



FACTORS ASSOCIATED WITH ADHERENCE TO SAFETY-PROTOCOLS IN HANDLING MEDICAL WASTES AMONG HEALTHCARE WORKERS IN A SELECTED TERTIARY HEALTHCARE FACILITY IN LAGOS STATE, NIGERIA

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ABSTRACT: *Background: The safe handling of medical waste is critical to preventing occupational exposures and reducing public health risks, particularly in resource constrained settings like Nigeria. Despite institutional policies and global guidelines, adherence to safety protocols among healthcare workers appears inconsistent. Similarly, studies to determine the reasons for this inconsistency remain unsolved. Therefore, this risk behavior diagnostic study guided by behavior theories assessed predictors of adherence to safety protocols among healthcare workers (HCWs) at Lagos University Teaching Hospital (LUTH). Methods: A cross-sectional survey study design was employed, involving 403 consenting healthcare practitioners selected by stratified sampling technique. A validated structured 55-item questionnaire was used for data collection and analysis was performed by the computer-assisted statistical software IBM SPSS version 23. Descriptive statistics were used to summarize measures of variables in the study, while inferential statistics, including ANOVA and logistic regression analyses, were used to assess the relationships between independent variables and adherence behavior, and to determine variables with significant predictive values at 5% level of significance. Results: Findings revealed that respondents scored (26.1 ± 2.3) on a 33-point scale for self-reported adherence behavior, representing a prevalence of 79.1% with above average knowledge of 63.6% and mean score of (8.9 ± 2.1), strong motivation of 83.6% and mean score of (27.6 ± 1.8), and good behavioral skills of 78.2% and mean score of (25.8 ± 1.9). Tetanus vaccination was below expectation (34.7%) and disposal of contaminated PPE was equally unacceptably low (29.8%). Logistic regression revealed motivation as the strongest predictor of adherence ($\beta = 0.61$, $p = 0.004$), followed by behavioral skills ($\beta = 0.57$, $p = 0.002$) and knowledge ($\beta = 0.48$, $p = 0.008$). ANOVA indicated a significant difference in adherence across job roles with Nurses and HCWs with 6-10 years of experience showing significantly higher adherence ($p = 0.001$ and $p = 0.002$, respectively). Conclusion and Recommendations: The study concludes that multiple factors are involved in the dynamics of adherence to safety protocols in medical waste handling. While HCWs demonstrate foundational knowledge, skills and generally high levels of motivation, intrinsic motivation was the most significant determinant of adherence. Interventions should therefore emphasize motivational reinforcement, continuous training, and supportive workplace environments to sustain high adherence. Strengthening institutional policies and promoting a safety-oriented culture can further safeguard healthcare workers. These measures align with global occupational health goals and can reduce infections and environmental risks associated with medical waste.*

KEYWORDS: Adherence, Behavioural Skills, Healthcare Workers, Medical Waste, Motivation, Occupational Exposure, Safety Protocols.



INTRODUCTION

Medical waste handling is a critical component of healthcare systems worldwide, particularly given the volume of hazardous waste generated daily by healthcare facilities. Medical waste is defined as waste that requires special handling and disposal procedures due to its potential for disease transmission or other health risks, including needles, blades, blood-soaked materials, chemicals, and biotechnological products (WHO, 2023). The World Health Organization (WHO) estimates that healthcare activities generate millions of tons of waste annually, with approximately 15% classified as hazardous (WHO, 2022). Improper handling of this waste is associated with significant public health risks, including the transmission of bloodborne pathogens such as hepatitis B, hepatitis C, and HIV, particularly through needlestick injuries (Prüss-Üstün et al., 2019).

In Sub-Saharan Africa, the challenges associated with safe handling of medical waste are even more pronounced, largely due to infrastructural deficits, limited financial resources, and inadequate training (Ogundiran et al., 2021). Lagos State, Nigeria, one of the most densely populated regions in Sub-Saharan Africa, hosts a vast network of healthcare facilities. However, studies have shown that up to 70% of medical waste generated within Nigerian healthcare settings is improperly handled, leading to elevated risks of disease transmission and environmental contamination (Ogunseye et al., 2022). Healthcare workers (HCWs) in Lagos State are particularly vulnerable, often facing occupational exposure due to inadequate training, non-adherence to safety protocols, and inconsistent availability of personal protective equipment (PPE).

Theories, such as the Information-Motivation-Behavioral Skills (IMB) model and the Health Belief Model (HBM), provide conceptual frameworks for understanding healthcare workers' behaviors regarding medical waste handling. The IMB model, in particular, highlights that accurate information, strong motivation, and effective behavioral skills are essential predictors of adherence to health-promoting behaviors, including safe medical waste-handling practices (Fisher et al., 2006). Additionally, environmental and institutional factors—such as the availability of resources like sharps containers, PPE, and structured training programs—play a critical role in influencing adherence behaviors (Tilahun et al., 2023).

Despite awareness of the risks associated with poor medical waste handling, adherence to safety protocols remains alarmingly low among healthcare workers. A study conducted in Lagos State reported that 84.7% of healthcare workers failed to comply with standard medical waste handling and disposal procedures (Okoye & Elom, 2023). Similarly, research from other regions of Nigeria and Africa has highlighted a substantial gap between knowledge and practice, suggesting that the challenge is not solely informational but also motivational and behavioral (Iheanacho et al., 2020; Tilahun et al., 2023). The persistent non-adherence significantly contributes to occupational exposures, accounting globally for 5% of HIV infections and 40% of hepatitis B and C infections among healthcare workers (WHO, 2022).

These realities underscore a critical public health concern: the improper handling of medical waste not only jeopardizes the health and safety of healthcare workers but also facilitates broader environmental contamination and community-level disease transmission. In Lagos State, the inadequate enforcement of medical waste management policies, insufficient training programs, and resource limitations exacerbate the problem (Ogundiran et al., 2021). While studies have documented the risks associated with poor medical waste handling, there remains



a gap in understanding the specific individual and systemic factors that predict adherence to safe-handling protocols within the Nigerian context, particularly in Lagos State.

Hence, this study seeks to investigate the factors associated with adherence to safety protocols in handling medical waste among healthcare workers in a selected tertiary healthcare facility in Lagos State, Nigeria. By assessing knowledge, motivation and behavioral skills, this research aims to provide evidence-based insights necessary for designing interventions that enhance adherence to safety protocols, ultimately reducing occupational exposures and improving public health outcomes.

METHODOLOGY

Research Design

This study employed a cross-sectional survey study design to assess the factors associated with adherence to safety protocols in handling medical waste among healthcare workers in Lagos University Teaching Hospital (LUTH) between the period of February and March 2025.

Study Location

This study was conducted at the Lagos University Teaching Hospital (LUTH), which is located in Idi-Araba, Surulere, Lagos State, Nigeria. Established in 1962, LUTH is one of the foremost teaching hospitals in Nigeria and is affiliated with the College of Medicine, University of Lagos. As a tertiary healthcare facility, it serves as a referral center for primary and secondary healthcare institutions across Lagos State and the surrounding areas, catering to a large population due to its strategic location in Nigeria's most populous city.

LUTH has a 761-bed capacity, making it the largest teaching hospital in Nigeria. The hospital provides a wide range of healthcare services, including general and specialist medical care, surgical procedures, and diagnostic services. It is also a hub for research, medical training, and capacity building, with various programs designed for healthcare professionals, students, and researchers.

In addition to its clinical and research roles, LUTH manages a significant volume of medical waste due to the high number of patients it serves daily. This includes infectious, pathological, and sharps waste generated from clinical activities, making the hospital an ideal study area for assessing adherence to safe medical waste handling protocols.

Inclusion and Exclusion Criteria

Eligible participants were healthcare workers who had been employed in Lagos University Teaching Hospital for not less than seven months and who were directly involved in the handling of medical waste, specifically doctors, nurses, and laboratory technicians that gave their written consents to be part of the study. Healthcare workers who were severely indisposed (e.g., ill at the time of data collection), those who were under suspension or any form of disciplinary action, those who had not worked for at least seven months, as they might still have been on probation and lacked adequate experience and familiarity with medical waste handling practices, or those who declined participation were excluded from the study.



Sample Size and Sample Techniques

The study involved a total of 403 consenting healthcare practitioners from LUTH, calculated employing the sample size computational formula used by Kish Leslie (1965). The formula states that:

$$N = \frac{Z\alpha^2 \cdot P(1-P)}{D^2}$$

where:

N – Sample size

D – The desired degree of accuracy, which is taken to be 0.05

P – The estimate of the satisfaction rate among target population (which was assumed to be 50% in the absence of a pre-existing estimate) 50% = 0.5

Zα – The standard normal deviation of 1.96 which corresponds to 95% confidence interval.

Substituting:

$$N = \frac{1.96^2 \times 0.50(1-0.50)}{0.05^2}$$

$$N = \frac{3.8416 \times 0.50 \times 0.5}{0.0025}$$

$$N = \frac{3.8416 \times 0.25}{0.0025}$$

$$N = \frac{0.9604}{0.0025}$$

$$N = 384$$

This shows that the minimum sample required to avoid type-1 error is 384.

10% attrition was added which brought the total sample size to 422.

The study employed a three-stage sampling technique involving stratified sampling, cluster random sampling, and purposive sampling to ensure comprehensive representation of healthcare workers handling medical waste in Lagos University Teaching Hospital (LUTH).

In the first stage, the entire population of healthcare workers was stratified into three professional categories—doctors (approximately 350), nurses (approximately 900), and laboratory technicians (approximately 250). A total population of 1,500 healthcare workers was considered, and a sample size of 422 (including a 10% allowance for non-response) was proportionally allocated to each stratum using the formula:

$$ni = (Ni / N) \times n$$



where n_i is the sample size for each stratum, N_i is the population size of each stratum, N is the total population (1,500), and n is the desired sample size (422). This yielded 98 doctors, 253 nurses, and 70 laboratory technicians.

In the second stage, cluster random sampling was used to select departments within each stratum. Balloting was employed to randomly select clinical units or departments. For doctors, five departments were selected; for nurses, ten units; and for laboratory technicians, five laboratories. The number of participants per department was determined based on the size and operational feasibility of each unit.

In the final stage, purposive sampling was applied within the selected units. Healthcare workers who were available during the study period and met the inclusion criteria were recruited until the allocated sample size for each unit was reached. Recruitment occurred across all shifts to ensure that participants from various duty rosters were represented. This multi-stage sampling approach enhanced the representativeness of the study population and ensured that a diverse cross-section of relevant healthcare workers was captured.

Variables

Independent Variables and Dependent Variable

The independent variables measured in this study included information on the socio-demographic characteristics of healthcare workers (such as age, sex, professional category, and years of experience), the level of information adequacy (knowledge and awareness regarding adherence to safety protocols in handling medical waste and risks associated with improper handling of medical waste), the level of motivation (attitudes, perceptions, drives and incentives), and the level of behavioural skills towards adherence to safety protocols in handling medical waste. Knowledge was assessed using 14 dichotomously scored items (true/false), with a total reference score of 14. Motivation was measured using a 33-point Likert scale with four response options: “strongly agree,” “agree,” “disagree,” and “strongly disagree.” Behavioral skills was also assessed on a 4-point Likert scale across 11 items, yielding a total rating scale of 33.

The dependent variable (main outcome) was the self-reported adherence behavior towards adherence to safety protocols in handling medical waste. This was measured using 11 questions with responses based on a 4-point Likert scale: “never,” “rarely,” “often,” and “always,” giving a total reference score of 33. All responses to the 11 adherence behavior-related questions were transformed to rating scale by computation to generate the overall score and summaries of descriptive statistics.

Instrument Validity and Reliability

The validity of the instrument was ensured by designing the constructs in alignment with the theoretical framework of the Information-Motivation-Behavioral Skills (IMB) model, which guided the study on adherence to safety protocols in handling medical waste. A thorough literature review further confirmed the appropriateness and relevance of the variables measured in the questionnaire. The internal consistency of the instrument, as determined by Cronbach’s alpha during a pilot study, was greater than 0.7 across all constructs, indicating acceptable reliability. Additionally, a test-retest reliability coefficient of 0.84 demonstrated a high level of stability and consistency of the instrument over time.



Data Collection Procedure

The study was conducted at Lagos University Teaching Hospital (LUTH). Two research assistants specialized in public health that had completed CITI Program Human Research Investigation online ethics training course (<https://www.citiprogram.org/>) were recruited to collect data. All research assistants were trained on study specific processes. They were provided with written materials and inclusion and exclusion criteria. The research assistants introduced the aim, obtained written consent from the eligible healthcare workers, and then administered the questionnaires to them while also assisting them with any issue arising from completing the questionnaire.

Data Analysis and Test of Significance

The collected raw data obtained through questionnaire were entered into version 23 of SPSS where computed transformations were carried out to generate descriptive statistics before proceeding to inferential statistics. Univariate descriptive analysis of socio-demographic, adherence-specific knowledge, motivation, behavioural skills and self-reported adherence behavior variables was performed by aggregating the items under each independent variable to assess their respective mean scores, which were reported as mean values and percentage mean scores (prevalence).

Analysis of variance (ANOVA) was conducted to test for statistically significant differences in the level of self-reported adherence behavior across professional categories and years of experience. Logistic regression analysis was performed to determine the strength and direction of association between adherence (dependent variable) and the IMB constructs (independent variables), with the level of significance set at 5%.

Ethical Issues

Ethical approval to conduct the study was obtained from both Babcock University Health Research Ethics Committee (BUHREC) and Lagos University Teaching Hospital Health Research and Ethics Committee (LUTHHREC) following thorough review of the research protocol to ensure the safety, confidentiality, and protection of the rights of all human participants. The BUHREC approval was granted under protocol number BUHREC 971/24, while the LUTHHREC approval was granted under protocol number ADM/DSCT/HREC/APP/7254.

Before participation, prospective participants were adequately informed about the purpose, procedures, potential benefits, and risks of the study. Written informed consent was obtained from each participant prior to data collection in accordance with ethical standards.

RESULTS

Socio-demographic Characteristics

The study captured data from 403 healthcare workers. The age of respondents ranged from 20 years to above 50 years, with an average age of approximately 34 years. More than half of the participants (53.9%) were females, while 46.1% were males.

In terms of educational attainment, a majority (294/403, 72.9%) held tertiary education qualifications, while 109 (27.1%) had postgraduate degrees. Nurses constituted the largest professional group (240/403, 59.6%), followed by doctors (95/403, 23.6%) and laboratory scientists (68/403, 16.9%).

Regarding training on medical waste handling, 280 (69.5%) reported having received prior training, with 140 (34.7%) indicating that their most recent training occurred within the past year.

(See Table 1 for detailed distribution of socio-demographic characteristics.)

Table 1: Socio-Demographic Characteristics of Respondents

Item	Frequency (n=403)	Percentage (%)
Age Group		
20-29 years	120	29.8
30-39 years	150	37.2
40-49 years	80	19.9
50 years and above	53	13.1
Gender		
Male	185	46.1
Female	218	53.9
Marital Status		
Single	145	36.0
Married	200	49.6
Divorced	35	8.7
Widowed	23	5.7
Educational Level		
Tertiary education	294	72.9



Postgraduate education	109	27.1
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Job Role

Doctors	95	23.6
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Nurses	240	59.6
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Laboratory Scientists	68	16.9
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Years in Healthcare

Less than 1 year	30	7.4
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1-5 years	120	29.8
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6-10 years	140	34.7
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More than 10 years	113	28.1
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Training in Medical Waste Handling

Yes	280	69.5
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No	123	30.5
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Last Training Received

Less than 1 year ago	140	34.7
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1-3 years ago	90	22.3
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More than 3 years ago	50	12.4
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IMB Constructs

Information (Knowledge)

The findings from this study revealed that the majority of participants demonstrated accurate understanding of key safety measures, with 94.3% correctly identifying the role of personal protective equipment (PPE), 96.8% recognizing the importance of handwashing, and 91.8% aware of the risks associated with handling contaminated sharps.

Despite this overall competence, notable knowledge gaps were observed in specific areas. Only 34.7% of the respondents acknowledged the necessity of tetanus vaccination for healthcare workers exposed to medical waste, and just 29.8% correctly understood the proper procedures for the disposal of contaminated PPE. These findings underscore the need for targeted training interventions to strengthen knowledge in these critical areas of occupational safety. (See Table 2 for full details.)

Table 2: Findings on Knowledge

Respondents in this Study (N=403)

Statements for consideration	Frequency (Correct)	Percentage (%)
Wearing gloves alone provides complete protection	310	76.9
Hepatitis B is a common infection from waste handling	355	88.1
Universal precautions include disposing of sharps properly	345	85.6
Sharps can be disposed of in any sealed container	180	44.7
PPE must be worn during all waste handling stages	380	94.3
Handwashing reduces cross-contamination risk	390	96.8
HIV can be transmitted through contaminated sharps	370	91.8
Tetanus vaccination is unnecessary	140	34.7
Hepatitis C is a risk from improper disposal	360	89.3
Chemical waste should be separated	355	88.1
Contaminated PPE should be disposed in regular bins	120	29.8
Radioactive waste requires specialized disposal	375	93.0
Gloves do not need to be replaced between tasks	195	48.4
Improper disposal causes environmental pollution	398	98.8



Motivation

The findings presented in this study reflect the motivational drivers behind adherence to safety protocols in handling medical waste. A significant majority of the respondents, 336 (83.4%), reported that their compliance was primarily due to a sense of personal responsibility, while 332 (82.3%) were motivated by the awareness of the severe consequences of infections. In contrast, a smaller proportion, 156 (38.6%), indicated that institutional rewards influenced their adherence, and only 175 (43.4%) were motivated by peer expectations. These results suggest that intrinsic factors—such as personal ethics and perceived risks—play a more dominant role in adherence than external incentives. (See Table 3 for full details).

Table 3: Findings on Motivation

Respondents in this Study (N=403)

Statements for Consideration	SD F(%)	D F(%)	A F(%)	SA F(%)
I adhere to medical waste handling protocols to avoid risk	21 (5.2)	42 (10.4)	205 (50.9)	135 (33.5)
I follow safety protocols to protect myself and others	18 (4.5)	49 (12.1)	194 (48.2)	142 (35.2)
I adhere because my colleagues expect me to	34 (8.4)	79 (19.6)	175 (43.4)	115 (28.6)
I follow protocols for institutional rewards	41 (10.2)	90 (22.3)	156 (38.6)	116 (28.9)
I adhere as it reflects my professional identity	25 (6.2)	58 (14.3)	182 (45.1)	138 (34.4)
I follow protocols due to fear of disciplinary action	32 (7.9)	76 (18.8)	172 (42.6)	123 (30.7)
I adhere to gain recognition as a responsible worker	37 (9.3)	70 (17.5)	168 (41.8)	126 (31.4)
I follow protocols because of the severe infection consequences	24 (5.9)	48 (11.8)	192 (47.7)	139 (34.6)
I adhere due to a sense of belonging to my team	27 (6.8)	61 (15.2)	187 (46.5)	127 (31.5)
I follow protocols for professional ethics alignment	19 (4.8)	56 (13.9)	198 (49.2)	130 (32.1)
I follow protocols to avoid legal consequences	22 (5.5)	66 (16.4)	180 (44.8)	134 (33.3)



Behavioural Skills

The findings on the behavioural skills of healthcare workers towards safe medical waste handling practices are presented in Table 4. A large proportion of respondents demonstrated high confidence in routine safety procedures, with 310 (77%) reporting confidence in the correct use of personal protective equipment (PPE), and 330 (82%) affirming their ability to consistently follow universal precautions. Additionally, 339 (84%) expressed confidence in handling sharp objects safely, while 350 (87%) felt assured in their ability to maintain proper hand hygiene. Furthermore, 330 (82%) reported confidence in identifying appropriate waste disposal bins. However, slightly fewer respondents indicated confidence in navigating unexpected challenges during waste handling (314, 78%) and educating others on safe practices (322, 80%). These findings suggest that while behavioural skills are generally strong among the respondents, targeted training may further improve preparedness for complex or non-routine scenarios. (Refer to Table 4 for full details.)

Table 4: Findings on the Behavioral Skills

Respondents in this Study (N=403)

Statements for Consideration	SD (n%)	D (n%)	A (n%)	SA (n%)
Confident in correctly using PPE	32 (8%)	60 (15%)	181 (45%)	129 (32%)
Know how to follow universal precautions	24 (6%)	48 (12%)	202 (50%)	129 (32%)
Confident in cleaning up hazardous spills	40 (10%)	73 (18%)	161 (40%)	129 (32%)
Capable of identifying appropriate disposal bins	28 (7%)	56 (14%)	193 (48%)	125 (31%)
Confident in handling sharps safely	20 (5%)	44 (11%)	210 (52%)	129 (32%)
Prepared to manage accidental exposure	36 (9%)	64 (16%)	169 (42%)	133 (33%)
Confident in maintaining proper hand hygiene	16 (4%)	40 (10%)	218 (54%)	129 (32%)
Ensure compliance even during busy shifts	24 (6%)	48 (12%)	197 (49%)	133 (33%)
Comfortable educating others on safe practices	28 (7%)	52 (13%)	189 (47%)	133 (33%)
Able to access and replace PPE	20 (5%)	40 (10%)	202 (50%)	141 (35%)
Confident in resolving unexpected challenges	32 (8%)	56 (14%)	177 (44%)	137 (34%)



Outcome Variable

Self-Reported Adherence Behavior

The frequency of responses on adherence to safety protocols in handling medical waste revealed that a significant majority of respondents reported consistent compliance with key safety behaviors. A total of 359 (89.1%) indicated that they regularly follow universal precautions, while 358 (88.8%) reported washing their hands immediately after handling medical waste. Additionally, 348 (86.3%) ensured the proper disposal of contaminated sharps, and 338 (83.9%) consistently reported and documented incidents of safety protocol non-compliance. However, only 155 (38.5%) of the respondents indicated that they always inspect personal protective equipment (PPE) for wear and tear before use, and just 163 (40.4%) actively reminded colleagues to adhere to safety procedures. These results indicate that while overall adherence is high, further emphasis on proactive measures like PPE inspection and peer accountability may be necessary to optimize safety compliance. (See Table 5 for full details.)

Table 5: Findings on the Self-reported Adherence Behavior

Respondents in this Study (N=403)

Statements for Consideration	Never (n%)	Rarely (n%)	Often (n%)	Always (n%)
I wear all recommended PPE while handling medical waste.	20 (5.0%)	40 (9.9%)	180 (44.7%)	163 (40.4%)
I adhere to universal precautions during every task.	15 (3.7%)	38 (9.4%)	190 (47.1%)	160 (39.7%)
I wash my hands immediately after handling medical waste.	10 (2.5%)	35 (8.7%)	195 (48.4%)	163 (40.4%)
I follow proper procedures for disposing of contaminated sharps.	12 (3.0%)	45 (11.2%)	185 (45.9%)	161 (39.9%)
I report needle-stick injuries or hazardous waste exposures.	25 (6.2%)	50 (12.4%)	170 (42.2%)	158 (39.2%)
I inspect PPE for damage or wear before using it.	18 (4.5%)	42 (10.4%)	188 (46.7%)	155 (38.5%)
I report and document incidents of non-compliance.	30 (7.4%)	55 (13.6%)	160 (39.7%)	158 (39.2%)
I sanitize contaminated surfaces immediately after exposure.	14 (3.5%)	37 (9.2%)	180 (44.7%)	172 (42.7%)
I keep my vaccinations up to date.	20 (5.0%)	45 (11.2%)	175 (43.4%)	163 (40.4%)



I consistently follow safety protocols, even when unsupervised. 12 (3.0%) 40 (9.9%) 182 (45.2%) 169 (41.9%)

I actively remind colleagues to follow safety protocols. 22 (5.5%) 48 (11.9%) 170 (42.2%) 163 (40.4%)

Summaries of Descriptive Statistics for the Study Variables

Levels of IMB Constructs and Self-Reported Adherence Behavior

The findings displayed in Table 6 show the summaries of the statistics computed for the study variables descriptively. It can be observed that the level of knowledge regarding safety protocols adherence in handling medical waste, measured on a 14-point scale, yielded a mean score of 8.9 ($SD = \pm 2.1$), representing 63.6% of the total expected knowledge, indicating that the respondents demonstrated above average knowledge. The level of motivation, assessed on a 33-point rating scale, had a mean score of 27.6 ($SD = \pm 1.8$), reflecting a high motivation prevalence of 83.6%, suggesting that respondents were strongly motivated to adhere to safety protocols in handling medical waste. Similarly, behavioural skills measured on the same 33-point scale showed a mean score of 25.8 ($SD = \pm 1.9$), indicating a prevalence rate of 78.2%, which signifies a good level of skill among the respondents. Finally, the outcome variable, self-reported adherence behavior, measured on a 33-point scale, had a mean score of 26.1 ($SD = \pm 2.3$), representing a prevalence of 79.1%. These findings suggest that overall adherence and the constructs of the IMB model were relatively high among the respondents. (Refer to Table 6 for full details.)

Table 6: Summaries of Descriptive Statistics Computed for the Respondents

Respondents in this Study (N=403)

Variable	Max. Score on Reference Scale	Mean	$\pm SD$	Prevalence
Level of Knowledge	14	8.9	2.1	63.6%
Level of Motivation	33	27.6	1.8	83.6%
Level of Behavioural Skills	33	25.8	1.9	78.2%
Level of Self-reported adherence behavior	33	26.1	2.3	79.1%



Relationship Between IMB Constructs and Adherence to Safety Protocols Using Logistic Regression Analysis

Dynamics of Self-Reported Adherence Behavior Using IMB Constructs

The logistic regression analysis model was applied to determine the extent to which the IMB constructs (knowledge, motivation, and behavioral skills) predict adherence to safety protocols in handling medical waste. The overall model was statistically significant ($p < 0.05$), confirming that these personal-level dispositions significantly predict self-reported adherence behavior.

Among the predictors, motivation emerged as the strongest predictor of adherence ($\beta = 0.61$, $\text{Exp}(\beta) = 1.84$, $p = 0.004$), suggesting that as healthcare workers become more motivated, either intrinsically or through perceived consequences, their likelihood of adhering to recommended safety protocols significantly improves. Behavioral skill also showed a good and statistically significant positive relationship with adherence ($\beta = 0.57$, $\text{Exp}(\beta) = 1.77$, $p = 0.002$), indicating that higher competence and self-efficacy in safety protocol adherence in handling medical waste directly contributes to improved compliance. Knowledge, though slightly less influential than the other constructs, still significantly predicted adherence behavior ($\beta = 0.48$, $\text{Exp}(\beta) = 1.62$, $p = 0.008$), demonstrating that understanding safety protocols is a relevant component of behavioral adherence. (Refer to Table 7 for details.)

Additionally, the study examined adherence patterns across different job roles and years of experience using ANOVA. Findings revealed that nurses reported significantly higher adherence behavior ($p = 0.001$) compared to doctors ($p = 0.002$) and laboratory scientists ($p = 0.014$), though there was no significant difference between doctors and lab scientists ($p = 0.21$). Furthermore, years of experience influenced adherence levels, with healthcare workers having 6-10 years of experience, demonstrating significantly higher adherence ($p = 0.002$) than those with less than 1 year ($p = 0.008$) and 1-5 years ($p = 0.017$). However, the difference between the 6-10 years and more than 10 years groups was not statistically significant ($p = 0.11$).

These findings confirm that both individual-level dispositions (as captured by the IMB model) and professional demographics, such as job role and years of experience, significantly shape adherence behavior to medical waste safety protocols. The IMB model thus remains a valid and practical framework for understanding and improving compliance behavior among healthcare workers. (See Table 7 and Fig. 1 and Fig. 2 for details.)

Table 7: Relationship Between Information, Motivation, Behavioral Skills and Self-reported Adherence Behavior to Safety Protocols Using Regression Analysis

Variable	Beta (β)	Exp(β)	p-value
Knowledge	0.48	1.62	0.008
Motivation	0.61	1.84	0.004
Behavioural Skill	0.57	1.77	0.002

Fig. 2: Conceptual framework derived from the information-motivation-behavioural skills model driving the study

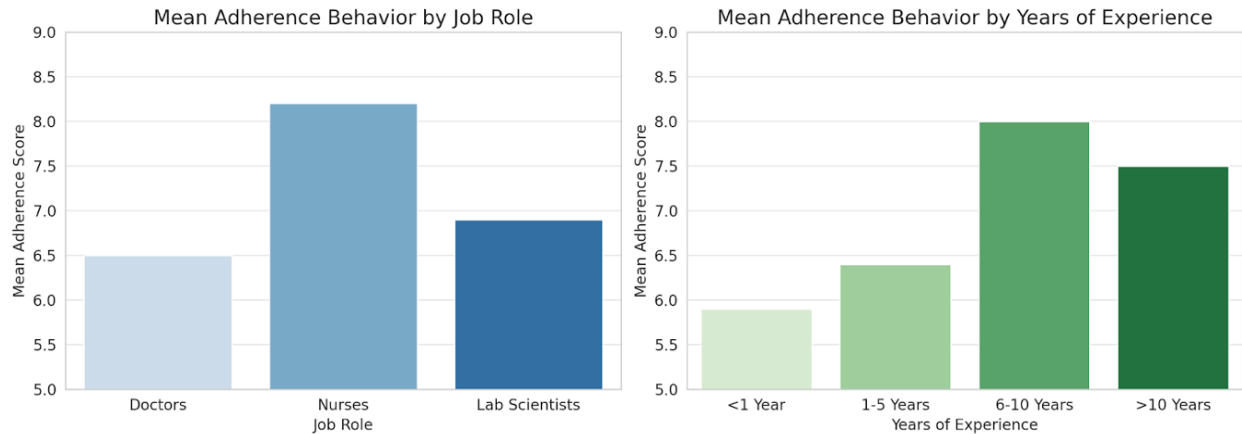
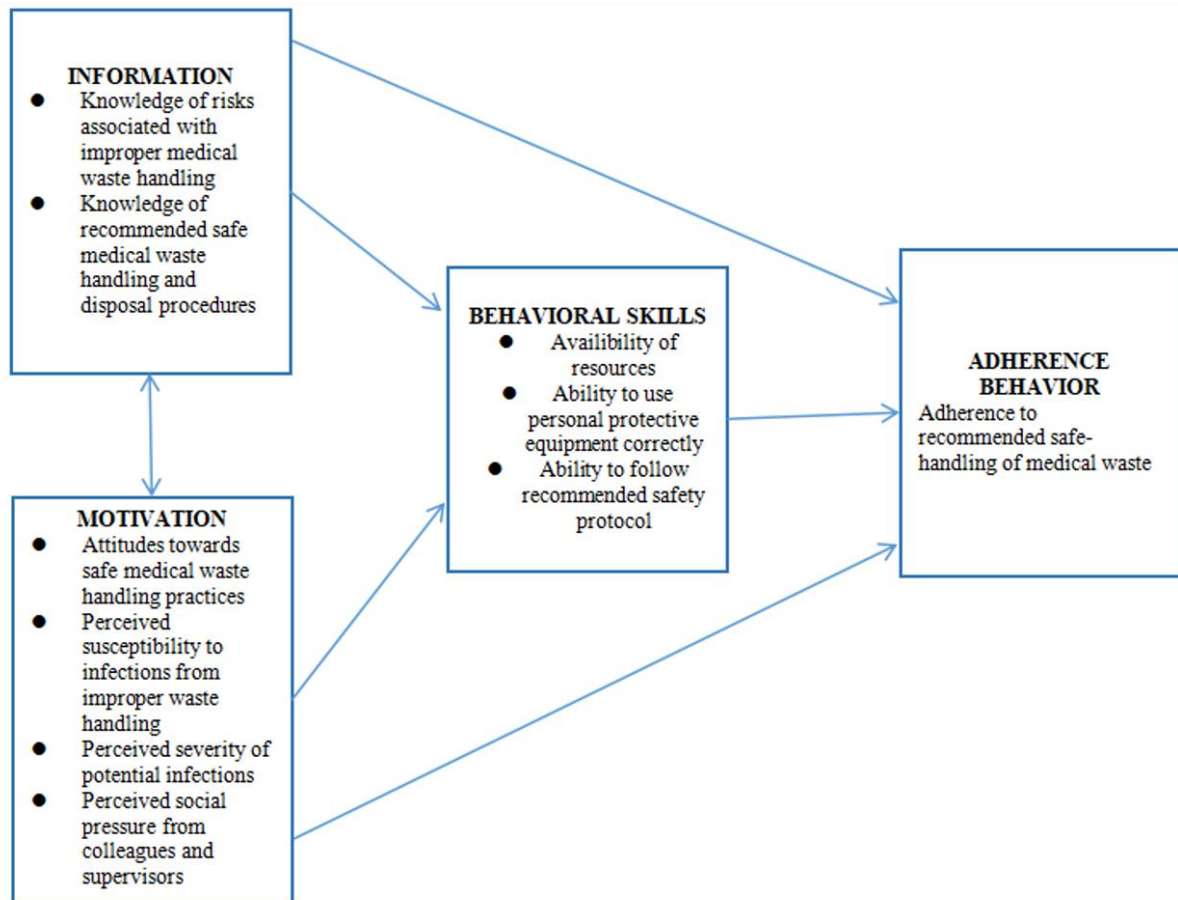


Fig. 1: Graphs showing mean adherence behavior by job role and by years of experience





DISCUSSION

Information

The study sought to assess the role of knowledge, motivation, and behavioral skills in predicting adherence to safety protocols in handling medical waste, using the IMB model as a guiding framework. A total of 403 healthcare workers participated in the study from a selected tertiary healthcare facility in Lagos State, Nigeria. The findings revealed that respondents demonstrated above-average levels of knowledge, with a mean score percentage of 63.6%. A high level of awareness was reported for key safety practices, including the use of personal protective equipment (PPE) (94.3%), the importance of handwashing (96.8%), and risks associated with contaminated sharps (91.8%). These findings are consistent with earlier studies, such as those by Jones et al. (2020), which reported generally high levels of safety awareness among healthcare professionals in clinical settings.

However, despite this relatively high level of awareness, notable knowledge gaps were identified in specific areas. For instance, only 34.7% of the respondents were aware of the importance of tetanus vaccination, and just 29.8% correctly understood the procedures for disposing of contaminated PPE. This suggests that while general awareness is adequate, there is insufficient depth in certain critical aspects of medical waste management. Similar gaps have been reported in other studies across low- and middle-income settings. Abdelnabi (2023) observed that although healthcare workers were familiar with day-to-day safety practices, they lacked a broader understanding of the long-term health and environmental consequences of improper medical waste handling. In the same vein, Bello and Yusuf (2022) found that inadequate awareness of environmental risks undermined full adherence to safety guidelines.

Furthermore, this study confirms previous research by Tilahun et al. (2023) and Mlouki et al. (2023) which emphasized the role of structured and continuous training programs in improving safety knowledge among healthcare workers. The findings reinforce that while awareness of basic safety measures may be widespread, there is a pressing need for more comprehensive education that addresses less commonly emphasized topics, such as vaccine-preventable occupational exposures and the broader public health implications of improper waste disposal.

Within the context of the Information-Motivation-Behavioral Skills (IMB) model, knowledge (or information adequacy) is a critical determinant of adherence behavior. The knowledge gaps identified in this study, particularly those related to vaccination protocols and environmentally safe disposal methods, suggest that additional educational interventions are necessary to foster complete compliance with safety standards. Thus, healthcare institutions and policymakers should prioritize the implementation of targeted training programs that not only reinforce procedural knowledge but also enhance understanding of the systemic and environmental consequences of poor handling of medical waste.

Ultimately, the above-average knowledge observed in this study, though promising, represents a missed opportunity if not strengthened through continuous education and institutional policy reinforcement. A more holistic training approach integrating health, environmental, and occupational perspective could significantly improve adherence to safety protocols and contribute to safer healthcare environments in Nigeria.



Motivation

In addition to the knowledge levels observed, this study reported a significantly positive level of motivation among healthcare workers regarding adherence to safety protocols, with a mean motivation score percentage of 83.6%. This demonstrates a high level of internal drive towards compliance with safety measures. A substantial majority of respondents cited personal responsibility (83.4%) and fear of infection (82.3%) as their main sources of motivation. Fewer respondents, however, were driven by institutional rewards (38.6%) or peer expectations (43.4%). These findings are consistent with those of (Garcia & Lee, 2019), who emphasized that intrinsic motivation, particularly professional commitment and ethical obligation, serves as a more powerful influence on compliance behavior than external rewards.

The strong predictive influence of motivation in this study is further validated by logistic regression analysis ($\beta = 0.61$, $\text{Exp}(\beta) = 1.84$, $p = 0.004$), indicating a statistically significant association between motivation and adherence to safety protocols. This supports the broader literature that positions motivation as a key behavioral determinant. Tilahun et al. (2023) similarly observed that perceived susceptibility to occupational hazards and the influence of institutional culture significantly impact healthcare workers' safety practices.

However, despite the high average motivation score, a subset of respondents expressed reduced motivation due to workplace-related barriers, such as insufficient supply of PPE, inadequate supervision, and lack of managerial incentives. These findings are in line with Dang et al. (2021), who identified that limited access to resources and poor institutional support can erode motivation and hinder compliance. Likewise, Okwuobi et al. (2022) reported that motivation-enhancing mechanisms like performance recognition and financial incentives significantly improve compliance among healthcare staff.

When viewed through the lens of the Information-Motivation-Behavioral Skills (IMB) model, motivation stands out as a critical component in shaping adherence behavior. The results from this study suggest that while intrinsic factors like personal responsibility and fear of exposure are strong motivators, their sustainability is dependent on enabling institutional environments. The variability in motivation levels among respondents could reflect disparities in institutional policies and the degree of managerial commitment to occupational safety.

As such, the findings underscore the importance of motivation-focused interventions that go beyond traditional awareness campaigns. Hospital administrators and policymakers should consider establishing structured incentive schemes, such as recognition programs and improved working conditions, to reinforce and sustain high motivation levels. These efforts will not only boost morale but also promote a culture of safety and compliance across healthcare facilities in Lagos State.

Behavioral Skills

The findings regarding the level of behavioral skills towards safe medical waste handling practices among respondents revealed a generally good level of competence, with key indicators showing strong adherence to essential safety practices. Specifically, 84% of healthcare workers reported safely handling sharps, 82% adhered to universal precautions, and 77% demonstrated correct use of personal protective equipment (PPE). This suggests that the respondents displayed solid behavioral skills necessary for the safe management of hazardous medical waste and the prevention of occupational exposure. These results align with the work



of Adams et al. (2021), who noted that although healthcare workers often show strong technical ability, more focused training in problem-solving and peer education could enhance their performance and overall compliance with safety protocols.

Despite the encouraging overall scores, there were observable gaps in certain areas. However, confidence in managing unexpected challenges (78%) and educating others (80%) was slightly lower. These figures point to a moderate shortfall in self-efficacy when compared to routine procedures. This aligns with the findings of Ferreira et al. (2024), who stressed that although baseline technical skills are essential, the ability to adapt and apply these skills under non-routine or high-pressure circumstances is critical for consistent safety adherence. Similarly, Obayomi et al. (2023) observed that many healthcare workers lack the confidence to manage emergency waste incidents, a shortcoming often linked to insufficient practical training. Akinwale and Sanni (2022) also found that infrequent refresher training contributes to weak performance in non-standard situations.

From the lens of outcome expectancy, most respondents appeared confident that adherence to proper waste-handling practices could significantly reduce the risk of infections, yet some hesitated when it came to teaching others or dealing with unusual waste types. This suggests that although the perceived benefit of compliance is recognized, the gap in comprehensive training may inhibit full behavioral execution in complex scenarios. This was further confirmed by logistic regression findings, which showed behavioral skills to be a significant predictor of adherence ($\beta = 0.57$, $\text{Exp}(\beta) = 1.77$, $p = 0.002$), reinforcing their vital role in safety compliance.

Applying the Information-Motivation-Behavioral Skills (IMB) model, it is clear that behavioral skills play a direct role in shaping adherence behaviors. Even in the presence of adequate knowledge and motivation, weak practical application can undermine compliance. The variability in behavioral skills observed in this study could be attributed to inconsistent training approaches across institutions and varying levels of resource availability. Therefore, targeted interventions, such as regular simulation exercises, hands-on workshops, and peer-led demonstrations, are essential to strengthen behavioral skills, particularly in the areas of emergency response and peer education.

Ultimately, if healthcare workers can clearly perceive the benefits of proper medical waste handling and are adequately trained to respond under both routine and non-routine conditions, their adherence to safety protocols is likely to improve. Healthcare management should prioritize capacity-building initiatives that not only reinforce technical knowledge but also build confidence and problem-solving skills, thereby enhancing overall safety culture and performance within healthcare settings.

Self-Reported Adherence Behavior

Findings from this study indicate that healthcare workers demonstrated a relatively high level of self-reported adherence behavior towards adherence to safety protocols in handling medical waste, with a prevalence rate of 79.1%. This result reflects commendable adherence practices compared to prior reports of lower compliance across various Sub-Saharan healthcare settings such as those found in Alabi et al. (2021), Eze et al. (2022), and Okeke et al. (2021). Notably, our findings are consistent with those of Nguyen et al. (2022), who observed high compliance rates in institutional settings with active safety monitoring, although discrepancies remain in areas that involve peer-to-peer accountability and proactive safety behaviors.



In this study, adherence to universal precautions was high (89.1%), and proper hand hygiene was frequently reported (88.8%), reflecting a well-internalized culture of basic safety practices. In addition, safe handling of sharps (86.3%) and documentation of exposure or injury (83.9%) were also widely observed among respondents. However, concerning gaps emerged in routine inspection of personal protective equipment (38.5%) and peer reminders to reinforce safety protocol compliance (40.4%). These findings align with those reported by Eze et al. (2022), who noted that while healthcare workers may adhere to safety norms individually, social desirability bias and institutional culture often limit the full expression of peer-led interventions. Likewise, Omotayo et al. (2023) emphasized that weak peer accountability mechanisms hinder optimal adherence even in technically competent environments.

Several respondents also cited systemic barriers such as insufficient waste segregation infrastructure and high workloads as impediments to full compliance. These barriers mirror earlier observations by Alabi et al. (2021), who identified institutional deficiencies rather than knowledge gaps as key drivers of noncompliance in Nigerian healthcare settings. Although most healthcare workers in our study demonstrated accurate knowledge and motivation, environmental constraints frequently disrupted the consistent translation of intention into action.

Anchored in the Information-Motivation-Behavioral (IMB) skills model, these findings underscore that adherence behavior is not solely a function of individual knowledge or motivation but is significantly shaped by contextual variables and institutional capacity. While the behavioral skills component among workers appears moderately strong, environmental facilitators, such as adequate waste bins, timely PPE replacement, and supervision, must be in place to reinforce action. Thus, while self-reported adherence appears encouraging, the potential divergence from actual behavior due to institutional limitations warrants structured intervention.

To address these gaps, healthcare facilities should invest in strengthening operational infrastructure and promoting a culture of shared accountability. Interventions could include regular PPE inspections, peer-led safety workshops, and integration of behavioral reinforcement mechanisms into routine facility supervision. Doing so will bridge the gap between perceived and actual adherence, ultimately contributing to more sustainable and consistent practice. This study contributes to filling a critical gap in the literature by applying the IMB model to analyze the predictors of medical waste handling compliance and by identifying modifiable institutional determinants that can improve public health safety outcomes.

CONCLUSION

This study reported a relatively high level of knowledge and motivation, alongside moderate behavioral skills for adopting safety protocol adherence in handling medical waste, which together informed an overall good but not optimal level of adherence among healthcare workers. Motivation was identified as the strongest predictor of adherence, followed closely by behavioral skills and knowledge. While compliance with core practices such as universal precautions and hand hygiene was commendable, gaps in behavioral execution and institutional support structures remain critical concerns.



The findings emphasize that improving adherence requires more than just awareness; it necessitates continuous educational reinforcement, motivation-enhancing strategies, and practical skill-building interventions tailored to workplace realities. By applying the IMB model, this study underscores the need for a more integrated and holistic approach—one that goes beyond information delivery to include environmental enablers, supportive policies, and peer-driven accountability systems. Future interventions should therefore focus on structured training, workplace motivation schemes, and infrastructure improvements to bridge the gap between reported and actual adherence practices, thereby ensuring consistent and sustainable compliance in medical waste management across healthcare facilities.

RECOMMENDATIONS

The identified gaps in knowledge retention, motivation, and behavioral skill execution towards adherence to medical waste handling protocols among healthcare workers necessitate the implementation of continuous, structured training programs and workplace-based health education. Regular refresher courses and simulation-based skill-building exercises should be introduced to strengthen healthcare workers' capacity to comply with safety protocols, particularly in high-risk procedures such as handling contaminated PPE and emergency waste situations.

In addition, motivation-driven interventions such as recognition programs and intrinsic motivation strategies should be adopted to reinforce personal responsibility and professional accountability. Healthcare administrators must prioritize the provision of adequate resources—including PPE and waste disposal infrastructure—while also ensuring regular inspection and maintenance systems are in place to support adherence efforts.

Furthermore, a supportive policy environment backed by strong managerial commitment is essential to sustain compliance. Future public health campaigns and institutional efforts should therefore adopt a holistic approach, integrating information, motivation, and behavioral skill enhancement. This will help ensure consistent and sustainable adherence to safety protocols in medical waste management, ultimately promoting safer healthcare environments and reducing occupational health risks.

Abbreviations

ANOVA: Analysis of Variance, BUHREC: Babcock University Health Research and Ethics Committee, HBM: Health Belief Model, HCWs: Healthcare Workers, HREC: Health Research Ethics Committee, IMB: Information Motivation Behavioral Skills Model, LMICs: Low- and Middle-Income Countries, LUTH: Lagos University Teaching Hospital, PPE: Personal Protective Equipment, SDGs: Sustainable Development Goals, WHO: World Health Organization.

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