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Original Research Article

Management of solid healthcare wastes in some government healthcare facilities in Enugu state, Southeast Nigeria: a cross-sectional study

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ABSTRACT

Background: The significance of healthcare wastes (HCWs) consists in their hazardous component, which constitutes real danger to public health. In Nigeria, healthcare waste management (HCWM) has remained a problem yet to be properly recognized and so addressed. The study aimed to sensitise health workers and the public on the need for proper management of HCWs, considering the public health implications of not doing so.
Methods: The waste management systems of ten healthcare facilities (HCFs) were assessed, using a modification of the WHO rapid assessment tool. In each HCF, segregated wastes were collected daily for ten days and quantified by weighing, using a spring balance.
Results: Administratively, the HCWM system was poor in the ten HCFs (40.6%). 70% of them had satisfactory waste segregation, 81%, good waste treatment, and 26.7% adequate transportation methods for waste. None of the HCFs had budget allocation for HCWM, and 90% had inadequate storage facilities. Mean waste generation was 1.81 kg/day, 0.23 kg/patient/day, 0.16 kg/bed/day, and proportion of infectious wastes 16.8%. Correlation between the number of patients and proportion of infectious waste, was positive, strong and significant (r=0.80, p=0.01), and between bed occupancy rate and proportion of infectious waste, was positive too, but weak, and insignificant (r=0.34, p=0.34).
Conclusions: In view of the identified weaknesses of the ten HCFs in HCWM, budget allocations for HCWM, improving waste storage facilities and transportation, with strengthening of waste segregation, collection, and treatment, would help to ensure adequate HCWM in the HCFs.

Keywords: Healthcare, Waste, Management, Government, Facilities, Enugu

INTRODUCTION

Part of the problem of waste definition is the difficulty of determining at what point an object becomes a waste and at what point it ceases to be a waste. However, according to the Basel convention, wastes are defined as substances or objects, which are disposed of, or, are intended to be disposed of, or are required to be disposed of by the provisions of national laws.[1] Similarly, classifications of wastes also pose some problems, as there are no universally accepted criteria for such classifications. However, based on the origin and risk to human and environmental health, wastes can be categorized into household wastes, municipal wastes, commercial and non-hazardous industrial wastes, hazardous (toxic) industrial wastes, healthcare wastes, human and animal wastes, and incinerator wastes.

Healthcare waste (HCW) or medical waste (MW) is the total waste stream generated from healthcare facilities (HCFs), including hospitals, research centres, and laboratories. The significance of HCWs consists in their

hazardous component, which although smaller in proportion compared to the total wastes, constitutes real danger to public health. Relevant studies have shown that about 15% of all the wastes generated in HCFs are hazardous, while the remaining 85% are non-hazardous or general wastes.[2] Hazardous waste is a waste that has properties that make it potentially dangerous or harmful to human health or environment, and is usually characterized by its ignitable, corrosive, reactive, or toxic nature. As result of its hazardous component, HCW or MW has been receiving increased attention in recent years. Obviously, this current heightened attention to HCWs, is as a result of the infectious constituent of the hazardous component, which although constituting only a small part of the total HCW, (about 10%-25%), accounts for a considerable portion of the costs incurred by a HCF for its disposal.[3,4] Infectious waste (IW), is the waste type suspected to contain pathogens (bacteria, viruses, or fungi), in sufficient concentration or quantity to cause disease in susceptible hosts.[5] Consequently, untreated HCWs disposed of, at the municipal dumpsites, can lead to an unhealthy and hazardous environment around the health institutions, affecting the patients, staff and the community.[6-11] In the U.S.A., about 15% of total hospital waste is considered infectious, in India the range is between 15% and 35%, while in Iran about 29.89% has been reported.[12,13] In Nigeria, a rate of 21.3% for hazardous waste was reported by.[14]

The greatest risk due to IW is the risk of needle injuries, with their potential to cause hepatitis B, hepatitis C or human immunodeficiency virus (HIV) infections. Comparatively, the risk of infection due to needle prick is higher for hepatitis, than HIV.[15] Findings from epidemiological studies indicate that a person who experiences one needle stick injury used on an infected source, has risks of 30%, 1.8%, and 0.3% of becoming infected with hepatitis B virus (HBV), hepatitis C virus (HCV) and HIV respectively.[16] Available data indicate that in 2000, 21 million people worldwide were infected with hepatitis B virus, 2 million with hepatitis C virus and 260,000 with HIV due to injections with contaminated syringes.[17] Statistics have further shown that about 5.2 million people (including 4 million children) die from waste-related diseases annually.[18]

The amount of generated HCW varies from one HCF to another. Among the factors that determine the quantity of waste generated by a HCF are, the type of HCF, number of inpatients, available waste segregation options, seasonal variation, number of hospital beds, proportion of patients treated on a daily basis and the level of national income.[5,19] HCW management (HCWM) is a multi-stage process, which goes through waste collection, segregation, storage, transportation, and ends with treatment and final disposal.[2] Proper management of HCW not only causes its weight and volume to decrease, but also reduces its infectivity and contents of organic compounds.[20] Therefore, the goal of IW management is to reduce its potential hazards, in order to protect public health and the environment.[21] However, in spite of the inherent benefits of proper HCWM, improper HCWM still remains a problem in many countries of the world today. In fact, in a survey of 22 countries by the WHO, 18-64% of them were reported to have unsatisfactory HCWM facilities, predictors of which include lack of awareness, insufficient resources, and poor disposal mechanisms.[8]

Like in other parts of the world, in Nigeria, HCWM has remained a problem yet to be properly recognised and so addressed. As revealed by relevant past studies on HCWM, some of the attributable reasons for poor HCWM in the country, include non-segregation of HCWs, (HCWs are usually mixed with municipal waste and treated together off-site), absence of HCWM policy, and lack of awareness about HCWM among healthcare workers.[9,22-26]

Between 2007 and 2011, the incidence of hepatitis B infection in Nigeria rose from 5, 222 cases in 2007 to 7, 825 in 2011.[27] Then, it was projected that the populations of people living with HIV/AIDS in Nigeria could rise from 2, 999, 000 in 2007 to 3,300,004 in 2011. Over these years, however, the prevalence of HIV/AIDS actually fell slightly from 5.3 in 2003 to 4.1 in 2010 at the national level, but in Enugu State, it increased from 4.9 in 2003 to 5.1 in 2010. These data clearly indicate that without adequate measures put in place to check the rising trends in the prevalence of the two infections, especially hepatitis B, the situation might continue to worsen with time. Without doubt, one of the strategies that could help to reverse this ugly trend, is proper management of HCWs, which might eventually help to reduce the risks of the two infections attributable to IWs.

The aim of the study is therefore to sensitise health workers and the public on the need for proper HCWM considering the public health implications of not doing so.

METHODS

The State was divided into clusters and random stratified sampling was used to select the ten Government HCFs (5 primary and 5 secondary facilities) that participated in the study. In all, 30 copies of the questionnaire were administered to Doctors, Nurses, Midwives, Pharmacists, Laboratory Scientists, and Ward orderlies/waste handlers from the ten HCFs that were involved in the study. The questionnaire covered administrative aspects of the waste management system (e.g. training of staff regarding HCWM, written policy dealing with HCWM, budget allocation for HCWM, use of personal protective equipment in waste management and awareness of hospital staff on wastes management); types and quantities of wastes generated in the HCFs; waste segregation, collection, transportation, storage, treatment, and final disposal practices. Inventory of wastes was taken from the Out-patient Departments,

Maternity/Labour wards, In-patient wards, Operating theatre(s), Pharmacy, and Laboratory units of the HCFs.

The waste management systems of the HCFs were assessed, using a modified version of the rapid assessment tool and grading system as suggested by.[28,29]

To quantify the wastes generated by each Department of a HCF, modified methods of inventory taking were used.[10,14] Segregated wastes were collected daily in polythene waste bags. Categories of waste collected and quantified included general (domestic), pathological, sharps, and infectious types. With the aid of spring balances, the weights of wastes of the various categories were separately determined. In each HCF, the weighing of segregated wastes were usually done by cleaners, nurses, or other department members of staff, charged with taking inventory of the department's wastes, on a daily basis, for a period of ten days. Data were collected from March 2017 to August 2017. The data so obtained were analysed as descriptive statistics (frequency distributions and means), t-test and Pearson product moment correlations, using MaxStat statistical software (version 3.60). P-value ≤ 0.05 was considered significant.

RESULTS

Thirty copies of the questionnaire were administered to health workers (doctors, nurses, laboratory scientists, waste management officers, ward orderlies/waste handlers) in the ten HCFs. Wastes were mainly segregated into general (domestic), pathological, sharps, and infectious categories, and weighed every day for a period of ten days in each HCF.

Table 1: Administrative part of HCW management in 10 HCFs in Enugu state.

Parameter	Weight value	Healthcare facility scores									
		A	B	C	D	E	F	G	H	I	J
Training of staff regarding HCWM	5	5	5	5	0	0	0	0	0	0	5
Written policies dealing with HCWM	2	0	0	2	0	0	2	0	2	0	2
Budget allocation for HCWM	4	0	0	0	0	0	0	0	0	0	0
Designated HCWM officer	5	5	5	0	5	0	0	0	5	0	5
Use of PPE during collection, transportation and treatment of HCW	2	2	2	2	2	2	2	2	2	2	2
Total	18	12	12	9	7	2	4	2	9	2	14
Proportion of total weight value		66.7%	66.7%	50%	38.9%	11.1%	22.2%	11.1%	50%	11.1%	77.8%
Mean		40.6%									

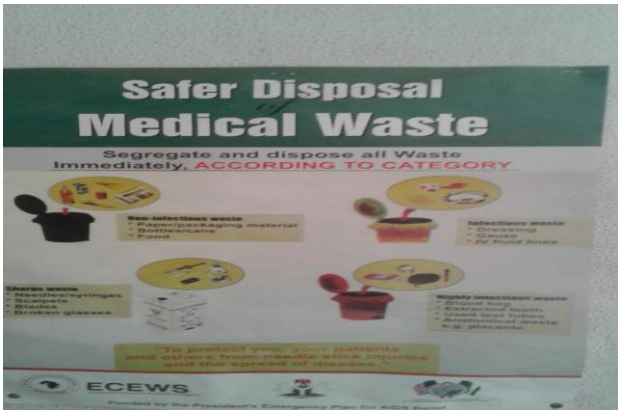

Figure 1: Waste management poster at a primary HCF.

Table 1 shows the administrative aspect of HCWM in the ten HCFs. As shown in the table, 6 (60%) of 10 facilities did not have training of their staff on HCWM, 6 (60%) of 10 did not have written policies dealing with HCWM, 10 (100%) of 10 facilities had no budget allocation for HCWM, while 5 (50%) of the 10 facilities had designated HCWM officer. 10 (100%) of 10 facilities used PPE during collection, transportation and treatment of HCW. Overall, the mean score of all the 10 facilities in the administrative aspect of HCWM was 40.6%, considered as poor according to the grading system.[29]

Table 2 shows waste segregation practices in the 10 HCFs. According to the table, 7 (70%) of the 10 facilities properly segregated their wastes.

The table also shows that health workers in 7 (70%) of the 10 HCFs had the awareness on the need to properly segregate their wastes. Overall, 70% is considered as medium, according to the grading system.[29]

Table 2: Waste segregation in 10 HCFs in Enugu State.

Parameter	Weight value	Healthcare facility scores									
		A	B	C	D	E	F	G	H	I	J
Proper segregation of waste	5	5	5	0	5	0	5	0	5	5	5
Awareness of health workers on	2	0	2	0	2	2	2	0	2	2	2
classification and segregation											
requirements											
Total	7	5	7	0	7	2	7	0	7	7	7
Proportion of total weight value		71.4%	100%	0%	100%	28.6%	100%	0%	100%	100%	100%
Mean		70%									

Table 3: Waste collection in 10 HCFs in Enugu state.

Parameter value	Weight	Healthcare facility scores									
		A	B	C	D	E	F	G	H	I	J
No recapping of used syringes	2	2	2	2	2	2	2	0	2	2	2
Sharps are collected in sharps container or	5	5	5	5	5	0	5	0	5	5	5
destroyed using needle destroyers											
Sharps are containers are puncture resistant and leak proof	2	2	1	2	2	0	2	0	2	2	2
Sharps containers or needle destroyer are always available	1	1	1	1	1	0	1	0	1	1	1
Total	10	9	10	10	2	10	0	10	10	10	10
Proportion of total weight value		100%	90%	100%	100%	20%	100%	0%	100%	100%	100%
Mean		81%									

Table 4: Waste storage in 10 HCFs in Enugu state.

Parameter	Weight value	Healthcare facility scores									
		A	B	C	D	E	F	G	H	I	J
Storage area meets the proper requirements	1	0	0	1	0	0	0	0	0	0	0
Wastes are removed before the maximum allowable storage time is exceeded	1	1	1	1	1	1	1	1	1	1	1
Total	2	1	1	2	1	1	1	1	1	1	1
Proportion of total weight value		50%	50%	100%	50%	50%	50%	50%	50%	50%	50%
Mean		55%									

Table 5: Waste transportation in 10 HCFs in Enugu state.

Parameter	Weight value	Healthcare facility scores									
		A	B	C	D	E	F	G	H	I	J
Waste is always transported away from patient areas and other clean areas	0.5	0	0	0.5	0.5	0.5	0	0.5	0.5	0	0.5
Waste is transported in a closed (covered)	1	0	0	0	0	0	0	1	0	0	0
wheeled transport cart											
Total	1.5	0	0	0.5	0.5	0.5	0	1.5	0.5	0	0.5
Proportion of total weight value		0%	0%	33.3%	33.3%	33.3%	0%	100%	33.3%	0	33.3%
Mean		26.7%									

Table 6: Waste treatment and final disposal in 10 HCFs in Enugu state.

Parameter	Weight value	Healthcare facility scores									
		A	B	C	D	E	F	G	H	I	J
HCF treats its infectious wastes (either on site or off site) before final disposal	25	20	20	20	20	20	20	25	20	20	20
Treatment system destroys or mutilates sharps	1	1	1	0	1	1	1	0	1	1	1
waste in order to prevent reuse											
Total	26	21	21	20	21	21	21	25	21	21	21
Proportion of total weight value		80.8%	80.8%	76.9%	80.8%	80.8%	80.8%	96.2%	80.8%	80.8%	80.8%
Mean		82%									

Figure 2: Waste storage site at a primary HCF.

Table 3 shows waste collection in the 10 HCFs. As shown in the table, 9 (90%) of the 10 facilities did not recap their used syringes, 8 (80%) of 10 collected their sharps in sharps containers, while 8 (80%) of 10 always had sharps containers available. Overall, waste collection was 81% successful in the 10 HCFs, considered as good according to the grading system.[29]

Figure 3: Waste storage site at a secondary HCF.

Table 7: Categories (daily average) (in kg) of wastes generated in 10 HCFs in Enugu state (N=10 days).

HCF	Waste categories				
	General	Pathological	Sharps	Infectious	Total
A.	1.05	0.20	0.690	0.30	2.24
B.	0.32	0.40	0.002	0.11	0.83
C.	0.21	0.15	0.138	0.06	0.56
D.	0.69	0.08	0.200	0.14	1.11
E.	2.64	0.30	0.600	0.31	3.85
F.	0.92	0.06	0.056	0.22	1.26
G.	1.64	0.05	0.550	0.42	2.66
H.	0.64	0.15	0.550	0.61	1.95
I.	0.79	0.26	0.500	0.48	2.03
J.	0.59	0.30	0.420	0.29	1.60
Mean	0.95	0.20	0.321	0.29	1.81

Table 8: Daily (average) quantities of total and infectious wastes generated per facility in 10 HCFs in Enugu state (in kg) and % of infectious wastes (N=10 days).

	Total waste (in Kg)		Infectious waste (in kg)		Proportion of infectious waste (in %)	
S/N	PHC	DH	PHC	DH	PHC	DH
1.	2.24	3.85	0.30	0.31	13.4	7.9
2.	0.83	1.25	0.42	0.22	13.5	17.6
3.	0.56	2.66	0.06	0.42	10.7	16.0
4.	1.11	1.95	0.14	0.61	15.5	31.3
5	1.60	2.04	0.29	0.48	18.1	23.6
Mean	1.27	2.34	0.24	0.42	14.2	19.3
Overall mean		1.80		0.33		16.8
t		2.05				1.23
p		0.07				0.25

Key: PHC= Primary Healthcare Centre; DH= District Hospital.

Figure 4: Waste disposal site at a primary HCF (incinerator).

Table 4 shows waste storage processes in the 10 HCFs. From the table it is seen that 9 (90%) of the 10 facilities had storage areas which did not meet proper requirements for storage. On the average, the ten HCFs met 55% of the requirements for proper waste storage, considered as medium according to the grading system.[29]

Figure 5: Waste disposal site at a secondary HCF (open dump).

Table 5 shows waste transportation services in the 10 HCFs. As shown in the table, 6 (60%) of 10 facilities had wastes always transported away from patient areas and

other clean areas, and 9 (90%) of 10 did not transport wastes in a closed (covered) wheeled transport cart. Overall, transport of wastes was 26.7% successful in the 10 HCFs, considered as poor according to the grading system.[29]

Table 9: Daily (average) quantities of total wastes generated per patient in 10 HCFs in Enugu state (in kg).

HCF	No. of pts/day (average) day	Total waste/day (in kg)	Quantity (in Kg)/patient
A	5	2.24	0.45
B	4	0.83	0.21
C	5	0.56	0.11
D	15	1.11	0.07
E	4	3.85	0.96
F	12	1.25	0.10
G	20	2.66	0.13
H	22	1.95	0.09
I	26	2.04	0.08
J	20	1.60	0.08
Mean	13.3	1.81	0.23

Key: HCF= Healthcare facility.

Table 10: Daily (average) quantities of total wastes generated per bed in 10 HCFs in Enugu state (in kg).

HCF	No of beds (bed/day)	Total waste (in Kg)/day	Quantity (in Kg)
A	10	2.24	0.22
B	3	0.83	0.28
C	8	0.56	0.07
D	6	1.11	0.19
E	10	3.85	0.39
F	20	1.25	0.06
G	14	2.66	0.19
H	14	1.95	0.14
I	54	2.04	0.04
J	40	1.60	0.04
Mean	20.9	1.81	0.16

Key: HCF= Healthcare facility.

Table 6 shows waste treatment and final disposal in the 10 HCFs. As shown in the table, 8 (80%) of the 10 facilities had treatment systems that destroy or mutilate sharps. On the average, waste treatment and final disposal in the ten HCFs was 82%, considered as good according to the grading system.[29]

Table 7 shows the quantities and categories of waste generated in the ten HCFs. As shown in the table, the average quantity of total wastes generated by each of the ten facilities ranges from 0.56 kg/day to 3.85 kg/day. The mean quantity of total wastes generated per day by each of the ten facilities was 1.81 kg/day.

Table 8 shows the quantities of total wastes and infectious wastes generated daily by the ten HCFs (PHCs and DHs). The table also shows the proportions of infectious wastes generated per day in the ten facilities. As shown in the table, the average daily quantities of total waste generated in the PHCs range from 0.56 kg/day to 2.24 kg/day with a mean of 1.27 kg/day, while in the DHs, the range is from 1.25 kg/day to 3.85 kg/day with a mean of 2.34 kg/day.

Proportions of infectious to total wastes in the PHCs range from 10.7% to 18.1% with a mean of 14.2%, while in the DHs, the range is from 7.9% to 31.3% with a mean of 19.3%. Between the PHCs and DHs, there was no significant difference in total daily generated wastes (p=0.07) and the proportions of infectious to total wastes (p=0.25).

Table 9 shows the quantities of total waste generated daily per patient in the 10 HCFs. As shown in the table, the average daily quantities of total waste generated in the ten HCFs vary from 0.56 kg to 3.85 kg, with a mean of 1.81 kg. The daily amounts of total waste generated per patient vary from 0.07 kg/patient/day to 0.96 kg/patient /day, with a mean of 0.23 kg/patient/day.

Table 11: Relationship between number of patients seen daily and proportion of infectious to total waste in 10 HCFs in Enugu state.

HCF	No. of patients daily	Total waste/day (in kg)	Proportion of infectious wastes (in %)
A	5	2.24	13.4
B	4	0.83	13.5
C	5	0.56	10.7
D	15	1.11	15.5
E	4	3.85	7.9
F	12	1.25	17.6
G	20	2.66	16.0
H	22	1.95	31.3
I	26	2.04	23.6
J	20	1.60	18.1
Mean	13.3	1.81	16.8
r			0.80
p			0.01

Key: HCF= Healthcare facility.

Table 12: Relationship between bed occupancy rate and proportion of infectious to total wastes in 10 HCFs in Enugu state.

HCF	No of beds	Bed occupancy rate (in %)	Total waste/day (in kg)	% of infectious
A	10	50	2.24	13.4
B	3	0	0.83	13.5
C	8	0	0.56	10.7
D	6	50	1.11	15.5
E	10	10	3.85	7.9
F	20	10	1.25	17.6
G	14	7.1	2.66	16.0
H	14	50	1.95	31.3
I	54	3.7	2.04	23.6
J	40	7.5	1.60	18.1
Mean	18	18.8	18.1	16.8
r				0.34
p				0.34

Key: HCF= Healthcare facility.

Table 10 shows the quantities of total waste generated per bed per day in the ten HCFs. The table shows that while the quantities of total waste generated daily in the ten facilities vary from 0.56 kg to 3.85 kg, with a mean of 1.81 kg, the amounts of total wastes generated per bed per day vary from 0.04 kg/bed/day to 0.39 kg/bed/day, with a mean of 0.16 kg/bed/day.

Table 11 shows the relationship between the average number of patients seen at each of the 10 HCFs and proportion of infectious wastes to total wastes generated. From the table it is seen that while the average number of patients seen in the HCFs varies from 4 to 26, with a mean of 13.3; the proportion of infectious to total wastes generated varies from 7.9% to 31.3%, with a mean of 16.8%. Pearson product moment correlation coefficient for the relationship between the average number of patients seen daily in the HCFs and the proportion of infectious wastes generated is positive, strong (r=0.80) and significant (p=0.01).

Table 12 shows the relationship between bed occupancy rate and proportion of infectious to total wastes generated in the 10 HCFs. As shown in the table, the bed occupancy rates vary from 0% to 50%, with a mean of 18.8%, whereas the proportion of infectious to total wastes varies from 7.9% to 31.3% with a mean of 16.8%. Pearson product moment correlation coefficient for the relationship between bed occupancy rate and the proportion of infectious waste generated in the 10 HCFs is positive, weak (r=0.34), and insignificant (p=0.34).

DISCUSSION

Healthcare waste management is the classification, collection, storage, transportation, treatment, and disposal of waste, including the supervision of such operations

and aftercare of disposal to ensure it does not cause harm/injury to persons.[30] Good HCWM in a hospital depends on a dedicated waste management team, good administration, careful planning, sound organisation, underpinning legislation, adequate financing, and full participation by trained staff.[31] In the present study, the overall the administrative aspect of waste management system was poor in the ten HCFs (40.6%), according to the grading system.[29] 70% of the HCFs had satisfactory waste segregation, 81% good waste treatment (including proper treatment of infectious wastes), and 90% had sharps properly collected in sharps containers. None of the HCFs had budget allocation for HCWM, 90% had inadequate storage facilities, and 73.3% inadequate transportation methods for waste. The overall poor waste management system in the ten HCFs probably resulted from non-existence of written policies on HCWM, absence of budget allocation for HCWM, lack of staff training on HCWM, inadequate storage and transportation systems, among others. These findings are in tandem with what had been earlier reported by past studies, indicating that about 18-64% of the 22 countries surveyed by WHO did not have satisfactory HCWM facilities, resulting from lack of awareness, insufficient resources, and poor disposal mechanisms.[8]

In the ten HCFs, the average quantity of wastes generated per day was 1.81 kg, while the mean proportion of infectious to total wastes generated was 16.8%. There was no significant difference between the PHCs and DHs in the generation of wastes (p=0.07) and the proportion of infectious to total wastes (p=0.25). The proportion of infectious wastes to total wastes, as found in this study, is comparable to what had been reported for the USA (15%) and India (15-35%), but considerably lower than what was reported for Iran (29.89%) and Nigeria (21.3%) by.[12-14] The study found the quantity of waste per patient per day to be 0.23 kg/patient/day, while the quantity of waste per bed was 0.16 kg/bed/day. Again, these findings are considerably lower than those reported by a similar study in Nigeria.[10] However, the mean quantity of wastes generated per person per day is comparable to what was reported by.[32] Reports of the amounts of HCW generated by different HCFs vary from one place to another, even for studies conducted within the same locality. Among the factors that determine the amount of HCW generated by a HCF, are the type of HCF, number of inpatients seen per day, number of hospital beds, proportion of patients seen on a daily basis, resources, available waste segregation options, seasonal variations and the income level of the country.[5,19] These factors could therefore explain the reported variations in HCW generation across the globe, and even within the same country, hence the disparity between the figures reported for Nigeria and the one revealed by the present study.

At 16.8% proportion of infectious to total wastes, the correlation between the average number of patients seen per day in the HCFs and the proportion of infectious to total wastes generated in the facilities was positive, strong and significant ((r=0.80, p=0.01). While the number of patients seen at the HCFs correlated strongly and positively with the proportion of infectious to total waste, the bed occupancy rate had a weak, positive and insignificant correlation (r=0.34, p=0.34) with the proportion of infectious waste to the total waste stream.

The most important step in the minimization of HCWs is appropriate segregation of hazardous-infectious waste from total waste.[33] The present study found that 70% of the ten HCFs properly segregated their wastes, which is a positive step towards minimizing the amounts of wastes that need to be managed. It has been demonstrated that proper management of HCW not only reduces its weight and volume, but also reduces its infectivity and organic content.[20] Although in the management of HCWs, the three R's (reduce, reuse and recycle) cannot be conveniently applied, the first R (reduce or minimize) is actually being employed by the ten facilities, hence 70% of them properly segregated their wastes. As has already been pointed out, this would help to reduce the weight, volume, and infectivity of the wastes.[20] To address the problem of inadequate waste management in the ten HCFs, one area of their weaknesses, which is lack of budgetary provision for HCWM, needs to be tackled, and this if done, would have a multiplier effect in the other aspects of the HCWM process.

CONCLUSION

Although generally, the HCWM system was poor in the ten HCFs (40.6%), 70% of them segregated their wastes, and waste collection was 81% successful in them. However, none of the ten HCFs had budget allocation for HCWM. Transportation methods were poor (73.3%) and 90% did not have good storage areas for wastes. Mean waste generation was 1.81 kg/day, 0.23 kg/patient/day, 0.16 kg/bed/day, and the proportion of infectious to total wastes was 16.8%. Correlation between number of patients seen every day and proportion of infectious to general waste was positive, strong and significant (r=0.80, p=0.01); and between bed occupancy rate and proportion of infectious wastes, was positive too, but weak, and insignificant (r=0.34, p=0.34).

In view of the identified weaknesses of the ten HCFs in HCWM, addressing the problem of budget allocations for HCWM, improving waste storage facilities and transportation, with strengthening of waste segregation, collection, and treatment would help to ensure adequate HCWM in the HCFs.

Limitations of the study

Some of the limitations to the study include that:

- Most of the HCFs had few occupied beds, hence low bed occupancy rates, which probably had affected the quantities of wastes generated daily per facility,

the quantities of waste per patient per day, and the quantities per bed per day.

- It was not possible to capture every waste generated in the HCFs, as some outpatients, because of lack of awareness about HCWM, did not dispose of the wastes at the designated places in the HCFs.

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