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Segregation Practices by Health Workers in Urban Hospitals - A Step Necessary to Achieve Minimization and Effective Biomedical Waste Management

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Abstract

Effective segregation practice of biomedical waste is a critical process in hospital waste management and maintenance of a 'risk-free' health care environment. Failure to appropriately identify and isolate infectious from non-infectious wastes could lead to a myriad of health and biomedical waste management issues, which include high risk of cross-contamination, high risk of infection, difficulty in the assessment of waste generation, categorization, and composition of hospital waste. The aim of this study is to assess the segregation practice among health workers in selected hospitals in Abuja towards achieving effective waste management. A descriptive and cross-sectional study was conducted among 430 participants from six hospitals in Abuja. Data were collected using a pretested, structured questionnaire and on-the-spot observation. Reliability analysis and descriptive statistics were employed for the analysis of data. Most of the respondents agreed to the segregation at the point of generation 366 (91.5%), majority of the respondents supported the use of color-coded bins for segregation. The Cronbach's alpha $\alpha = 0.830$, loading factor (0.601- 0.949) which indicates that the measuring tool was reliable and the items on the questionnaire showed co-relatedness and consistency. The study revealed that most of the respondents were sensitized and practiced the process of segregation. Although these practices were observed on the spot, they could later change thus, sustenance of these practices is expedient to maintain a lasting and workable waste management framework. Government and hospital waste management team to prioritize the segregation process through an adequate budget for supplies of segregation materials.

Keywords: *Contamination, Health risks, Infection, Minimization, Segregation.*

Introduction

Segregation practice is vital in achieving the minimization of hazardous wastes, effective management of biomedical waste, and identification of medical wastes [1]. Segregation is the first stage in proper healthcare waste management. It involves the isolation of biomedical waste from the entire hospital waste. It was reported that medical waste segregation is an important step in the reduction of the volume of hazardous waste, also making it possible for accurate assessment of the composition using color-labeled bags to effectively separate infectious waste from non-infectious waste [2]. This process is conducted by separating the different waste streams based on certain criteria, namely nature, hazardous properties of the waste, type of treatment, and disposal practices that are applied [3].

Segregation forms an integral part of proper biomedical waste management which has been

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recommended to be carried out first at the source of generation, such as the areas of patient care activity, diagnostic services, operation theatres, labour, treatment, etc. The doctors, nurses, pharmacists, laboratory scientists, technicians, and auxiliary workers are the primary generators of these biomedical wastes, especially the hazardous portion.

Thus, health workers are under obligation to adequately manage these wastes from the point of generation to final disposal. Consequently, poor segregation practice at the health facility implies wrong precision of estimates of the various categories of wastes. Therefore, the act of segregation provides a useful guide for the assessment of the different waste streams generated, of which many are hazardous requiring special handling in order to forestall health hazards [4].

The World Health Organization (WHO) recommends the segregation of biomedical waste at the source of generation. Also, it provides guidelines for the safe and sound management of medical waste in developing countries [5, 6]. The WHO recommends color-coding of waste receptacles to facilitate the segregation of healthcare waste at the source of generation and should be kept a few meters apart from each other [5, 6].

Segregation of wastes could lead to a clean solid waste stream that could be easily, safely, and cost-effectively managed through recycling, composting, and landfilling [7]. The different categories of healthcare hazardous waste should be separated by collecting in different and suitable containers and undergo safe treatment and disposal. Poorly separated biomedical wastes increase the volume of waste sent for treatment or untreated wastes that are sent to landfills [8]. Segregation of biomedical wastes is advantageous to the public health system as health hazards are reduced on the general public after exposure to the dumped waste, reduction of medical waste impacts positively on a budget of waste management [4].

Satisfactory segregation practice will ensure a reduction in the quantity of medical waste and attendant cost of management. The aim of the study was to assess the segregation practices among the health workers in some hospitals in Abuja.

Materials and Methods

Selection of the Area

The study was conducted in Abuja, the political and administrative seat of Nigeria. According to United Nations Fund for Population Activities [9], Federal Capital Territory is estimated to have a population of 3,324,000 people. There are many private and public (district) hospitals to serve the increasing population in this location.

Sample Size Determination

Cochran's formula is for calculating representative sample size for an infinite population was used [10].

$$n0 = z2pq/e2$$

n0	=	sample size
z	=	1.96 (this is the selected critical value of desired confidence level)
p	=	0.5 (assuming the maximum variability, which is equal to 50%)
q	=	1- p
e	=	0.05 (±5% desired level of precision at 95% confidence level)
n0	=	(1.96)2(0.5) (0.5)/ (0.05)2
n0		384.16

Therefore, n0 = 384 (minimum sample size for this study).

An overage of (12%) of 384 was added to the sample size to cover for attrition, incomplete responses, and late responses in order to maintain a minimum sample size for the study.

Sampling Technique

Six (6) hospitals were used for the study, and 430 participants were selected using a random sampling method. The hospitals were stratified into two groups, private and public, based on the ownership and management of the hospitals and

were lettered alphabetically to remove identifiable information.

Data Collection

A pretested, structured, self-administered, and self-completed questionnaires which required the participant's response on the socio-demographic factors, standard handling practices variables inclusive of segregation and others were used to collect data. The purpose of the study and questionnaire were explained to the participants to obtain their consent to participate in the study.

Data Analysis

Data were entered and coded. The Statistical Package for Social Sciences (SPSS version 20.0) was used for the data analysis. The results generated were presented with frequency counts, percentages, and the statistical level of significance for the inferential statistics was set at $p<0.05$. Descriptive and reliability statistics were employed to analyze the data.

Results and Discussion

Table 1 shows the socio-demographic factors of the health workers across the six hospitals in Abuja. There were 220 (55.00%) male health workers, while the female was 180 (45.00%) in the study. About 134 (34.0%) of the respondents had over 15 years of working experience. Nurses 115 (29.0%) were the majority of the health workers in the study. Most of the respondents were bachelor's degree holders as their highest educational qualification.

Table 1. Socio-demographic Characteristics of Respondents (N = 400)

Socio-demographic Characteristics	Category	Study Participants N (%)
Gender	Male	220 (55.0)
	Female	180 (45.0)
Health Professionals	Doctors	64 (16.0)
	Nurses	115 (28.8)
	Laboratory Scientists	96 (24.0)
	Pharmacists	71 (17.8)
	Others	54 (13.5)
Years of Working Experience	1-4	98 (24.5
	5-9	80 (20.0)
	10-15	88 (22.0)
	> 15	134 (33.5)
Educational Qualification	Bachelor's degree	343 (85.7)
	Fellowship	3 (0.8)
	Master's degree	6 (1.5)
	Doctorate	4 (1.0)
	Others	44 (11.0)
Member of Biomedical WMT	Yes	191 (47.8)
	No	209 (52.2)
Hospital Type	Public	289 (72.2)
	Private	111 (27.8)

WMT- Waste Management Team

Tables 2 and 3 show the percentage frequency count of the 400 respondents; 366 (92.0%) agreed to the practice of segregation at the point of generation, while 368 (92.0%) respondents

supported the use of red colour-code for highly infectious biomedical wastes and about three-quarters of the respondents supported the use of other recommended colour-codes as stipulated by World Health Organization.

Table 2. Segregation of Biomedical Wastes at Different Locations

Items	**Positive Responses**
	Frequency N (%)
Point of generation	366 (91.5)
General wastes container	241 (60.3)
Dumpsite	179 (44.8)

Table 3. Colours of the Containers and Liners for Effective Segregation of Biomedical Wastes

Items	**Positive Responses**
	Frequency N (%)
Yellow for infectious waste	333 (83.3)
Red for highly infectious wastes	368 (92.0)
Blue for glass	305 (76.3)
Black for general wastes	323 (80.8)
Brown for pharmaceutical wastes	192 (48.0)

Positive responses = Agree/ Strongly Agree

Table 4 shows a reliability analysis of the segregation process of biomedical waste in public and private hospitals (n=400). The mean ± standard deviation score (4.0956 ± 0.8308) for the segregation processes of biomedical wastes shows that the segregation process will be effective for sound biomedical waste management. Factor loading ranged from (0.601-0.949) which is good and requires that all mean components are added to the summation, Cronbach's alpha, $\alpha = 0.830$, showed the questionnaire is reliable.

Table 4. Reliability Analysis of Segregation Process of Biomedical Waste (N= 400)

Items	**Mean**	**SD**	**Factor Loading**	**Cronbach's Alpha**
Segregation of biomedical wastes is usually carried out at different locations				
Point of generation	4.433	0.6176	0.913	**0.830**
General wastes container	3.578	1.1455	0.665	-
Dump site	3.105	1.1736	0.946	-
Proper segregation is achieved by making use of appropriate labeled coloured containers or coloured liners to effectively separate infectious waste from general/domestic waste				
Yellow for infectious waste	4.295	0.7412	0.838	-
Red for highly infectious wastes	4.503	0.6717	0.908	-
Blue for glass	4.265	0.8164	0.870	-
Black for general wastes	4.335	0.7901	0.897	-
Brown for pharmaceutical wastes	3.743	1.0314	0.601	-
Proper waste collection, treatment, transportation and disposal is significant in safe management of biomedical waste	4.603	0.4900	0.949	-
Mean ± SD	**4.0956**	**0.8308**	-	-

The findings in the study revealed that the nurses, laboratory scientists, pharmacists, and doctors were principally involved in the segregation practice and agree with the report of the previous study [11]. This is also similar to the previous study at Minna, Niger State, Nigeria [12], where the majority of respondents were nurses (59.0%), followed by laboratory scientists (26.0%). The result of the study showed that nurses were the majority of the respondents which corroborates with previous studies [11, 13, 14] in Nigeria, South Africa, and Nigeria, respectively. It differed from the previous study [15], where domestic workers were the majority of the respondent. Nurses are among the principal health workers in the hospital setting and are strictly involved in most of the health activities conducted in the healthcare institutions where biomedical waste is majorly generated. The disparity in the health workers could be attributed to the geographical location, time of the study, and sampling techniques.

The finding in this study is similar to a previous report [13] where respondents had bachelor's degrees as the highest educational qualification. More so, the finding in this study showed that respondents were aware and supported segregation as one of the processes of standard operating procedure, which agrees with the reports of [13, 16, 17] that respondents were aware of segregation practices in the health care facilities. This finding could be attributed to adequate knowledge through training of health workers, use of posters, job aids, and standard operating procedure (SOP) guidelines for identification and proper handling of medical wastes to reduce the total hazardous wastes stream and cost of biomedical waste management. Previous reports stipulated that generation, segregation, transportation, treatment, storage, and disposal are important steps to achieving effective biomedical waste disposal [18, 19].

The finding in this study revealed that the respondents practiced segregation, the findings agree with earlier work carried out in Lagos and Abuja [20], where health workers demonstrated segregation practices. The findings in this study are at variance with the previous studies [3, 11] in Jos, and Yenegoa, where inadequate segregation practices were observed.

This study showed that over three-quarters of the respondents were aware and practiced segregation at the point of generation. The results agree with the reports of [15, 21, 22] in which the majority of the respondent's practiced segregation at the source of generation. Hospital wastes should be segregated at the source [3]. Previous work [11] is at variance with the finding in this study, where at the point of segregation, practices were unsatisfactory.

This study showed that over three-quarters of the respondents were aware of the appropriate use of the colour-code system. This finding is similar to the previous work [17] where most of the respondents were aware of the use of colour-codes for segregation in Uganda. More so, the finding agrees with the earlier study reported [22] on the establishment of a three-bin system policy of biomedical wastes in Ethiopia which reflected on the segregation practices by the respondents.

The finding in this study is in consonance with the report [15] in Lagos where the majority of the respondents practiced colour-coding segregation. Previous study reported that about (18.00%) out of (53.00%) studies demonstrated segregation practices [8]. The finding in this study differs from the reports of previous studies [4, 16, 23] where colour-coding practices were poorly implemented. This disparity could be attributed to a lack of sensitization on effective segregation, inefficiencies of waste minimization strategies and inadequate funds to provide the colour-coded linings and containers. Also, previous study [24] proposed the black, yellow, and red (three-bin system) for general, infectious, and highly infectious waste respectively.

Figure 1. The three coloured liners for Segregation of Biomedical Wastes

Conclusion

The study showed that the health workers were aware of segregation as part of the standard operating procedures. The respondent practiced segregation from the point of generation using colour-coded receptacles as stipulated by WHO. Thus, it appears the respondent understood the need for effective segregation in ensuring effective waste management.

Recommendations

The hospital waste management and infection control team should provide colour receptacles and ensure its use in order to achieve proper segregation practices.

Conflicts of Interest

The authors declare there are no conflicts of interest.

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