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Assessment of Practices and Awareness of Safety Measures of Biomedical Wastes Management among Health Workers in Metropolitan Hospitals in Abuja, Nigeria

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Abstract

Effective and efficient biomedical wastes management is vital in the health care delivery system. Safe environment and public health could possibly be achieved through the standard practices of biomedical wastes procedures with safety measures in place. The aim of this study is to evaluate the practices and awareness of safety measures among health workers towards biomedical wastes management in selected hospitals in Abuja, Nigeria. Data were collected by structured questionnaire and on- the-spot observation. Three private and three public hospitals that provides health care services in Abuja were surveyed. Descriptive and inferential statistical analysis were used in the analysis of the data. Chi-square (χ^2) test was used to determine the level of significance set at $p \leq 0.05$. The male health workers were 220 (55.00%) and the female were 180 (45.00%) in the survey. The Nurses were the highest respondents in the study with percentage frequency of 117(28.75%) followed by the Laboratory Scientists 96 (24.00%), Pharmacists 71 (17.75%), Doctors 64(16.00%) and other health care workers 54 (13.50%). The practices of handling biomedical waste among health workers is a significant factor of biomedical wastes management ($p<0.05$). Also, the awareness on safety measures among health workers is a significant factor of biomedical wastes management ($p<0.05$). The study revealed that there are gaps in the standard practices of handling biomedical wastes such as transportation from point of generation, treatment, temporal storage and disposal, whereas awareness of safety measures and practices is appreciable. Training of health workers on standard practices of handling biomedical wastes is crucial in achieving efficient biomedical wastes management in the hospitals. Government should be involved in the policy making and ensure the enforcement of strict compliance in accordance with WHO stipulations.

Keywords*: Safety measures, environment, public health, biomedical wastes, health workers.*

Introduction

The proliferation of hospitals mostly in the urbanized locations in Nigeria, population surge and use of hospitals (Chima *et al*., 2011; Chima *et al*., 2014; Useh *et al*., 2018), largely contributes to the total wastes stream of various categories that could become a daunting task for handling, storage, treatment and disposal of biomedical wastes.

In developing nations, poor management of biomedical wastes is usually encountered which are attributable to lack of awareness on the public health implication, non-participation of government and ineffective legislation (Derres *et al*., 2018). This suggests improper handling of waste during generation, collection, inappropriate storage methods, treatment, transport, lack of personal protective equipment, untrained personnel and unsafe disposal options (Chima *et al*., 2014).

Effective and efficient biomedical wastes management should be paramount in any functional health care delivery system. The World Health Organization have designed a biomedical waste management guideline to ensure safe management of these wastes generated from health care activities (Derres *et al*., 2018). Vital steps are involved in the appropriate biomedical wastes management process which are listed as follows: segregation, transportation, treatment, storage, disposal

including minimization and reuse (Rao *et al*., 2004). The process can involve a number of intermediary stages (Ola-Adiza *et al*., 2015).

The belief that it is the sole responsibility of the government to manage biomedical and general wastes has made waste generators (health workers) to neglect their primary duty of proper handling of biomedical wastes and barely think of the adverse effects of improper biomedical wastes management. The international policy states that the generator of waste is responsible for the proper handling, treatment and disposal of wastes and has only been theoretical (Ngwuluka *et al*., 2009). Obviously, there exist a missing link among the policymakers, regulators and health care establishments on establishing laws, enforcement and implementation of effective and efficient biochemical wastes management in the health care institutions. Comparative information on the practices of handling and awareness of safety measures of biomedical wastes management are scanty especially in hospitals located in the urban areas in Nigeria. Hence, the aim of the study is to assess the practices of handling and awareness on safety measures of biomedical wastes management among health workers in public and private hospitals in Abuja.

Materials and Methods

Selection of the area

The study was carried out in Abuja the Federal Capital Territory of Nigeria. Abuja is divided into six Area Councils of which Abuja Municipal Area Council, a densely populated area because of the administrative seat of government and commercial activities. According to United Nation Fund for Population Activities, UNFPA (2015), Federal Capital Territory is estimated to have a population of 3,324,000 people. The municipal has many private and public (district) hospitals to serve the increasing population.

Sample size determination

The researcher used Cochran's formula ($n_0=z^2pq/e^2$) for calculating sample size when the population is infinite (Glenn, 1992).

Where:

n_0 = sample size

z = selected critical value of desired confidence level

p = estimated proportion of an attribute that is present in the population

q = 1- p

e = desired level of precision taking 95% confidence level with ±5% precision, the calculation for required sample size was calculated as follows:

p = 0.5; hence q =1-0.5 = 0.5; e = 0.05; z =1.96

$n_0 = z^2pq/e^2$

$n_0 = (1.96)^2(0.5)\ (0.5)/\ (0.05)^2$

n_0 = 384.16

Therefore; n_0 = 384 (minimum sample size for this study)

An overage of (12%) of 384 was added to the sample size to offset for the reasons of non-response, incomplete response and late response in order to have the acceptable minimum response size for the study.

Sampling technique

Six (6) hospitals were selected for the study, using 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 ensure anonymity and confidentiality.

Data collection

Structured self-administered and self-completed questionnaires were used to collect the data. Consent forms were filled by the participants to obtain their consent to participate in the study. Participation was voluntary and participants were free to withdraw at any time. Confidentiality was assured by excluding all the names of the hospital surveyed and respondents.

Data analysis

Statistical Package for Social Sciences (SPSS version 20.0) was used for the analysis of the data. Chi-Square statistical test of significance was used to determine the level of significance of association. Level of significance difference was set at $p \leq 0.05$.

Results and Discussion

Table 1 shows the socio-demographic factors of the health workers across the six metropolitan hospitals in Abuja. The male health workers were 220 (55.00%) and the female were 180 (45.00%). The Nurses were the highest respondents with percentage frequency of 117 (28.75%) followed by the Laboratory Scientists 96 (24.00%), Pharmacists 71 (17.75%), Doctors 64 (16.00%) and other health care workers 54 (13.50%). The result of the study is similar to the reports of

Deress *et al*. (2018) in Ethiopia, Imam *et al*. (2019) in Kano, Nigeria though confined to surgical theatres as the male respondents and nurses were predominant. The Nurses are one of the indispensable health professionals in the health care institutions and are basically involved in most of the generation and segregation of health care wastes. Contrastingly, Awodele *et al*. (2016) in Lagos reported that the majority were domestic workers followed by Nurses and female respondents. The variation in the health professionals could be attributed to method of sampling techniques, location of the health facility and availability of the health professionals during the study.

The practices of handling biomedical wastes as shown in Table 2, the result showed that all the respondents agreed that proper biomedical wastes treatment leads to a reduction in volume of infectious wastes and reduces the risk of transmission of diseases, that treatment of biomedical wastes enhances the safe transportation of biomedical wastes to the disposal site and minimizes transmission of diseases. Almost all the respondents agreed that the practices of segregation of infectious wastes at the source of generation is prime indicator to achieving a sound biomedical wastes management. Over half of the total respondents agreed that intensive training and retraining of health workers on the effective waste management activities are performed. Previous studies showed an increased awareness and knowledge of segregation (Chima *et al*., 2014; Awodele *et al*., 2016; Uchechukwu *et al*., 2017). The finding in the study is consistent with the study conducted in selected health care establishments at Lagos and Abuja that revealed majority of health workers especially in Lagos have received training, segregation is practiced in both locations but treatment of biomedical wastes is still lacking in both locations (Dunloye *et al*., 2018). On the other hand, the findings in the study differs from Ola- Adisa *et al*. (2015) that reported in a study carried out in 30 health care establishments in Jos North, Plateau state showed that the practice of segregation was poor among the health workers, majority of the health workers were barely trained and disposal of biomedical wastes were unprotected and obsolete methods such as burial and incineration were practised. Another study conducted in hospitals in India, revealed unsatisfactory segregation practices, health workers lacked the awareness, training and poor treatment of biomedical wastes in hospitals (Rhada *et al*., 2009). Lack of biomedical wastes management policies in hospital and unpreparedness to tackle the issues could be attributable to the lack of awareness on proper practices of biomedical wastes management.

The Standard Operating Procedure designed for biomedical wastes management process is shown in Table 3. Over three quarter of the respondents agreed to practicing standard operating procedure (SOP) designed for segregation in the hospital. Over half of the respondents agreed to practicing standard operating procedure (SOP) designed for storage in the hospital. The finding in the study revealed that the respondents had the understanding of identification and separation of the different types of biomedical wastes which reflected in the practices of segregation. All the hospitals surveyed practiced segregation of sharps, as the sharps were mostly segregated into sharp boxes and most especially the public hospitals made efforts to use colour coded bins, containers or liners. This is in conformity with the findings of Awodele *et al*. (2016) in Lagos, where majority of the respondents' practised segregation using colour-code. This shows that the health workers have realized the importance of segregation in the management of biomedical wastes. The awareness and availability of SOP guidelines and posters at the various service areas in the hospitals such as diagnostic laboratories, in-patients' wards, operating theatres and pharmacy could attribute to the high level of compliance to the segregation practices in the hospitals as observed.

Segregation is carried out at the point of generation but later mixed with general wastes during collection for final disposal (Debere *et al*.,2013; Yelebe *et al*., 2015) in (Ethiopia and Nigeria) respectively. Udofia *et al*. (2015) reported that about (53.00%) of studies revealed that segregation was practised, only (18.00%) of the studies showed compliance to the use of colour coded bins. Although in some instances black nylon bags were used to collect and store medical wastes, which could cause blind mix up of infectious and non-infectious wastes.

The result showed that over three-quarter of the health workers practised the standard operating procedure of segregation, disposal, labelling and treatment. The result of the study

revealed that in most of the hospitals biomedical wastes were mostly carried manually by the cleaners and hospital attendants to the temporary storage sites as trolleys were occasionally used. This is consistent with the reports of Abah and Ohimain (2011), Muluken *et al*. (2013) where medical wastes receptacles were manually lifted by hospital cleaners, wastes handlers and auxiliary staff.

Though over half of the total respondents showed the practice of standard storage procedure but the observation further revealed that the temporary storage/disposal sites were in an open space not secured and unprotected areas from neither the sun nor rain. This is in conformity with the report of (Ndiaye *et al*., 2012).

The wastes are found tied in bags dumped in the metal bins and most times the bins are filled to the brim such that the wastes drop and litter around the disposal site. This indicates that the wastes are not promptly lifted away for final disposal. The delay of the disposal from the hospital premises could pose environmental risk such as air pollution and presence of disease transmitting rodents. The distance of the temporary storage site is less than 10m from the busy side of the hospital which could portend health risks to humans. This finding is comparable with the study carried out in Owerri, where temporary disposal site was not more than 10m from the hospital facilities (Chima *et al*., 2014).

Table 4, shows the methods of biomedical waste treatment to ensure safe disposal. The result of the study showed that all the respondents were aware and practised disinfection, well over half of the respondents agreed to the practice of autoclaving as a biomedical wastes treatment before disposal. About three-quarter of the respondents did not practise microwaving and shredding. The result shows that the majority of the respondents practised chemical disinfection of some categories of infectious wastes generated from diagnostic laboratories and operating theatres. Over half of the total respondents practised autoclaving especially of medical wastes generated from the diagnostic laboratories prior to the temporary disposal. The treated medical wastes by these methods could ensure safe transportation of medical wastes from point of generation to the disposal sites. Majority of the respondents do not have adequate knowledge nor practise the method of microwaving and shredding. Abah and Ohimain (2011) reported that autoclaving was practised in the hospitals surveyed. Chima *et al*. (2015) reported that about half of the respondents practised chemical disinfection. Contrastingly, commonly used methods of treatment for medical wastes in developed countries are steam sterilization, autoclaving and incineration with air pollution control equipment (APC) (Patwary *et al*., 2011).

The disposal procedures of biomedical wastes in hospitals is shown in Table 5. The result of the study showed that over three-quarter of the total respondents agreed to burning pit and incineration practices and less than a quarter of the total respondents agreed to landfill and recycling disposal method. Furthermore, the results showed that most biomedical wastes are transported occasionally in closed compaction vehicles to designated burning pits. The incineration method employed in hospitals were dysfunctional without air pollution control (APC) equipment (Udofia *et al*., 2015). The finding in the study is similar to the reports of Chima *et al*. (2015) where over three-quarter of the respondents were aware of the methods of burning pits. The finding in the study is consistent with the reports by Abah and Ohimain (2011), Uchechukwu *et al*. (2017) and Denloye *et al*. (2018) where most health care facilities in Nigeria practise open dumpsite and periodical burning of biomedical wastes. The disposal procedures were further ranked to know the commonly practiced disposal method of biomedical wastes in the hospitals. Burning pit ranked first of the disposal methods while incineration ranked second of the disposal method practiced in the hospitals.

Table 6, shows the awareness of safety measures by health workers where all the respondents were aware of the need to comply with safety measures. The result showed adequate knowledge of the need for safety measures in handling biomedical wastes that will lead to proper attitude and practice in order to achieve safe environment for health workers, hospitals visitors and the general public.

Protective devices for handling biomedical wastes is shown in Table 7.

All of the 400 (100.00%) respondents agreed to the use of gloves, face masks, apron and safety boots. Also, most of the respondents agreed to the use of google.

The result of the study showed that all the respondents were aware and use personal protective equipment. This shows that the respondents portray proper attitude and practice towards prevention of occupational hazards. The study showed that there was relative compliance with the WHO standards that stipulates heavy duty gloves, boot and apron (Pruss *et al*., 1999). The finding in the study differed where only gloves were mainly used among other personal protective accessories (Awodele *et al*., 2016; Uchechukwu *et al*., 2017). This could be attributed to lack of funds and lack of awareness of safety measures. Adequate use of complete personal protective equipment is essential to anyone handling hospital wastes (Awodele *et al*., 2016).

Table 8 shows that there is a significance difference between the practices of handling biomedical wastes among the health workers and biomedical wastes management ($p \leq 0.05$). There is a significance difference between awareness of safety measures among health workers and biomedical waste management ($p \leq 0.05$) shown in Table 9.

Table 1. Socio-demographic Characteristics of Respondents

Socio-demographic Characteristics	**Category**	**Study Participants n (%)**
Gender	Male	220 (55.00)
	Female	180 (45.00)
Health Professionals	Doctors	64 (16.00)
	Nurses	115 (28.75)
	Laboratory Scientists	96 (24.00)
	Pharmacist	71 (17.75)
	Others	54 (13.50)
Years of Working Experience	1-5	98 (24.50)
	5-10	80 (20.00)
	10-15	88 (22.00)
	> 15	134 (33.50)
Educational Qualification	Bachelor's degree	343 (85.70)
	Fellowship	3 (0.75)
	Master's degree	6 (1.50)
	Doctorate	4 (1.00)
	Others	44 (11.00)
Member of Biomedical WMT	Yes	191 (47.75)
	No	209 (52.25)
Hospital Type	Public	289 (72.25)
	Private	111 (27.75)

Table 2. Percentage Frequency of Practices of Handling Biomedical Wastes

Items	**Positive Responses Frequency N (%)**
Intensive training and retraining of health workers on the effective waste management activities are performed	266 (66.50)
Segregation of infectious waste at the source of generation is prime indicator to achieving a sound medical waste management	398 (99.50)
Segregation is the essence of effective biomedical waste management practice therefore the responsibility of segregation should be that of the generator of biomedical waste	384 (96.00)

Waste management team is constituted to design waste management plan, policy documents and technical guidelines and supervision and coordination of waste management activities	302 (75.50)
Availability and enforcement of standard guidelines and biomedical waste management rules in health care facilities enhances effectiveness of biomedical waste management.	355 (88.75)
Biomedical wastes generated in the hospital should be collected on a daily basis and transported by Trolleys or Wheel barrows to a temporary storage site within the hospital	380 (95.00)
Biomedical wastes treatment leads to a reduction in volume of infectious waste and reduces the risk of transmission of diseases	400 (100.00)
Treatment of biomedical wastes enhances the safe transportation of biomedical wastes to the disposal site and minimizes transmission of diseases.	400 (100.00)

Positive responses = Agree/ Strongly Agree

Table 3. Percentage Frequency of Standard Operating Procedure (SOP) for Biomedical Waste Management

Items	**Positive Responses Frequency N (%)**
Segregation	375 (93.75)
Labelling	328 (82.00)
Treatment	315 (78.75)
Transport	295 (73.75)
Storage	255 (63.75)
Disposal	352 (88.00)

Positive responses = Agree/ Strongly Agree

Table 4. Percentage Frequency of Methods of Biomedical Waste Treatment

Items	**Positive Responses Frequency N (%)**
Disinfection	400 (100.00)
Autoclaving	286 (71.50)
Microwaving	66 (16.50)
Shredding	103 (25.75)

Positive responses = Agree/ Strongly Agree

Table 5. Percentage Frequency of Biomedical Waste Disposal Procedures

Items	**Positive Responses Frequency N (%)**	**TWF**	**RII**	**Rank**
Burning Pit	288 (72.00)	1595	3.99	1
Incineration	270 (67.50)	1572	3.93	2
Dumping	133 (32.25)	1183	2.96	3
Landfill	47 (11.75)	1016	2.54	5
Burial	118 (29.50)	1133	2.83	4
Recycling	75 (18.75)	1016	2.54	5

Positive responses = Agree/ Strongly Agree

Key: TWF- Total Weighted Frequency
RII- Relative Importance Index

Table 6. Percentage Frequency of Awareness of Safety Measures among Health Workers

Items	**Positive Responses Frequency N (%)**
There is need for compliance with standard biomedical waste rules and regulations for improved waste management in the hospital	400 (100.00)
Regular monitoring and evaluation of hospital waste management practices and the performance of the systems periodically enhances safe handling and disposal	400 (100.00)
There is need to educate and equip especially the on-site biomedical waste workers on the use of complete personal protective to prevent accidental injury by sharps	400 (100.00)
Protective accessories are important to minimize the risk of exposure to nosocomial infection among health workers	395 (98.75)
Trainings will improve safe handling and disposal of biomedical waste	400 (100.00)

Positive responses = Agree/ Strongly Agree

Table 7. Percentage Frequency of Protective Devices for Handling Biomedical Waste to minimize Occupational Hazards

Items	**Positive Responses Frequency N (%)**
Gloves	400 (100.00)
Face Masks	400 (100.00)
Apron	400 (100.00)
Safety booth	400 (100.00)
Googles	390 (97.50)

Positive responses = Agree/ Strongly Agree

Table 8. Relationship between Practices of Handling Biomedical Waste and Biomedical Waste Management

	Practices of Handling Biomedical Waste				
Biomedical Waste Management	**Good Practice (%)**	**Poor Practice (%)**	**Total**	χ^2	**p-value**
Good waste management	302 (83.6)	59 (16.4)	361 (100.0)	213.2894	0.000
Poor waste management	11 (28.2)	28 (71.8)	39 (100.0)		

The chi-square (χ^2) test revealed that there is relationship between practices of handling biomedical wastes and biomedical waste management since the p-value is (<0.05) therefore the alternative hypotheses is accepted, the practices of handling biomedical waste among health workers is a significant factor of biomedical waste management.

Table 9. Relationship between Level of Awareness on Safety Measures among Health Workers and Biomedical Waste Management

Biomedical Waste Management	**Level of Awareness on Safety Measures**		**Total**	χ^2	**p-value**
	High Awareness (%)	**Low Awareness (%)**			
Good Waste Management	395 (100.0%)	0 (0.0%)	395 (100.0%)	296.1934	0.000
Poor Waste Management	0 (0.0%)	5 (100.0%)	5 (100.0%)		

The chi-square (χ^2) test revealed that there is a relationship between the awareness on safety measures among health workers and biomedical waste management since the p-value is (< 0.05). The alternative hypothesis is accepted, and that the awareness on safety measures among health workers is a significant factor of biomedical waste management.

Conclusion

This study showed that there are gaps in the implementation of standard practices of handling biomedical wastes in the hospitals such as in the areas of transportation from point of generation, treatment, temporal storage and disposal. Awareness of safety measures and practices are appreciable however should be improved upon. Moreover, this study has shown that the practices of handling biomedical wastes and awareness of safety measures are related to biomedical waste management ($p \leq 0.05$).

Recommendations

Regular training, workshops and seminars on standard practices of handling biomedical wastes and safety measures among health workers to secure the health of the populace and the environment. The hospital management should regularly monitor and enforce the execution of proper handling procedures of biomedical wastes. Also, strict compliance to the use of personal protective equipment among health workers is critical in the prevention of occupational hazards. Involvement of government and related agencies to establish laws and policies for functional and sustainable system towards achieving an efficient biomedical wastes management.

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