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Determinants of Medical Waste Management Practices Among Primary Healthcare Workers in Port Harcourt Metropolis, Rivers State, Nigeria

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Abstract: When medical waste generated from a health facility is not managed properly, it can be hazardous to the environment. This study focused on determinants of medical waste management among primary healthcare workers in Port Harcourt Metropolis, Rivers State. Six objectives, six research questions and five hypotheses were stated to guide the study. Literature was reviewed under conceptual framework, theoretical framework and empirical review. The study adopted descriptive correlational study design. The population of study are 2,605 primary healthcare workers in Port Harcourt Metropolis. The sample size was 382 healthcare workers selected using the multistage sampling procedure. The instrument for data collection was a self-structured questionnaire titled 'Medical waste Management Questionnaire (MWMQ)', with a reliability coefficient of 0.72. Data collected were analysed using the Statistical Package for the Social Sciences (SPSS) version 27.0, and results were presented as means and Pearson Correlations at the 0.05 level of significance. The result showed that the extent to which medical waste management was practiced among primary healthcare workers in Port Harcourt Metropolis was high (3.49±0.81). The result further showed that there was a statistically significant relationship between practice of medical waste management and knowledge (r-value = 0.48; n = 367; p = 0.00), availability of waste management resources (r-value = 0.65; n = 367; p = 0.00), accessibility of waste management resources (r-value = 0.51; n = 367; p = 0.00), and years of work experience (r-value = 0.47; n = 367; p = 0.00). It was concluded that, the determinants of medical waste management were: knowledge of waste management, availability of waste management resources, accessibility of waste management resources, and years of work experience. It is recommended among others that, the primary health care management board should ensure that colour coded wastes bins are not lacking, by supplying them timely to the health facilities to ensure that the health care workers do not find it difficult to segregate the medical wastes generated.

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1. Introduction

Every healthcare facility has an obligation to ensure that the medical waste it generates is managed properly, so as to protect its workers, clients and the environment from exposure and harm. Healthcare service delivery and its underlying activities inevitably produce waste products that can become environmental and health hazards if

they are not well managed. Generally, about 85% of the waste generated by healthcare facilities belongs to the general, non-hazardous category, while the remaining 15% consists of infectious, toxic or radioactive materials [1]. In many settings, waste from healthcare processes is not treated properly [2]; instead, it is thrown into ordinary dustbins, thereby creating health hazards [3]. Mingled with household solid waste, these products contaminate air, water and the wider environment, and medical waste is regarded as the second most hazardous waste stream globally after radioactive waste [4]. Medical waste encompasses sharps, human body parts, blood, chemical and pharmaceutical wastes and discarded medical devices [5], and it is generated mainly in hospitals, primary care facilities, laboratories, mortuaries, autopsy centres, blood banks and nursing homes [6].

The management of these wastes cannot be ignored if the health of healthcare workers, patients and the general public is to be maintained, and effective medical waste management is an integral component of acceptable professional healthcare practice. Its core components are waste segregation, storage, transportation and disposal [7], with collection recognised as a further distinct stage [8]. Hazardous medical waste may take the form of sharp objects, human tissues discarded during surgical operations, blood, vomitus, and chemical and pharmaceutical materials; depending on the level of hazard, such waste should be disposed of according to approved international standards. Nevertheless, according to the same World Health Organization guideline, medical waste is in many instances disposed of together with domestic waste in landfills or open municipal dumpsites. In the absence of standard prescriptive guidelines for its timely disposal, medical waste may pollute the environment and become a channel for disease transmission and epidemic outbreaks [9].

The health consequences of poorly managed medical waste can be devastating. Mismanagement can result in hospital-acquired infections, occupational health hazards and food contamination, and sharps contaminated with blood facilitate the transmission of hepatitis B, hepatitis C, HIV and other viral infections [10]. When waste from patients with viral infections such as HIV or COVID-19 is poorly disposed of, unsuspecting individuals and waste scavengers may come into contact with it and become infected; health workers, patients, visitors, waste handlers and the general public are all susceptible in such a scenario. In many countries, segregation of hazardous and medical waste is limited and such waste is usually mixed with non-infectious waste, posing a great danger to public health [11]. Improper management of healthcare waste therefore exposes health workers, waste handlers and the community to infections, toxic effects and a higher risk of injury [12]. If healthcare workers perceive these consequences correctly, they are more likely to adopt good disposal practices; however, other factors, including knowledge, attitude and the resources at their disposal, may also determine how medical waste is managed.

Knowledge of medical waste management is a prerequisite for its proper practice. Increased familiarity with waste management is expected to foster a positive attitude and, subsequently, better practice. Awareness, however, does not automatically translate into action: in Sokoto, Northwest Nigeria, awareness of proper waste disposal was lacking, and most of the people who were aware of solid waste management strategies did not put them into practice [13]. The role of knowledge in shaping both attitude and practice therefore deserves empirical attention.

Attitude is a person's readiness or tendency to respond positively or negatively to an object or situation; for healthcare workers, it reflects their readiness to engage in proper healthcare waste management. Negative attitudes have been documented in the form of waste containers overloaded beyond recommended limits and temporary storage in improvised, obscure areas where waste remained exposed to people, animals and the

environment [14]. Such attitudes endanger the environment and surrounding populations and, if left unchecked, can lead to poor management of medical waste.

All healthcare staff are expected to follow a plan of action and guidelines for waste disposal, as Wafula and colleagues emphasised, with incineration and landfilling being the most commonly used disposal methods. Beyond individual factors, organisational conditions also matter: the magnitude of the work, supervision difficulties, financial constraints and the absence of specialised waste personnel have been reported as key challenges in waste management [15], and such constraints have been linked to the prevalence of indiscriminate dumping in developing countries such as Nigeria [16].

In Port Harcourt Metropolis, numerous primary healthcare facilities generate medical waste that must be disposed of properly to avoid harmful effects on the populace. Although no empirical reports were found, the researchers' observation indicates that medical waste management is one of the major challenges facing these facilities. Unlike tertiary and secondary facilities, whose waste attracts the attention of waste management agencies, primary healthcare facilities receive comparatively little oversight. Many of them lack proper medical waste management systems because of poor funding, low prioritisation of waste management and the absence of competent waste administrators. Although some institutional mechanisms exist for addressing waste accumulation and its associated hazards, implementation lapses persist owing to poor logistics and the absence of a stable waste management system at the primary healthcare level. This increases the risk of human contact with hazardous and highly infectious waste and exposes the population to several forms of environmental pollution. Moreover, policy attention has focused largely on household waste, and studies of medical waste management practice in primary healthcare facilities in Rivers State remain few.

To address this gap, the present study investigated the determinants of medical waste management practice among primary healthcare workers in Port Harcourt Metropolis, Rivers State. Specifically, the study sought to:

1. investigate the extent of medical waste management practice among primary healthcare workers in Port Harcourt Metropolis;
2. ascertain knowledge of waste management as a determinant of medical waste management practice;
3. ascertain attitude towards waste management as a determinant of medical waste management practice;
4. investigate availability of waste management equipment as a determinant of medical waste management practice;
5. investigate accessibility of waste management resources as a determinant of medical waste management practice; and
6. examine years of work experience as a determinant of medical waste management practice.

Corresponding to objectives 2–6, the following null hypotheses were tested at the 0.05 level of significance: there is no significant relationship between the practice of medical waste management and (H₀₁) knowledge of waste management, (H₀₂) attitude towards waste management, (H₀₃) availability of waste management equipment, (H₀₄) accessibility of waste management resources and (H₀₅) years of work experience among primary healthcare workers in Port Harcourt Metropolis.

2. Materials and Methods

2.1 Study design

The study adopted a descriptive correlational design, which allowed the extent of medical waste management practice to be described and its relationships with the hypothesised determinants to be quantified without manipulation of any variable.

2.2 Study area and population

The study was conducted in Port Harcourt Metropolis, Rivers State, Nigeria. The population comprised all 2,605 primary healthcare workers employed in the primary healthcare facilities of the two major Local Government Areas (LGAs) that make up the Metropolis.

2.3 Sample size and sampling procedure

A sample of 382 primary healthcare workers was selected through a multistage sampling procedure. In the first stage, simple random sampling was used to select five primary healthcare facilities from each of the two LGAs. In the second stage, non-proportional stratified sampling was used to determine the number of respondents to be drawn from each selected model primary health centre. In the final stage, the respondents were selected by simple random sampling.

2.4 Research instrument

Data were collected with a self-structured questionnaire titled the Medical Waste Management Questionnaire (MWMQ). The instrument measured medical waste management practice (13 items covering segregation, collection, storage and disposal; see Table 1), knowledge of waste management, attitude towards waste management, availability and accessibility of waste management resources, and years of work experience. Item means were interpreted against a criterion mean of 2.50, with values of 2.50 and above indicating a high extent and values below 2.50 a low extent. The reliability coefficient of the instrument was 0.72.

2.5 Data collection and analysis

Of the 382 questionnaires administered, 367 were correctly completed and retained for analysis, representing a usable response rate of 96.1%. Data were analysed with IBM SPSS Statistics version 27.0. Mean and standard deviation were used to answer the research question on the extent of practice, and Pearson's product-moment correlation coefficient was used to test the null hypotheses. A hypothesis was rejected when $p < 0.05$.

3. Results

3.1 Extent of medical waste management practice

Table 1. Mean and standard deviation of the extent of medical waste management practice among primary healthcare workers in Port Harcourt Metropolis (n = 367)

S/N	Items	Mean	SD	Remark
1	Separated different types of wastes generated from the source	3.93	0.32	High extent
2	Separated wastes in colour-coded containers	3.42	1.00	High extent
3	Ensured that infectious wastes are not mixed with other types of waste	3.76	0.59	High extent
4	Collected sharps with puncture-proof containers	2.95	1.38	High extent
5	Medical wastes are collected from the ward daily	3.68	0.66	High extent

6	Wastes are collected with sealed bags	3.69	0.72	High extent
7	Tightly closes or seals collection containers when they are three-quarters full	3.64	0.70	High extent
8	Stored medical wastes in special containers	3.63	0.81	High extent
9	Medical waste storage areas are marked with a caution sign	3.55	0.88	High extent
10	There is a well-designated storage area for medical wastes	3.61	0.80	High extent
11	Disposed of medical waste properly	3.75	0.52	High extent
12	There is a waste disposal plan	3.50	0.80	High extent
13	Drug containers or glass bottles are recycled or reused	2.31	1.31	Low extent
	Grand mean	3.49	0.81	High extent

Note: Criterion mean = 2.50.

Table 1 shows that the grand mean of 3.49 ± 0.81 exceeded the criterion mean of 2.50, indicating that medical waste management was practised to a high extent among primary healthcare workers in Port Harcourt Metropolis. Twelve of the thirteen practice items were rated high, the highest being the separation of different types of waste at source (3.93 ± 0.32). The only item rated low was the recycling or reuse of drug containers and glass bottles (2.31 ± 1.31).

3.2 Determinants of medical waste management practice

Table 2. Pearson correlation between knowledge of waste management and practice of medical waste management

Variables	Statistic	Medical waste management	Knowledge	Decision
Medical waste management	Pearson correlation	1	0.48*	H ₀₁ rejected
	Sig. (2-tailed)	—	< 0.001	
	N	367	367	
Knowledge	Pearson correlation	0.48*	1	
	Sig. (2-tailed)	< 0.001	—	
	N	367	367	

*Significant at $p < 0.05$.

Table 2 shows a statistically significant positive relationship between knowledge and the practice of medical waste management ($r = 0.48$, $n = 367$, $p < 0.001$). Thus, H₀₁ was rejected.

Table 3. Pearson correlation between attitude towards waste management and practice of medical waste management

Variables	Statistic	Medical waste management	Attitude	Decision
Medical waste management	Pearson correlation	1	0.23	H ₀₂ not rejected
	Sig. (2-tailed)	—	0.54	

Variables	Statistic	Medical waste management	Attitude	Decision
Attitude	N	367	367	
	Pearson correlation	0.23	1	
	Sig. (2-tailed)	0.54	—	
	N	367	367	

Not significant; $p > 0.05$.

Table 3 shows that the relationship between attitude and the practice of medical waste management was not statistically significant ($r = 0.23$, $n = 367$, $p = 0.54$). Thus, H_{02} was not rejected.

Table 4. Pearson correlation between availability of waste management equipment and practice of medical waste management

Variables	Statistic	Medical waste management	Availability	Decision
Medical waste management	Pearson correlation	1	0.65*	H_{03} rejected
	Sig. (2-tailed)	—	< 0.001	
	N	367	367	
Availability	Pearson correlation	0.65*	1	
	Sig. (2-tailed)	< 0.001	—	
	N	367	367	

**Significant at $p < 0.05$.*

Table 4 shows a statistically significant positive relationship between the availability of waste management equipment and the practice of medical waste management ($r = 0.65$, $n = 367$, $p < 0.001$). This was the strongest association observed in the study. Thus, H_{03} was rejected.

Table 5. Pearson correlation between accessibility of waste management resources and practice of medical waste management

Variables	Statistic	Medical waste management	Accessibility	Decision
Medical waste management	Pearson correlation	1	0.51*	H_{04} rejected
	Sig. (2-tailed)	—	< 0.001	
	N	367	367	
Accessibility	Pearson correlation	0.51*	1	
	Sig. (2-tailed)	< 0.001	—	
	N	367	367	

**Significant at $p < 0.05$.*

Table 5 shows a statistically significant positive relationship between the accessibility of waste management resources and the practice of medical waste management ($r = 0.51$, $n = 367$, $p < 0.001$). Thus, H_{04} was rejected.

Table 6. Pearson correlation between years of work experience and practice of medical waste management

Variables	Statistic	Medical waste management	Work experience	Decision
Medical waste management	Pearson correlation	1	0.47*	H_{05} rejected
	Sig. (2-tailed)	—	< 0.001	
	N	367	367	
Work experience	Pearson correlation	0.47*	1	
	Sig. (2-tailed)	< 0.001	—	
	N	367	367	

*Significant at $p < 0.05$.

Table 6 shows a statistically significant positive relationship between years of work experience and the practice of medical waste management ($r = 0.47$, $n = 367$, $p < 0.001$). Thus, H_{05} was rejected.

4. Discussion

4.1 Extent of medical waste management practice

The study found that medical waste management was practised to a high extent among primary healthcare workers in Port Harcourt Metropolis (3.49 ± 0.81). This is not surprising, because the respondents were health professionals who had undergone formal training that exposed them to the proper handling of waste. The finding corroborates that of Wafula and colleagues, whose study in primary healthcare facilities in Kampala, Uganda, reported a high extent of medical waste management practice. It is also similar to the finding of Kwikiriza et al. in rural Uganda, where medical waste was stored properly at designated sites within the health facility [17]. The similarity may be attributed to the homogeneity of the respondents, who were healthcare workers in all the studies. The weakest practice identified, the recycling or reuse of drug containers and glass bottles, indicates that waste minimisation remains the least developed link in the waste management chain.

By contrast, the finding differs from that of Oyekale and Oyekale, whose national study of healthcare waste management practices and safety indicators in Nigeria revealed poor compliance with waste management practices, including waste prevention and reduction [18]. It is also not in agreement with the study of Omoleke et al. at primary healthcare centres in Kebbi State, where 76% of the surveyed health workers expressed dissatisfaction with the waste treatment practices adopted in their facilities and the overall level of medical waste management practice was poor [19]. These differences may be due to variations in study location, institutional support and the reliance of the present study on self-reported rather than observed practice.

4.2 Knowledge of waste management

Knowledge was significantly and positively related to the practice of medical waste management ($r = 0.48$, $p < 0.001$). This is expected, as knowledge is a prerequisite for any healthcare practice, and it may also reflect awareness programmes and media announcements on waste management in the area. The result is in line with that of Laor et al., who reported a significant relationship between knowledge and practice of solid waste management among highland residents in Northern Thailand [20], and with that of Adogu et al., who reported a similar association among residents of Owerri Municipal,

Imo State, Nigeria [21]. By implication, activities that raise knowledge, such as awareness campaigns and in-service training, are likely to improve practice in the same direction.

4.3 Attitude towards waste management

Unlike knowledge, attitude was not significantly related to the practice of medical waste management ($r = 0.23$, $p = 0.54$). This finding differs from those of Shahzadi et al. in a rural community of Lahore, Pakistan [22], Eshwari et al. among semi-urban residents of coastal Karnataka, India [23], and Adeyemo et al. in the university area of Ogbomoso, Nigeria [24], all of which reported a positive relationship between attitude and waste management practice. The divergence may arise because those studies involved household residents, whose waste behaviour depends largely on personal disposition, whereas the practice of healthcare workers is governed mainly by institutional protocols, supervision and the resources provided. The finding is also consistent with the attitude-behaviour gap noted by Kaoje and colleagues, in which favourable dispositions do not necessarily translate into corresponding action.

4.4 Availability and accessibility of waste management resources

Availability of waste management equipment showed the strongest association with practice ($r = 0.65$, $p < 0.001$). This is expected, because the absence of facilities and equipment directly inhibits proper waste handling. The finding aligns with Ogwueleka, who observed that effective waste management in Nigeria requires adequate facilities and equipment, which are frequently lacking [25]. It is also supported by Ezeah and Roberts, who reported that solid waste collection vehicles imported from developed countries were quickly abandoned because spare parts were unavailable, illustrating how resource shortages undermine waste management systems [26].

Accessibility of waste management resources was likewise significantly related to practice ($r = 0.51$, $p < 0.001$). This corroborates the analysis of Ezeah and Roberts, which identified access to waste management resources as one of the most predominant inhibitors of effective waste management in Nigerian cities. It is also consistent with Ogwueleka's observation that environmental agencies are unable to perform their duties effectively because of limited access to the necessary resources. Together, these results suggest that providing equipment is not sufficient on its own: the equipment must be positioned where and when workers need it.

4.5 Years of work experience

Years of work experience were significantly and positively related to the practice of medical waste management ($r = 0.47$, $p < 0.001$). Longer service gives healthcare workers repeated exposure to facility routines, in-service training and supervision, which consolidates correct segregation, collection and disposal habits. Experienced workers are also better placed to anticipate hazards and to navigate resource shortages. This suggests that structured mentoring, in which experienced staff model correct practices for newer colleagues, could help to sustain good waste management across the workforce.

4.6 Limitations

The study has some limitations. Its cross-sectional correlational design does not permit causal inference. Practice was self-reported and may therefore be subject to social desirability bias, which could partly explain the high level of practice observed. The study was confined to primary healthcare facilities in one metropolis, which limits generalisability to other settings. Future studies should combine questionnaires with direct observation and audits of waste streams, and should re-examine the role of attitude with larger and more diverse samples.

5. Conclusion

Medical waste management was practised to a high extent among primary healthcare workers in Port Harcourt Metropolis, Rivers State. Knowledge of waste

management, availability and accessibility of waste management resources, and years of work experience were significant determinants of this practice, while attitude towards waste management was not. Of these, the availability of waste management equipment showed the strongest association, underscoring the central role of resource provision in safe medical waste management at the primary healthcare level. Based on the findings, the following recommendations are made: The primary healthcare management board should collaborate with the waste management agency to ensure that the medical waste generated is adequately managed, and should supply colour-coded waste bins in good time so that workers can segregate waste without difficulty. The primary healthcare management should consistently emphasise proper waste management during routine staff briefings in order to sustain the good level of knowledge found among the workers. Heads of facilities should ensure that medical waste management resources are consistently available at designated points to encourage proper management of such waste. The primary healthcare management board should ensure that medical waste management resources are accessible to primary healthcare workers at all times. Primary healthcare workers should collaborate with waste management companies to sustain the proper disposal of medical waste. Primary healthcare workers with longer years of service should model proper waste management practices for other workers to ensure the continuity of good practice.

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