SAS Journal of Medicine
Abbreviated Key Title: SAS J Med
ISSN 2454-5112
Journal homepage: https://saspublishers.com

OPEN ACCESS

Medicine

Health Care Waste Assessment in a Secondary Health Care Facility in Anambra State, Nigeria

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DOI: 10.36347/sasjm.2024.v10i01.014 | **Received:** 08.12.2023 | **Accepted:** 12.01.2024 | **Published:** 29.01.2024

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Abstract **Original Research Article**

***Background*:** Proper management of waste generated in healthcare facilities is very important for patient safety, disease containment, and the general safety of healthcare workers in the facilities. It is important that healthcare workers have a good knowledge of healthcare waste management, develops good attitude towards healthcare waste management and practices standard health care waste management protocols as stipulated by the World Health Organization. ***Objectives*:** This study therefore assessed the knowledge, attitude and practice of health care waste management among health care workers in Borromeo Hospital, Anambra State. ***Methods*:** A cross sectional descriptive study was carried out among healthcare workers selected using multistage sampling technique in 6 categories of healthcare workers (doctors, nurses, lab scientists/technicians, pharmacists/technicians, hospital attendants) in Borromeo Hospital, Onitsha, using a pre-tested, semi-structured, interviewer-administered questionnaire. Data collected were analyzed using SPSS version 22 and associations and correlations between dependent and independent variables were tested at the bivariate level using Pearson Chi-square test and t-test as appropriate. The level of statistical significance was set at 5%. ***Results*:** A total of 73 healthcare workers were studied. Most of the respondents were female nurses with 0-5 years of working experience.58.9% of respondents had a very good knowledge of health care waste management and 37% had a relatively good knowledge. Majority of respondents (85%) agreed that HBV immunization prevents hospital transmission while 79.4% disagreed that containment of sharps does not help in safe management of hospital wastes.89% of the respondents adheres strictly to waste management regulations while only 2.7% of the respondents do not wear gloves in handling medical waste. Most of the respondents (83.6%) agreed that the number of patients in the facility was the single main factor affecting the quantity of medical wastes generated. At the bivariate level, the independent predictors of health workers qualifications, years of experience and effective in-service training on waste management were the means through which good knowledge, good practice and factors affecting good knowledge and practice of hospital waste management were assessed. The deficiency in practice level can be linked to the poor economic status of the facility which limits them from adopting WHO standard practices in management of health care wastes. ***Conclusion*:** In conclusion, this study has shown that despite the high level of knowledge of healthcare waste management practice and relatively good attitude towards healthcare waste management exhibited by health workers in Borromeo Hospital, the hospital waste management practice is still suboptimal. Hence, there is a need to reform the healthcare waste management facilities and train the hospital community with regards to healthcare waste management practice to achieve effective and functional results.

Keywords: Healthcare waste, waste management, waste generation, waste disposal, waste segregation, incineration, healthcare workers, healthcare facility.

BACKGROUND

The fear of continuous outbreaks of infectious and communicable diseases in our society has demanded vigilant measures to be outlined and carried out to aid in the prevention and control of diseases, hence adequate management of health care waste is obligatory for efficient delivery of medical services. Health care waste is defined as all types of waste generated in health care establishments, whether it is infectious or non-infectious in nature, chemicals, and hazardous as well as non-hazardous [1]. Most health institutions are sited at the center of cities, showing the great need to ensure that health care wastes are properly managed. The health care workers and the hospital community at large have a huge role to play in carrying out these preventive and control measures since they remain one of the first points of contact of disease outbreaks and they contribute significantly to the generation of the wastes [2].

According to World Health Organization (WHO), Healthcare wastes constitute hazardous and non-hazardous wastes. 10 - 25% of HCW is hazardous [2, 3]. Hazardous waste is grouped as waste that is potentially harmful to those who encounter it, due to its infectious, biological, chemical, and other harmful contents. While non-hazardous wastes are those which are classified as non-risk. In the hospital, the workers make use of a lot of materials that can constitute wastes during the process of patients' disease diagnosis, treatment and care, ranging from sharps, plastics, gloves, bandages, body tissues and lots of others [3]. These above can come from the wards, theatres, laboratories, hallways, hostels and waste dumps nearby to the hospital and can be infected with the patients' body parts, blood, body fluids which can harbor microorganisms and serve as their reservoir for growth and multiplications [4].

Poor health care waste management still poses a challenge in some of our health care facilities. Several concerns are limiting the proper management of health care waste, and this is raising some environmental concerns among stakeholders in the health sector [1-5]. Reasons for failure about health hazards related to health care wastes can be due to the absence of waste management and disposal systems, insufficient financial and human resources and low priorities given to the topic in question. It can also be a result of a lack of formal training and knowledge of the workers on appropriate health care waste management [6, 7].

The World Health Organization estimates that each year there are about 8 to 16 million new cases of Hepatitis B virus, 2.3-4.7 million cases of Hepatitis C and 80,000- 160,000 cases of HIV due to unsafe injections disposal and mostly due to poor healthcare waste management system [8]. Indiscriminate dumping of health care wastes also increases the chances of survival and mutations of the pathogenic microorganisms in the waste, which can then cause disease outbreaks in the hospital and the surrounding community [9].

Overall, health care waste management is a principal component of health care service delivery, which should be carefully evaluated by healthcare service providers. This is to ensure the safety of medical personnel and other health care workers who are directly or indirectly involved in the whole processes of healthcare wastes generation, collection and disposal [9]. There are always protocols for waste disposals in health care facilities, but these protocols are sometimes ignored by the hospital workers thereby compromising the standards for waste management. The gap between these protocols and their implementations needs to be narrowed or risks explosions of cases of medical hazards in health care facilities [10].

The level of health care waste management differs in different hospitals due to a wide range of reasons. The secondary health facility: Borromeo Hospital, is selected for this assessment because of its location inside the city, which makes it prone to the generation of a lot of medical waste. The risk of contact with highly infectious health care waste in hospitals is high, so there's a need for more research to be done on activities of waste management in hospitals to inform the necessary bodies or authorities of any vital findings that can be used to draft policies beneficial to the health sector.

The general objective of this study is to assess the healthcare waste management practices in Borromeo Hospital, Anambra state. However, the specific objectives was to determine the sources, types and disposal sites of wastes generated in Borromeo Hospital, Anambra state**,** to assess the level of knowledge of healthcare waste management among health care workers in Borromeo Hospital, Anambra state**,** to assess the attitude of heastate.re workers in Borromeo Hospital, Anambra state to health waste management, to assess the effectiveness of healthcare waste management practices among healthcare workers in Borromeo Hospital, Anambra state and to assess the factors affecting healthcare waste management practices among healthcare workers in Borromeo Hospital, Anambra state.

METHODOLOGY

Study Area

The research was carried out in a secondary health facility - St. Charles Borromeo Hospital, Onitsha Anambra State. The hospital was built and commissioned by the Catholic Archdiocese of Onitsha in 1964 and was officially opened in 1965 by Archbishop Charles Heerey.

Study Design

The research design was a descriptive cross-sectional type, on assessment of healthcare waste

management practices among health workers in the secondary health facility: Borromeo Hospital, Onitsha, Anambra State.

Study Population

The study population was made up of healthcare workers in St. Charles Borromeo hospital, Onitsha, whose activities are pertained to hospital waste management. These comprised of Doctors, Nurses, Pharmacists, Lab technicians, hospital cleaners and waste handlers who meet the inclusion criteria.

Sample Size

The sample size was calculated using the formula.

$nf = n/1+n/N$[75]

nf is the desired sample size when the population is less than 10,000.

n is the desired sample size when population is greater than 10,000

Where N is the estimate of the population size = 194 (From the Staff Records, Borromeo Hospital, Anambra State.

$(n = Z^2pq/d^2)$[75].

Where n is the minimum sample size.

Z= the standard normal deviate (1.96)

d= the degree of precision (d = 0.05)[75].

In a study titled healthcare waste management: what does the health workers in a Nigerian tertiary hospital know and practice, 93% is the proportion of healthcare workers were able to identify correctly two hazards of healthcare waste.[11]

Therefore, $p = 0.93$

q= the proportion of people without factor under study (q=1-p), which is 1-0.93= 0.07

$n= (1.96)^2(0.93)\ (1-0.93)/\ (0.05)^2$

n= 100

nf= 100/1+100/194

nf= 67

Using the non-response rate of 10%,

The adjusted sample size was 67/1-0.10.

= 67/0.90

= 73 respondents

Sampling Technique: Multi-stage sampling technique was used to enroll respondents into this study.

Inclusion Criteria

All healthcare staff currently working in St. Charles Borromeo hospital Onitsha and have worked for at least 6months in the hospital will be considered for the study.

Exclusion Criteria

This included healthcare workers in St. Charles Borromeo Hospital, Onitsha who do not handle healthcare wastes, those who will be ill, those who are on annual leave, and those who have worked less than 6months in the hospital.

Data Collection Method/ Study Instrument

The data was collected using a standardized and well-structure questionnaire prepared in English and explained in simple terms to the respondents for easy understanding; the respondents were guided through the questions as they filled the questionnaire.

Pretesting: The instruments of data collection for this study were pretested in Nnamdi Azikiwe University Teaching Hospital, Nnewi.

Data Management

The level of knowledge was assessed by the knowledge scores of the different types of wastes, and methods and processes involved in waste management while the attitude was assessed by analyzing a set of common attitudes of health workers towards healthcare waste management. The appropriateness of the healthcare waste management practice was assessed by the appropriate practice scores.

The questions to assess the knowledge of health workers on healthcare waste management were scored using the five-point Likert scale with the options of 'Strongly Agree', 'Agree', Undecided, 'Disagree', 'Strongly', 'Disagree'. In this Likert scale, values ranging from 0-1 were given at a specified interval of 0.25 with '1' given for 'Strongly Agree' and '0' for 'Strongly Disagree'. Scores 0 – 4 out of 12 was considered as poor knowledge, scores between 4 – 8 represented average knowledge while scores greater than 8 represented a good knowledge of healthcare waste management. For healthcare workers' attitude towards healthcare waste management, participants were required to tick 'Strongly Agree', 'Agree', Undecided, 'Disagree', 'Strongly', 'Disagree'. 6 statements about attitudes towards healthcare waste management. Scores 0 – 2 were considered bad, 3 – 4 was considered good while scores of 5 –6 were considered very good.

To determine the appropriateness of the practice of healthcare waste management by health workers, participants ticked 'Yes' or 'No' for 9 statements regarding health workers waste management practice. Each correct answer was awarded 1 and each wrong answer awarded 0. Participants with scores of 0 – 3 were considered to have bad practice. Scores between 4 and 6 were considered as good while scores of 7 – 9 were considered as very good.

Statistical Analysis

Descriptive and inferential statistics were applied where necessary. Numerical variables were reported as means and standard deviations while categorical data was reported using proportion and percentages. The association between outcome and independent variables were analyzed using the Chi-square test (or Fischer's exact, when appropriate). Level of statistical significance was set at $p \leq 0.05$ for all

inferential statistics and standard deviations. The results were presented in Tables and Charts.

RESULT

A total of 73 questionnaires were administered to healthcare workers as focal points (healthcare waste management informants) at Borromeo Hospital, Onitsha, Anambra State, Nigeria. The same 73 questionnaires were retrieved giving a response rate of 100%.

Table 1: Socio Demographic Characteristics of the Respondents

VARIABLE	FREQUENCY	PERCENTAGE
GENDER		
Female	50	68.5
Male	23	31.5
Total	73	100.0
AGE		
21 – 29	27	37.0
30 – 37	29	39.7
38 – 46	12	16.4
47 – 54	3	4.1
55+	2	2.7
Total	73	100.0
OCCUPATION		
Doctor	17	23.3
Hospital Attendant/Assistant	11	15.1
Laboratory Scientist/technician	8	11.0
Nurse/midwives	24	32.9
Pharmacist	13	17.8
Total	73	100.0
QUALIFICATION		
BMLS	2	2.7
BSc	8	11.0
HND	5	6.8
Laboratory Technician	1	1.4
MBBS	17	23.3
OND	7	9.6
PHD	1	1.4
RM	1	1.4
RN	14	19.2
RN, RM	5	6.8
WAEC	12	16.4
EMPLOYMENT STATUS		
Full-time	55	75.3
Part-time	18	24.7
Total	73	100.0
YEARS OF EXPERIENCE		
0-5years	54	74.0
10-15years	4	5.5
15+ years	5	6.8
5-10years	10	13.7
Total	73	100.0
RANK		
NA	33	45.2
Chief Nursing Officer	1	1.4
Consultant	1	1.4
HOD	2	2.7
House Officer	2	2.7
Junior Nurse	1	1.4
Junior Officer	1	1.4

VARIABLE	FREQUENCY	PERCENTAGE
Medical Officer	9	12.3
Nursing officer	18	24.7
Total	73	100.0
ANY IN-SERVICE TRAINING		
No	33	45.2
Yes	40	54.8
Total	73	100.0

Table 2 summarizes the socio-demographic characteristics of the respondents. The mean Age of the respondents was 31. Greater part of the respondents were female and Nurses. 75% of the respondents have 0-5years of experience and only 24.7% of them are part time workers.

Table 2: Respondents to Knowledge of HWM

VARIABLE	RESPONSE					Mean likert	Decision
	SA (5)	A (4)	U (3)	D (2)	SD (1)		
There are different types of waste generated by health care(N=73)	54(74.0)	19(26.0)	0	0	0	4.74	Agree
Waste management is one of the core standards of health care (N=73)	49(67.1)	23(31.5)	1((1.4)	0	0	4.66	Agree
Any discarded biological products such as tissues and blood from clinics, wards and laboratories are not regarded as medical waste	4(5.5)	2(2.7)	3(4.1)	30(41.1)	34(46.6)	1.79	Disagree
Less than 50% of waste generated by health care institutions is medical waste	10(13.7)	19(26.0)	0	23(31.5)	0	2.36	Disagree
Color-coded bins is not part of waste management strategy to separate wastes	3(4.1)	8(11.0)	8(11.0)	28(38.4)	26(35.6)	2.10	Disagree
Equipment for proper waste management are not enough to address waste management practices	13(17.8)	33(45.2)	10(13.7)	11(15.1)	6(8.2)	3.49	Agree
To achieve good standards of patient care, waste management does not need to be addressed	6(8.2)	1(1.4)	3(4.1)	21(28.8)	42(57.5)	1.74	Disagree
Handling waste poses a risk to human health	43(58.9)	19(26.0)	1(1.4)	8(11.0)	2(2.7)	4.27	Agree
Poor handling and disposal of waste poses threat to environmental health and cause ecosystem imbalance	48(65.8)	22(30.1)	2(2.7)	0	1(1.4)	4.59	Agree

Table 3: Respondents' Knowledge of HWM Continued

VARIABLE	FREQUENCY	PERCENTAGE
What is the best container for waste collection(n=73)		
Plastic Bin	53	72.6
Bags	12	16.4
Cardboard boxes	3	4.1
Trolley/wheelbarrows	5	6.8
What is the best waste disposal method		
Sanitary landfill	6	8.2
Incineration	58	79.5
Buried on hospital ground	1	1.4
Open burning	8	11.0
Can you describe any of the biohazard symbols?		
No	10	13.7
Yes	63	86.3
Total	73	100.0

Table 2 & 3 are the results of the knowledge of healthcare waste management in the hospital among the respondents.

Table 4: Respondents' Knowledge of Healthcare Waste Management Summary

KNOWLEDGE SCORE	FREQUENCY	PERCENTAGE
BAD KNOWLEDGE (0 – 49%)	3	4.1
GOOD KNOWLEDGE (50 -69%)	27	37.0
VERY GOOD KNOWLEDGE (70 – 100%)	43	58.9
TOTAL	73	100.0

Table 4 summarizes the knowledge of respondent's knowledge of healthcare waste management.37% of the healthcare workers had good knowledge while 58.9% had very good knowledge.

Attitude of Healthcare Workers toward Healthcare Waste Management

Table 5: Respondents Attitude toward Healthcare Waste Management

VARIABLE	SA (5)	A (4)	U (3)	D (2)	SD (1)	Mean Likert	Decision
Segregation of waste at source increase the risk of injury to waste handlers	9(12.3)	13(17.8)	4(5.5)	23(31.5)	24(32.9)	2.45	Disagree
Containment of sharps does not help in safe management of hospital waste	8(11.0)	5(6.8)	2(2.7)	26(35.6)	32(43.8)	2.05	Disagree
Occupational safety of waste handlers is a must	55(75.3)	13(17.8)	5(6.8)	0	0	4.68	Agree
Use of color code for segregation of waste is a must	34(46.6)	23(31.5)	11(15.1)	4(5.5)	1(1.4)	4.16	Agree
Hepatitis B immunization prevent transmission of hospital acquired HBV infection	41(56.2)	21(28.8)	7(9.6)	4(5.5)	0	4.36	Agree
Post exposure prophylaxis should be initiated as soon as possible	51(69.8)	20(27.4)	2(2.7)	0	0	4.67	Agree

Table 5 summarizes the attitude of respondents towards hospital waste management. A large proportion of the respondents had a good attitude towards healthcare waste management.79.4% disagreed that containment of sharps does not help in safe management of hospital waste. 93.1% believed that occupational safety of waste handlers is a must. Only 85% agreed while HepB immunization is important to prevent hospital acquired HBV infection.

Healthcare Waste Management Practice

Table 6: Respondent's Practice of Healthcare Waste Management

VARIABLE	FREQUENCY	PERCENTAGE
Do you segregate waste at the point of generation of the waste?		
No	6	8.2
Yes	67	91.8
Total	73	100.0
Is medical waste treated on site of generation in your health center?		
No	50	68.5
Yes	23	31.5
Total	73	100.0
If yes, what kind of medical waste treatment system do you use? N= 23		
autoclaving	1	4.35
chemical	3	13.04
incineration	19	82.61
Is waste transported out of your health center?		
No	6	8.2
Yes	67	91.8
What is used to transport the waste		
Not aware	8	
Truck	55	75.4
Plastic Bin	2	2.7
Wheelbarrow	6	8.3
Truck/Wheelbarrow	2	2.7
Total	73	100.0
Are sharps and vial containers sealed when ¾th full in your health centre?		
No	23	31.5

VARIABLE	FREQUENCY	PERCENTAGE
Yes	50	68.5
Total	73	100.0
Do you wear gloves when handling medical waste?		
No	2	2.7
Yes	70	97.3
Total	73	100.0
Are there any medical waste regulations or code of conduct in your health center		
No	4	5.5
Yes	69	94.5
Total	73	100.0
If yes, do you strictly adhere to the regulations?		
No	8	11.0
Yes	65	89.0
Total	73	100.0

Table 6 highlights the practice of hospital waste management among respondents. Majority of the respondents (97.3%) wear gloves when handling hospital waste. Most of the respondents (91.8.3%) accepted that they segregate waste at the point of generation. Only (11%) do not adhere strictly to the hospital's regulations on waste management.

Table 7: Summary of the Practice Scores

PRACTICE SCORE	FREQUENCY	PERCENTAGE
POOR PRACTICE (0 – 49%)	2	2.7
FAIR PRACTICE (50 -69%)	5	6.8
GOOD PRACTICE (70 – 100%)	66	90.4
TOTAL	73	100.0

Table 7 summarizes the appropriateness of respondents practice of healthcare waste management. 90.4% of the healthcare workers had good knowledge while 6.8% had fair practice.

Factors Affecting Healthcare Waste Management

Table 8: Respondents' Factors Affecting Healthcare Waste Management

VARIABLE	FREQUENCY	PERCENTAGE
What in your own opinion affects the quantity of wastes in your facility?		
Number of patients	61	83.6
Type of patients (adults/children/pregnant women)	12	16.4
Total	73	100.0
Tick cultural belief that likely affects the disposal of human parts or tissues in your facility		
NR	3	4.1
Re incarnation	12	16.4
Religious use	27	37.0
Ritual use	31	42.5
Total	73	100.0
How are human parts disposed of?		
Burning	2	2.7
Burying	47	64.4
Patients dispose on their own along with other wastes	24	32.9
Total	73	100.0
Does your hospital have a waste management team?		
NR	1	1.4
No	2	2.7
Yes	70	95.9
Total	73	100.0

Table 8 summarizes the factors affecting hospital waste management practice in Borromeo Hospital, Onitsha, Anambra state. Most of the respondents (83.6%) had the opinion that the number of patients admitted in the facility affects the quantity of hospital waste. The cultural belief that likely affects waste handling was ritual use (42.5%), religious use (37%) and reincarnation (16.4%). Burying was the main method of disposal of human parts as stated by most of the respondents (64.4%). 95.9% of respondents agreed that the healthcare facility has a team for hospital waste management.

Table 9: Chi Square Test of Association between Knowledge of Waste Disposal and Qualification

QUALIFICATION	LEVEL OF KNOWLEDGE			TOTAL	X2 VALUE	P-Value
	BAD KNOW.	GOOD KNOW.	VERY GOOD			
BMLS	0	1	1	2	20.908[a]	0.403
BSc	1	2	5	8		
HND	0	5	0	5		
MBBS	1	4	12	17		
OND	0	4	4	8		
PHD	0	0	1	1		
RM	0	0	1	1		
RN	0	3	11	14		
RN, RM	0	1	3	4		
RN, RM	0	0	1	1		
WAEC	1	7	4	12		
Total	3	27	43	73		

Statistically significant (p≤0.05), χ^2=Pearson Chi square.

Table 9 summarizes the association between qualification of respondents and knowledge of healthcare waste management. There was no statistically significant difference between in-service training and other level of knowledge (p>0.05).

Table 10: Chi Square Test of Association between Knowledge of Waste Disposal and Years of Experience

YEARS OF EXPERIENCE	LEVEL OF KNOWLEDGE			TOTAL	X2 VALUE	P-Value
	BAD KNOWLEDGE	GOOD KNOWLEDG	VERY GOOD			
0-5years	2	22	30	54	10.084[a]	0.121
10-15years	0	3	1	4		
15+ years	1	0	4	5		
5-10years	0	2	8	10		
Total	3	27	43	73		

Statistically significant (p≤0.05), χ^2=Pearson Chi square.

Table 10 summarizes the association between knowledge of healthcare waste management and the years of experience of the respondents. There was no statistically significant difference between knowledge of waste disposal and years of experience.

Table 11: Chi Square Test of Association between Knowledge of Waste Disposal and In Training on Waste Management

IN TRAINING	LEVEL OF KNOWLEDGE			TOTAL	X2 VALUE	P-Value
	BAD KNOW.	GOOD KNOW.	VERY GOOD			
No	1	14	18	33	0.846[a]	0.655
Yes	2	13	25	40		
Total	3	27	43	73		

Statistically significant (p≤0.05), χ^2=Pearson Chi square.

There was a non-significant association between knowledge of waste disposal and training of waste management.

Table 12: Chi Square Test of Association between Practice and Some Factors

VARIABLE	LEVEL OF PRACTICE			TOTAL	X^2	p-value
	POOR	FAIR	GOOD			
Sex						
Female	1	3	46	50	.528[a]	0.768
Male	1	2	20	23		
Total	2	5	66	73		
Edu Qualification						
BMLS	0	2	2	2	24.300[a]	0.230
BSc	0	8	8	8		
HND	0	5	5	5		
MBBS	2	17	13	17		
OND	0	8	7	8		
PHD	0	1	0	1		
RM	0	1	1	1		
RN	0	14	14	14		
RN, RM	0	4	4	4		
RN, RM	0	1	1	1		
WAEC	0	12	11	12		
TOTAL	2	73	66	73		
Employment status						
Full-time	2	4	49	55	0.756[a]	0.685
Part-time	0	1	17	18		
TOTAL	2	5	66	73		
Years of Experience						
0-5years	1	2	51	54	16.807	0.010*
10-15years	0	2	2	4		
15+ years	0	1	4	5		
5-10years	1	0	9	10		
TOTAL	2	5	66	73		
RANK						
Not specified	0	2	31	33	48.931[a]	0.01*
Chief Nursing Officer	0	0	1	1		
Consultant	1	0	0	1		
HOD	0	1	1	2		
House Officer	0	0	2	2		
Junior Nurse	0	0	1	1		
Junior Officer	0	0	1	1		
Medical Officer	1	1	7	9		
nursing officer	0	0	3	3		
Nursing officer	0	0	4	4		
Nursing Officer	0	0	11	11		
Registrar	0	1	4	5		
TOTAL	2	5	66	73		
Any training						
No	0	3	30	33	2.093[a]	0.351
Yes	2	2	36	40		
TOTAL	2	5	66	73		

There is a statically significant difference between years of experience, ranks of HCWs and HWM practice ($p<0.05$)

There is no statistical significance difference between sex, educational qualification, employment status, in service training and level of HWM practice.

DISCUSSION

This study therefore assessed the knowledge, attitude and practice of health care waste management among health care workers in Borromeo Hospital, Anambra State.

Results of this study observed that 58.9% of respondents had a very good knowledge of health care waste management and 37% had a relatively good knowledge while 4.1% had little or no knowledge of health care waste management. This finding agrees with

the observations of Wafula *et al.,* which had (71.5%) of health care workers working in primary health care facilities in Kampala, Uganda responding with good knowledge of health care waste management [12], and another study carried out in a tertiary health facility in Nigeria, NAUTH Nnewi which showed 99% of the respondents having good knowledge of health care waste management. However, different other research studies argue weakly against the result of this research. A study conducted by Abah *et al.,* reported a poor (46%) knowledge of health care waste management in a tertiary facility in Nigeria [13]. Another study carried out by Onoh *et al.,* in South-Eastern Nigeria, reported a 41.5% knowledge of health care waste management among health care workers which is poor [2]. The disparities amongst studies could be attributed to the different organizational settings of the health facilities, the career advancement levels of the respondents, exposure level and training of the health care workers and length of service of the health workers.

Health care waste segregation at source is very vital for proper disposal and poses no risk to the health care worker or waste handler handling the waste at the time. In this study, 64.4% of the respondents agreed with immediate health waste segregation for easy handling and disposal to improve infection control. Sharps used in hospital settings are potentially harmful and infectious and need to be immediately contained as a good safety practice. This study queried the importance of containing sharps and 79.4% of the respondents agreed that containment of sharps helps in safe management of health care waste. Querying further the health care workers attitude towards health care waste management, the study sought to get their response on the importance of occupational safety for waste handlers with 93.1% of the respondents agreeing that occupational safety must be prioritized for health care waste handlers while 78.1% of the respondents agreed that color codes must be used to segregate health care wastes. Noteworthy is the attitude of 85% of health care workers in Borromeo hospital towards Hepatitis B virus prevention who agreed that immunization prevents transmission and offers protection in cases of injury with infected sharp tools while an interesting 97.2% of respondents agreed on initiation of post exposure prophylaxis immediately after contact.

The positive attitude of health care workers towards health care waste management observed generally in this research study is collaborated by the studies carried out by Onoh *et al*., in Southeastern Nigeria [2], and Deres *et al*., in North Ethiopia. The study carried out by Deress *et al*., showed that 66.2% of the study participants had a favorable attitude to health care waste management [12]. Other research studies which has shown health care workers having a favorable attitude towards health care waste management includes Dalu *et al*., (74.1%) [13]. Akkajit *et al*., (>85%) [14], and Jalal *et al*., (73.1%) [15]. This positive similarities maybe be attributed to the fact healthcare workers have the innate mental to protect themselves and their patients against harm.

Knowledge, attitude and practice of concepts like health care waste management tend to show variable results in studies conducted for a particular community. It is no surprise that a study group with good ratings on knowledge could perform lowly in attitude and practice. It is also obtainable that a study group with good knowledge could perform well in attitude ratings but abysmally in practice. These variations between level of knowledge and practice are caused by many factors within and outside the study group environments. The findings of this research study demonstrated that the health care workers exhibited a very impressionable level of practice of health care waste management. Statistically, the study respondents showed 91.8% health care waste segregation at the point of generation, 91.8% out-of-facility waste transportation, 68.5% seal sharps and vial containers when ¾th full, 97.3% wear gloves when handling medical waste and 89% adhere strictly to the medical waste regulations instituted in 94.5% of respondent's health facilities. The study however, showed a poor 31.5% treatment of medical waste at the site of generation with 82.61% adopting incineration as their current system of use. Good practice of health care waste management is also observed in the studies carried out by Parrida *et al*., which showed 68% good practice level [16], Onoh *et al*., 53.9%[2] and Nwankwo *et al*., which reported a 90% good practice level. The research studies of Rasheed *et al*., in Pakistan which reported a 62.5% use of incinerator [16], and Debere *et al*., in Ethiopian hospitals [17], both agrees with the findings of this study which showed an 82.62% use of incinerator for waste management. It is convenient to say then that incineration is one of the commonest means of waste management in facilities with a good practice of health care waste management. There are, however, many research studies which disagree with the results of this study. A tertiary health facility study conducted by Abah *et al*., in Nigeria reported a 0% practice of health care waste management [18], while Wassie *et al*., reported that health facilities in Addis Abbaba had a generally poor practice of health care waste management [19]. The World Health Organization frowns deeply at the use of incinerators for health care waste disposal as it has been reported that the method pose great environmental and health risks. WHO reports that very toxic pollutants and harmful pathogens are released into the environment when health care wastes are disposed of by incineration.

There are many factors that either promote or constrain good knowledge, attitude and practice of health care waste management. Some of these factors as sampled in this study includes the quantity of waste generated in a facility, cultural or religious beliefs of health care workers and patients as well as presence of a health care waste regulatory mechanism in a health facility. The study respondents affirmed that the quantity

of waste generated in the facility depends majorly on the number of patients rather than on the type of patients received. Among the cultural and/or religious belief that affects the disposal of waste, ritual uses had 42.5%, followed closely by religious inclinations at 37% and then reincarnation at 16.4%. This finding remains unsurprising because of the known knowledge on the beliefs of the people of Southeastern Nigeria about superstitions, culture and religion. This strong belief in culture and tradition was also translated to the way human parts are being disposed. An interesting 64.4% of respondents agreed that human parts are buried properly as a means of disposal while 32.9% recanted that patient and/or patients' relatives take home with them human parts along with other waste for disposal. This finding could be different had the study been conducted in a setting with less inclinations to culture and tradition. The study also was able to establish that Borromeo hospital has a waste management team. There is a paucity of knowledge on the effects of culture, religion and tradition on health care waste disposal. Studies carried out over time have not been able to interrogate the influence of superstitious beliefs on health care waste disposal.

Educational qualification and professional training of the different cadres of health workers is also a good marker for determination of knowledge, attitude and practice of health care waste management. Health workers in health facilities generate different kinds of health care waste and the management of these wastes is also different. A medical laboratory scientist generates a different kind of waste in the laboratory which also requires peculiar management protocol from that generated by a physician or a nurse. In a study conducted by Adogu *et al*., [20], health attendants had the lowest level of knowledge which could be attributed to their level of training but the findings was disputed by a cohort study conducted in Morocco which showed that health attendants had higher level of waste separation knowledge than nurses and doctors [20]. It was however observed in his study that there was no statistically significant difference between in-service training and other level of knowledge ($p>0.05$) hence educational qualification or training played no major role in the knowledge of health care waste management of respondents. Also, there was no significant association between knowledge of waste disposal and training on waste management in this study. This however contrasts with findings of Elnour *et al*., which attributed improved knowledge, attitude and practice of health care waste management to the trainings received by health workers at the White Nile State main hospitals in Sudan. Elnour *et al*., reported an improved level of practice after an educational intervention program in the facilities [21]. Interesting of note in this study is the no statistically significant difference between knowledge of waste disposal and years of experience. Muthoni *et al*., argues that the years of work/service experience positively improves the knowledge, attitude and practice of health care waste management because of continuous in-service training, exposure and adherence to health waste regulations of the facility and the region of operation [22].

This study has the following limitations. Since the assessment of the hospital waste management practices was self-reported, there is a possibility that the information will be biased as respondents (healthcare workers) may try to give their hospital a face-lift by giving desirable responses. This challenge will however be overcome by assuring them of the confidentiality of the research and that the aim of the study is to improve the appropriateness of hospital waste management practices and not necessarily for fault finding.

CONCLUSION

Health care waste management is becoming a priority issue because of the perceived dangers health care waste poses. Health care workers in Borromeo hospital exhibited a good knowledge and attitude of health care waste management. There is a need for improvements in the practice of health care waste management in the facility. This deficiency in practice level can be linked to the poor economic status of the facility which limits them from adopting WHO standard practices in management of health care wastes. Incineration, though not a standard practice, is the method of choice for health waste treatment which unfortunately is not done at the site of generation. Culture, traditional and religious beliefs contribute greatly to the methods of human health care waste disposal in the facility among both health workers and patients. There is a health waste management team in the facility and this health waste management team regulates the treatment and disposal of health care waste but does not conduct regular in-service training for health workers in the facility. Regular training of health workers on health care waste management by the hospital management to ensure they adhere to standard global protocols of health care waste management.

Competing Interests: The authors declare that they have no competing interests.

Financial Support/ Sponsorship: The authors declared that this study has received no financial support.

Ethical Considerations

This research work was done with approval from the Nnamdi Azikiwe University Teaching Hospital Health Research Ethics Committee (NAUTHHREC) through the Head of Department of Community Medicine, Nnamdi Azikiwe University. Permission was sought from the head of the facility after the Ethical approval form gotten from NAUTHHREC was presented to the management. Participants were well oriented on the objectives of the study; verbal consent was sought prior to administration of the questionnaire which emphasized the right to non-participation. Data

confidentialities were preserved according to the Helsinki declaration of bioethics.

Funding: The authors received no specific funding for this work.

Authors' Contributions

This work was carried out in collaboration among all authors. All the authors were involved in the writing of this manuscript and overall revision. The authors read, approved the final manuscript and agreed to be accountable for all aspects of the work.

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