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Hospital waste generation and management practices in Owerri, Nigeria

Nwakwuo Geoffrey Chima[1]*, Abanobi Okwuoma C.[1], Abaraogu Uchechukwu John[1], Uwalaka Chiamaka Henrietta[1], Asonye Iheoma Chekube[1] and Nwankpa Promise[2]

[1]Department of Public Health Technology, Federal University of Technology, P.M.B. 1526, Owerri, Imo State, Nigeria.
[2]Department of Biochemistry, Imo State University, P.M.B. 2000, Owerri, Imo State, Nigeria.

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This study is aimed to estimate the rate of waste generations and describe the waste disposal/management practices. The study surveyed the waste generation and management practice of 12 hospital and clinics selected using multistage sampling techniques from the list of hospitals in Owerri Municipal. Wastes generated were weighed and parallel to that, data on patient influx, number of beds, length of stay and waste management practices were collected through a questionnaire. The average waste generated from the survey was 49.8 kg/day and 0.58 kg/bed/day comprising 16% hazardous and 84% non-hazardous. Fifty percent of the wastes generated were disposed openly in municipal bins. Also 41.7% of sharps are disposed mixed with municipal waste and despites high awareness on hazardous nature of hospital waste, only 16.7% of waste are collected in colour coded bags with 33.3% having laid down waste management plans for waste disposal. With the per day waste generation of hospital waste exceeding the per capita per day international generation of waste, that is, 0.25 kg in a country where an average citizen live on less than a dollar per day, there is an urgent need for increasing awareness and education on hospital waste generation and its implication for disposal and management.

Key words: Hospital waste generation, segregation, hazardous, non-hazardous, management, Owerri, Nigeria.

INTRODUCTION

The increasing number of hospitals in Nigeria and the inadequate management of hospital waste have posed a great threat to health and the environment through increasing waste stream. Waste is an issue in the world today, and waste quantities are generally growing (Babatola, 2008). But unfortunately, the lack of available and comparable data for many countries does not always allow reliable comprehensive assessment of waste-related issues. Few data are available on the composition of hospital waste, which is characteristically and extremely heterogeneous in nature (Dehghani et al., 2008).

Any anthropogenic activity is known to generates some wastes and these wastes described with the term

*Corresponding author. E-mail: chimakyte@yahoomail.com. Tel: +2348037359481.

"hospital waste", refers to waste generated during the diagnosis, treatment, or immunization of human beings or animals or in research activities in these fields or in the production or testing of biological substances (Babatola, 2008). Although a large part of hospital waste usually consists of hazardous/clinical and non-hazardous waste which could be solid or liquids (wastewater), hospital waste in general are by-products of healthcare activities and may include a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices, genotoxic waste, radioactive materials and heavy metals (WHO, 2011).

Johannessen (1997) provided generation rates of health-care waste by regions with Africa excluded. Also, a review of health-care waste generation rates has been provided by the World Health Organization (Pruss et al., 1999) for various country and hospital situations with none for Nigeria. This could be an indication of few available data (from different facilities and states) to estimate the generation of hospital waste in Nigeria.

Depending on the industrial base, waste is likely to vary from country to country (Babatola, 2008) with tendencies for higher generation rates in higher income countries due to industrialization. Although, the quantities of hazardous waste generated have decreased in many countries, an increase has been recorded in some due to changes in definitions such as industrialization and number of hospitals (Pruss et al., 1999).

In middle and low-income countries, health-care waste generation is usually lower than that in high-income countries (Khan et al., 2004). It suffice to state that despite waste management issues suffered by countries like Bangladesh, it produces very small quantity of hospital waste as compared to developed countries like United States of America (4.5 kg/bed/day). The 0.934 kg/bed/day average hospital waste generation rate reported for Sylhet city is in consistence to that of Dhaka city (1.2 kg/bed/day), but much lower than that of developed countries like USA (4.5 kg/bed/day), and France (2.5 kg/bed/day) (Sarkar et al., 2006; Rahman et al., 1999) but yet, poor management of waste has been reported for these developing nations (Fikru, 2004; Yemane and Millogo, 2000).

The actual hospital generation figures can vary greatly on a daily basis and the kilogram per bed per day generation figure itself is difficult to estimate. This variation can be attributed to the different methodologies used to calculate per bed generation figures.

The present low rate of waste collection especially in developing countries does not encourage the hospital to do special efforts to minimise the quantities of waste. In Nigeria, the lack of will by policy makers and implementtation groups to adopt current technology in healthcare waste management is an emerging challenge towards healthcare waste management with correspondent environment and public health implications for incorrect disposal. Hospital wastes are too hazardous to be treated carelessly and poor management of these wastes tends to spread infections and contaminate the entire environment of the hospital and its surrounding.

The basic concept of waste management in a hospital according to Sarkar et al.(2006), do not differ basically from that in hotels, schools and catering establishments since certain areas of the hospital render the same type of basic services; but as earlier stated, some waste generated in the hospital are too hazardous to be treated negligently.

World Health Organization (WHO) (2000) reported that from the total waste generated by healthcare activities, 80% is general waste (non-hazardous) and the remaining is considered as hazardous (infectious waste, pathological waste, sharps, genotoxic waste, chemical waste, wastes with high content of heavy metals, pressurized containers and radioactive waste). This fraction of waste generated at hospitals are known as special or regulated medical waste (Lee et al., 2004), and yet has not attracted the same level of attention as other type of wastes, particularly in developing countries, despite been labelled "hazardous".

Although waste generation depends on numerous factors such as the established waste management methods, type of hospital establishment, hospital specialization, the proportion of reusable items employed in hospital and proportion of patients treated on a day-care basis (Suwanneem, 2002), the level at which these factors influences the quantity of hospital waste generated is not well understood but reflects a loss of materials and energy and imposes economic and environmental costs on hospital management for its collection, treatment and disposal. The rate of waste generation may also differ due to geographical location, season of the year, collection frequency, social status of the patient (income, living standard, awareness about diseases), as well as present hospital management legislation, etc.

Traditionally, hospital wastes have been disposed off with the municipal wastes in landfills. However, since the late 1980's, the spreading trend of immunodeficiency virus (HIV), hepatitis B virus (HBV) and other agents associated with blood bone diseases has raised public awareness and concerns of the disposal of hospital waste. As a result, these wastes are required to be treated in a special way and not to be mixed with municipal waste (Abanobi et al., 2011).

The improper management of hospital waste causes serious problems that impairs human and animal health and ultimately results in economic, environmental and biological losses (Sharholy et al., 2008). Poor management of hospital waste implies a combination of improper handling of waste during generation, collection, storage, transport and treatment and includes; handling without personal protective equipment, poor storage, manual transport for longer distances, use of uncovered

Figure 1. Map of Nigeria showing Imo State (Inserted Right bottom: Map of Imo State Showing Owerri).

containers, exposure times beyond acceptable limits, lack of worker and equipment decontamination procedures, etc.

Proper management of hospital waste is critical to health and wellbeing of urban and rural residents (World Bank, 2003). The management of hospital waste requires its removal and disposal from the healthcare establishments as hygienically and economically as possible, by methods that all stages minimizes the risk to public health and to the environment. The proper collection of hospital waste however, will help reduce the volume of infectious wastes and consequently, the cost of treatment and disposal.

As a general rule, hospital management should coordinate the collection of infectious and other wastes separately, and the local authorities should be responsible for the treatment of infectious waste (Environmental Protection Agency, 1990) under professional supervision.

This study is aimed to estimate the rate of waste generations and describe the waste disposal/management practices. An attempt will also be made to classify these wastes into two general categories, that is, hazardous and non-hazardous.

METHODOLOGY

This study employed a cross-sectional design to assess hospitals for waste generation, disposal and management practice. The study was conducted in Owerri Municipal (See area circled red in the inserted Map) within an interval of two months in 2009 using questionnaire vis-à-vis physical observation to assess waste generation rates, as well as waste handling and disposal practices.

Using a multistage sampling technique, twelve (12) hospitals (healthcare facilities) in Owerri Municipal, either public (government owned) or private (individual owned) were selected using stratified sampling techniques for weighing and estimation of waste generation in kg/bed/day. The waste generated by the selected hospital were collected, weighed and recorded on a special data sheet.

A validated weighing scale was used to measure and generate data on the waste generated in the hospitals. Data were compiled so as to enable the estimation of the generation quantity. The quantities of hospital waste were presented in terms of kg/day and kg/bed/day waste generated.

The physical composition of the waste was also determined. Before segregation, the waste were disinfected with large quantity of bleach known as “JIK” (3.85% m/v sodium hypochlorite) and with the aid of a large forceps, a glove and a nose mask, the wastes were then segregated into hazardous and non-hazardous components. This procedure was a continuous effort to measure and understand the waste generation in hospitals.

The questionnaire (structured) was pretested on five hospitals and the reliability was found to be 0.76 using Cronbach’s alpha. The questionnaire was made up of two sections, to be filled out by the statistic unit (used to collect information on the number of beds, patient influx and average length of stay) and the other by the waste management unit of the surveyed hospitals covering information on waste handling and management practices.

The raw data gathered from the questionnaire was compiled and analyzed using SPSS version 20 and Microsoft excel and the

Table 1. Waste generation.

Hospital	Class of hospital	No. of beds	Bed occupancy (%)	Total weight of waste (kg)/day
Federal Medical Centre	Public	404	98.0	340.0
General Hospital	Public	182	72.5	112.0
St. David Hospital	Private	87	99.8	42.5
Umezuruike Hospital	Private	50	100.0	25.1
Salvation Hospital	Private	19	97.4	14.9
Austin-Grace Hospital	Private	20	50.0	7.1
Ikenegbu Hospital	Private	30	80.0	15.9
Aladinma Hospital	Private	20	97.7	11.2
Ezem Medical Centre	Private	15	93.3	8.0
Lucky Clinic	Private	6	50.0	2.5
Uchendu Clinics	Private	20	45.0	12.7
Area L Health Centre	Public	7	28.6	5.0

Mean waste generation: 49.7475 kg/day and 0.5815 kg/bed/day.

Table 2. Categories/composition of waste.

Hospital	Total weight of waste (kg)/day	Total weight of waste kg/bed/day	Kg/bed/day Hazardous	Kg/bed/day Non-Hazardous
Federal Medical Centre	340.0	0.842	0.152	0.690
General Hospital	112.0	0.615	0.086	0.529
St. David Hospital	42.5	0.489	0.073	0.416
Umezuruike Hospital	25.1	0.502	0.070	0.432
Salvation Hospital	14.9	0.786	0.126	0.660
Austin-Grace Hospital	7.1	0.354	0.046	0.308
Ikenegbu Hospital	15.9	0.530	0.106	0.424
Aladinma Hospital	11.2	0.560	0.095	0.465
Ezem Medical Centre	8.0	0.535	0.064	0.471
Lucky Clinic	2.5	0.408	0.061	0.347
Uchendu Clinics	12.7	0.637	0.089	0.548
Area L Health Centre	5.0	0.720	0.144	0.576

quantitative data presented in tables and figures.

RESULTS

As mentioned in Table 1, according to the categorization of hospital status and class developed in the methodology, about 25% of the hospitals were public/government owned whereas the remaining 75% are all private owned hospitals. The result of the survey on the per day and kg/bed/day waste generation on Table 1, shows that the average waste generation rate of Owerri Municipal is about 46.4 kg/day and 0.58 kg/bed/day.

The waste composition and the waste segregation performed on per day hospital waste generation are shown in Table 2. Hazardous waste generation for the hospitals ranged between 12-20% while non-hazardous range between 80-88% with an average generation of approximately 16 and 84% non-hazardous (Figure 1).

The composition of the waste observed at the temporary waste disposal bin of one of the surveyed hospitals is shown in Figure 2 and photograph of a temporary disposal site not more than 10 m from hospital facilities is shown in Figure 3. Greater percentage (50.0%) of waste generated are shown to be disposed in open dump with about 41.7% of sharps generated disposed openly mixed with other wastes into municipal waste bins (Figure 2).

The means of transportation for hospital was observed in one of the private facilities surveyed is represented pictorially in Figure 4.

Despite report on increased awareness (100%) of hospital staff on hazardous nature of wastes, only 16.7%

Figure 1. Average composition of hospital waste in surveyed facilities.

Figure 2. Composition of hospital waste in a temporary disposal container.

Figure 3. Temporary hospital waste disposal site at General hospital.

Figure 4. Transportation of hospital waste from a surveyed private health facility.

Table 3. Waste handling and management practice.

Variable	Frequency	(%)
Label hospital waste		
Yes	4	33.3
No	8	66.7
Treatment of waste before final disposal		
Yes	2	16.7
No	10	83.3
Use of colour coded waste bags		
Yes	2	16.7
No	10	83.3
Staff awareness of hazardous nature of waste		
Yes	12	100.0
No	0	0.0
Use of personal protective equipment		
Yes	10	83.3
No	2	16.7
Presence of waste management plan		
Yes	4	33.3
No	8	66.7
Inclusion of waste management responsibility for staff		
Yes	6	50.0
No	6	50.0

of the hospitals use colour coding for waste collection. Although there is a greater use (83.3%) of personal protective equipments in waste handling and disposals, only 33.3% of the hospitals have lay down waste management plan with half (50%) including waste management responsibility for their staff and unit heads with only 16.7% applying the colour coding of waste bags or treating waste before final disposal (Table 3).

Waste management from cradle to grave has been given low attention in this surveyed facilities as waste

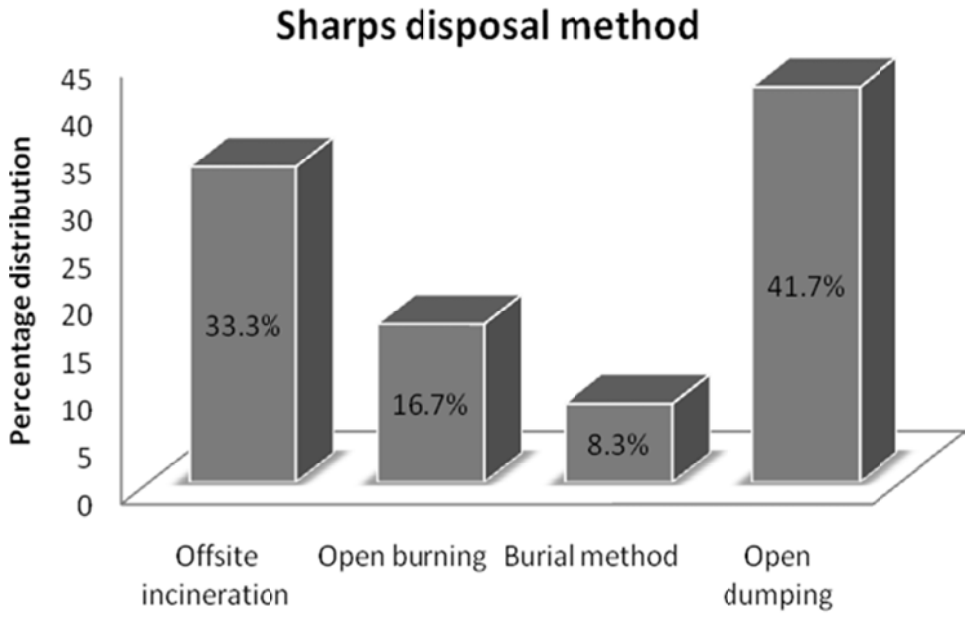

Figure 5. Sharps disposal methods.

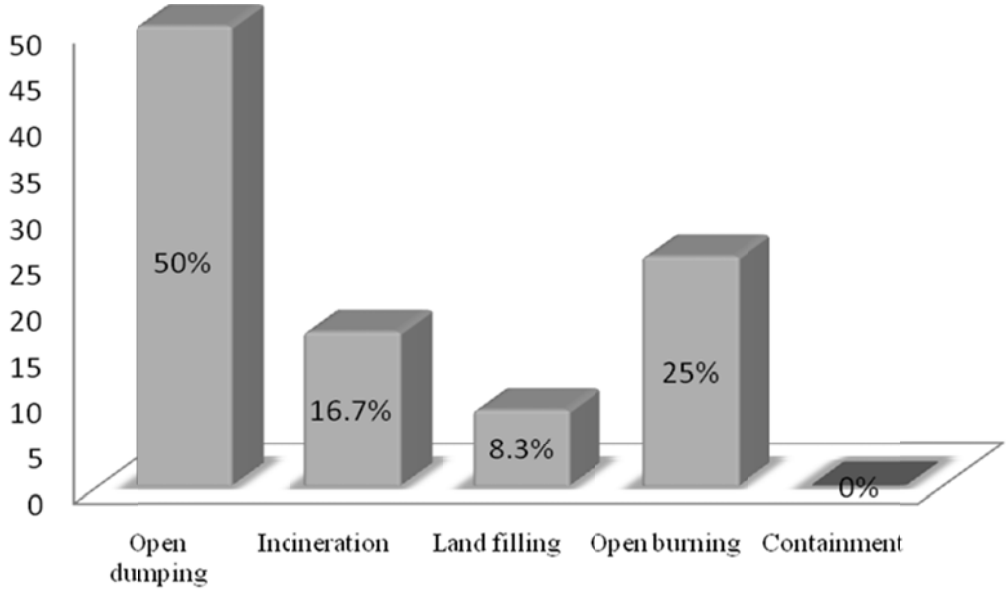

Figure 6. Waste disposal methods.

streams are not properly segregated from collection, carelessly disposed at temporary sites complimented with poor waste transportation and disposal system in some facilities (Figures 4, 5 and 6).

DISCUSSION

Hospital waste is one of the most neglected part of the waste management in Owerri Municipal as well as other cities in Nigeria (Babatola, 2008; Abanobi et al., 2011; Vivan et al., 2012). Neither the government nor the hospital authorities pay proper attention to this issue.

The unhygienic waste disposal by many hospitals and clinics in Nigeria poses serious occupational health hazard and treat to the people living around the vicinity of the hospitals. Most hospitals dispose every kind of wastes (hazardous and non-hazardous) in nearby

municipal dust bins without any pre-treatment whatsoever (Abanobi et al., 2011; Vivan et al., 2012).

In the hospitals surveyed in Owerri Municipal, wastes were collected mostly three times daily in the surveyed hospitals and the average generation rate is 0.58 kg/bed/day. This rate is lower than 0.934 kg/bed/day reported in Sylhet City (Bangladesh), 1.2 kg/bed/day in Dhaka (Bangladesh), 4.5 kg/bed/day in USA, and 2.5 kg/bed/day in France (Rahman et al., 1999). But consistent with a study on medical waste generation of 0.573 kg/bed/day in Lagos (Longe and Wlliams, 2006) and 0.81 kg/bed/day in the inpatient wards (Abah and Ohimain, 2011). Several other studies have reported a higher generation rates (Mohanmadi-Baghaee, 2000; Mato and Kaseva, 1999; Askarian and Vikili, 2001; Olubukola, 2009; Mohseni, 2001; Ashrafi, 2005; Bdour, 2007).

Although WHO reported in 1999, the average generation rate of teaching hospital ranges between 4.1 and 8.7 kg/bed/day (WHO, 1999). This is contrary to that reported for University College Hospital, Ibadan (UCH) of 1.3-1.5 kg waste per bed/day and 1.5-2 kg waste per bed/day in Obafemi Awolowo University Teaching Hospital, Ile-Ife (OAUTH) (Toyobo et al., 2012). This can be attributed to the fact that rates may vary from country to country and from hospital to hospital (depending on the level of care and type of services provided).

This study revealed that 16% portion of the hospital waste generated is hazardous. This is much lower than that reported for Denmark (25%) and USA (28%), and consistent with the rate in Dhaka (15.5%) (Rahman et al., 1999), indicating differences in geographical location, living habits and standards, availability of different treatment facilities, and perhaps the ways in which solid wastes are categorized in different countries. This portion of waste labelled “hazardous” requires special attention for their proper disposal. The remaining portion of wastes can be easily disposed off into the municipal dust bins if carefully segregated and treated.

A few changes in material procurement process in hospitals, mandatory staff education in waste segregation, proper hygiene education to the scavengers, treatment of selected hazardous materials, and such other few efforts can get hospitals off the list of major hazardous materials to be disposed off to the municipal dust bins. Once these wastes are properly segregated, the hazardous portion can be treated by different treatment options and properly disposed off.

Medical wastes are sources of contamination and pollution to both humans and the natural environment. Its improper disposal may be hazardous if it enters water supplies or local sources used by nearby communities or wildlife. It also poses risk to scavengers and children if a landfill is insecure (Vivan et al., 2012). Scavengers may be exposed to sharps, pharmaceuticals and chemicals through direct contact with infectious material and recycling of infectious objects from these bins and/or landfills is potentially capable of causing disease and illness in man, through direct contact with their users.

Keeping the healthcare workers safe against occupational health risks arising from hospital waste management, requires a strategic and well implemented and effective waste control measures. This will help protect even patients and the populace who also have chances of contracting infection caused by airborne pathogens or spores harboured in medical waste. Despite the fact that some portion of the hospital waste has been labelled hazardous and increased awareness of health personnel on the risk of health-care waste, waste has been poorly managed in most facilities in Nigeria and other developing countries (Abanobi et al., 2011). And even with the increased level of awareness of hospital staff on the hazardous nature of hospital waste, the hospitals in Owerri has taken little step to ensure the propel disposal of medical waste. Only 16.7% uses colour coding for disposal of waste and 33.3% has any form of laid down waste management plan. Incinerations in most facilities are still done openly at proximal to the facilities and/or openly in dumpsites.

The proper collection and disposal of hospital waste will reduce the volume of infectious wastes and consequently the cost of treatment (Abanobi et al., 2011). As a general rule, waste management especially infectious waste and other hazardous waste should be properly collected by hospital management and treated by local authorities responsible for these wastes (EPA, 1990). And with the pervasive collection, transportation and disposal of hospital waste mixed with municipal waste in Nigeria, there is need to promote compliance with the “National Policy on Injection and Health-care Waste Management” for improved waste management in Nigeria.

Hospital waste management practices in most hospitals are poor (Manyele, 2004) and according to Abanobi et al. (2011) on a study done on medical waste in Owerri, there are neither proper waste management methods employed by hospitals nor proper waste management plans in these hospitals.

Disposal methods are still poor generally with greater percentage (50%) of total wastes and 41.7% sharps disposed into municipal waste stream. A similar improper disposal has been reported by several studies (Babatola, 2008; Abanobi et al., 2011; Vivian et al., 2012).

It is essential that different authorities (government and private) be involved in the monitoring and control of the environment, recognizing the nature of the problem hospital waste posses and develop legislation to regulate hospital sanitation and fortify implementation of existing ones. Some of the problems discovered to be associated with these hospital facilities in term of waste management include: Despite the awareness of hospital personnel on the hazardous nature of hospital waste, there is still negligence on the consequences and impact of improper waste handling and management practices; Practice of colour coding for waste collection before disposal was

poor. The National Policy on Injection and health-care waste management of the Federal Ministry of Health are not properly implemented; Lack of comprehensive waste management plans for the management of hazardous hospital waste with improper managerial interventions on reducing waste generation (inadequate waste minimization interventions); Inadequate disposal of waste (refuse) into municipal waste and liquid waste into municipal poorly channelled and managed sewerage system without treatment; and Reuse of disposables especially plastics after disposal; among several other problems.

Conclusions

Limited concentration has been given to hospital waste and the unhygienic disposal of hospital waste in Owerri Municipal poses a serious health hazard to the city dwellers in general as well as scavengers patrolling municipal bins. The hospitals require hygienic approach in handling, storage; transport, treatment and disposal of their wastes by the methods that at all stages, minimize the risk to public health and to the environment. This approach requires proper knowledge of waste generations and factor influencing them. The average generation rate of 0.58 kg/bed/day including about 16% of hazardous waste is lower than those reported for some developing and developed Nation. Enlightenment of hospital administrators, proper hygiene education to the scavengers, mandatory staff education in waste segregation, and legislation to regulate hospital waste management will help change the traditional habits of different group of people involved in this sector. Waste management system has to be reviewed and improved in conformation with the WHO pollution control standards as reduction in waste generation can only be achieved if waste points are identified, and effective alternatives determined or waste minimization applied.

Recommendation

Based on the findings of this study and in view of the problems discovered during the study, the following recommendations are made to help health care facilities improve and standardize hospital waste management plan. These will serve as baseline for further study and are not limited to:

1. There is need to train and enlightenment all hospital personnel of the potential risk of hospital waste from handling, storage, transport; treatment and disposal. That which has proven effective in hospital waste management in Tanzania (Manyele 2004);
2. Organizing seminars for hospital personnel and waste management personnel by management regulators/agencies on current waste management technologies, enlightening them on the needs to design a (risk free) waste management plans in actualizing good waste management practice;
3. Expert waste management in accordance with the National Policy on Injection Safety and Healthcare Waste Management of the Federal Ministry of Health, 2007 (Federal Republic of Nigeria Gazette 2007) will help properly manage and reduce hospital waste stream;
4. Workable incinerators should be provided by hospitals in accordance with the requirements of the National Policy on Injection Safety and Healthcare Waste Management of the Federal Ministry of Health, 2007 as well as those that conforms to the WHO standards for pollution control, providing cost effective services for smaller hospital establishments. This will enhance waste minimization;
5. Waste segregation from cradle to grave amongst hospitals as means of minimising generation should be encouraged and a well informed and trained staff appointed for separate collection, transport, treatment, and proper disposal of infectious hospital waste;
6. Storing of waste at using the specification of the bins (colour, size, type etc. according to the 2007 National Guideline on Environmental Health Practice in Nigeria, the Biomedical Waste (Management and Handling) Rules 1998/2000) and other applicable laws is necessary;
7. There should be a developed routine for proper waste collection and treatment, transportation and disposals at dumping site with attention to using chemical disinfectants treatment;
8. Provision of protective clothes and safety measures for waste collectors or handlers should be enhanced and sharps management practice that decreases the possibility of injury and spread of infections adopted;
9. It is also necessary to promote a regular monitoring and evaluation of hospital waste management practices and the performance of the systems periodically; and
10. Further studies should exploit the strategies of maximizing waste generation factors, as well as the cost effectiveness of waste management methods and apply it to design appropriate waste management plans for different hospital.

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Conflict of Interests

The author(s) have not declared any conflict of interests.

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