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Biomedical Waste Generation and Management in Public Sector Hospital in Lagos City, Nigeria

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Abstract

The management of healthcare waste has been identified as a major problem confronting developing countries but very little empirical studies exist in this regard. This study examined the healthcare waste management practices of selected hospitals in Lagos, Nigeria. The study specifically compared the regulations and practices regarding healthcare waste management of public hospitals with that of private hospitals in Lagos, Nigeria. Our findings revealed that the public hospitals have waste management policy. One of the private hospitals does not have a waste management policy. Both the public and private hospitals have waste management plan as well as a waste management team. Supervisory staff members of all the hospitals have waste management responsibilities included in their job descriptions. The findings of this study also indicated that the two public hospitals generate more wastes than the private hospitals. This is expected given that the public hospitals have more number of beds, wards and departments compared to private ones. Apart from one of the private hospitals, all the three hospitals segregate their waste into different categories. This is done by first identifying the waste type and then separating non-infectious or general waste from infectious waste.

Keywords: Biomedical, Waste, Generation, Public Sector and Hospital

1.0 Introduction

Hospitals are health institutions providing patient care services. It is the duty of hospital and healthcare centers to take care of the public health. This may directly be through patient care or indirectly by ensuring a clean, healthy environment for their employees and the community (Patil and Pokhrel, 2015). In the process of healthcare delivery, healthcare waste is generated which includes sharps, human tissues or body parts and other infectious materials (Baveja et al., 2017), also referred to as "Medical Waste" or "Hospital Solid Waste".

Healthcare wastes are defined to include all types of wastes produced by health facilities such as general hospitals, medical centers and dispensaries. Healthcare wastes represent a small amount of total residues generated in a community. However, such residues can potentially transmit diseases and present an additional risk to the staff of the healthcare facilities, patients and the community when the wastes are not managed properly.

Throughout the world, healthcare is one sector that has witnessed significant improvement. However, it seems that the fraction of waste generated at healthcare institutions has not attracted the same level of attention as other types of wastes, despite its serious health implications (Coad, 2016; WHO, 2012; Oweis et al., 2015). The wide variety of activities at healthcare facilities generates different types of waste and there is always a danger of spreading infection due to mishandling of infectious waste or sharps (Chaerul et al., 2018). The public health impacts of healthcare waste are determined by the overall waste management strategy adopted by the hospitals or health centers. Healthcare waste management involves management of a range of activities, which are mainly engineering functions, such as collection, transportation, operation/treatment of processing systems, and disposal of waste. However, in most cases, initial segregation and storage activities are the direct responsibility of nursing personnel. If the infectious component gets mixed with the general non-infectious waste, the entire mass becomes potentially infectious. It is the

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responsibility of hospitals and other healthcare institutions to ensure that there are no adverse health and environmental consequences as a result of their waste handling, treatment and disposal activities (Patil and Pokhrel, 2015).

2.0 Literature Review

The World Health Organization defines healthcare waste as the total waste stream from health-care establishments, research facilities, laboratories, and emergency relief donations. In addition, it includes the waste originating from “minor” or “scattered” sources – such as that produced in the course of healthcare undertaken in the home (dialysis, insulin injections, etc.). The WHO classifies medical or healthcare waste into communal waste or general waste and special waste. Communal or general waste is all solid waste not including infectious, chemical, or radioactive waste. This waste stream can include items such as packaging materials, bedding, waste water from laundries, office supplies and other substances that do not pose a special handling problem or hazard to human health or the environment (WHO, 2012).

Healthcare waste management is a process that ensures proper hygiene in the health institution and safety of healthcare workers and communities (Sanitation Connection, 2013). Johannessen et al. (2017) opine that proper management of medical waste can minimize the risk, both within and outside healthcare facilities. The first priority is to segregate wastes, preferable at the point of generation into reusable and non-reusable, hazardous and non-hazardous components. They identified other important steps as, the institution of a sharps management system, waste reduction, avoidance of hazardous substances wherever possible, ensuring worker safety, providing secure methods of waste collection and transportation, and installing safe treatment and disposal mechanisms.

Medical waste should be transported within the hospital by means of wheeled trolleys, containers or carts that are not used for any other purpose. The trolleys have to be cleaned daily. Off site transportation vehicle should be marked with the name and address of carrier. Biohazard symbol should be painted and suitable system for securing the load during transport should be ensured. Such a vehicle should be easily cleanable with rounded corners. Johannessen et al. (2017) recommend that transportation of medical waste on public roads must be carried out by trained staff in a dedicated vehicle with closed containers.

Rao et al. (2004) suggest that all disposable plastic should be subjected to shredding before disposing off to vendor. Final treatment of medical waste can be done by technologies like incineration, autoclave, hydroclave or microwave. According to Diaz et al. (2015), some of the more common treatment and disposal methods utilized in the management of infectious healthcare wastes in developing countries are: autoclaves and retorts; microwave disinfection systems; chemical disinfections; combustions (low-, medium-, and high-technology); and disposal on land (dump site, controlled landfill, pits and sanitary landfill).

3.0 Materials and Methods

This study examined the healthcare waste management practices of public and private hospitals in Lagos, Nigeria.

The study sampled two large public hospitals and two large private hospitals in the Victoria Island region. For the sake of confidentiality, the public hospitals are referred to as Hospital A and Hospital B and the private one are also referred to as Hospital C and Hospital D.

This study was set off and planned as a multiple case study of four hospitals in Lagos, Nigeria. The methodology adopted for this study is also similar to that used by Oweis et al. (2015). This included a two-stage strategy. The first stage involved an examination of the rules, procedures, and regulations set forth by the hospitals’ directory to be followed by the personnel regarding the management of healthcare waste generated at the hospitals. The second stage included spending enough time in the different departments of the hospitals recording observations and writing notes in the critical manner about the practices of the healthcare waste management by staff responsible for waste management.

The researcher made three visits to each of the hospitals, taking note of how healthcare wastes are managed. These visits were made to the general medical wards, maternity wards, surgical and critical care wards, operating theatres, and orthopaedic sections of the hospitals. The researcher also made use of both primary and secondary data. Secondary data was obtained from the hospitals’ documents. Primary data was collected from questionnaire administration and interviews with authorities of the hospitals, health workers and personnel in charge of infection control and healthcare management at the hospitals. The questionnaire and interview guide were developed based on the recommendations of the World Health Organization for evaluation of hospital waste management in developing countries.

The questionnaire and interview guide were, however, pre-tested in order to inform the shaping of the final questionnaire. Considering the sensitive nature of such questions, the pre-testing exercise was important. Prior approval was gotten from the management of each of the hospitals in obtaining information for the study. The results obtained were discussed to ascertain the extent to which healthcare wastes are handled in the light of written policies and the established international standards in this regard (WHO, 2012).

4.0 Result and Discussion

4.1 Findings

This section discusses the findings of the study. We first discuss the characteristics of the four selected and then discuss the healthcare waste management policies and regulations, and the healthcare waste management practices. Hospital characteristics selected hospitals

Table I presents a description of the four hospitals selected in this study. Hospital A is a public hospital located in the densely populated Metropolitan Area in the Victoria Island Region of Lagos, Nigeria. The facility has 294 beds and ten wards. Hospital B is also a public hospital in the Victoria Island Metropolitan Area in the Greater Victoria Island Region. It is made up of ten wards, 191 beds and 44 units. Hospitals C and D are both private hospitals in Victoria Island Metropolitan Area in the Victoria Island Region. Hospital C has 42 beds and seven departments, whilst Hospital D has four departments, 30 beds and two wards. All four hospitals treat general cases.

Clearly, the public hospitals are larger with higher number

of beds, wards and departments compared to the private hospitals. Healthcare waste management policies and regulations Hospital A has an existing document that outlines the hospital waste management policy. The

management of the Hospital indicated that though a policy document exists, it has not yet been distributed to the facility. There is no manual or guideline

Hospital	Type		Departments	Wards	Beds
	Public	Private			
Hospital A	✓		–	10	204
Hospital B	✓		44	10	191
Hospital C		✓	7	–	42
Hospital D		✓	4	2	30

Table I.
Hospital characteristics

document on management of hospital wastes available at the Hospital. The Hospital’s management also reported that they were not aware of any legislation applicable to the hospital waste management. The Ministry of Health (Lagos State) has a document on management of hospital waste but the Hospital has no idea about this document. Hospital A has a plan for waste management as well as a waste management team made up of a team leader, a team member and waste handling staff. The team leader is usually the infection prevention/control coordinator, and the team member is an environmental officer, and the head of orderlies is the one in charge of waste handling. All hospital supervisory staff has waste management responsibilities included in their job descriptions. The Hospital has no policy that promotes the use of reusable products, disposable products where feasible, and there is equally no policy that promotes the use of office paper that is chlorine free, or greater than 20 percent recycled content. Hospital B has a policy for hospital waste management in a document entitled “Healthcare Waste Management Policy”. The Healthcare Waste Management Policy document at the Hospital also contains guidelines on management of hospital waste and this document is available in the facility. The management of this Hospital is aware of legislation applicable to the hospital waste management which is enshrined in the legislative Acts; vaccination Ordinance cap 76, mortuaries and funeral Facilities Act 563, and Food and Drugs Law 305b (2016), as well as the Environmental Assessment Regulations 2012 (LI 1652). The management of the Hospital was fully aware of the document on hospital waste management at the Ministry of Health, “Steps in Waste Management”. Hospital B has a waste management plan and a waste management team headed by a physician specialist, a senior nursing officer as a member, and orderlies form the waste handling staff. Supervisory staff has waste management responsibilities included in their job description.

Hospital C has a policy document that outlines how hospital waste should be managed at the Hospital. There is also no guideline document on management of hospital waste available in the hospital. The management is also however not privy to any guideline document at the Ministry of Health or any legislative act applicable to hospital waste management. The Hospital has a waste management plan and a waste management team. But there was no specification on who are the team leader, team member and waste handling staff. Supervisory officers do not have waste management responsibilities included in their job descriptions. Hospital C has guidelines specifying purchasing preference for products in minimal packaging as well as policies that promote the use of office paper that is greater than 20 percent recycled content, and purchasing

of unbleached, processed chlorine free sanitary napkins, paper towels and toilet paper.

Hospital D does not have a detailed hospital waste management policy. It simply has a one page document that provides a general guideline on how waste should be handled at the Hospital. The management of this Hospital indicated that they were aware of legislations applicable to waste management in the hospital but could not state these relevant legislative acts. The Hospital has no idea of any guideline document on hospital waste management available at the Ministry of Health. There is a waste management plan with a waste management team made up of a general service manager as the team leader, a nursing Services manager as a team member, and waste handling staff. Supervisory officers have waste management responsibilities as part of their job description. The Hospital has no guideline specifying purchasing preference for products in minimal packaging and policies that promote the use reusable products was also not available.

The findings clearly showed that both public hospitals and one of the private hospitals have waste management policy. In terms of waste management plan, the findings again indicated that both public and private hospitals have waste management plan as well as a waste management team. Also, supervisory staff members of public and private hospitals have waste management responsibilities included in their job descriptions.

4.2 Healthcare waste management practices

We now discuss the healthcare waste management practices of the hospitals in terms of waste characterization, waste segregation, waste generation, waste collection and storage, transportation and, treatment and final disposal.

4.3 Waste characterization

Hospitals generate waste from the various activities they perform and these include both domestic and healthcare waste. In the public hospitals, Hospital A failed to provide information on the quantity of waste the Hospital generates, the composition of healthcare waste, the department that generates the highest amount of waste as well as the department that generates the lowest amount of medical waste. These were not known. At Hospital B, healthcare waste is quantified as 3771.43 kg/day, and this was composed of 10 percent regulated waste, 70 percent infectious waste, 10 percent sharps waste, 5 percent pathological waste, and 5 percent chemical waste. The highest amount of waste is generated in the theater and obstetrics and gynaecology departments, while the VIP wards record the lowest amount of waste.

With respect to the private hospitals, Hospital C could not actually quantify the amount of waste it generates. In terms

of the composition, they indicated that waste at the Hospital is made up of 80 percent regulated waste, 5 percent infectious waste, 5 percent sharps waste, 5 percent pathological waste, and 5 percent chemical waste. The nurses department is said to generate the highest amount of waste, while the X-ray department generates the lowest amount of waste. Hospital D also indicated that their daily amount of waste generated is 21.7 kg/day but they could not provide information on the composition of the waste, which department produces the highest amount of waste and which department produces the lowest amount of waste. It is expected that there will be clear variations in terms of the quantity of waste generated at public and private hospitals. The findings of the study indicated that public hospitals generate more wastes compared to the private hospitals. This may be attributed mainly to the fact that public hospitals have more number of beds, wards and departments, compared to their private counterparts. Waste characterization was however not properly practiced. Both public and private hospitals did not have an effective system of measuring and quantifying waste.

4.4 Waste segregation

Medical waste segregation is very important in minimizing the volume of hazardous waste by making it easy to assess the composition of generated waste. Apart from Hospital C, all the three hospitals segregate their waste into different categories. This is done by first identifying the waste type and then separating non-infectious or general waste from infectious waste. In Hospital A, waste segregation is done by all medical staff.

In Hospital B, this is done by auxiliary staff, while in Hospital C waste segregation is done by doctors. Hospital A and Hospital C seem to have an effective system of waste segregation. The Hospitals use color coding system for identifying and segregating infectious waste, sharps and non-infectious waste. Despite the existence of some level of segregation of waste in most of the hospitals, results of the study revealed that segregation principles are not so much adhered to by the collectors contracted for off-site waste disposal at the dumpsites or burning sites. This poses health risk to the general public. WHO report estimates that in 2017, there were several injections undertaken with contaminated syringes caused about 23million infections of Hepatitis B and Hepatitis C and HIV (WHO, 2015).

The findings showed that public hospitals have a system for segregating waste into non-infectious and infectious wastes. In the case of the private hospitals, only one hospital practice waste segregation. Interestingly, one public hospital and one private hospital use color-coding system for identifying and segregating infectious waste, sharps and non-infectious waste.

4.5 Waste collection and storage

All four hospitals (both private and public) confirmed there were defined procedures for the collection and storing of waste from specified units. We found that both public and private hospitals have internal storage facilities for temporarily storing the waste before they are finally disposed off-site. Such internal storage area must be well sanitized and secured in such a way that it should be accessible only to authorized persons (Pru'ss et al., 2012). However, our findings revealed that both public and private hospitals have well secured but poorly sanitized temporary

storage area. Apart from Hospital A, waste is not labeled with the Bio-Hazard symbol. The hospitals usually have daily collection and storage of waste within the facilities done by auxiliary staff. In both public and private hospitals, waste collections from the waste production points within the hospitals are somehow regular, but collections from the internal storage area by external waste collectors are quite irregular. In Hospital B, non-infectious waste is stored in big containers and emptied twice-a-week to the final disposal sites.

4.6 Transportation

Transportation of healthcare waste is done both on-site and off-site. On-site transportation involves transporting the waste in the temporary storage area within the hospital. This should usually be by means of wheeled trolleys, containers or carts that are not used for any other purpose. On-site transportation in Hospital A and Hospital B are done by using wheel barrows. Covered bins with wheels are used to transport waste on-site in both Hospital C and Hospital D. Transportation and disposal of medical waste must be tracked, inspected and monitored by appropriate regulatory bodies to assist in the evaluation of any potential harm to the environment and human health. Off-site transportation of healthcare waste on public roads must be carried out by trained staff in a dedicated vehicle with closed containers (Johannessen et al., 2017).

In Hospitals A, B, C and D, off-site transport of the hospital waste is undertaken by Municipal Assemblies with the use of trucks. Clearly, public hospital use wheel barrows for on-site transportation while the private hospital use covered bins for on-site transportation. In terms of off-site transportation, both public and private hospitals rely on the services of the Municipal Assemblies.

4.7 Treatment and final disposal

There are more common treatment and disposal methods used in the management of infectious medical waste in developing countries and these include autoclaves and retorts; microwave disinfection systems; chemical disinfections; combustions (incineration); and disposal on land (dump site, controlled landfill, pits and sanitary landfill) (Diaz et al., 2015). In Hospital A, non-infectious waste is disposed off at the final disposal site using the municipal landfill, while incineration is used for infectious waste. In Hospital B, burning is the final disposal method. Infectious waste is disposed by incineration in the hospital. Other methods used include chemical disinfectants and burial. Hospital C uses auto clave, or with a chemical disinfectant to dispose infectious waste. In Hospital D, placentas and blood waste are treated with bleach in the sluice room and flushed out. While amputations, still birth and other body parts are taken by patient's relatives for burial. Incineration is used for final disposal of sharp ends and gauze, bandages, cotton are burnt. Also, surgical waste are sent to the Department of Histopathology at Lagos State Teaching Hospital for analyses and appropriately disposed. The findings showed that both public and private hospitals employ standard methods for disposing healthcare waste.

4.8 Other healthcare waste management issues

There are no subcommittees in the different departments of Hospital A to monitor disposal of medical waste, and staff in charge of medical waste management have only basic level education. There has not been any attempt to re-

evaluate how to handle the hospital's regulated medical waste. There has also been no waste audit in the last three years, and equally no register is maintained for waste disposal. The hospital has not implemented any program to eliminate the use of mercury-containing products but indicated that there were no acts of mismanagement of medical waste. The waste management duties in Hospital A are not under any particular department but are done by all staff members in the facility. There is training sessions organized for all newly hired staff on waste management. After this initial training however, no annual training on health and environmental effects of mercury is given.

Hospital B has a subcommittee in the various departments to monitor disposal of medical waste and the Hospital is in the process of re-evaluating how to handle regulated medical waste through the upgrading of the incinerator to control pollution, as well as exploring alternative technologies for on-site treatment and disposal. The hospital has had a waste audit in the last three years, and maintains a register for waste disposal. The hospital however does not have a program in place to eliminate the use of mercury-containing products. There are sometimes reports of acts of mismanagement of medical waste. Investigations in Hospital B revealed that there is no training for newly hired staff on waste management but there is annual training on health and environmental effects of mercury for all staff within the facility. Only designated personnel are trained on how to properly clean up mercury spill. This training also includes information on waste segregation and disposal of infectious waste.

There is a subcommittee (including Doctors and Nurses) in the different departments of Hospital C to monitor disposal of medical waste. The subcommittees are in the process of re-evaluating how to handle the hospital's regulated medical waste by contracting for off-site services. The hospital maintains a register for waste disposal and has had a waste audit in the last three years. A program is also in place to eliminate the use of mercury-containing products. The findings of the study revealed that in Hospital C, newly hired staff are trained on waste management as well as given annual training on health and environmental effects of mercury. They are also educated on how to properly clean up mercury spill. Annual education on waste management for employees includes information on waste segregation and disposal of infectious waste.

Hospital D did not indicate the existence of subcommittees in the various departments to monitor disposal of medical waste. There was also no indication of any waste auditing in the last three years. There is no register for waste disposal and there is no training organized for staff on healthcare waste management.

5.0 Conclusions and Recommendation

Healthcare is one sector that has witnessed significant improvement. However, it seems that the fraction of waste generated at healthcare institutions has not attracted the same level of attention as other types of wastes, particularly in developing countries, despite the fact that healthcare waste is labeled as hazardous waste because it poses serious and direct threat to human health. The management of healthcare waste has been identified as a major problem confronting developing countries but very little empirical studies exist in this regard.

This study examined the healthcare waste management

practices of selected hospitals in Lagos, Nigeria. The study specifically compared the regulations and practices regarding healthcare waste management of public hospitals with that of private hospitals in Lagos, Nigeria. Our findings revealed that the public hospitals have waste management policy. One of the private hospitals does not have a waste management policy. Both the public and private hospitals have waste management plan as well as a waste management team. Supervisory staff members of all the hospitals have waste management responsibilities included in their job descriptions. The findings of this study also indicated that the two public hospitals generate more wastes than the private hospitals. This is expected given that the public hospitals have more number of beds, wards and departments compared to private ones.

Apart from one of the private hospitals, all the three hospitals segregate their waste into different categories. This is done by first identifying the waste type and then separating non-infectious or general waste from infectious waste. Both public and private hospitals have internal storage facilities for temporarily storing the waste before they are finally disposed off-site. On-site transportation in the public hospitals is done by using wheel barrows while covered bins with wheels are used to transport waste on-site in the two private hospitals. In all the hospitals, off-site transport of the hospital waste is undertaken by Municipal Assemblies with the use of trucks with sealed airtight bags, marked with the Bio-Hazard symbol. Both public and private hospitals employ standard methods for disposing healthcare waste. Some of the hospitals did not have subcommittees in charge of managing healthcare waste.

In conclusion, waste is a higher risk when it is hazardous and should be handled with care. This is why managing healthcare waste is essential and must be seen as such by hospitals in Lagos, Nigeria. The current waste management practices are not the best. There is more room for improvement in managing healthcare waste in Lagos, Nigeria.

Awareness needs to be created on the policies and legislative instruments that guide the handling, treatment, and final disposal of healthcare waste. It would be useful to develop an effective system of waste characterization in both public and private hospitals. This is very important in ascertain how resources are allocated in the management of healthcare waste. Hospitals – especially the private ones – need to consider adopting a good waste segregation system. This must include the use of color-coding system for identifying and segregating infectious waste, sharps and non-infectious waste. Also, both public and private hospitals need to constitute committees to be in charge of healthcare waste management. The hospitals must institute regular training regime for their staff members in charge of healthcare waste management.

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