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Biomedical Waste Treatment: A Case Study of some Selected Hospitals in Bayelsa State, South-South, Nigeria

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ABSTRACT : *The treatment and disposal of solid medical waste from hospitals in Nigeria has been of growing concern in recent times. This is due to the hazardous nature of these wastes and the potential threat to spread deadly diseases to humans and other living organisms. To characterise and quantify these wastes, a study was carried out to ascertain the generation of biomedical wastes from ten hospitals in Bayelsa State, South-South, Nigeria. The hospitals were categorised into Tertiary, Secondary and Primary health institutions, and grouped into Public and Private owned facility. The result revealed that all the hospitals involved disposed their generated waste into municipal waste dumpsites without any form of treatment, leading to unhealthy and hazardous environment around the health institutions, affecting patients and staffs and the well-being of the general public. The study also showed that about 4330 kg total waste was generated per month by all ten hospitals of which 69% and 31% were generated by Public and Private hospitals respectively. The Tertiary, Secondary and Primary hospitals generate 69%, 28% and 3% of the total waste respectively and the average biomedical waste generated per bed per day was 0.18 kg. The study was concluded with recommendations for improvements on biomedical wastes handling and treatment in order to render proper and adequate waste disposal system in health institutions of Nigeria.*

KEYWORDS: *Biomedical wastes, health institutions, infectious waste, incinerator, segregation*

I. INTRODUCTION

Good medical care is vital for life, health and general well-being and hospitals are health institutions that provide these services. Wastes generated from the hospitals, health care centres, medical research institutions, blood banks, medical labouratories, etc. [1], usually include sharps, human tissue or body parts and other infectious materials and is referred to as "Health care waste", "Hospitals solid waste", and or "Biomedical solid waste" [2, 3].

While waste management has become a critical issue which has taken a central place in the national health policies of developed nations and is attracting considerable interest, in most developing countries like Nigeria, the handling and treatment of municipal solid waste (MSW) or domestic waste have not received sufficient attention [4]. In most developing countries like Nigeria, the management, treatment, and handling of medical waste is often very poor as medical wastes are still handled and disposed together with municipal solid waste into landfills and/or open municipal dumpsites at various locations within the cities [5]. Yet only about 75-90% of the waste is non-risk while the remaining 10-25% of medical waste is hazardous, creating a variety of health risk for the municipal workers, the general public and the environment, because of the presence of infections biological, hazardous and radio-active waste materials [6].

In Nigeria, for example, this unwholesome medical waste disposal practices may be attributed to ignorance, lack of awareness of the potential dangers this poses to the health of the people and the environment, including ground water, the high cost of effective and efficient management and handling of the waste by the authorities concerned, lack of strict laws and policies or enforcement of the laws governing the disposal of the medical waste by government agencies. Another important factor that may be responsible for this poor waste management practice is the problem of corruption, generally affecting all section of government agencies and parastatals. Furthermore, valuable information's on the definitions, nature, classification, generation rate, method of collection, storage and disposal of medical waste is very scarce.

The aim of this study therefore, is to evaluate the actual situation of medical waste management in Bayelsa State, South-South, Nigeria, with a view of:

(i) Quantitatively determining the types and quantity of medical waste generated,
(ii) Examining the existing waste management practices and its compliances with standard international produces for biomedical waste management and
(iii) Making useful contribution and suggestion to Government and hospital authorities were necessary on how best to handle the waste so as to minimize risk and protect human lives and the environment from pollution.

II. METHODOLOGY

2.1 Study Area

Bayelsa State with its capital, Yenagoa, is located in the Niger Delta Region, South-South of Nigeria. The state has a population of about 2 million people [7]. Presently, the State Government through the Bayelsa State Environmental Sanitation Authority is responsible for the collection and disposal of municipal solid waste through private companies contracted to carry out these services. Disposal of the municipal solid waste mixed with the medical waste with no treatment at all is carried out, in open municipal dumpsites along Tombia-Amassoma road, and this has led to serious environmental and social problems in Yenagoa, the state capital.

2.2 Sampling and Data Collection

A general survey of the operating procedures practiced in the handling, treatment and disposal of medical waste was carried out on some government and private hospitals present in the state with the capacity to handle simple to fairly complicated health problems. These hospitals, which may be classified as secondary health care centres, were examined to determine the nature and quantity of wastes generated, including their waste management practice.

Table 1: Inventory of Health care facilities sampled

Hospitals	Category	Hospital Type	Number of Beds
A	Tertiary	Public	154
B	Tertiary	Public	102
C	Tertiary	Private	82
D	Secondary	Public	74
E	Secondary	Private	54
F	Secondary	Private	48
G	Secondary	Private	38
H	Primary	Public	24
I	Primary	Public	20
J	Primary	Public	15
Total		10	611

Detailed information was collected from each ward/department/labouratory by means of structured questionnaires administered on the appropriate category of staff in the wards and departments of each hospital. Each field worker engaged during the study was fully kitted with protective wears.

Polythene bags were provided for each ward/department/depending on the expected waste generation rate. The waste were sorted out into different components and measured after every 24 hours. Waste generation rates were obtained on weight basis as described by Sangodoyin and Coker [8] and Silva et al [9]

The waste generated in the hospital kitchen and restaurants, and the soiled clothes sent to the laundry were not included in the study.

III. RESULT AND DISCUSSION

3.1 Assessment of Operating Procedures

During this study, it was observed that majority of the hospitals investigated had no waste management department or plan. There is also no training programme for the sanitary workers. Only hospital C and E has a pit used for burning some waste.

3.2 Segregation

The best way to reduction and effective management of biomedical waste is segregation and identification of waste. This can be achieved by sorting the waste into colour coded polythene bags of containers. Investigation revealed that all ten hospitals gave priority to segregation of sharps, biohazardous and infectious wastes. These wastes are segregated at the point of generation in the wards/department using cylindrical sharp aluminium containers fitted with polythene bags inside, for easy disposal. However, these segregated wastes are mixed together with other types of waste generated in the hospitals at the external waste storage facility during collection and disposal at municipal dumpsites, thereby endangering the lives of the sanitary workers, general public and the environment. It was also observed that the collection of these wastes from the external storage facilities within the hospital premises and subsequent disposal at the municipal dumpsites by the contracting firms is not regular.

3.3 Waste Generation

Investigation revealed that none of the hospitals had records of volume and kind of waste they generate making this the most difficult aspect of evaluation during this survey. Table 2 presents the details of various kinds and quantity of biomedical waste generated by each of the ten hospitals investigated. The results are presented with average values on a weight basis (kg/day).

Table 2: Waste Generation Rate (Average values)

Nature of waste	Hospitals										Cumulative	
	A	B	C	D	E	F	G	H	I	J		
	Kg/d	Kg/d	Kg/d	Kg/d	Kg/d	Kg/d	Kg/d	Kg/d	Kg/d	Kg/d	Kg/d	%
Infectious waste	24.67	11.79	8.45	8.23	4.04	2.80	2.70	0.43	0.30	0.32	63.73	44.74
Sharps	5.31	1.12	0.90	1.90	0.88	0.88	0.65	0.51	0.48	0.20	12.83	8.88
Pharceutical	3.20	2.02	1.30	-	1.02	1.12	0.35	-	-	-	9.01	6.24
Radiological waste	3.26	1.01	1.00	-	0.98	0.89	0.29	-	-	-	7.43	5.14
Non-infectious waste	19.62	8.58	6.72	5.45	3.72	3.07	2.15	0.50	0.42	0.28	50.51	34.99
Total Generation	56.06	24.52	19.20	15.58	10.64	8.76	6.14	1.44	1.20	0.80	144.34	100
Total Generation/bed/day	0.36	0.24	0.23	0.21	0.20	0.18	0.16	0.06	0.06	0.05	0.18 kg/bed/ Day	

The data presented in Table 2 summarizes the average quantity of biomedical waste generated by all ten hospitals. The result shows that these ten hospitals cumulatively generate approximately 4330 kg of medical waste per month, of which only about 35% is non-infectious. Which means that, the remaining 65% is hazardous and about 44.74% is infectious, and while the remaining 20.26% (consisting of sharps – 8.88%; pharmaceutical waste – 6.24%; and radiological waste – 5.14%) is also harmful to human and the environment. Hence, 65% of biomedical waste generated by these hospitals is infectious and harmful to humans and the environment.

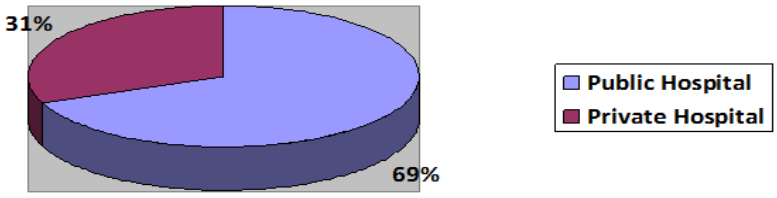

Figure 1: Percentage waste distribution by Hospital type

Fig. 1 shows that the public hospitals generate more wastes than the private hospitals. This shows higher patronage in the public hospitals, maybe due to low costs and proximity to residential homes especially in the rural areas. The average biomedical waste generation for the public hospitals is 0.16 kg/bed/day whereas that of the private hospitals is 0.19 kg/bed/day. This means that more waste is generated per bed in the private hospitals and potentially more severe cases are handled in the private hospitals.

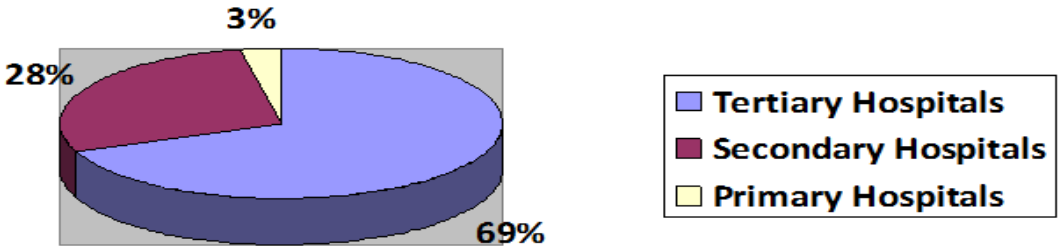

Figure 2: Percentage Waste distribution by Hospital Category

Fig. 2 shows the percentage biomedical wastes distribution based the hospital's category. Tertiary hospitals generates an average 0.27 kg/bed/day approximately 69% of the total wastes generated by all ten hospitals whereas the secondary and primary hospitals generate an average 0.19 kg/bed/day and 0.06 kg/bed/day respectively. This distribution might be due to the location of these hospitals as the tertiary hospitals are all located in highly populated areas and the primary hospitals are mainly situated in the rural sparsely populated areas.

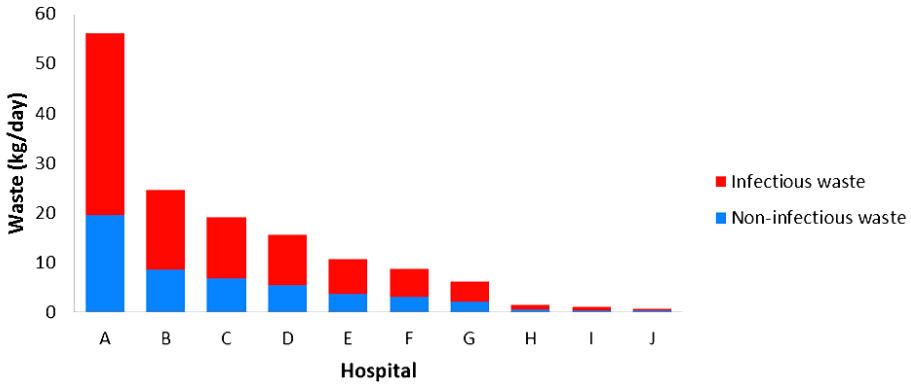

Figure 3: Hospitals Infectious/Non-infectious Waste distribution

Fig. 3 illustrates the daily distribution of infectious and non-infectious waste for all ten hospitals. All hospitals showed higher values of infectious wastes due to the classification of sharps, pharmaceutical waste and radiological waste as infectious wastes. The results also follow a descending order according the number of beds each hospital contains. The private hospital generated more pharmaceutical and radiological wastes compared with the public hospitals.

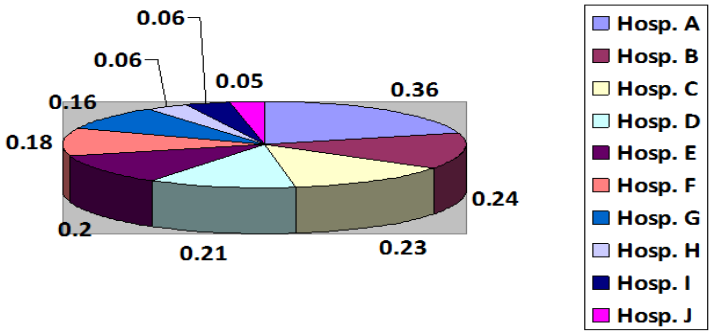

Figure 4: Hospitals waste distribution in Kg/bed/day

The result shown in Fig. 4 gives the average rate of biomedical waste generation for the ten hospitals as 0.18 kg/bed/day with (A – 0.36 kg/bed/day; B – 0.24 kg/bed/day; C – 0.23 kg/bed/day; D – 0.21 kg/bed/day; E – 0.20 kg/bed/day; F – 0.18 kg/bed/day; G – 0.16 kg/bed/day; H – 0.06 kg/bed/day; I – 0.06 kg/bed/day; J – 0.05 kg/bed/day) generated by the individual hospitals.

The average biomedical waste generation 0.18 kg/bed/day obtained in this study is relatively low compared with 1.27 kg/bed/day and 5.4 kg/bed/day for similar hospitals in Ibadan, Nigeria and Frieburg, Germany [5, 8]. It is also low relative to 6.6 kg/bed/day for a typical US hospital [10]. This low waste generation rate may be as a result of poor patronage of these hospitals due to the poverty, preference to alternative/traditional medicine, and religious beliefs and practices by the people living in the study area.

3.4 Final Disposal

This study showed that the present waste management practiceemployed by the sampled hospitals in Bayelsa State is poor. There are no incinerators in any of the health facilities for burning infectious wastes, and no form of treatment is carried out on the waste before disposal, except hospitals C and E, were there is an open pit used for burning some of the waste considered extremely harmful by the hospital authorities.

A visit to the municipal dumpsite along Tombia-Amassoma road revealed nothing more than open dumping and burning of theses wastes, with human scavengers having a filled day looking for what they can pick, reuse or refurbish and possibly resell to the public without considering the health implications of their actions.This open burning practice and the leachate produced at these dumpsites poses a serious environmental problem to the atmosphere, underground water, surrounding rivers and the general well-being of the people.

IV. CONCLUSION

Management of biomedical waste is a serious environmental problem in developing countries like Nigeria. This present study has shown that the hospital administrations, the state governments and indeed the government of the Federal Republic of Nigeria currently pay little or no attention to the management of biomedical waste in Bayelsa State and Nigeria at large. It is shown that hospitals in Bayelsa State generate an average of 0.18 kg/bed/day of medical waste leading to about 4330 kg/month, of which more than 65% is both infectious and hazardous to health.

From the investigations carried out, the following suggestions are made:

(i) Every health care facility should have a waste management unit to seriously handle the waste management practice.
(ii) Cleaners, Nurses and sanitary workers handless should be properly trained.
(iii) Sorting of wastes at source using the colour-coded system being practiced in countries like UK, India etc. should be introduced.
(iv) Government should formulate and enforce laws on good waste disposal practices.
(v) Government should ensure that health care facilities have good and functioning incinerators or provide a central incinerating facility where these waste could be taking to and treated before final disposal.

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