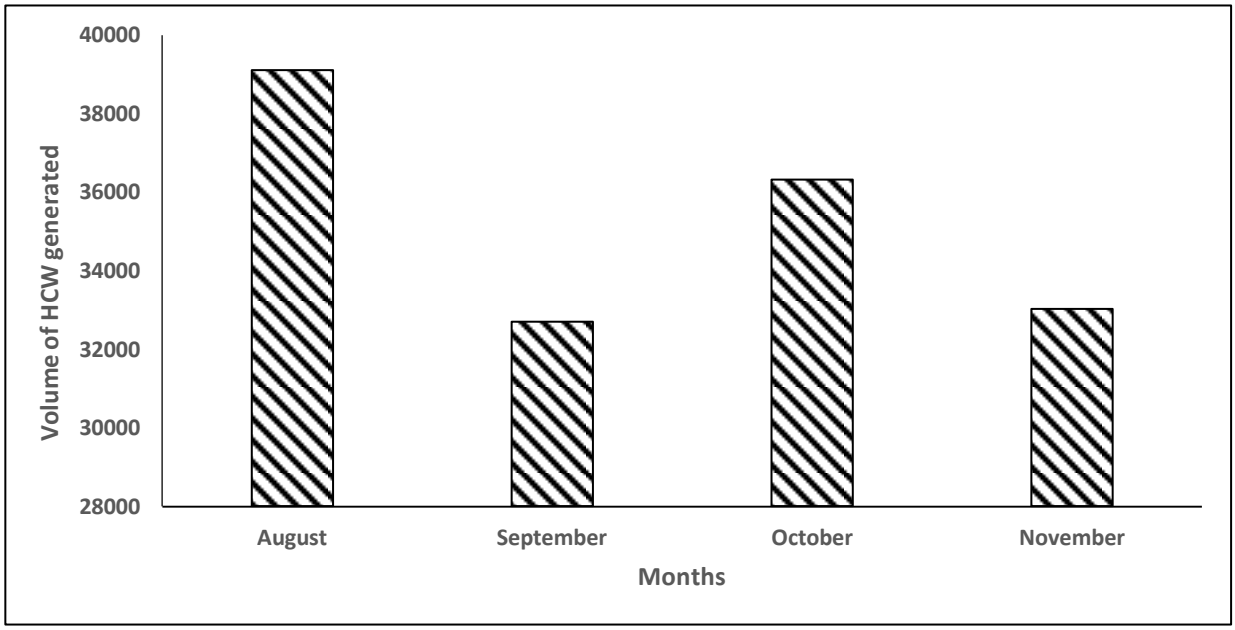

Fig 2: Monthly HCW generated in government hospitals in Delta State

Table 4 shows the healthcare waste characteristics in Delta State. In Delta State, 37% of the HCW generated in Delta State are infectious waste, while 12% of the healthcare waste are pathological waste.

Table 4: Volume of the types HCW generated in Delta State

	Warri	Asaba	Sapele	Ughelli	Kwale	Burutu	Total	%
General Waste	4579	3513	2381	2142	1878	1536	**16029**	**16.2**
Sharps	5555	2784	2434	2148	1926	1616	**16463**	**16.6**
Infectious	9576	8240	5327	5004	4676	4152	**36975**	**37.3**
Pathological	2806	2783	2204	1861	1606	1314	**12574**	**12.7**
Pharmaceutical	3994	3234	2822	2551	2324	2083	**17008**	**17.2**
Total	**26510**	**20554**	**15168**	**13706**	**12410**	**10701**	**99049**	**100**

Source: Field work 2019

In government hospitals in Delta State, infectious waste tends to be the most generated HCW type, while pathological HCW is the least generated type of HCW in Delta State.

Table 5 shows a calculated F value of 27.53 at P<0.05 which is greater than the critical F value of 2.23 at P<0.05, since calculated F value is greater than critical table value the model is significant. Therefore, there is significant variation in healthcare waste generation in Delta State.

Table 4.4: ANOVA on the variation in the volume of Healthcare Waste

	Sum of Squares	df	Mean Square	F	Sig.	Remark
Between Groups	2207147.210	5	441429.442	27.530	.000	Significant variation exists
Within Groups	7600322.687	474	16034.436			
Total	9807469.898	479				

Looking at the Sig. column in the Bonferroni post hoc test, there are values less than or with 0.05 (see Table 6).

These values are 0.00 to 0.013. These values correspond with the comparison between the healthcare waste generated in Warri Healthcare facility and other healthcare facilities, and Asaba healthcare facility and other healthcare facilities. Conclusively, healthcare waste generated in Warri and Asaba significantly varies from healthcare waste generated in other healthcare facility in the state. However, healthcare waste generated in Warri facility varies significantly from healthcare waste generated in Asaba

Table 6: Bonferroni

(I) Location Healthcare	(J) Location Healthcare	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1 Warri	2 Asaba	**74.450***	**20.022**	**.003**	**15.38**	**133.52**
	3 Sapele	**141.775***	**20.022**	**.000**	**82.71**	**200.84**
	4 Ughelli	**160.050***	**20.022**	**.000**	**100.98**	**219.12**
	5 Kwale	**176.250***	**20.022**	**.000**	**117.18**	**235.32**
	6 Burutu	**197.613***	**20.022**	**.000**	**138.55**	**256.68**
2 Asaba	1 Warri	**-74.450***	**20.022**	**.003**	**-133.52**	**-15.38**
	3 Sapele	**67.325***	**20.022**	**.013**	**8.26**	**126.39**
	4 Ughelli	**85.600***	**20.022**	**.000**	**26.53**	**144.67**
	5 Kwale	**101.800***	**20.022**	**.000**	**42.73**	**160.87**
	6 Burutu	**123.163***	**20.022**	**.000**	**64.10**	**182.23**
3 Sapele	1 Warri	**-141.775***	**20.022**	**.000**	**-200.84**	**-82.71**
	2 Asaba	**-67.325***	**20.022**	**.013**	**-126.39**	**-8.26**
	4 Ughelli	**18.275**	**20.022**	**1.000**	**-40.79**	**77.34**
	5 Kwale	**34.475**	**20.022**	**1.000**	**-24.59**	**93.54**
	6 Burutu	**55.838**	**20.022**	**.083**	**-3.23**	**114.90**
4 Ughelli	1 Warri	**-160.050***	**20.022**	**.000**	**-219.12**	**-100.98**
	2 Asaba	**-85.600***	**20.022**	**.000**	**-144.67**	**-26.53**
	3 Sapele	**-18.275**	**20.022**	**1.000**	**-77.34**	**40.79**
	5 Kwale	**16.200**	**20.022**	**1.000**	**-42.87**	**75.27**
	6 Burutu	**37.563**	**20.022**	**.919**	**-21.50**	**96.63**
5 Kwale	1 Warri	**-176.250***	**20.022**	**.000**	**-235.32**	**-117.18**
	2 Asaba	**-101.800***	**20.022**	**.000**	**-160.87**	**-42.73**
	3 Sapele	**-34.475**	**20.022**	**1.000**	**-93.54**	**24.59**
	4 Ughelli	**-16.200**	**20.022**	**1.000**	**-75.27**	**42.87**
	6 Burutu	**21.363**	**20.022**	**1.000**	**-37.70**	**80.43**
6 Burutu	1 Warri	**-197.613***	**20.022**	**.000**	**-256.68**	**-138.55**
	2 Asaba	**-123.163***	**20.022**	**.000**	**-182.23**	**-64.10**
	3 Sapele	**-55.838**	**20.022**	**.083**	**-114.90**	**3.23**
	4 Ughelli	**-37.563**	**20.022**	**.919**	**-96.63**	**21.50**
	5 Kwale	**-21.363**	**20.022**	**1.000**	**-80.43**	**37.70**

*. The mean difference is significant at the 0.05 level.

VI. CONCLUSION

The study revealed that the healthcare facility in Warri produced the most HCW and more than half of the total HCW produced in the Delta State is generated from Medical, Maternity and Surgical wards. An average of 5kg/patient/day HCW is generated in Delta State. The study revealed that there is a statistically significant variation in healthcare waste generation in Delta State, with Warri and Asaba differing from other healthcare facility in the state. The HCW generated in Delta State is highly hazardous and improper disposal of this HCW could become a health hazard.

It is therefore recommended that to achieve proper management of HCW, HCW site engineering design, cost and environmental impact assessment must be considered so as to minimize health risks, minimize adverse environmental impacts, minimize cost and, maximize public acceptability.

Certain predetermined regions are to be stayed away from for removal of solid waste and all the more especially for risky wastes to limit ecological effects including pollution of surface and ground water.

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