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Cleaners' Perception of Solid Waste Generation in the University College Hospital, Ibadan, Nigeria

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Abstract Environment-friendly approach to hospital waste management practices is imperative, if health of staff, patients and quality of the environment would be guaranteed. To achieve this, information on quantity and composition of hospital solid waste generation is essential. The study explored cleaners' perception of quantity and composition of solid waste produced in the activity areas of University College Hospital (UCH), Ibadan, Nigeria. Data were obtained through perceptual rating of cleaners that dealt directly with solid waste in UCH. Cleaners were required to rate the level of generation of fourteen identified solid waste components peculiar to hospitals as found in literature. Data for the study were collected through the use of structured questionnaires, using purposive sampling technique. One of every cleaner in each of forty (40) selected units in the study area was surveyed randomly. Cleaners were asked to rate solid waste components generated in each unit using a five Likert scale. Findings of the study showed that the mean WGI for the study area was 2.3. Seventeen activity areas had their mean WGI higher than the mean index ($\overline{WGI}$), while the remaining thirteen had negative deviations around the index. It was established that level of perception of medical solid waste generation in the areas other than clinics and wards was very low. It was found that 95% of the activity areas sampled were perceived to produce high quantity of nylon/polythene/plastics waste.

Mean results shows variation in the quantity and components of solid waste generated in the activity areas of UCH. Therefore, the input of cleaners in assessing solid waste quantity and characteristics in hospitals is very important for effective waste management strategy.
***Keywords*:** Cleaners, Perception, Medical waste, Solid waste and University College Hospital

1.0 Introduction

Studies on quantity and composition of healthcare solid waste generation abound in literature (Engdaw *et al*., 2009; Haylamicheal, *et al*., 2011; Kagonji and Manyele, 2011; Idowu, *et al*., 2013; Tasfahun, *et al*., 2014). Those focusing on solid waste production in tertiary hospitals involving different activity areas are very hard to come by, especially in the developing countries (Akinpelu, 2017). This study is set to fill the gap in literature. The research work relied on information obtained from perception of cleaners to estimate the quantity and characteristics of solid waste generated in the activity areas of the institution. The University College Hospital (UCH), Ibadan, Nigeria is a tertiary hospital which was established before independence. The hospital engages in treatment, training, research and provision of accommodation among others. These activities lead to waste generation that was diverse in nature. This was as a result of areas of specialties and scale of operation of the hospital. The evaluation of quantity and components of solid waste produced in each of these areas is pivotal to its effective management. It has been established however that lack of reliable data on the quantity and components of healthcare waste is one of the factors responsible for inadequate waste management practices, particularly in developing countries (WHO, 2004).

In recent past, scholars have documented health hazards associated with improper management of healthcare waste (Coker, 2002; Pruss-Ustun *et al*., 2005; Manyele and Lyasenga, 2010). Coker (2002) in his study posits that inadequate management of healthcare waste is a major cause of diseases such as hepatitis B and C, HIV/AIDS and tetanus. Eye infections, asthma, dysentery, sore throat and cough are related diseases, some of which are life-threatening. Furthermore, the study established that nurses, doctors, pharmacists, and waste handlers including cleaners and other auxiliary staff as well as patients' relations are prone to the diseases. Manyele and Lyasenga (2010) observed that sharp materials are most dangerous category of healthcare waste. They reported that injuries occur because syringe, needles or other sharps have not been collected in safety boxes. It was documented that in the year 2000, 16,000 HCV, 66,000 HBV and 1000 HIV infections occurred as a result of exposure to medical waste among healthcare professionals worldwide (Pruss-Ustun *et al*., 2005).

It is pertinent therefore, that components and generation rate of medical waste be ascertain for sustainable planning and implementation of waste management strategies. Of importance is the input of cleaners in the quantification and characterization of medical waste, especially in a big healthcare

institution such as University College Hospital (UCH), Ibadan. This is because cleaners deal with waste on daily basis; as such, it is expected that they have idea of quantity and components of waste produced in their unit. Studies on cleaners' perception of healthcare solid waste generation in activity areas of tertiary hospitals in Low-income countries have not been empirically documented (Akinpelu, 2017). Thus, this study is embarked on to explore this neglected area of research with a view to contributing to the existing knowledge in the field. In achieving the aim, the study collected data on the cleaners' perception on the rate of solid waste generation and components generated in the activity areas of the University College Hospital, Ibadan.

Information on cleaners' perception of the quantity and components of solid waste produced daily in their place of assignment could provide insight into the quantity and composition of waste generated in such activity area. Therefore this study is set to provide answers to the following questions: What are the cleaners' perceptions of the quantity and characteristics of solid waste produced in the activity areas of UCH? Are there variation in the quantity and composition of solid waste generated in the activity areas? These and other questions were answered by this study. Findings of this study would provide information to policy makers on the importance of cleaners' input in designing an informed strategy for medical solid waste management in the activity areas of UCH in particular and teaching hospitals in general.

2.0 Methodology

The study utilized primary data obtained through questionnaire administration. In administering the questionnaire, the hospital was stratified into eight major groups, consisting of 101 units. Using purposive sampling technique, 40 units where there were cleaners were selected for survey. One of every cleaner in each of forty activity areas was sampled randomly. From this sampling technique, a total of 40 questionnaires were administered. Information were obtained on quantity and components of solid waste generated in the activity areas of UCH, Ibadan. Solid waste produced in UCH were classified into twelve categories has found in literature (Coker and Sridhar, 2010). These included: pathological, pharmaceutical, infectious, radioactive and sharp. Others were paper, nylon/polythene/plastics, food waste, rag & textile, metal & cans, broken glass & bottle and old furniture. Cleaners were asked to rate solid waste components generated in each activity areas using a five Likert scales of Very low (VL), Low (L), Just high (JH), High (H) and Very high (VH). A weight value of 1, 2, 3, 4 and 5, was assigned to each of the ratings respectively. Further analysis gave rise to the Addition of the Weight Value (AWV). The AWV of each component was arrived at by adding the product of the number of responses for each component and the respective weight value assigned to it (Afon, 2006). This is expressed in mathematical terms as

$$AWV=\sum_{i=1}^{5} CiVi \qquad (i)$$

Where: AWV = Addition of weight value,

Ci = Number of cleaners rating an attribute i; and

Vi = weight attached to attribute i (1, 2, 3, 4, 5)

To arrive at WGI, AWV is divided by the total number of responses. This is also expressed mathematically as

$$WGI = \frac{AWV}{\sum_{i=1}^{5} Ci} \quad \text{(ii)}$$

Where: WGI = Waste Generation Index and Ci = is as defined previously.

Waste Generation Index (WGI) ranged between the values of 1 and 5. The higher the WGI, the higher the quantity of the component was perceived to be generated. The WGI obtained for each solid waste component in the respective activity areas is as presented in Table 1.1.

3.0 Results and discussion

Discussed in this section are the findings on solid waste generation based on assessment of cleaners in the different activity areas of the University College Hospital (UCH), Ibadan, Nigeria.

3.1 Solid waste generation using the cleaners' perceptual data

Using the aforementioned method, the mean index for each solid waste components in the activity areas denoted by $\overline{WGI}$ was computed by adding up the WGI of the entire components and dividing it by the number of the listed components (n) (n=12). The mean WGI of the activity areas under study is 2.3 (see Table 1.1), implied that the perceived level of solid waste generation in general was close to low (2.0).

Seventeen activity areas had their mean WGI higher than the mean index ($\overline{WGI}$). These activity areas included Accident and Emergency (3.1), Central X- ray (2.5), Public-Private Laboratory (2.8), Operation theatre (2.9), Geriatric ward (2.7), Mortuary (2.4) and Private suite (2.9). Others were Medical ward (2.5), Surgery ward (2.8), Labour ward complex (3.0), General out-patient (2.7), Geriatric clinic (2.4), Surgery clinic (2.8), Pharmacy (2.7), Non-Academic Staff Union (NASU) canteen (2.4), Nursing school (2.5) and Alexandra brown hall (2.5). The perception levels of solid waste produced in these activity areas were close to just high on aggregate. On the other hand, activity areas such as Paediatrics, Hospice, Radiology clinic, Children clinic, Kitchen and College had mean WGI that was the same as the mean index (2.3) of the forty activity areas under investigation. The remaining activity areas had their mean WGI to be lower than mean index. In this group were Radiology ward (2.2), Nerou-science unit (2.1), Obstretrics and Gyneacology (2.1), Intensive care unit (2.0), ENT and Eye (2.2); Special treatment disease (2.2) and Physiotherapy (2.1). Others included: Medical clinic (2.1), Ante-natal (2.0), Human resources unit (2.0), Senior Staff canteen (2.1), Access bank (2.1), Union bank (1.9), Alanu house (2.2), Mosque (1.8), Central record unit (1.6) and Church (2.0).

To further show the perception level of cleaners on solid waste generation in the study area, all the waste components were grouped into two based on their standard deviations. The first group had their deviation higher than $\overline{WGI}$. This established that the perceived solid waste generation was

higher than $\overline{WGI}$. Waste components in the second group were those with negative deviation. It means the $\overline{WGI}$ is higher than the waste generation index (WGI).

Table 1 Computed Waste Generation Index in the Activity Areas of University

Activity Area	Pathological	Pharmaceutical	Infectious	Radioactive	Sharps	Paper	Nylon/ poly/plastic	Food waste	Rag & Textile	Metal / Can	Broken bottle	Old furniture	Total	Mean
Accident & Emergence	3.0	4.0	5.0	2.0	5.0	3.0	4.0	5.0	2.0	2.0	2.0	1.0	38.0	3.2
Central X-ray	1.0	3.0	4.0	3.0	3.0	3.0	4.0	2.0	2.0	2.0	2.0	1.0	30.0	2.5
Public-Private laboratory	1.0	2.0	5.0	2.0	5.0	3.0	4.0	3.0	2.0	2.0	3.0	2.0	35.0	2.9
Operation theatre unit	5.0	3.0	5.0	2.0	5.0	2.0	4.0	2.0	3.0	2.0	2.0	1.0	36.0	3.0
Geriatric ward	1.0	3.0	5.0	1.0	4.0	2.0	4.0	5.0	2.0	2.0	2.0	1.0	32.0	2.7
Mortuary	5.0	2.0	4.0	1.0	2.0	2.0	3.0	2.0	2.0	2.0	2.0	1.0	29.0	2.4
Private suite	1.0	3.0	5.0	2.0	4.0	3.0	4.0	5.0	2.0	3.0	2.0	2.0	35.0	2.9
Radiology ward	1.0	2.0	4.0	1.0	3.0	2.0	4.0	2.0	2.0	2.0	2.0	1.0	26.0	2.2
Neuro-science unit	1.0	2.0	3.0	1.0	3.0	3.0	4.0	2.0	2.0	2.0	1.0	1.0	25.0	2.1
Medical ward	1.0	3.0	5.0	1.0	3.0	2.0	4.0	4.0	2.0	2.0	2.0	1.0	30.0	2.5
Surgery ward	4.0	2.0	5.0	2.0	4.0	2.0	4.0	2.0	2.0	2.0	2.0	3.0	34.0	2.8
Paediatrics	1.0	2.0	5.0	1.0	3.0	2.0	4.0	2.0	2.0	2.0	2.0	1.0	27.0	2.3
Obstretrics & Gynaecology	2.0	2.0	4.0	1.0	3.0	2.0	3.0	2.0	1.0	2.0	2.0	1.0	25.0	2.1
Labour ward complex	5.0	4.0	5.0	2.0	4.0	2.0	3.0	3.0	3.0	2.0	2.0	1.0	36.0	3.0
Intensive care unit	1.0	2.0	5.0	1.0	3.0	2.0	3.0	1.0	1.0	2.0	2.0	1.0	24.0	2.0
Hospice	1.0	2.0	3.0	1.0	2.0	4.0	4.0	3.0	1.0	2.0	1.0	2.0	26.0	2.3
General out-patient unit	1.0	2.0	5.0	1.0	5.0	3.0	5.0	5.0	1.0	2.0	2.0	2.0	33.0	2.7
ENT & Eye	1.0	2.0	4.0	1.0	3.0	2.0	4.0	2.0	1.0	2.0	2.0	1.0	25.0	2.1
Special Treatment	1.0	2.0	4.0	1.0	2.0	3.0	4.0	2.0	1.0	2.0	2.0	1.0	25.0	2.1
Radiology clinic	1.0	3.0	4.0	2.0	2.0	3.0	4.0	2.0	1.0	2.0	2.0	2.0	28.0	2.3
Physiotherapy	1.0	2.0	3.0	1.0	1.0	3.0	4.0	2.0	1.0	2.0	2.0	1.0	23.0	1.9
Geriatric clinic	2.0	2.0	5.0	2.0	3.0	2.0	3.0	5.0	1.0	2.0	1.0	1.0	29.0	2.4
Surgery clinic	2.0	3.0	5.0	2.0	4.0	3.0	4.0	3.0	2.0	3.0	1.0	1.0	33.0	2.8
Medical clinic	1.0	2.0	4.0	2.0	3.0	3.0	3.0	2.0	1.0	2.0	1.0	1.0	25.0	2.1
Children clinic	1.0	3.0	5.0	2.0	3.0	2.0	3.0	3.0	1.0	2.0	1.0	1.0	27.0	2.3
Ante-natal	1.0	2.0	4.0	2.0	3.0	2.0	2.0	3.0	1.0	2.0	1.0	1.0	24.0	2.0
Human resources unit	1.0	1.0	1.0	1.0	1.0	5.0	4.0	3.0	1.0	3.0	1.0	2.0	24.0	2.0
Pharmacy	1.0	4.0	4.0	1.0	1.0	4.0	4.0	3.0	2.0	2.0	2.0	1.0	29.0	2.4
Kitchen	1.0	1.0	1.0	1.0	2.0	2.0	5.0	5.0	3.0	3.0	2.0	2.0	28.0	2.3
NASU canteen	1.0	1.0	1.0	1.0	2.0	2.0	5.0	4.0	3.0	4.0	3.0	2.0	29.0	2.4
Senior staff canteen	1.0	1.0	1.0	1.0	1.0	2.0	5.0	4.0	2.0	3.0	2.0	2.0	25.0	2.1
Access Bank	1.0	1.0	1.0	1.0	1.0	4.0	4.0	3.0	2.0	3.0	2.0	2.0	25.0	2.1
Union Bank	1.0	1.0	1.0	1.0	1.0	4.0	3.0	2.0	1.0	2.0	2.0	2.0	21.0	1.8
Alanu house	1.0	2.0	2.0	1.0	1.0	3.0	4.0	3.0	3.0	2.0	2.0	2.0	26.0	2.2
Mosque	1.0	1.0	1.0	1.0	1.0	2.0	4.0	2.0	2.0	2.0	1.0	1.0	19.0.	1.6
College	1.0	1.0	1.0	1.0	1.0	4.0	4.0	4.0	3.0	3.0	2.0	2.0	27.0	2.3
Central Record unit	1.0	1.0	1.0	1.0	1.0	5.0	1.0	2.0	2.0	1.0	1.0	1.0	18.0	1.5
Nursing school	1.0	2.0	1.0	1.0	1.0	5.0	5.0	5.0	4.0	3.0	1.0	1.0	30.0	2.5
Alexandra brown hall	1.0	2.0	1.0	1.0	1.0	4.0	5.0	5.0	2.0	4.0	2.0	2.0	30.0	2.5
Church	1.0	1.0	1.0	1.0	1.0	4.0	4.0	3.0	2.0	2.0	2.0	1.0	23.0	1.9
Mean WGI	1.5	2.1	3.3	1.4	2.6	2.9	3.9	3.0	1.9	2.3	1.8	1.4	2.3	2.3
WGI- $\overline{WGI}$	-0.8	-0.2	1.0	-0.9	0.3	0.6	1.6	0.7	-0.4	0.0	-0.5	-0.9	0.0	0.0
(WGI- $\overline{WGI}$)^2	0.64	0.04	1.00	0.81	0.09	0.36	2.56	0.49	0.16	0.00	0.25	0.81	0.00	0.00

Presented in Table 1.1 are seven solid waste components with positive deviations about the mean. The solid waste components in this category ranked in order of importance were nylon/polythene/plastics materials, infectious, food waste, paper and sharps. Their respective deviations were 1.6, 1.0, 0.7, 0.6 and 0.3. The implication of this is that WGI of each solid waste component was higher than $\overline{WGI}$ of the forty activity areas combined. The components were mostly generated on daily basis, due to the indispensability of activities that produced them. Based on their deviations, nylon/polythene/plastics materials (1.6) were perceived as highest. It was mainly (5.0) produced from General Out-patient unit, Kitchen, Non-Academic Staff Union canteen, Senior Staff canteen, Nursing school and Alexandra hall. The quantity of nylon/polythene/plastics materials generated in the aforementioned activity areas is a function of multipurpose usage of the materials. Next in rank is infectious waste (1.0). It was largely (5.0) generated from activity areas such as Accident and Emergency unit, Public-Private Laboratory, Geriatric ward, Medical ward, Operation theatre, Private suite and Surgical ward. Others were Paediatrics, Labour ward complex, Intensive care unit, General out-patient, Geriatric clinic, Surgery clinic and Children clinic. This implied that most of materials used for patients in these units became infectious. Findings of this study agreed with the reports of Akinpelu (2017) that most activity areas surveyed in the University College Hospital (UCH), Ibadan, generated more of general (domestic) and infectious waste.

In addition, infectious waste generation was however least (1.0) in areas such as Human resources unit, Kitchen, Non-Academic Staff Union canteen, Senior Staff canteen, Access, bank and Union bank. Others were Mosque, College, Central Record unit, Nursing school, Alexandra Brown hall and Church. These activity areas rarely produced infectious waste because they were not meant for the treatment of patients but complement medical services of the University College Hospital, Ibadan. Solid waste component with the least (0.2) positive deviation was sharps. It has highest (5.0) perceived level of production in Accident and Emergency unit, Public-Private Laboratory and Operation theatre unit. It could be inferred that health cases handles in the aforementioned areas required the use of sharp materials, which later become sharp waste. The least (1.0) was reported in activity areas such as Physiotherapy department, Human Resources unit, Pharmacy, Kitchen, Non-Academic Staff Union canteen, Senior Staff canteen, Access bank, Union, bank and Alanu house. Others were Mosque, College, Central Record unit, Nursing school, Alexandra Brown hall and Church. The quantity of sharp materials generated in the activity areas could be attributed to the fact that those activity areas performed functions that were secondary to core purpose of establishing the hospital. This finding is in-tandem with results of a study carried out by Akinpelu (2017). The author reported that sharp wastes were rarely produced in activity areas of UCH where complementary services were being rendered.

Similarly, solid waste components having negative deviation about the

$\overline{WGI}$ included: pharmaceutical, rag/textile, broken bottle, pathological, radioactive and old furniture. Their respective deviations in order of importance about the $\overline{WGI}$ were -0.2, -0.4, -0.5, -0.8, -0.9 and -0.9. Pharmaceutical waste had the highest (-0.2) negative deviation. The Mean WGI (2.1) of the component is close to the $\overline{WGI}$ (2.3). It could be inferred that the quantity of waste material produced was perceived to be low. It is however worth noting that pharmaceutical waste was generated chiefly (4.0) from activity areas like Accident and Emergency unit, Labour ward complex and Pharmacy department. Apart from Central X-ray, Geriatric ward, Operation theatre unit, Private suite, Medical ward, Radiology clinic, Surgery clinic and Children clinic, the perceived level of the quantity of waste component produced from other areas of the hospital was below the average. Rag/textile waste was next in ranking with (-0.4) negative deviation. The waste component was perceived to be highest (4.0) at the Nursing school. The reason was that nursing students that resided in the hostels often discard their abandon textile materials into the storage receptacles provided by the school. Activity areas such as Operation theatre unit, Labour ward complex, Kitchen, NASU canteen and Alanu house perceived level (3.0) was higher than the average. The remaining areas surveyed were perceived to produce the waste component at the rate below the average. Pathological waste was next in ranking with (-0.8) negative deviation. Earlier study by Akinpelu (2017) established that pathological wastes were considered as sensitive materials that should be handled with utmost care. It is either sent to pathological laboratory or autopsy room for proper examination, before it is disposed under tight supervision. It was perceived to be highest (5.0) in Operation theatre, Mortuary and Labour ward complex. Other activity areas except for Surgery ward (4.0) and Accident and Emergency unit (3.0), recorded the least.

Radioactive and old furniture waste had the least (-1.9) negative deviations. Information gathered from the cleaners confirmed that this type of waste materials was rarely turned out. This could be adduced to the fact that patients that required radioactive materials were view in number and very hazardous in nature, while old furniture have long life span, hence small quantity of waste were produced. Both waste had highest WGI (3.0) in Central X-ray and Surgery ward as presented in the table 1.1. In all other activity areas the ranking of the waste is either low (2.0) or very low (1.0). This implied that radioactive materials were used only in specialized units, while old furniture materials were rarely generated because of its durability.

Moreover, it could be established that infectious waste had its WGI in all the clinics and wards to be higher than $\overline{WGI}$ of the forty activity areas altogether. Clinics and wards are major activity areas where the primary functions of establishing the hospital are performed. Consequently, high rate of infectious materials (gloves, plaster, bondage, and cotton wool among others) used on daily basis. It could be established therefore that all clinics and wards in UCH generated

infectious waste with variation in the quantity produced based on nature of clinic or ward. Nylon/polythene/plastics had its WGI in all activity areas higher than $\overline{WGI}$ except in few places such as Ante-natal (2.0) and Central record (1.0). It could be inferred that most of materials used in the study area were packed with nylon or polythene. Plastics were observed to be used mainly for storing of solid waste and carrying of materials from one unit to another. It was common materials that were utilized in most of the sampled areas. This supported by result obtained by Akinpelu (2017) in a study conducted in UCH, Ibadan. He reported that high quantity of nylon/polythene and plastics materials were produced in most of the activity areas surveyed.

Further analysis showed that $\overline{WGI}$ of the activity areas surveyed is higher than WGI of radioactive waste in all the activity areas, except in X-ray units. The implication is that 97.5% of all the activity areas sampled did not produced radioactive materials. Table 1.1 showed that twelve activity areas had WGI of 2.0. The remaining twenty-seven (27) areas had (1.0) WGI. Old furniture had its WGI in all the activity areas to be lower than $\overline{WGI}$ of the forty activity areas combined except in Surgery ward (3.0). Old furniture waste as presented in the table had fourteen activity areas with WGI of 2.0, while twenty-five out of forty areas surveyed recorded WGI of 1.0. It could be concluded that old furniture waste was rarely generated in 97.5% of the study area. This could be adduced to the long life span of most furniture materials.

Findings of the study showed that level of perception of medical solid waste generation in the areas other than clinics and wards was very low, except for places such as Alanu house, Nursing school and Alexandra brown hall where small quantity of pharmaceutical waste was produced. The generation of pharmaceutical waste in the activity areas might be attributed to their residential nature. Production of nylon/polythene/plastics materials were perceived to be generally high in all the activity areas surveyed, except in Ante-natal and Central record unit. The level of nylon/polythene/plastics waste generated in the study area is a testimony to indispensability of its usage. It can be established that 95% of the activity areas sampled were perceived to produce high quantity of nylon/polythene/plastics waste.

4.0 Conclusions and Recommendations

Findings of the study have clearly shown that cleaners' perceptual data in the formulation of an informed policy on solid waste management is imperative. The study showed that there was variation in the quantity and components of waste generation in the activity areas of the University College Hospital (UCH), Ibadan. It is suggested therefore that the basis for allocation of human and material resources to waste management activities in the study area should be guided by the information on the characteristics and quantity generated in each of the unit and department. Priority should however be given to medical areas of the hospital in terms of resources allocation, regulations and monitoring of waste management practices. The sections were where

substantial infectious and/or hazardous waste emanated. Future research should be directed towards investigating the cleaners' perceptual data on the rate of generation and adequacy of storage receptacles in the different activity areas of UCH. This would provide information that would enhance effective and efficient solid waste collection.

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