Assessment of Medical Waste Management in Private Hospitals

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Abstract—Recent happening globally especially in the developing country such as Nigeria has shown that there is need to conduct a survey on medical waste management due to direct or indirect adverse effect on the environment and human health. The medical waste management in private hospitals in Lagos State was assessed. Information on hospitals was collected from Lagos State Ministry of Health, Alausa. Nine hospitals were visited and questionnaires and schedules were administered on the current status of medical waste management such as hospital generation information, waste amount, separation, collection, temporary storage and training. Data collected were analysed using descriptive statistics. The results showed that the total medical wastes were 207.16 Kg/day. Of the total medical wastes produced in studied area in one day, 119.07 Kg consisted of hazardous-infectious wastes, 85.91 Kg municipal wastes and 2.18 Kg sharp wastes. The average generation rate of total medical waste was 1.14 ± 0.2 Kg/bed-day. However, these rates were 0.72 ± 0.01 Kg/bed-day, 0.47 ± 0.01 Kg/bed-day and 0.01 ± 0.002 Kg/bed-day for hazardous-infectious, municipal and sharp wastes respectively. The percentages of hazardous-infectious wastes, municipal wastes and sharp wastes were 60.00%, 39.10% and 0.83% respectively. The hospitals waste management was evaluated poor in terms of separation, collection, transportation, temporary storage and training aspects and good in the treatment aspect.

Keywords—Active bed, assessment, generation rate, hospital waste, waste management

1 INTRODUCTION

Solid waste is any solid material in the material flow pattern that is rejected by the society while management can be defined as the judicious use of a means to achieve an end. With rapid urbanization the world over, the potential threat constituted to public health by improperly disposed waste is of serious concern (WHO, 2005). Sanitation and waste are inseparable two critical issues currently engaging the attention of developing countries, including Nigeria (Coker, 2002). Waste can be categorized in various ways as solids, liquids, abattoir, domestic, industrial, agricultural, commercial, radioactive, hazardous, hospital wastes and others. Hospital (Medical) solid wastes are considered hazardous waste due to its components such as pathogenic microbial factors, hazardous chemical, radioactive substances and sharp materials (Prusset al., 1999). Medical waste is of environmental concern because of its infectious nature that can spread diseases and cause injury to human (Hassan et al., 2008).

Researchers such as Amooel (2003), Tudor et al (2005), Da Silva et al. (2005) and Akter (2000) reported that any negligence in the management of the waste may be of direct or indirect adverse effect on the human health and its environment. Recently, one of the reasons of an increase in medical waste generation was notable advances in the field of medicine and health care (Kardanmoghadamat et al., 2014). It is an understatement to say that the effective management of waste and sanitation marks an entry point for development. Medical waste is defined as any solids, liquids, sharps waste including its containers and any other intermediary product, which is generated during the diagnosis treatment or immunization of human beings or animals in research pertaining there to, or in the production or testing (Pruss et al., 1999). It is generated from all type of healthcare institutions, including hospitals, clinics, (veterinary) offices, and medical laboratories.

It comes mostly from the administrative and housekeeping functions of health care establishment and may also include waste generated during maintenance of health care premises (Agu, 2008). A Study conducted in ten large public and private hospitals of Rawalpindi and Islamabad shows that segregation practices (for risk and non-risk waste) at the point of generation were not followed. Waste segregation issues were due to lack of training of medical and other staff including sweepers and ward servants. There were no waste bins. Waste was collected without using standard operating procedures for final disposal and treatment. The study suggests that training of hospital staff can lead to improved hospital risk waste management practices (Verma, et.al., 2008).

Health-care waste includes all the wastes generated by medical activities. It embraces all activities of diagnosis as well as curative, preventive and palliative treatments in the field of human and veterinary medicine. This simply means that every wastes produced by a medical institution (public or private), a medical research facility or a laboratory is considered as health-care waste. Over the decade, the growth of the medical sector around the world combined with an increase in the use of disposable medical products has contributed to the large amount of medical waste generated (Edmund, 2012). The main drivers of solid waste problems in Nigeria have been attributed to poverty, high population and urbanization growth rates compounded by a weak and underfunded infrastructure (Walling et al 2004). It is also suggested that management of solid waste in Nigeria cities continues to pose serious challenges due to the absence of appropriate and organized waste management culture and technologies, arising from financial, political instability, poor implementation of policy and technological constraints. The main problems in the hospital waste management were highlighted as follows: Lack of separation of semi-domestic and hazardous waste (Askarianet al., 2010); lack of necessary
facilities for treatment of infectious waste (Farzadkia et al., 2013), and inadequate training of staff and lack of foresight personal protective equipment (Raigani Shiraiz et al., 2008). The waste generation rates per bed varied between different countries, different cities and even the different hospitals of a city are presented in Table 1. Sources of medical waste generation are presented in Table 2.

Table 1: Waste generation rate per bed at hospitals

| Country      | Waste generation rate (Kg/bed day) | Reference          |
|--------------|------------------------------------|--------------------|
| Dhaka        | 1.2                                | Privacy et al., 2009 |
| Germany      | 3.6                                | Mulej et al., 2007  |
| Netherlands  | 1.7                                | Mulej et al., 2007  |
| England      | 3.3                                | Mulej et al., 2007  |
| Brazil       | 3.5                                | Da Silva et al., 2005 |
| Taiwan       | 2.41 – 3.26                        | Cheng et al., 2010  |
| Libya        | 1.3                                | Swalim et al., 2009 |
| Canada       | 1.5 – 3.9                          | Mato and Kasenga, 1997 |
| Tanzania     | 2.4                                | Mato and Kasenga, 1997 |
| India        | 0.5 – 2                            | Prad et al., 1999   |
| Thailand     | 1                                  | Kerdewan, 2000     |
| Bangladesh   | 1.2                                | Privacy et al., 2009 |
| Turkey       | 0.63                               | Bingnig et al., 2009 |
| Southern Brazil | 3.3                     | Da Silva et al., 2005 |

Source: Farzadkia et al. (2015)

Table 2: Sources of Medical Waste Generation

| Areas of Waste Generation | Activities Performed | Types of Waste                          |
|---------------------------|-----------------------|-----------------------------------------|
| Emergency ward and operation Theatre | Minor and major procedures | Blood and body fluids, surgical procedures |
| Accidental operative procedures | syringes and needles, blades, gloves and masks | Blood and body fluids, surgical procedures |
| Gynaecological surgery and treatment in Obstetrics and Gynaecology | Harvesting | Blood and body fluids, surgical procedures |
| Theatres and operating rooms | Child birth and family, syringes and needles, blades, and gloves | Blood and body fluids, surgical procedures |
| Pathological Laboratory | Culture preparation, sample collection, Microscopic observation and testing of all diseases | Blood and body fluids, surgical procedures |
| Injection room | Immunization and treatment | Blood and body fluids, surgical procedures |

Source: Jagadeesh et al. (2014)

Several researchers have observed poor medical waste disposal service in hospitals globally (Askarian et al., 2010; Jagadeesh et al., 2014; Farzadkia et al., 2015). They observed that the general awareness on issues related to medical waste management was generally lacking among the generators and the handlers. Improper collection, storage, treatment and disposal of these wastes can lead to serious environmental damage of various kinds. Some of the health problems associated with improper collection, treatment and disposal of healthcare waste include typhoid fever, cholera, skin disease, malaria and others diseases. Hence, the disposal of items used at health institution must be handled with utmost care so as to ensure that health care workers, patients and members of the community at large are protected from the dangers of secondary transmission of diseases and cause of injuries. This study was to assess different aspects of the current status of medical waste management in private hospitals of Lagos State, Nigeria.

2 Methodology

2.1 Site Description

Lagos State was former capital of Nigeria, geographically situated in the South Western part of Nigeria. It spans the Guinea Coast of the Atlantic Ocean for over 180km on the South, from the Republic of Benin on the West to its boundary with Ogun State in the North and East of Nigeria. It falls within longitudes 030 50`E and 030 38`E and latitudes 060 20`N and 060 18`N. The total territorial area of 3,577sq km, about 787sq km or twenty-two percent (22%) is wetland area and hasa population estimated at 21 million in 2014, which makes it the largest city in Africa. The state is divided into twenty Local Government Areas (Fig. 1).

2.2 Data Collection

Information on the location of private hospitals in Lagos State of Nigeria was collected from the Ministry of Health, Lagos. Three hospitals were used as pre-testing and nine hospitals were randomly selected across the State for the study. Information regarding staff strength, services available, wards, units, and numbers of beds, years in operation, average rate of occupancy of beds, profile of waste handlers, activity, type and colour of container and waste management practices such as separation and handling, collection, transportation, temporary storage, disposal and training.

The methods; in-depth interview, and participant observation strategy/discussion were also adopted in this study. The discussion was organized so as to obtain additional information from the respondents and also the heads of units and wards to validate some of the results from the questionnaires and the interview. For simplicity in data analysis, two alternatives (Yes and No) were design and code 1 and 0 were also assigned to those which complied with the law (positive) and those which did not comply with the law (negative) respectively. Then, frequency of positive and negative responses were calculated for each part of the hos-
hospital waste management and were converted in to 0 – 100 to be classified. The ranking of the hospital management was categorized into three including poor (0 – 60%), moderate (60 – 80%), and good (80 – 100%) (Jonidiet al., 2013).

Based on principle and confidentiality, in regards to the collected and use of the information obtained from each hospital, the names of the hospitals were coded as H1 to H6. The calculations were based on the weights of the waste that was generated regularly in the selected hospitals over a period of one week.

2.3 Data Analysis

The data were analyzed using 17.0 versions of SPSS. The waste generated rates (WG) per occupied bed, available bed, and inpatient per day was determined as follow.

WG= \[ \frac{\xi (W_r - W_b)}{\text{Occupied bed}} \] (1) or

WG = \[ \frac{\xi (W_r - W_b)}{\text{Available Bed or Occupied Bed}} \] (2)

Where

WG = Waste generated rates (Kg/ day) or (Kg / bed /day) 
\( \xi \) = summation 
W_r = Weight of the bin filled with sample waste (Kg) 
W_b = Weight of empty bin (Kg) 
Inpatient = Number of patient hospitalized.

Occupied bed = Number of hospital patient who occupies a bed.

Table 3: Types of containers used to collect different types of hospital waste

| Types of waste                      | Container          | Colour used by hospital |
|------------------------------------|--------------------|-------------------------|
| General                            | Plastic bag in container | Black plastic bag |
| Chemical and Pharmaceutical, Infectious Pathology | Plastic bag in yellow/white | Yellow/white Plastic bag |
| Sharp                              | Yellow in box/box  | Yellow/white bin or box |

3 RESULTS

The general information about the studied hospital, waste generation rate and waste management practices are presented in Table 4, 5 and 6 respectively.

Table 4: General information for the studied hospital

| Hospital | Activities                  | No. of active bed | No. of ward | No. of personnel | Years in operation |
|----------|-----------------------------|-------------------|-------------|------------------|-------------------|
| H1       | Specialized/General         | 48                | 6           | 56               | 43                |
| H2       | Specialized/General         | 38                | 5           | 38               | 33                |
| H3       | Specialized/General         | 34                | 5           | 29               | 29                |
| H4       | General                     | 26                | 4           | 19               | 21                |
| H5       | General                     | 12                | 2           | 14               | 14                |
| H6       | General                     | 8                 | 2           | 11               | 12                |

Table 5: The average waste generation rates of hospital

| HOSPITAL | GENERATION RATES |
|----------|------------------|
| H1       | H2              |
| H3       | H4              |
| H5       | H6              |
| Total Waste |
(Kg/day) | 60.25 ± 2.13     |
| Hazardous | 33.95 ± 2.11    |
| Municipal | 26.25 ± 1.99  |
| Sharp    | 2.16 ± 0.44     |
| Total Waste |
(Kg/day-bed) | 1.21 ± 0.20    |
| Hazardous | 0.71 ± 0.11     |
| Municipal | 0.55 ± 0.34    |
| Sharp    | 0.02 ± 0.01     |

Table 6: Waste Management Practices

| HOSPITAL | WASTE MANAGEMENT PRACTICES |
|----------|-----------------------------|
| Separation | S1, S2, S3, S4, S5, S6, S7, 50.0 |
| Collection | C1, C2, C3, C4, C5, C6, C7, C8, 50.0 |
| Transportation | S1, S2, S3, S4, S5, S6, S7, 33.3 |
| Disposal | TS1, TS2, TS3, TS4, TS5, TS6, 33.3 |
| Man power | ST1, ST2, ST3, ST4, ST5, ST6, 33.3 |
| Protective devices | PD1, PD2, PD3, PD4, PD5, PD6, 100 |
| Treatment | TW1, TW2, TW3, TW4, TW5, TW6, 100 |

CODE FOR WASTE MANAGEMENT

S1 = Separation
S6 = Non-Separation
C1 = Different container/bag
C6 = same container/bag
L1 = Label
L6 = Non-label
TS1 = Temporary storage in ward
TS5 = Non-temporary storage in ward
S1 = All the staff was trained for waste management
S6 = only cleaner are trained for waste management
PD1 = Use of protective devices
PD6 = Non usage of protective devices
TW1 = Treatment of waste
TW6 = No treatment of waste
4 DISCUSSION

4.1 General Information about the Studied Hospital

General information of the studied private hospitals is presented in Table 4. The average number of active beds and employees were 28 and 29 respectively. Two of the hospitals usually hired specialist surgery when operation case arising. All the hospitals have no environmental health specialist.

4.2 Generation of Medical Waste in the Studied Hospital

The waste generation rate is presented in Table 5. The average and standard deviation medical waste generation rates were 1.14 ± 0.12 Kg/bed-day. The results also showed that these generation rates were different from one hospital to the other hospital. The highest and lowest daily waste generation rates were 1.53 ± 0.30 Kg/bed-day and 0.80 ± 0.02 Kg/bed-day in H2 and H6 hospitals, respectively. The percentages of hazardous-infectious wastes, municipal wastes and sharp wastes were 60.00%, 39.17% and 0.83% (see Fig. 2) respectively. The high generation rate of hazardous-infectious waste compared to municipal (non-infectious) waste in the studied hospitals can be due to lack of a plan for the operation of waste separation.

Fig. 2: The graphical representation of the waste composition of the surveyed hospital.

These findings collaborate with Farzadkia et al., (2015) that waste generation rates per bed varied between different countries, different cities of a country and even different hospital of a city. The causes of these differences can be attributed to the following condition and capacity of a hospital, the nature and quality of medical services, standard of equipment, hospital location, variety of sections of the hospital such as surgery, general and so on, the number of patients, laboratory areas, use of disposable materials, attention to different aspects of hospital waste management especially separation, recycling, re-use and purification of infectious wastes and different levels of staff training in regards to waste management.

4.3 Hospital Waste Management Practices

The status of hospital waste management practices is presented in Table 6. The results indicate that waste separation was ranked poor (50%). This can be attributed to lack of initial training of new staff on waste management. The staff both old and new should be trained and re-trainee. The waste separation should be placed on its producers (such as doctors, nurses and paramedics). For proper management of medical wastes they need to be separated and stored in colour containers at the point of generation.

The results reveal that hospital in collection, transportation, temporary storage and training aspects were poor 50.0%, 33.3%, 33.3% and 33.3% respectively (see Table 6). Lack of labeling of waste bags/containers and temporary storage in the ward were the main reasons for the poor condition of hospital waste management in the studied hospitals. Despite this forthcoming, the results showed that that 100% of the studied hospitals did staff numbers use safety equipment (protective devices) such as special clothes, gloves, mask, boots and others in waste transportation. All the hospitals treated their wastes with the use of incineration. Two of the hospitals (H1 and H2) use autoclave as well as incineration for their wastes treatment.

5 CONCLUSION

The following conclusions can be derived from this study: The total medical wastes were 207.16 Kg/day. Of the total medical waste produced in private hospital in Lagos State in one day, 119.07 Kg consisted of hazardous-infectious wastes, 85.91 Kg municipal wastes, and 2.18 Kg sharp wastes. The average and standard deviation medical waste generation rates were 1.14 ± 0.12 Kg/bed-day. The results also showed that these generation rates were different from one hospital to the other hospital. The highest and lowest daily waste generation rates were 1.53 ± 0.30 Kg/bed-day and 0.80 ± 0.02 Kg/bed-day in H2 and H6 hospitals, respectively. The percentages of hazardous-infectious wastes, municipal wastes and sharp wastes were 60.00%, 39.17% and 0.83% (see Fig. 2) respectively. Overall, status of waste management was ranked poor in the studied hospital in term of separation, collection, transportation, temporary storage and training aspects and good in the treatment aspect.

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