Generation and Disposal of Solid Clinical Waste in General Hospital and Infectious Disease Hospital, Ikot Ekpene, Akwa Ibom State, Nigeria: Characterization and Management Strategies

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Abstract
Clinical waste in health facilities still constitutes a major risk to public health and the environment. A descriptive survey on their characterization and management was conducted in General Hospital and Infectious Disease Hospital Ikot Ekpene. A non-Probability sampling design was used in the methodology of this work. Questionnaires were administered to a sample of forty-five (45) respondents involved in management of wastes. This was obtained through systematic sampling technique used in selecting the respondents. The data collected were subjected to statistical analysis using percentage, and frequency tables. The researcher also adopted oral interview method to obtain information related to the study. From the results of data analysis, it was observed that general hospital generates 25.25 times much volume of health care waste than Infectious Diseases Hospital (IDH); the wastes so generated were not quantified, thus the researcher adopted the Douet Billing per Service Unit of the Institution Method of waste measurement to arrive at the results, and only solid health care wastes were quantified. It was also found in the course of the study that health care waste management was not given serious attention in the selected hospitals in Ikot Ekpene L.G.A. The most commonly used waste management method in the hospitals was open dumping. Six categories of health care wastes were identified in the two health facilities, namely; infectious, pathological, sharps, pharmaceutical, chemical and radioactive wastes. Physical, chemical, and biological hazards were also identified. General and Infectious Diseases hospitals (IDH) were respectively made of 14 wards/units, 239 beds and 6 wards/units, 28 beds. An estimated total of 33.4 kg/day (0.0334 tons/day) of solid health care wastes were generated in the two hospitals. Open dumping, incineration, burying and open burning were the different methods of waste disposal. In conclusion, the study revealed that health care waste was poorly managed in the selected hospitals in Ikot Ekpene L.G.A This calls for serious concern, having in mind the tendency for infection transmission arising from poor health care waste management in the area.

Keywords: dumping, radioactive, protection, sharps and cytotoxic

INTRODUCTION
The waste produced from health-care activities carries a higher potential for infection and injury than any other type of waste (Pruss et al., 1999). Therefore inadequate and inappropriate handling and disposal of health-care wastes may have serious public health consequences and a significant impact on the environment. It is therefore essential that wherever it is generated, safe and reliable methods for its handling and disposal must be adopted. Health-care waste includes all the wastes generated by health-care establishments like hospitals, research facilities, and laboratories. According to Pruss et al, (1999), between 75% and 90% of the waste produced by health-care providers is non-risk likened to domestic waste. The remaining 10% to 25% of health-care waste is regarded as hazardous materials that may be infectious, toxic or radioactive (capable of creating varieties of health risks). Thus a sound management of health-care waste is a crucial component of environmental health protection. According to Anozie (2000), infectious and anatomic wastes such as cultures and stock of infectious agents waste from infected patients, and waste contaminated with blood represent the majority of hazardous waste (15%) produced by health-care activities. Other categories of waste produced include Sharps such as syringes, disposable scalpels and blades represent 1%.
Chemicals and pharmaceuticals such as solvent and disinfectants, expired, unused and contaminated drugs amount to about 3%. Genotoxic waste, radioactive matter and heavy metal content represent about 1% (Johannessen, Dijkman, Barlone, Henraitham, Boyer and Chandra, 2000). Pyrek (2003) realized that throughout the world, every year an estimated 12,000m injection is administered. Though data are lacking in Nigeria on health-care waste generation rates, in USA 3.2 million tons of health-care waste are generated yearly, an estimated rate of 10% to 15% generated yearly by hospitals is infectious. High-income countries can generate up to 6kg of hazardous waste per person per year. In the majority of low-income countries, where health-care waste is not separated into hazardous or non-hazardous waste, the total health-care waste per person per year is from 0.5kg to 3kg (USEPA, 1990). Inappropriate solid waste disposal is a serious public health problem in most developing countries including Nigeria (Awurum, 2005). In Nigeria the importance of waste disposal as a public health problem was underlined by the establishment in 1998 of the Federal Environmental Protection Agency (FEPA), which was empowered to regulate all gaseous, liquid and solid waste handling and disposal processes (Sridhar and Ayeni, 2002; Shaba, 2002 and Obionu, 1999). However, this agency is now defunct. Waste can exist as solid, liquid or gas. The disposal of solid and hazardous waste in or on the land without careful planning and management can present serious danger to human health and the environment (Oyaigbervwen, 1988).

The United States Environmental Protection Agency (USEPA) has defined solid waste as any useless, unwanted or discarded material. The Scottish Environment Protection Agency (SEPA) and Highland Council (SEPA/HC, 1992) categorized waste generally into three major groups namely controlled, special and medical. The World Health Organization holds that health care waste includes all the waste generated by health care establishments, research facilities and laboratories (WHO, 2003). Hospitals generate more than two million tons of waste each year. Only 15% of these are exclusively infectious, and are suspected to contain pathogens in sufficient concentrations to cause disease in susceptible hosts (WHO, 1999). Many hospitals simply dump all waste streams together there are no defined procedures, regulations, legislations or polices on clinical waste management in hospitals in Akwa Ibom state, Nigeria. The personnel involved, from the collection to the final disposal stages have little or no formal training in clinical waste management. In addition, there is no documentary evidence of quantity of waste generated by each unit in each hospital.

This study was designed to investigate the generation and management of clinical waste in general hospital and Infectious disease hospital Ikot Ekpene, Akwa Ibom State in order to ascertain the hazards they pose to public health and the environment.

METHODS
The descriptive survey was used to assess the clinical waste management practice in the study area using generated data, without making any generalization beyond the observation at hand (Knapp, 1978).

Target Population
The target population for the study was all relevant officers involved in solid clinical waste management from the two hospitals selected in Ikot Ekpene, Akwa Ibom State. The officers included all Chief Medical Directors or Superintendents, Heads of Departments/Units, all Environmental Health Practitioners, and all Community Health Extension Workers (CHEWs) or cleaners in the hospitals. Also, all these key officers were interviewed accordingly.

Sampling Technique and Sample Size
The simple random sampling (balloting) method was used in selecting the hospitals from each category (government and private). Proportionately, four were selected from the 14 government hospitals and three out of the nine voluntary / private hospitals. The government hospitals selected were General hospital, Ikot Ekpene, General hospital Efin, General hospital Ikota Oron and Immanuel General Hospital, Eket, while the private hospitals included St Luke’s hospital, Anua, St Mary’s hospital Urwa Akpan and Qua Iboe Church Leprosy hospital, Efin. The convenience sample method was adopted based on Gay (1996) method of sample size selection for selection of target population. According to Gay (1996) setting guidelines for sample size selection,

1. The larger the population the smaller the percentage of the population needed to get a representative sample.

2. For smaller population, N<100 this is little point in sampling, the entire population is surveyed.

Heads of departments and Head orderlies for the two selected hospitals were:

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Heads</th>
</tr>
</thead>
<tbody>
<tr>
<td>General hospital Ikot Ekpene</td>
<td>30</td>
</tr>
<tr>
<td>Infectious diseases hospital</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
</tr>
</tbody>
</table>

Applying Gay’s principles for smaller population N < 100, survey the entire population. Therefore, the entire population size of 45 was used as respondents in this study. The major instrument for data collection was the structured questionnaire on solid clinical waste management. In-depth interviews of selected unit heads in charge of waste management practices were undertaken using the interview guide. Also, personal inspection of dumpsites in the hospitals was carried out.
**Estimation of Weight of Clinical Waste**

The weight estimation of solid clinical waste in the hospitals was based on modified Coker et al. (1999) methodology; and the FEPA (2001) now Federal Ministry of Environment, Housing and Urban Development formula, which states that the total weight of waste in each facility is divided by the number of occupied bed spaces. The waste was sorted and weighed for only ten consecutive days in each hospital. This was limited to only solid clinical wastes generated from each unit of the hospitals. To determine the quantity of solid clinical waste generated by the hospitals, a waste quantification method known as billing per service unit of institution method as described by Douet (1989) was adopted. According to Douet (1989), the wastes could be weighed or their weight estimated. It could also be quantified by bulk volume such as carts or individual containers such as bags as adopted in this study.

**RESULTS**

In General Hospital Ikot Ekpene, results from the 15 wards/units are presented in Table 1. There were similarities but quantities varied in some types and categories of solid clinical wastes generated in all the wards/units. Pharmaceutical wastes (e.g. drugs and their containers, vials, gloves and syringes) were generated in all the wards/units. Infectious wastes (e.g. cotton wool, swabs and gauze), chemical wastes (e.g. disinfectant), and pathological wastes (e.g. blood and blood products) were also generated in all wards/units except the Pharmacy. Sharps (e.g. needles and blades) were not generated in the Pharmacy and Radiography units. Radioactive wastes were only generated in Radiography units.

Tables 1 and 2 showed that seven major categories of solid clinical wastes were found to be recurrent in General Hospital and Infectious Disease Hospital namely: infectious wastes, sharps, pathological, pharmaceutical, chemical, heavy metal (mercury) and radioactive wastes. These solid clinical wastes generated in the health facilities were classified into three types according to the nature of health hazards associated with them namely: physical, chemical and biological hazards. These hazardous wastes also harboured pathogenic microorganisms such as *Staphylococcus aureus*, *Streptococcus pneumoniae*, etc. All the Wards/Units generated infectious, sharps, chemical, pharmaceutical and pathological wastes except the Pharmacy unit, which generated pharmaceutical waste only and the Out-patient Department/Emergency unit that generated heavy metal in addition to the types of waste mentioned above. Quantification of wastes was carried out on the two hospitals for ten (10) days and data are presented according to the quantification of daily health care wastes generated by the wards/units of the two hospitals. At the General hospital Ikot Ekpene, Labour Ward generated the highest wastes volume of 273kg/10 days and a minimum of 1.8kg/10 days in the laboratory unit. At the infectious Diseases hospital (IDH), the Male Medical Ward generated the highest quantity of 5.1kg/10 days, while the least of 1.4kg/10 days came from Radiography unit. A total of 446.9kg of health care wastes were generated in General hospital (mean of 44.69kg), while 17.7kg were generated in Infectious Diseases hospital (mean of 1.77kg).

**DISCUSSION**

This finding agrees with the work of Sunde (2000) who found that solid clinical waste is a heterogeneous mixture of many types of wastes and includes general waste (trash), potentially infectious wastes, hazardous and pathological wastes.

**Quantity and Nature of Health Hazards Associated With Clinical Wastes**

Table 2 summarizes all the types and nature of health hazards associated with solid clinical waste as reported in the seven hospitals. These were grouped into three (physical, chemical and biological). At the General Hospital Ikot Ekpene, Labour Ward generated the highest wastes (26.9kg/day), while the lowest was 0.17 kg/day in the X-ray unit. The average waste generated in this hospital was 42.9kg/day (Figure 1a & 1b). At the St Luke’s Hospital Anua, Uyo, Labour Ward again generated the highest quantity of solid clinical wastes (11.3kg/day) while the least, 0.17kg/day was in the X-ray unit as shown in (Figure 2a & 2b). A total of 246.2kg of health care wastes was generated for 10 days, giving an average of 24.62kg daily. (Figure 3a & 3b) shows that for the 10 days of survey, 194.9kg of solid clinical wastes were generated at Immanuel General Hospital, Eket with an average of 19.49kg of waste per day. The Pharmacy produced the highest amount of waste (34.5kg/day), while the lowest (3kg/day) was in the Nursery. On the quantity of solid clinical waste generated by the seven health facilities, it was found out that Labour/Antenatal wards and the theatre generated the largest quantities of wastes, while the X-ray and Nursery units produced the least in many hospitals. The findings showed that at the general Hospital Ikot Ekpene, Labour ward generated the highest quantity of solid clinical waste (26.9kg per day), while the lowest was 0.17kg/day in the X-ray unit. At the St Luke’s Hospital, Anua, Uyo, Labour ward again generated the highest (11.3kg/day) while the least (0.17kg/day) was generated in the X-ray unit. On the contrary, at the General Hospital Iquita, Oron, the highest quantity (2.92kg/day) of waste came from the theatre while the X-ray unit generated only 0.14kg/day.

**Waste Handling / Protective Equipment**

In all the health facilities surveyed, the various protective equipment used by staff included gloves,
face masks, overalls and boots worn either alone or in combination. Helmet was used only in Immanuel General Hospital, Eket. It was also observed that face mask was used only in General Hospital, Ikot Epkene and General Hospital, Iquita, Oron, while helmet with overalls were worn in General Hospital, Ikot Epkene and Immanuel General Hospital, Eket. Boots were worn only in General Hospital Ikot Epkene. The most common protective clothing or the highest was the combination of gloves and face mask stated by 24% of respondents, followed by gloves and boots (4%). Health workers in General Hospital, Etinan and St Mary’s Hospital, Urua Akpan combined boots and gloves at the same time as shown in Figure 4. This finding does not comply with the Occupational Safety and Health Administration (OSHA) recommendations which state that appropriate protective equipment must be used to reduce risk or workers exposure, and that employer must make readily available at no cost to employees appropriate specialized clothing or equipment to protect against exposure to blood and other potentially infectious materials. The Ministry of Health, Thailand (1995) also supports OSHA’s recommendations by listing some protective clothing for personnel who collect or handle chemical waste to include: helmet (with or without visors), face mask, eye protectors (safety goggles), overalls (coveralls), industrial aprons, leg protectors (boots), disposable gloves (medical staff) or heavy duty gloves (waste workers).

REFERENCES
Anozie, C. J. (2000). Health hazards of solid waste generated at the University of Calabar Teaching Hospital, unpublished research seminar, University of Calabar


Environmental Protection Department, the Hong Kong, Special Administrative Region Government (2001) (Draft) Code of Practice for the management of clinical Waste for Waste Collectors and major Clinical Waste Producers.


Louisiana Department of health and Hospital Regulations (1998). Occupational; Safety and health Administration (OSHA), Medical Waste Considerations for Waste Handlers Louisiana, Sanitary Code, xxvii


Shaba, B. O (2002). Solid Waste Management in the College of Medicine and LUTH, Lagos, Post Graduate Diploma Dissertation, University of Ibadan.

