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Study on Biomedical Waste Management in Surgical Theaters of Some Selected Hospitals in Urban Kano, Northern Nigeria

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Abstract- Biomedical waste management (BMW) is one very important aspect of environmental issue that needs to be taken more seriously. Rapid growth of human population especially in the developing countries has led to increase in quantity of biomedical waste produced in the health care facilities (HCF). The paper aimed at studying management of MW in surgical theaters in Urban Kano. A total of twelve (12) of HCFs were purposively sampled base on possession of a functioning theater, from the six major local government areas constituting urban Kano (one public and the other private). Questionnaire survey was used to solicit information from the theater attendants on various aspects of waste management: waste segregation, collection, storage, treatment, transportation, disposal, safety and exposure to risk as well as training. Out of 105 questionnaires administered, 81 representing 77% were retrieved. It was found out that waste segregation is poorly practiced, (26%), waste is poorly stored, treatment also very low, reported by only 29% and sharps especially syringes are disposed up anyhow, although some form of incineration was reported (29%). Final disposal of the waste is often in open dumpsites. Training was reported, (64%) that generally focused more on personal safety rather than medical waste management. Infectious waste generated ranges from 0.07kg/day to 3.60kg/day, among public hospitals. Noninfectious waste generated ranges from 0.82kg/day to 1.6kg/day. Infectious wastes generated among private hospitals ranges from 0.22kg/day to 2.57kg/day while noninfectious waste generated ranges from 0.0kg/day to 1.10kg/day. Of the average total generated waste produced, 18.0kg/day, public hospitals accounted for about 11.8kg/day while private hospitals accounted for 6.20kg/day. The result indicated that the management of biomedical waste is poorly executed, hence it was recommended that strategic measures should take to reduce the quantity of the waste produced, which may be achieved full segregation of the wastes and implementation of National Health Care Waste Management Plan (NHCWMP, 2007) in order to reverse the situation.

Keywords- Biomedical waste, Urban Kano, environmental pollution, healthcare workers, waste management.

I. INTRODUCTION

All human activities produce waste. It was well known that such waste may be dangerous and needs safe disposal. Industrial waste, sewage and agricultural waste pollute water, soil and air. It can also be dangerous to human beings and environment. Similarly, hospitals and other health care facilities generate lots of waste, called biomedical waste (BMW) or health care waste (HCW) or hospital waste, which can transmit infections, particularly HIV, Hepatitis B and C, and Tetanus, to the people who handle it or come in contact with it. Biomedical waste (BMW) is defined as any solids, liquids, sharps waste including its containers and any other intermediary product, which is generated during the diagnosis, treatment or immunization of human beings or animals in research pertaining there to, or in the production or testing [1]. One of the first critical steps in the process of developing a reliable waste management plan is characterization of wastes [2]. Most of the wastes generated in health care facilities (HCFs), including food waste are no more hazardous than general municipal solid waste, but become infected as they are mixed with infectious wastes at source. Therefore, BMW should be segregated into infectious wastes and non- infectious wastes and disposed of accordingly [1].

Most of the developing nations are facing many challenges and environmental degradation from unscientific management of BMW. Increase in population and rapid growth in the number of HCFs also elevated this problem [3]. There is an increasing concern over unscientific and improper disposal of BMW in developing countries such as India [4]. Hence, BMW disposal has become an issue of increasing concern. In Africa, the situation appears to be more critical as reports around the continent indicate poor

medical waste management (MWM) practices [5]. Manyele [5] described MWM in Tanzania as being poor, further he posited that general awareness on issues related to medical waste management was generally lacking among generators and handlers. This scenario of poor MWM is the same in South Africa, Mozambique, Swaziland and Kenya. Illegal dumping appears a serious problem in most countries. In Kwazulu Natal Province for example; about 45% of medical waste generated could not be accounted for, and there is general lack of adequate capacity, to properly manage the medical waste generated.

Similarly, [6] also posited that Solid Waste Management (SWM) is a major problem in most developing countries of the world due to its growing and endless generation coupled with poor management. In the same vein, medical waste management (MWM) is yet to receive sufficient attention in the overall SWM and often times neglected. Therefore, since BMW are and continuously generated, there is the need for continuous research to investigate the existing practices of healthcare facilities as to how they handle and manage those wastes and also to provide appropriate recommendations. The objectives of the study are to identify the current management of medical waste and handling practices within the selected hospital and also to characterize and quantify the amount of wastes generated in the theatres.

II. MATERIALS AND METHODS

II.I Study Area and Sites

Urban Kano encompasses all the six local government areas of Dala, Fagge, Gwale, Municipal, Nassarawa, and Tarauni, part of Kumbotso and Ungogo, Figure 1. This is in addition to part of local governments which was integrated in to local metropolis for planning purposes. It lies from Latitudes 11^0 52'N to 12^0 7'N and Longitudes 8^0 22.5`E to 8^0 47'E and is 472.14m above sea level. Urban Kano is bounded by Minjibir LGA on the North East and Gezawa LGA to the East, Dawakin Kudu LGA to the South East, Madobi and Tofa LGAs to the South West and lastly Dawakin Tofa LGA to the North West [7].

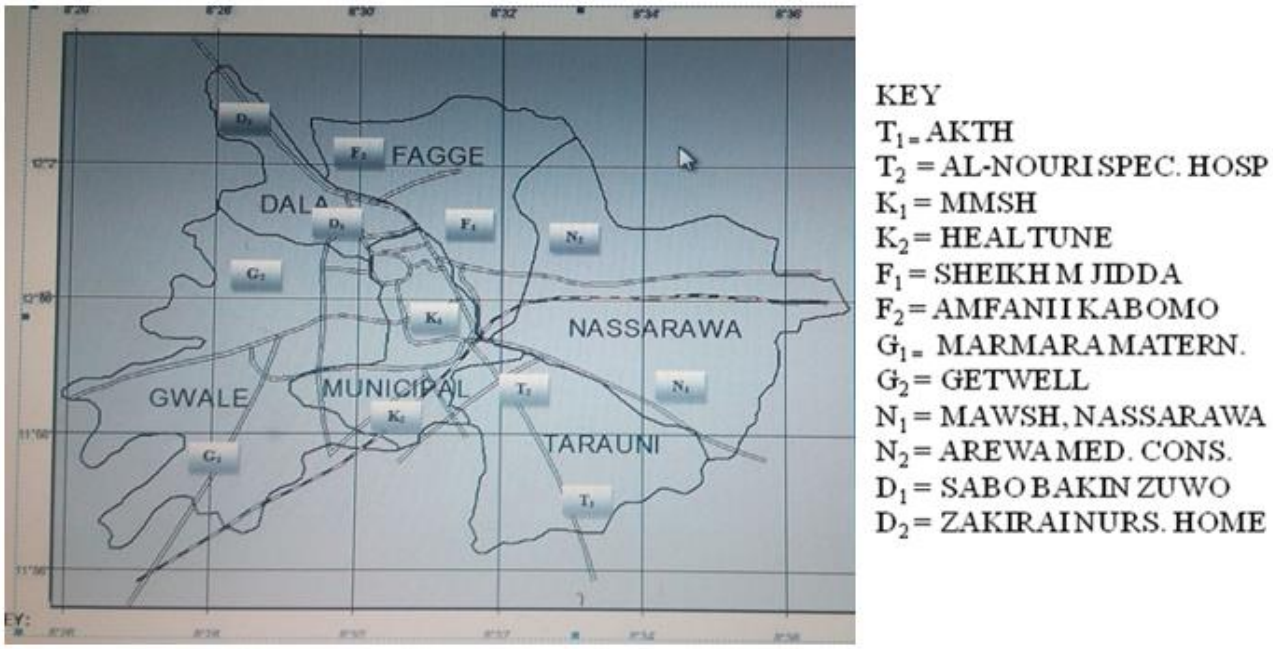

Figure 1: Map of Kano Metropolis and the Study Sites

Source**:** [8]

II.II Design and Sample Sites

A total of 141 registered private HCFs, 22 State own hospitals and clinics and many primary health Care services own by Local Governments are operating in the area under study, i.e. Kano Urban Area. The study was designed to have included two hospitals (one public and the other private) from each of the six local governments constituting Kano urban area, making a total of twelve (12) hospitals. The HCFs were chosen purposively based on possession of one or more theatres.

II.III Target Group and Sample size

The target groups were those staff involved in maintaining the theatres of each HCF. The sample comprised of all the staff (theater attendants) in the theaters of the selected HCFs.

II.IV Questionnaire Design

The questionnaire used for the data collection was a structured type with closed ended questions. The questionnaire contains 25 items related to MWM practice, such as segregation, handling, storage, transportation and disposal. The questionnaire was divided into six sections: A, B, C, D, E, and F. Section A includes information on

personal data of the respondent such as level of education, age, gender, and working period. Section B includes questions regarding waste segregation such as are MW segregated, who segregate the MW, and where the segregation is taking place. Section C contains survey questions regarding containers and waste sacs, such as identity of the containers, are they subjected to tear, and easy movement of the sacs. Section D fielded questions regarding MW storage. It included questions such as where MWs are stored in the HCF, specific mark indicating the storage area, sufficient area for the storage in the hospital or outside the hospital and if the storage area outside the hospital is well protected. Section E dealt with questions regarding training and includes questions like have you been trained, duration of the training and training of new workers. Sections F is on safety measures, taken by the attendants during work and includes enquiries related to wearing of gloves, multiple use of gloves, use of hands to press MW in sac, wearing of special protective clothes, exposure to needle injury, and vaccination.

II.V BMW Characterization

Characterization of the BMW was carried out as per the classification of BMW suggested by [9] in which the whole volume of the waste is characterized as either infectious or non-infectious. Special precautions like use of apron, thick impermeable gloves for protection against potential liquid contaminants and needle pricks along with a face mask were used throughout during the study.

II. VI BMW Quantification

Quantification of the BMW in all the HCFs was carried out using digital spring scale [10]. The average generation of various infectious and per each theatre was recorded two times each week for four weeks. Average total BMW generated (kg/day) was then estimated by dividing the gross weight of each category of the waste by eight. The average infectious (A) and non-infectious (B) wastes generated (kg/day) and net BMW generation (kg/day) at each source at each HCF was calculated using the formula: A+B=T [11].

III. RESULTS

Table 1: Socio-demographic Distribution of the Respondents

	Respondents (%)
Educational Status	
Primary	12 (15)
Secondary	64 (79)
Tertiary	05 (6)
Age (years)	
20 – 29	15 (19)
30 – 39	45 (56)
40 – 49	21 (25)
>49	-
P-value 1.0000	
Sex	
Male	72 (89)
Female	09 (11)
P-value 0.00001	
Working Experience (years)	
<1	03 (4)
1 – 3	12 (15)
3 – 5	10 (12)
5 – 7	19 (23)
>7	37 (46)
P- value 0.9456	

Table 2: Response on Waste Segregation/sorting

	Question	**Responses (%)**		
		Yes	No	Total
1.	Are medical waste segregated?	21 (26)	60 (74)	81 (100)
2.	Who segregate the Waste?			
	Cleaning staff	2 (10)		
	Medical staff	8 (38)		
	Cleaning and medical staff	8 (38)		
	I don't know	3 (14)		
	Total	21 (100)		
3.	Where segregation is taking place?			
	At the beginning near the source	16 (76)		
	After waste is collected	05 (24)		
	At the waste storage.	-		
	Total	81 (100)		

Table 3: Response on Containers and Waste Sacks

	Question	**Responses (%)**		
		Yes	No	Total
1.	Are containers identified and distinguished?	30 (37)	51 (63)	81 (100)
2.	Are waste sacks subjected to tear?	19 (23)	62 (77)	81 (100)
3.	Are measures carried out to prevent leaking?	57 (70)	24 (30)	81 (100)
4.	Are waste sacks transferred easily?	73 (90)	08 (10)	81 (100)

Table 4: Response on Medical Waste Storage

	Question	**Responses (%)**		
		Yes	No	Total
1.	Where is medical waste stored temporarily?			
	Waste sacks	05 (6)		
	Special vessels	46 (57)		
	Normal plastic containers	30 (37)		
	Total	81 (100)		
2.	Is there specific mark showing the storage area?	08 (10)	73 (90)	81 (100)
3.	Is the storage area sufficient?	48 (59)	33 (41)	81 (100)
4.	Is the storage area closed properly?	39 (48)	42 (52)	81 (100)
5.	Is the storage protected well?	38 (47)	43 (53)	81 (100)
6.	Is there any storage area outside?	3 (4)	78 (96)	81 (100)

Table 5: Treatment, Transportation, and Disposal of Waste

	Question	**Responses (%)**		
		Yes	No	Total
1.	Are MW treated before disposal?	24 (30)	57 (70)	81 (100)
2.	Which of the following treatments are available?			
	Autoclaving of waste	02 (9)		
	Incineration	07 (29)		
	Encapsulation of sharps	10 (42)		
	Waste burial within the HCF	-		
	Chemical disinfection of body fluid	-		
3.	How are MW transported outside?			
	Open vehicle	52 (64)		
	Closed vehicle	23 (28)		
	I don't know	06 (8)		
	Total	81 (100)		
4.	Where is the final destination of the waste?			
	Municipal dumping sites	37 (46)		
	Landfills	18 (22)		
	Jakara river	03 (4)		
	I don't know	23 (28)		
	Total	81 (100)		

Table 6: Response Regarding Training

	Question	**Responses (%)**		
		Yes	**No**	**Total**
1.	Have you received training on MWM?	29 (36)	52 (64)	81 (100)
2.	Duration of the training:			
	1 – 3 days	28 (54)		
	4 – 7 days	20 (36)		
	>7 days	04 (8)		
3.	Are new workers trained?	54 (67)	27 (33)	81 (100)

Table 7: Survey Question Regarding Safety Measures

	Questions	**Response (%)**	
1.	Do you wear globes always?	Yes always	81 (100)
		Sometimes	-
		Rarely	-
2.	Do you use same globe more than once?	Sometimes	02 (2)
		Rarely	01 (1)
		No	78 (97)
3.	Where do you get rid of soiled globes?	With MW	38 (47)
		With GW	43 (53)
4.	Do you put your hands in the waste to press it?	Sometimes	04 (5)

		Rarely	03 (4)
		No	74 (91)
5.	Do you wear special clothes during work?	Yes always	77 (95)
		Sometimes	04 (5)
		No	-

Table 8: Average Generation of Infectious and Non-Infectious Wastes Produced in Kg/day

HCF Code	Infectious **(A)**	Non-Infectious **(B)**	Total **(A+B)**	HCF Category
KM_1	1.67	1.36	3.03	Public
T_1	3.60	1.60	5.20	Public
F_1	2.15	0.82	2.97	Public
D_1	1.60	1.27	2.87	Public
GW_1	0.07	0.16	0.23	Public
N_1	2.74	0.83	3.57	Public
KM_2	0.60	0.30	0.90	Private
T_2	0.83	0.47	1.30	Private
F2	0.74	-	0.74	Private
D_2	0.22	0.20	0.42	Private
GW_2	2.57	-	2.57	Private
N_2	1.74	1.10	2.84	Private
Mean±SD	1.54±1.09	0.68±0.56	2.22±1.50	

Mean±SD values are significantly different ($p < 0.05$)

IV. DISCUSSION

Socio-demographic distribution of the Respondents is presented in Table 1. From the results, out of the 81 study participants; 12(15%), 64(79%) and 5(6%) obtained primary, secondary and tertiary education respectively. Age (years) of the respondents varied from 20-29, 30-39, 40-49, and > 49 respectively. The lower and the higher age groups (20-29 and > 49 years) for the respondents were observed to be 15(19%) and 0(0%). Amongst the study participants, 09(11%) and 72(89%) were observed to be males and females respectively. The lower and higher range for working experience (<1 and >7 years) respondents were observed to be 03(04) and 37(46%) respectively. Age and working experiences of the respondents were found to be not significantly associated ($p > 0.05$) with hospital waste management. This finding is contrary to the findings of [12] in which better attitude towards waste management is found to be higher among individuals in higher age groups than among the youth. On the other hand, gender was observed to be significantly different ($p < 0.05$) amongst the respondents.

The result on waste segregation is presented in Table 2, in which 74% reported that it is not practiced, what is mostly present is partial segregation of sharps. This finding conforms to the finding of [13] which indicated poor practice of waste segregation, and partial segregation of sharps only. By implication the remaining wastes are mixed (infectious and non-infectious). This present situation needs to be reconsidered; otherwise, the environment will continue to suffer from this improper practice of MWM because mixed waste is strongly hazardous to municipal workers and scavengers, as well as to the general public as it may lead to spread of infectious diseases such as HIV/AIDS [14].

Table 3 presented response on containers and waste sacks. The item on whether containers are identified and distinguished, the results showed that 51(63%) answered that the containers are not distinguished while 30(37%) answered otherwise. The possibility of waste sacks being subjected to tear, 62(77%) responded that the waste sacks do not tear while 19(22%) showed that the waste sacks rupture and leak. On measures taken to prevent leakage 57(70%) responded that such measures exist while 24(30%) answered no. Similarly, 57(70%) recorded in favor of measures that prevent leakage is an indicator of good WM practice. Item 4 is on onsite transportation of waste sacks. 73(90%) indicated that the waste sacks are transported easily while 8(10%) answered no. Although the results indicated that colour coding of the waste sacs is not well practiced, it is worth noting that measures are taken to prevent leaking of the waste. This will of course help in reducing spillage that can cause pollution or infections especially to the handlers.

Physical observation and interview with some study participants indicated that none of the HCFs surveyed have medical waste storage. The practice adopted as presented in Table 4 is the use of a plastic vessel to temporarily store the waste. In some hospitals especially private hospitals and few public hospitals use metallic drums. It is worth noting that there is no any mark or sign that indicate storage point as reported by 90% of the respondents. In addition, physical observation revealed that these containers in most cases are not properly covered nor well protected; hence, the place can easily be visited by vectors such as flies and rodents. The International Committee of the Red Cross [15] recommended that a specific area must be designated for storing medical waste and must be closed, and access must be restricted to authorized persons only.

The response on treatment and disposal is presented in Table 5 which showed 57(70%) of the respondents indicated that the waste produced is not treated before disposal, while 24(30%) answered that some forms of

treatment of waste exist. With regard to the item on type of treatment, 10(42%) agreed that there is encapsulation of sharps, 7(29%), incineration and 2(9%), autoclaving. On transportation of the waste outside, 52(64%) indicated open vehicle is used, 23(28%) closed vehicle while 6(8%) don't know. Item 4 is on final disposal of the waste, where 37(46%) indicated that municipal dumping sites are used, 23(28%) responded they don't know while 18(22%) indicated that the wastes are disposed of in landfills while 3(4%) responded that the waste is disposed of in River Jakara. This finding indicated that waste produced is not fully treated; rather it is mixed with general waste and dumped together in municipal dumping sites or landfills. This scenario is also found in some Lagos hospitals by [6] that identified two major challenges: open dumping within hospital premises or at municipal dumpsites and non-treatment of infectious wastes before final disposal. Open dumping is known to have no control over access to unauthorized persons or environmental pollution, hence, the potential health risk [16].

Training is another very important aspect of BMWM. The result in Table 4.7 indicated that only 26% of the respondents received training on MWM while the remaining 64% did not. Similar problem was reported in Port Harcourt by [16] who stated there is apparently lack of relevant training and protective equipment for waste handlers. The duration of the training also indicates that, 1-3 days, 54%, 4-7 days, 38% and > 7 days 8%. 67% believed new workers are trained while 33% believed not. This result shows that training is not given much priority. Botelho [17] reported that, to effectively manage healthcare wastes, provision of education and training is the strongest factor influencing degree of compliance to healthcare management procedures and regulations.

Safety measures taken by the staff is shown in Table 9. The result indicated that 100% use hand globes always, 97% use it once, 2% use it more than once while 1%, rarely. 53% get rid up of soiled hand globes with general waste while 47% get rid it with medical waste. On whether hands are used to press the waste, 91% indicates that they don't, 5%, sometimes, and 4% responded rarely. The last item is on use of special clothes during work, 95% responded that always they use it while 5% indicated sometimes. From this result it can be deduce that that some practices, although the percentage reported is low, are not in line with standard handling and management of MW. Medical waste contains potentially harmful micro-organisms which can infect hospital patients, health-care workers and the general public [18]. For this reason, medical waste should not be taken for granted, because it has been established that, worldwide, about 5.2 million people (including 4 million children) die each year from waste related diseases [19].

Table 8 presented the result on average of infectious and non-infectious wastes. The quantity of wastes generated showed high variation. Among public hospitals, sample site T_1 produces highest quantity of waste (3.60kg/day and 1.6kg/day), while G_2 generates highest quantity of waste (2.70kg/day) among private hospitals. This variation in quantity of wastes produced is due to difference in number of cases attended in the theaters each day. Other factors that contribute to high generation of waste as reported by [20] are type of HCF, level of status, degree of treatment and location. Statistically, there is significant difference between infectious and non-infectious waste generated. This finding is in line with what [21] reported, which stated that theaters and operating rooms generate large quantity of infectious wastes.

V. CONCLUSION

Conclusively, the results obtained indicated that proper medical waste management is poorly executed in some hospitals in Kano Metropolis. For this, there might be tendencies for the released untreated wastes to pollute the environment and also cause infection to the waste handlers, patients, visitors, and scavengers, who have little or no knowledge of the deleterious nature of this category of wastes. Meanwhile, in places where there is some degree of management, there is some form of segregation, that needs to be optimized in order to minimize the quantity of the wastes generated, and incineration treatment option. However, most often the incinerator is overworked unnecessary by burning of wastes that ought to be disposed of with general wastes. This practice will of course lower the life span of the incinerator.

VI. RECOMMENDATION

There is need to implement the recommendations made in the draft document, National Health Care Waste Management plan (NHCWMP) which was drafted in 2007. This document may serve as reference material for all the HCFs residing in the country.

The segregation of waste at source should be the main focus of each HCF, as this will reduce the quantity of waste generated and also cost of treatment. Colour coded bags can be improvised so long if is strong enough to disallow leaking.

There is also need for training and refresher courses to all stakeholders. The training will help in developing skills on one hand and raise awareness on the other. The refresher course will help in updating the staff on any changes that might have occurred in the system.

The hospitals at their own levels can also develop waste management policy that will serve as a guide on how to manage the waste they generate right from cradle to the grave.

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