

MEDICAL WASTE MANAGEMENT IN TERTIARY HEALTH FACILITIES IN SOUTHERN NIGERIA: AN ASSESSMENT OF ATTITUDE AND PRACTICE OF HEALTH WORKERS

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ABSTRACT

Aim: To assess the attitude and practice of medical waste management among health workers in tertiary health institutions in Benin City, Edo State.

Methodology: This was a descriptive cross-sectional study amongst health workers in tertiary health facilities in Benin City who were selected using stratified sampling technique. Pre-tested interviewer administered questionnaires were used for data collection and data was analyzed using the IBM SPSS 21.0.

Results: A total of 280 health workers participated in the study. Over three quarters of the respondents 241 (86.1%) had a positive attitude towards medical waste management (MWM) and majority 267 (95.4%) had good practice of medical waste management. Determinants of attitude and practice were occupation of respondents ($p = 0.035$) and attitude of respondents ($p = 0.004$), respectively.

Conclusion: Majority of the respondents had positive attitude and good practices of medical waste management. It is recommended that healthcare workers comply with the established rules regarding proper medical waste management.

Key words: Medical Waste, Attitude, Practice.

INTRODUCTION

Medical waste includes all wastes produced in healthcare or diagnostic activities.¹ The World Health Organization (WHO) classifies medical waste into infectious waste, pathological waste, sharps, chemicals, pharmaceuticals, genotoxic waste, radioactive waste and heavy metals waste.² The waste produced in the course of

healthcare activities carries a higher potential for infection and injury than any other type of waste.² Protecting public health through the management of wastes can be achieved by a variety of methods which can be summarized in an order of preference called the 'waste hierarchy' as follows: prevent, reduce, reuse, recycle, recover, treat and dispose.² Effective Medical Waste Management (MWM) is a stepwise process beginning with the generation of the waste, to the segregation and storage, then to the collection, treatment and final disposal of the waste.²

The correct segregation of health-care waste should be done at the point of generation and involves the use of separate colour coded and labeled containers for each segregated waste

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fraction as follows.^{2,3} Highly infectious waste: yellow, strong, leak-proof container marked “highly infectious” with biohazard symbol.² Other infectious waste, pathological and anatomical waste: yellow leak-proof container with biohazard symbol.² Sharps: yellow puncture-proof container, marked “sharps” with biohazard symbol. Chemical and pharmaceutical waste: brown container, labelled with appropriate hazard symbol; Radioactive waste: lead box labelled with radiation symbol; General healthcare waste: black plastic bags.²

Improper MWM poses a serious health risk to the health care workers, patients, waste handlers, and to the community at large and also causes environmental pollution.^{2, 4} The health hazards depend on the duration of exposure and the dose of toxic components that enter the body from the waste.⁵ The purpose of protective measures is to reduce the risks of exposure and the consequences.¹ Standard precautions must be taken by health care workers to reduce the risk of disease transmission.⁶

Globally, it is estimated that more than two million health care workers, including doctors and nurses are exposed to percutaneous injuries with infected sharps every year.² However, not only health care workers are at risk as the highest rates of occupational injury among all workers exposed to healthcare waste are reported by cleaning personnel and waste handlers. In the USA, the annual rate is 180 per 1000 workers.² In Ethiopia, Hepatitis B infection was 47.6% among waste handlers.⁷ The problem of medical waste management is of particular importance in developing countries, where the amount of waste being generated is rising rapidly as health-care services in those countries are expanded.⁸ A WHO assessment conducted in 2011 in 22 developing countries including Nigeria, showed that the proportion of healthcare facilities that do not properly dispose of medical waste ranged from 18.0% to 64.0%, with Nigeria having a proportion of 51.0%.⁹ Medical waste was often mixed with municipal waste and improperly disposed of. Improper disposal methods practiced included open dumping, burning and incineration not correctly practiced.⁹

Open dumping of medical waste is especially problematic. Where waste is dumped into areas without restricted access, scavengers may come into contact with contaminated waste⁹. Scavenging at medical waste disposal sites is associated with significant risk of injuries and infections.⁹ A person who experiences one needle stick injury from a needle used on an infected patient has risks of 30%, 1.8%, and 0.3%, respectively of becoming infected with HBV, HCV and HIV⁹. In Nigeria, more than 90% of the medical waste generated is disposed of in an unsanitary manner.¹⁰ There is a lack of adequate resources to effectively manage medical waste and also no specific agency or law regulating MWM.¹⁰

Proper MWM has obvious human and environmental health benefits, as well as significant economic advantages to health institutions. However, proper MWM can only be achieved if there is adequate knowledge, attitude and practice of MWM amongst health workers. This study will therefore assess the attitude, practice and risk perception of MWM amongst health workers in tertiary health institutions in Benin City, Edo state.

MATERIALS AND METHODS

The study utilized a cross-sectional descriptive study design and the study population comprised health workers in tertiary health institutions in the metropolitan city of Benin, the capital of Edo State, Nigeria. The city hosts an airport, many public and private institutions including government parastatals, educational institutions, industries, banks, markets, hotels and restaurants. There are three tertiary, 158 secondary and 268 primary health facilities of which 26 are public and 403 are privately owned in Benin City. Study population comprised health care workers in tertiary facilities. A minimum sample size of 275 using the formula for single proportion was obtained.¹¹ Multi-stage sampling technique comprising 2 stages was used to select respondents. Stage 1 comprised selection of tertiary facilities. Two of the 3 tertiary facilities in Benin-City were selected using simple random sampling by balloting. In stage 2, stratified

sampling technique was used to determine the number of respondents to be selected from each stratum. The cadre of the health workers formed the basis of each strata. Using the list of the health workers as the sampling frame, systemic sampling technique was used to select the required number of respondents using an appropriate sampling interval.

Data was collected using a pre-tested structured self-administered questionnaire comprising both open and closed ended questions and consisting of 4 sections. Section A sought information on the socio-demographic characteristics of the respondents, section B sought information on respondents' knowledge of medical waste management, section C consisted of questions that assessed respondents' attitude towards medical waste management and section D sought information on respondents' practice of effective MWM. Ethical Clearance was obtained from the University of Benin Ethics and Research Committee. Approval to conduct the study was obtained from the management of both tertiary institutions. The study was described to the health workers and informed consent was obtained from respondents. In order to ensure anonymity, serial numbers rather than names were used to identify the respondents. Respondents were informed that they had the right to decline participation or to withdraw from the study at any time they wished. They were also informed that there were no penalties or loss of benefits for refusal to participate in the study or withdrawal from it.

The questionnaires were screened for completeness by the researcher after which they were coded, entered into the IBM SPSS version 21.0 software and analysed. Attitude towards medical waste management was assessed using a total of 9 questions on a 3- point Likert scale. The most positive response to a question was given a score of 2 while the most negative response to a question a score of 0, giving a total minimum score of 0 and maximum score of 18. The total attitude score for each respondent was converted to percentages. Scores below 50.0% were categorized as negative attitude and scores that were 50.0% and above were categorized as

positive attitude. Cronbach's Alpha was used to assess the internal consistency and reliability of the attitude questions. A score of 0.762 was gotten, indicating good reliability.

A total of 7 questions were used to assess the practice of medical waste management. A score of 1 was given for correct answers and 0 for wrong answers giving a maximum score of 7 and a minimum score of 0. Scores were converted into percentages. Scores below 50.0% were categorized as poor practice and scores of 50.0% and above were categorized as good practice. Cronbach's Alpha was also used to assess the internal consistency and reliability of the practice questions. A score of 0.832 was gotten, indicating good reliability.

Test of associations were carried out using Chi-squared tests or the Fishers' Exact test where appropriate. Multivariate analysis using binary logistic regression was carried out using the 'enter approach' to further determine significant predictors of attitude and practice of MWM and control for confounders. The statistical measure for the analysis was the adjusted odds ratio and 95% confidence interval.

The level of significance was set at $p < 0.05$ for all statistical associations. Frequency tables were used to present the results.

RESULTS

A total of 280 respondents participated in the study. The mean age was 35.50 ± 7.83 years with a higher proportion of respondents 127 (45.4%) seen in the 30 - 39 years age group. Two hundred and twenty three respondents (79.6%) were females. The majority 265 (94.6%) of the respondents were Christians. All the respondents 280 (100.0%) had tertiary level of education and a higher proportion of the respondents 216 (77.1%) were Nurses. (Table 1)

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TABLE 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Variables	Frequency(n=280)	Percent
Age group(Years)		
20-29	66	23.6
30-39	127	45.4
40-49	72	25.6
≥50	15	5.4
Sex		
Male	57	20.4
Female	223	79.6
Marital Status		
Single	82	29.3
Married	195	69.6
Separated	2	0.7
Cohabiting	1	0.4
Religion		
Christianity	265	94.6
Islam	14	5.0
ATR*	1	0.4
Occupation		
Doctor	64	22.9
Nurse	216	77.1

Mean age (SD) = 35.50±7.83 years

ATR* = African Traditional Religion

Majority of the respondents, 276 (98.6%), 273 (97.5%) and 249 (88.9%) felt that medical waste management, medical waste segregation and colour coding of bins were important, respectively. Most of the respondents 276 (98.6%) felt that it was very important to use personal protective equipment in handling medical waste. Majority of the respondents 274 (97.9%) felt they have a responsibility to properly dispose infectious waste. Over nine-tenths of the respondents 273 (97.5%) believe that wrong waste segregation can cause infection. Majority of the respondents 255 (91.1%) believe their occupation increases chances of infection. Less than two-thirds 183 (65.4%) were immunized. (Table 2)

TABLE 2: ATTITUDE OF RESPONDENTS TOWARDS MEDICAL WASTE MANAGEMENT

Variable	Attitude (n=280)		
	Agree Freq (%)	Indifferent Freq (%)	Disagree Freq (%)
Medical waste management is important	276 (98.6)	3 (1.0)	1(0.4)
Medical waste segregation is important	273 (97.5)	1 (0.4)	6(2.1)
Colour coding of bins is important	249 (88.9)	25 (9.0)	6 (2.1)
Use of personal protective equipment in handling waste is important	276 (98.6)	0 (0.0)	4 (1.4)
Personal responsibility for proper disposal of medical waste	274 (97.9)	0 (0.0)	6 (2.1)
Wrong waste segregation can cause infection	273 (97.5)	0 (0.0)	7 (2.5)
Respondents occupation increases chances of infection	255 (91.1)	0 (0.0)	25 (8.9)
Burying can contaminate ground water	213 (76.1)	27 (9.6)	40 (13.3)
Burning can pollute the environment	254 (90.7)	12 (4.3)	14 (5.0)
Immunization against HBV and Tetanus is important	183 (65.4)	0 (0.0)	97 (34.6)

Over three-quarters of the respondents 241 (86.1%) had an overall positive attitude score towards MWM.

All respondents who were aged > 50 years 15 (100.0%) had positive attitude towards MWM. The association between age group and attitude

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towards medical waste management was not statistically significant ($p = 0.185$). (Table 3)

TABLE 3: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND TOTAL ATTITUDE SCORE OF RESPONDENTS

Variable	Total attitude score		Test statistic	p value
	Positive	Negative		
	(n=241) Freq (%)	(n=39) Freq (%)		
Age group				
20-29	51 (77.3)	15 (22.7)	Fischer's exact = 7.825	$p = 0.185$
30-39	113 (89.0)	14 (11.0)		
40-49	62 (86.1)	10 (13.9)		
>50	15 (100.0)	0 (0.0)		
Sex				
Male	101 (87.8)	14 (12.2)	Fischer's exact = 0.499	$p = 0.440$
Female	140 (84.8)	25 (15.2)		
Marital status				
Single	67 (81.3)	15 (18.3)	Fischer's exact = 14.674	$p = 0.050$
Married	173 (88.7)	22 (11.3)		
Separated	1 (50.0)	1 (50.0)		
Cohabiting	0 (0.0)	1 (100.0)		
Religion				
Christianity	227 (85.7)	38 (14.3)	Fischer's exact = 3.986	$p = 0.986$
Islam	13 (92.9)	1 (7.1)		
ATR	1 (100.0)	0 (0.0)		
Occupation				
Doctor	111 (91.3)	11 (8.7)	Fischer's exact = 4.696	$p = 0.035$
Nurse	126 (81.8)	28 (18.1)		

With a year increase in age, respondents were more likely by an odds ratio of 1.050 to have a positive attitude towards MWM, however, this was not statistically significant ($p = 0.115$, CI = 0.933 – 0.988). (Table 4)

TABLE 4: LOGISTIC REGRESSION MODEL FOR DETERMINANTS OF ATTITUDE TOWARDS MEDICAL WASTE MANAGEMENT

Predictors	B (regression co-efficient)	Odds ratio	95% CI for OR		P – value
			Lower	Upper	
Age	0.049	1.050	0.933	0.988	0.115
Sex					
Male	0.305	1.357	0.400	4.600	0.624
Female*		1			
Religion					
Christian	-0.537	0.584	0.072	4.751	0.615
Non – Christian*		1			
Occupation					
Doctors	0.192	1.212	0.376	3.903	0.748
Nurses*		1			
Marital status					
Never married	-0.184	0.832	0.340	2.034	0.686
Ever married		1			

***Reference category, $R^2 = 26.6\%$ - 32.0%, CI = Confidence Interval**

A higher proportion of male respondents 101 (87.8%) had positive attitude towards medical waste management. The association between respondents' sex and attitude towards medical waste was not statistically significant ($p = 0.440$). (Table 3) After adjusting for covariates, males were more likely by an odds ratio of 1.357 to have a positive attitude towards MWM ($p = 0.624$, CI = 0.400 – 4.600). (Table 4)

Doctors were more likely by an odds ratio of 1.212 to have positive attitude towards MWM compared to the nurses, this was however not statistically significant ($p = 0.748$, CI = 0.376 – 3.903). (Table 4)

Majority of the respondents 255 (91.1%) and 226 (80.7%) practiced waste segregation and collected waste in color coded bins, respectively. Over nine-tenths of the respondents 266 (95.0%) observed standard precautions when handling medical waste. The method of medical waste disposal most commonly practiced was burning 147 (52.2%). Others included autoclaving 108

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(38.6%), mechanical/chemical disinfection 102 (26.4%), microwave 35 (12.5%) and irradiation 25 (8.9%). (Table 5) Majority of the respondents 276 (98.6%) do not recycle medical waste. A higher proportion of the respondents 242 (86.5%) collected their wastes on a daily basis, 15 (8.9%) of respondents on a weekly basis and 13 (4.6%) of respondents on a monthly basis. (Table 5)

TABLE 5: RESPONDENTS PRACTICE OF MEDICAL WASTE MANAGEMENT

Variable	Frequency(n=280)	Percent
Respondents practice waste segregation		
Yes	255	91.1
No	25	8.9
Respondents collect waste in coloured bins		
Yes	226	80.7
No	54	19.3
Respondents observe standard precautions in handling waste		
Yes	266	95.0
No	14	5.0
Waste disposal method/ disinfection practiced		
Burning	147	52.5
Autoclaving	108	38.6
Mechanical/Chemical Disinfection	102	36.4
Microwave	35	12.5
Irradiation	25	8.9
Respondents that recycle waste		
Yes	4	1.4
No	276	98.6
Frequency of waste collection		
Daily	242	86.5
Weekly	25	8.9
Monthly	13	4.6

Majority of the respondents 267 (95.4%) had good overall practice of MWM.

All respondents who were greater than 50 years 15 (100.0%) had good practice of medical waste management. The association between age group

of respondents and their practice was not statistically significant ($p = 0.743$).

TABLE 6: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND PRACTICE OF MEDICAL WASTE MANAGEMENT OF RESPONDENTS

Total practice score (n = 280)					
Variable	Good Freq (%)	Poor Freq (%)	Test statistic	p value	
Age group					
20-29	62 (93.9)	4 (6.1)	Fishers' exact = 1.308	$p = 0.743$	
30-39	122 (96.1)	5 (3.9)			
40-49	68 (94.4)	4 (5.6)			
>50	14 (100.0)	0 (0.0)			
Sex					
Male	55 (96.5)	2 (3.5)	$\chi^2 = 0.208$	$p = 0.746$	
Female	212 (95.1)	11 (4.9)			
Marital status					
Single	79 (96.3)	3 (3.7)	Fisher's exact = 20.816	$p = 0.038$	
Married	186 (95.4)	9 (4.6)			
Separated	2 (100.0)	0 (0.0)			
Cohabiting	0 (0.0)	1 (100.0)			
Religion					
Christianity	252 (95.1)	13 (4.9)	Fisher's exact = 0.772	$p = 0.654$	
Islam	14 (100.0)	0 (0.0)			
ATR	1 (100.0)	0 (0.0)			
Occupation					
Doctor	61 (95.3)	3 (4.7)	$\chi^2 = 0.000$	$p > 0.999$	
Nurse	206 (95.4)	10 (4.6)			
Attitude					
Positive	234 (97.1)	7 (2.9)	$\chi^2 = 11.809$	$p = 0.004$	
Negative	33 (84.6)	6 (15.4)			

(Table 6) With a year increase in age, respondents were more likely by an odds ratio of 1.008 to have good practice of MWM ($p = 0.868$, CI = 0.920 – 1.104). (Table 7) A higher proportion of male respondents 55 (96.5%) had good practice of MWM but this was not statistically significant ($p = 0.746$). (Table 6) After adjusting for covariates, males still had better practice and were more likely by an odds ratio of 1.685 to have good

practice of MWM ($p = 0.606$, $CI = 0.232 - 12.231$). (Table 7) A higher proportion of respondents with positive attitude 234 (97.1%) had good practice of MWM, this was statistically significant ($p = 0.004$). (Table 6) Respondents with negative attitude were less likely to have good practice of MWM by an odds ratio of 0.232 and this was statistically significant ($p = 0.024$, $CI = 0.065 - 0.825$). (Table 7)

TABLE 7: LOGISTIC REGRESSION MODEL FOR DETERMINANTS OF PRACTICE OF MEDICAL WASTE MANAGEMENT

Predictors	B (regression co-efficient)	Odds ratio	95% CI for OR		P – value
			Lower	Upper	
Age	0.008	1.008	0.920	1.104	0.868
Sex					
Male	0.522	1.685	0.232	12.231	0.606
Female*		1			
Religion					
Christian	-17.691	0.000	0.000	-	0.999
Non – Christian*		1			
Occupation					
Doctors	-0.711	0.491	0.087	2.786	0.422
Nurses*		1			
Marital status					
Never married	0.124	1.132	0.234	5.483	0.877
Ever married		1			
Attitude of MWM					
Negative	-1.461	0.232	0.065	0.825	0.024
Positive		1			

*Reference category, $R^2 = 24.7\% - 32.0\%$, $CI =$ Confidence Interval

DISCUSSION

More than half of the respondents were females. This is similar to studies done in Bangladesh and Malaysia in 2012 and 2014, respectively where most of the respondents were females.^{12,13} This may be due to the fact that most of the respondents interviewed were nurses. Females are more common in nursing because it is generally perceived to be a feminine profession. Majority of the respondents were nurses. This is

similar to another study in Malaysia in 2011 where majority of the respondents were nurses.¹⁴ This could be because doctors are fewer in number than nurses at the healthcare facilities utilized in the study. The nature of training needed for the certification of doctors is arduous and this usually results in a smaller number of existing professionals as compared to nurses. However, the management of medical waste requires cooperation between all healthcare workers to ensure a minimization of the risks to their health.

Most of the respondents agreed that it was important to use PPE in handling medical waste. This is comparable to the study in Egypt in which majority of the doctors felt that using PPE was important in medical waste handling and disposal.¹⁵ Knowledge of the risk associated with exposure to infectious pathogens that may be present in medical waste could have contributed to the positive attitude of respondents towards the use of PPE in the course of their duties. Health-care waste handlers are at greatest risk from infectious hazards, especially sharps that are not disposed of into puncture-resistant containers.² PPE such as eye goggles, gloves, masks and gowns protects the wearers by creating a barrier between the hazard and the healthcare worker, thus reducing the incidence of infectious diseases that may be gotten during the course of their duties.

Majority of the respondents were of the opinion that they have a responsibility to properly dispose infectious waste. This is similar to another study done in India in which respondents stated that they believed that proper disposal of bio-medical waste that was generated by them was part of their responsibilities.¹⁶ The definite responsibility for ensuring that waste is disposed of lies with the person that generates the waste. This is because proper waste management begins from the point of generation and proper management at this point affects all the practices from then onwards. Majority of the respondents had a positive attitude towards medical waste management. This is comparable to studies conducted in Egypt and India where the healthcare workers had generally positive attitudes toward medical waste

management.^{15,17} A positive attitude results in the adoption of good medical waste management practices. A higher proportion of the respondents in this study practiced waste segregation. This is in contrast with a study conducted in 2014 in Ghana and in 2011 in Bangladesh where the majority of the respondents did not segregate their waste before disposal.^{18,19} However it is similar to the Indian study where majority of the respondents segregated their waste before disposal.²⁰ Waste segregation at point of generation is an important first step in proper medical waste management. It reduces health risks to the personnel handling the waste and to any possible scavengers at the dumpsite and also ensures proper disposal at the final site. Without segregation, hazardous and medical wastes may mishandled and disposed of together with domestic wastes, thus creating a health risk to municipal workers, the general public and the environment.¹⁶ Waste segregation should thus be practiced by all health care workers including nonmedical staff who also generate waste.

Most of the respondents observed standard precautions when handling medical waste. This is similar to a study done in Nassarawa State, Nigeria in 2015 in which majority of the respondents observed standard precautions when handling medical waste.²¹ This could be due to the provision of hand washing facilities and PPEs for the use of healthcare staff as well constant reminders placed at strategic points in the hospital wards emphasizing the importance of maintaining standard precautions at all times. This is commendable as it would reduce the risk of health personnel contracting diseases and hence limit possible spread to the patients they attend to. Standard precautions should be practiced by all clinical staff without exception, to limit the risk of potentially harmful organisms being transmitted through infectious medical waste.²¹

The method of medical waste disposal most commonly practiced was burning. This is similar to findings from the study done in 2011 in Ekpoma, where burning was the most common medical waste disposal method.²² Burning might be used at these facilities because of the

unavailability of any low-cost alternatives that are more appropriate and environmentally protective. During open burning, air pollutants are released into the atmosphere which may cause respiratory illnesses such as acute respiratory infections and chronic obstructive pulmonary disease to people residing nearby.²²

Most of the respondents had good practice of medical waste management. This is similar to findings from studies done in India in 2009 and 2013 where majority of the healthcare workers had good practice of medical waste management.^{17, 23} However, it is in contrast with findings from an Ekpoma study conducted in 2011 where respondents were reported to have poor medical waste management practices.²² This may be because most of the respondents had positive attitude towards MWM. Good practices on MWM reduce the risks associated with the collection and handling of medical waste and in addition, protects the environment and people living in it. In conclusion, majority of the respondents had positive attitude towards MWM and good practice of MWM. Continuous efforts by stakeholders should be made to ensure that the adequate practice of MWM is sustained.

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