

Medical Waste Generation in Hospitals and Associated Factors in Ibadan Metropolis, Nigeria

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Abstract: The study was conducted to determine the quantities of waste generated in selected hospitals in Ibadan Metropolis Nigeria and examine the factors that influenced the choice of methods and facilities used in managing waste generated. Eight hospitals were selected through systematic random sampling procedure using a sample size of 20% out of 21 public hospitals and 10% out of 42 private hospitals that rendered tertiary or secondary health-care services representing four public and private hospitals respectively. The results from the study revealed that public hospitals generated waste between 0.37 and 1.25 Kg/head/day while private hospitals generated between 0.12 and 0.28 Kg/head/day. It was established that infectious waste represented the highest rate of waste generation with 32.43% in Adeoyo; 28.57% in Jericho; 35.71% in Ring Road; 32.14% in Oni; 30.00% in Alaafia; 20.00% in Molly, 31.58% in Gold Cross and 38.89% in St. Lucia Hospitals. The study showed that financial capability was the most important factor that influenced public hospitals with relative important index value of 4.05 in the choice of facilities and methods used to manage waste generated. Other factors in order of importance were waste characteristics (3.97) and type of hospital (3.87). In private hospitals, the most important factor was financial capability (3.76) and other factors in order of importance were technical know-how of the manpower (3.52) and waste characteristics (3.41). The study suggests that there is need to develop better medical waste management policies.

Key words: Associated factors, hospital environment, management practice, medical waste, waste generation

INTRODUCTION

Waste management has continually generated global concern. Cities spend increasing resources to improve their practice. While the industrialized nations of the world are progressively solving their solid waste management problems, little progress is being recorded in most third world cities (Afon, 2005). There has always been the need for man to dispose of the waste generated in the course of his daily activities, and medical waste is part of the total waste streams generated in the built environment. Although, medical waste represents a relatively small portion of the total waste generated in a community, medical waste management is considered an important issue worldwide (Cheng *et al.*, 2009). Medical waste is infectious and hazardous. According to Becher and Lichtnecker (2002), medical waste presents a high risk to doctors, technicians, sweepers, hospital visitors and patients due to arbitrary management. It poses threats to environmental health and requires specific treatment and management prior to its final disposal (Hassan *et al.*, 2008). The recent developments in health-care units are precisely made for the prevention and protection of community health. Sophisticated instruments have come into existence in various operations for disease treatment. Such improvements and advances in scientific knowledge have resulted in per capital patient generation of wastes in

health-care units. Waste generated in the process of health care consists of variety of wastes including hypodermic needles, scalpels, blades, surgical cottons, gloves, bandages, clothes, discarded medicine and body fluids, human tissues and organs, chemicals and others. These are the most environmentally sensitive health-care by-products and they need greater attention and should be monitored (Remy, 2001).

Hospital, like any other center of man's activities, is a source for waste generation. A modern hospital is a complex, multidisciplinary system which consumes thousands of items for delivery of medical care and is part of physical environment (Hem-Chandra, 1999). Hospitals in the world over generally generate a wide variety of waste, some of which are similar in many respects to that produced by hotels and restaurants. Hospital solid waste means all wastes coming out of hospitals out of which 85% are actually non-hazardous, 10% are infectious wastes and 5% are non-infectious but hazardous in nature (WHO, 2004). Health Care Waste (HCW) is a by-product of health care that includes sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials. Medical waste refers to clinical waste materials that are produced from health-care facilities such as doctors' offices, research laboratories and nursing homes. These materials may include used syringes, soiled dressings, chemicals used to

treat illnesses, equipment and facility cleanser, radioactive materials and other waste streams generated in hospital environment (Lupe, 2009). According to Blackman (1996), health-care wastes are wastes generated from health-care establishments; hospitals, clinics etc, research facilities and laboratories. It also includes wastes originating from “minor” or “scattered sources” such as those produced in the course of health care undertaken, namely dialysis and insulin injection.

The process of waste management in our environment calls for concern in recent years. Wastes are being disposed indiscriminately in our surroundings, on the streets and in the drains. The industries are discharging their wastes without pre-treatment into streams and farmlands and this affects the natural environment. Hospitals and other health-care facilities are not left out of this obnoxious act. Hospital or biomedical waste has distinct features apart from all other types of waste because of its infectious and hazardous properties. It has equally received very little attention in Nigeria in contrast to the management of other types of solid waste as hospital waste management was in a deplorable state with less or no provision for the health-care waste disposal (Coker *et al.*, 1998). By the nature of its composition, hospital waste is a breeding ground for all sorts of diseases and infections if not properly handled, managed and controlled. In Nigeria, as close to the end of the third millennium, it was observed that there were weak policies on hospital waste management in Nigeria, and that is why it is not uncommon to find various components of hospital waste like used syringes, discarded blood vials, needles, empty description bottles etc. improperly disposed and left untreated (Coker *et al.*, 1998). The United States Agency for International Development, USAID (2009) stated that Nigeria did not have any plan or policy on health-care waste management as hospital waste is being mixed with municipal solid waste and this may subject the populace to the risk of HIV and other related diseases. Hence, this study aims to determine the components and quantities of waste generated and examine factors influencing the choice of facilities and methods used.

METHODOLOGY

Research design: In all researches, the nature of the data governs the method and the tool of research that may be appropriate for the research. In order to implement the research design and to ensure validity, recommendations by Cagno *et al.* (1999) were followed; by understanding materials usage in buildings, understanding activities in the building environment, analysis of the waste streams and providing recommendations to restore value. The study was conducted in Ibadan metropolis, Oyo State; in the southwestern part of Nigeria. The required

information on the number of hospitals in Ibadan Metropolis was obtained from the Oyo State Ministry of Health, Ibadan. A sample size of 20 and 10% were selected from a sample frame of 21 and 40 public and private hospitals respectively that registered with the Oyo State Government and rendered tertiary or secondary health-care services. Hence, there was random selection of four public and private hospitals respectively, and the hospitals were equally located across the geographical zones of the study area. The four public hospitals selected were Adeoyo Maternity Teaching Hospital, Yemetu; Jericho Specialist Hospital, Jericho, Oni Memorial Hospital, Off MKO Abiola Way, and General Hospital, Ring Road, Ibadan while the private hospitals were Alaafia Hospital, Mokola, Molly Specialist Hospital, Idi-Ape, Gold Cross Hospital, Yemetu and St. Lucia Hospital, Oke-Ado, Ibadan.

Data collection and analysis: The data was collected between November 2009 to January 2010. Waste audit was carried out in line with the method used by Kazuhiro and Harumi (2001) to determine the quantities of the waste generated through the use of weighing instruments. The quantities of waste generated were physically weighed in each hospital. The method used by Monaham (1990) and Gonzalez-Torre *et al.* (2003) were employed in the design of the questionnaires by ensuring that the questionnaires were administered to the selected hospitals to collect data on the management of waste generated. The questionnaires also addressed information on potential factors that can influence amount of waste generation and the type of management practice in place. The factors that influenced the choice of methods and facilities used in managing the waste were analyzed by the Relative Importance Index by using a scale of 1 to 5. The closer the relative importance index is to 5, the higher is the degree of importance of the factor.

RESULTS

Profile and background information of the hospitals:

The four public hospitals selected were Adeoyo Maternity Teaching Hospital, Yemetu; Jericho Specialist Hospital, Jericho, Oni Memorial Hospital, Off M.K.O. Abiola Way, and General Hospital, Ring Road, Ibadan while the private hospitals were Alaafia Hospital, Mokola, Molly Specialist Hospital, Idi-Ape, Gold Cross Hospital, Yemetu and St. Lucia Hospital, Oke-Ado, Ibadan. From the result shown in Table 1, Adeoyo Teaching Hospital formerly called Adeoyo Maternity Hospital was established in 1927 during the colonial days of Nigeria while Jericho and General public hospitals were established in 1976. Oni Memorial Hospital was established in 1981. The increasing need of the growing populace in Ibadan for medical attention led to the

Table 1: Year of establishment of hospitals

Name	Year of establishment
Adeoyo Maternity Teaching Hospital	1927
Jericho Specialist Hospital	1976
Ring Road General Hospital	1976
Oni Memorial Hospital	1981
Alaafia Hospital	1938
Molly Specialist Hospital	1986
Gold Cross Hospital	1984
St. Lucia Hospital	1967

Table 2: Characteristics of hospitals

Name	Type	Ownership
Adeoyo	Tertiary	Public
Jericho	Secondary	Public
General	Secondary	Public
Oni	Secondary	Public
Alaafia	Secondary	Private
Molly	Secondary	Private
Gold Cross	Secondary	Private
St. Lucia	Secondary	Private

establishment of more private hospitals in the study area (Table 1). It can be seen that the hospitals selected were characterized based on the varying types of treatment that they render (Table 2). It is shown that only Adeoyo

Teaching Hospital has departments, wards and laboratories that cuts across different sections of needs in hospital than other publicly and privately owned hospitals because it renders tertiary health-care services that always attract highest number of patients and other selected hospitals render secondary health-care services (Table 2, 3, 4 and 5).

Waste generation and generation rate: The rate of generation of the classes of wastes in each hospitals studied is shown in Table 6. The table shows that among all the classes of wastes generated in each hospital, infectious wastes had the highest rate of generation with 32.43% in Adeoyo Hospital; 28.57% in Jericho Hospital; 35.71% in General Hospital and 32.14% in Oni Hospital, and 30.00% in Alaafia Hospital; 20.00% in Molly Hospital; 31.58% in Gold Cross Hospital and 38.89% in St. Lucia Hospital. 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. The sharp items

Table 3: Departments available in the hospitals

Departments	Adeoyo	Jericho	General	Oni	Alaafia	Molly	Gold cross	St. Lucia
Surgery	X	X	X	--	X	X	X	X
Pediatrics	X	--	--	X	X	X	X	X
Out-Patient	X	X	X	X	X	X	X	X
In- Patient	X	X	X	X	X	X	X	X
Obstetrics and gynecology	X	X	X	--	X	X	X	X
Mortuary	X	--	X	--	X	X	--	--
Radiology	X	X	X	--	X	X	--	X
Pharmacy	X	X	X	X	X	X	--	X
Records	X	X	X	X	X	X	X	X
Accounts	X	X	X	X	X	X	X	X
Laboratory	X	X	X	X	X	X	X	X
Physiotherapy	X	--	X	X	--	--	--	--
Maintenance	X	X	X	X	X	X	--	X
Administrative	X	X	X	X	X	X	X	X
Kitchen	X	X	X	X	X	X	--	X

X: Existing; --: Not existing

Table 4: Wards available in the hospitals

Departments	Adeoyo	Jericho	General	Oni	Alaafia	Molly	Gold cross	St. Lucia
Medical	X	X	X	X	X	X	X	X
Surgical	X	X	X	X	X	X	X	X
Pediatrics	X	--	--	--	X	X	X	X
Gynecology	X	X	X	--	X	X	X	X
Anesthesia	X	X	X	X	--	--	--	--
Accident and emergency	X	X	X	X	X	X	X	X
Psychiatry	--	--	X	--	--	--	--	--

Table 5: Laboratories available in the hospitals

Laboratories	Adeoyo	Jericho	General	Oni	Alaafia	Molly	Gold cross	St. Lucia
Hematology	X	X	X	X	X	X	X	X
Radiology	X	X	X	--	X	X	--	X
Microbiological	X	X	X	X	X	X	X	X
Pathology	X	X	X	--	X	X	X	X
Chemistry	X	X	X	X	X	X	--	--
Blood Serology	X	X	X	X	X	X	--	--

Table 6: Percentages of generation of classes of hospital wastes

Class of waste	Adeoyo	Jericho	General	Oni	Alaafia	Molly	Gold cross	St. Lucia
General	8.11	10.71	7.14	21.44	15.00	15.00	5.26	16.66
Pathological	5.41	7.14	10.72	14.29	10.00	10.00	5.26	-
Infectious	32.43	28.57	35.71	32.14	30.00	20.00	31.58	38.89
Pharmaceuticals	13.51	14.29	14.29	10.71	10.00	20.00	10.53	11.11
Sharps	21.62	14.29	17.86	10.71	25.00	25.00	26.32	22.22
Chemicals	2.70	7.14	-	-	5.00	-	15.79	5.56
Genotoxic waste from	-	-	3.57	-	-	-	-	-
Heavy metals	5.41	-	3.57	-	-	5.00	-	-
Pressurized containers	10.81	17.86	7.14	10.71	5.00	5.00	5.26	5.56
Total (%)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 7: Percentages of waste generation in hospitals wards

Hospitals	Medical (%)	Maternity (%)	Surgical (%)	Pediatrics (%)	Gynecology (%)	Anesthesia (%)	Accident & Emergency (%)	Total (%)
Adeoyo	17.25	49.70	3.25	10.70	9.00	5.84	4.26	100.00
Jericho	22.00	42.80	10.20	--	9.00	8.00	8.00	100.00
General	26.05	49.50	10.08	--	3.05	5.00	6.32	100.00
Oni	24.80	--	10.00	57.20	--	5.00	3.00	100.00
Alaafia	23.92	29.70	22.47	15.27	6.00	--	2.64	100.00
Molly	24.00	37.00	20.04	12.96	5.00	--	1.00	100.00
Gold cross	27.73	26.42	14.77	18.33	9.67	--	3.08	100.00
St. Lucia	18.34	37.83	13.38	15.06	11.08	--	4.31	100.00

comprising waste materials that can cause cuts or punctures like needles, scalped blades, infusion sets that are either infected or not also constitute the larger percentage of waste generated in the hospitals. Cheng *et al.* (2009) showed in a study conducted on medical waste production in Taiwan, that 92% of the waste is infectious, and was the major source of waste in the hospitals. The Canadian Environmental Protection Act (2001) 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 is likened to the respondents' view that showed that much of the wastes generated in the hospitals are infectious. The percentage of non-hazardous waste namely general waste generated in all the hospitals is small when compared with other wastes directly generated in the sections of the hospitals where patients occupy for treatment purposes. This may be due to the fact that most of the hospitals studied did not have elaborate kitchen services for their staff and patients. This might have accounted for the low generation of general waste. The rate of waste generation in percentages in each of the wards in the selected hospitals shown in Table 7 shows that in all the hospitals studied, the highest percentage of waste generation occurred in maternity wards, and it was due to the frequent use of general wastes, pharmaceuticals, sharps, cotton wools and pads by women that just delivered. The least generation of waste occurred in the anesthesia wards of the selected hospitals.

The audit of the waste was carried out to determine the quantity of waste generated in each of the hospitals selected with weighing instruments. This was based on

the use of data on the occupancy rate per day per extracted from the database of the health-care facilities. The result of the waste audit indicates that public hospitals generate medical waste between 0.37 and 1.25 Kg/head/day while private hospitals generate medical waste between 0.12 and 0.28 Kg/head/day (Table 8). The table also shows that in all the hospitals selected, the quantity of wastes generated per head was most in Adeoyo Teaching Hospital. This was largely due to the fact that it had the largest number of patients and beds in all the wards, units and departments when compared with other hospitals. It was discovered that the largest quantity of wastes was generated in maternity wards followed by pediatrics wards (Table 7), and this was due to the

Table 8: Quantity of waste generated in the selected hospitals

Hospitals	Quantity (Kg/head/day)
Adeoyo	1.25
Jericho	0.72
General	0.93
Oni	0.37
Alaafia	0.28
Molly	0.26
Gold cross	0.19
St. Lucia	0.12

Table 9: Factors influencing choice of methods and facilities used to manage hospital medical waste in privately owned hospitals

Factors	RII	Ranking
Financial capability	3.76	1
Technical know-how of the Manpower	3.52	2
Waste characteristics	3.41	3
Type/Size of hospital	3.32	4
Infectious and hazardous nature of waste	3.26	5
Maintenance repair	3.09	6
Number of beds/ Patient capacity	2.93	7
Cultural and social basis	2.88	8
Logistics	2.83	9
Institutional framework	2.81	10

Table 10: Factors influencing choice of methods and facilities used to manage hospital medical waste in publicly owned hospitals

Factors	RII	Ranking
Financial capability	4.05	1
Waste characteristics	3.97	2
Type/size of the hospital	3.87	3
Number of beds/patient capacity	3.86	4
Technical know-how of the Manpower	3.79	5
Maintenance repair	3.70	6
Infectious and hazardous nature of waste	3.45	7
Logistics	2.91	8
Institutional framework	2.47	9
Cultural and social basis	2.13	10

frequent use of general wastes, pharmaceuticals, sharps, cotton wools and pads by pregnant women that just delivered and items needed in pediatric wards of the hospitals.

Analysis of factors influencing choice of facilities and methods used to manage hospital medical waste:

Table 9 shows by Relative Importance Index Method the ranking of the factors that influenced the choice of methods and facilities used to manage hospital medical waste in privately owned hospitals. It is shown that financial capability, technical know-how of the manpower and waste characteristics (waste load, waste reduce time, temperature, pH and pressure) with relative importance index values of 3.76, 3.52 and 3.41, respectively were the three most significant factors that influence methods and facilities used to manage wastes generated in the private hospitals studied. The result of the relative importance index method also indicated that cultural and social basis, logistics and institutional framework had index value of 2.88, 2.83 and 2.81, respectively as the least significant factors that influence the choice of methods and facilities used to manage hospital medical wastes.

The ranking of the factors that influenced the choice of methods and facilities used to manage hospital wastes in publicly owned hospitals is shown in Table 10. Financial capability, waste characteristics (waste load, waste reduce time, temperature, pH and pressure) and type/size of the hospital were the three most significant factors that influence methods and facilities used to manage wastes generated in public hospitals with index values of 4.05, 3.97 and 3.87, respectively. The study also shows that logistics, institutional framework and cultural and social basis has index value of 2.91, 2.47 and 2.13, respectively as the least significant factors that influence choice of methods and facilities used to manage wastes in publicly owned hospitals. This indicates that in both public and private hospitals, financial capability and waste characteristics were the major factors that mostly influenced the type of facilities and methods they could use to manage medical waste generated. It was discovered during interview process that in the face of reduced funding by the

owners/management of the hospitals, improvised facilities and methods were used to manage the waste, and this is contrary to the guidelines that stipulates adequate funding in order to have contemporary facilities base.

CONCLUSION AND RECOMMENDATION

The study shows that the health-care facilities studied belonged to public and private bodies. The public hospitals were owned exclusively by the Oyo State Government of Nigeria while the private hospitals were owned by individuals or corporate bodies interested in health-care delivery, and all the bodies were located in Ibadan. Among the public hospitals, only Adeoyo Teaching Hospital was categorized as a tertiary hospital while the other three public hospitals were categorized as secondary hospitals. This was based on the widest coverage of divisions and departments necessary in hospitals that existed in Adeoyo Teaching Hospital and the number of patients that were being attended to that far outsized what obtained in other hospitals. The private hospitals were comparably of lower categorization than the public hospitals, but still had departments and other necessary divisions required in a hospital system. The number of staff, facilities and infrastructural base of the hospitals studied varied. It was only Adeoyo Teaching Hospital that had the largest staff strength, hospital facilities and infrastructural base than other public and private hospitals. This was attributable to the tertiary category of hospital that it enjoyed by rendering specialized and tertiary medical services to patients.

The study reveals that public hospitals generate medical waste between 0.37 and 1.25 Kg/head/day while private hospitals generate medical waste between 0.12 and 0.28 Kg/head/day. It was discovered that the highest quantity of waste was generated in Adeoyo Teaching and Maternity Hospital with 0.37 Kg/head/day and least in Oni Memorial Hospital with 1.25 Kg/head/day among the public hospitals selected while Alaafia Hospital generated 0.28 Kg/head/day as the largest quantity of waste and St. Lucia Hospital generated the least quantity of 0.12 Kg/head/day waste among the private hospitals selected. The result is compared with medical waste generation rate reported by Mohammadi (2000) to be 2.7 Kg/bed/day in hospitals of Iran. Also, Radha *et al.* (2009) noted that general hospital and multi-specialty hospital in India generated 1.83 and 2.53 Kg/bed/day, respectively. The study shows that among all the classes of wastes generated in each hospital, infectious wastes had the highest rate of generation with 32.43% in Adeoyo Hospital; 28.57% in Jericho Hospital; 35.71% in General Hospital and 32.14% in Oni Hospital, and 30.00% in Alaafia Hospital; 20.00% in Molly Hospital; 31.58% in Gold Cross Hospital and 38.89% in St. Lucia Hospital.

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 volume of infectious wastes. The sharp items comprising waste materials that can cause cuts or punctures like needles, scalped blades, infusion sets that are either infected or not also constitute the larger percentage of waste generated in the hospitals.

Cheng *et al.* (2009) showed in a study conducted on medical waste production in Taiwan, that 92% of the waste is infectious, and was the major source of waste in the hospitals. The percentage of non-hazardous waste namely general waste generated in all the hospitals is small when compared with other wastes directly generated in the sections of the hospitals where patients occupy for treatment purposes. This may be due to the fact that most of the hospitals studied did not have elaborate kitchen services for their staff and patients. This might have accounted for the low generation of general waste. Financial capability and waste characteristics were the most significant factors that influence the choice of methods and facilities used to manage wastes generated in both public and private hospitals. The paper recommends that efforts must be made to seriously reduce quantity of waste generation by ensuring that adequate fund are in place to facilitate the use of appropriate facilities and methods in managing the waste generated.

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