

Original Research Article

BIOMEDICAL WASTE MANAGEMENT AWARENESS AND BEHAVIOUR: A CROSS-SECTIONAL SURVEY

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ABSTRACT

Background: Effective biomedical waste (BMW) management is essential in healthcare settings to ensure safety and environmental protection. However, variations in awareness and adherence to BMW protocols across healthcare workers can lead to hazardous outcomes. This study assesses the awareness, attitudes, and practices related to BMW management among interns, residents, and nursing staff in a tertiary care hospital's ENT ward.

Material and Methods: A cross-sectional, descriptive study was conducted using a structured, self-administered questionnaire among 89 healthcare workers, including 17 interns, 9 residents, and 63 nursing staff. Participants' knowledge, attitudes, and practices concerning BMW were evaluated. Descriptive statistics were applied to summarize findings, while chi-square tests analyzed associations between experience levels and BMW awareness.

Results: Among respondents, 80 correctly identified biomedical waste, while 8 misclassified general hospital waste as BMW. Knowledge of BMW Management Rules (2016) was high, with 79 respondents aware of the rules, yet only 45 knew the penalties for non-compliance. When asked about disposal practices, 51 participants correctly identified yellow bins for soiled dressings, while others incorrectly chose red. Chi-square analysis indicated no significant association between experience levels and BMW awareness ($\chi^2 = 1.73$, $p = 0.63$). A substantial portion (59%) of staff regularly referred to BMW guidelines, although training schedules varied significantly. Additionally, 68 respondents received BMW training within the past year, with notable gaps in knowledge related to handling sharps and liquid waste disposal.

Conclusion: The findings highlight high general awareness but emphasize gaps in specific BMW practices, particularly in correct categorization and handling methods. Misunderstandings around role-based responsibilities suggest a need for continuous training across all experience levels, with an emphasis on protocol adherence. Implementing a structured training schedule with periodic evaluations could enhance compliance and safety in BMW management.

Key Words: Biomedical waste, healthcare workers, biomedical waste management, ENT ward, healthcare safety, health awareness.

INTRODUCTION

Biomedical waste (BMW) management is an essential aspect of healthcare systems, particularly in high-risk areas like the ENT ward, where the volume and variety of waste generated (e.g., sharps,

infectious materials, and body fluids) pose significant risks to healthcare workers, patients, and the environment.^[1] Proper segregation, handling, and disposal of BMW are not only critical for infection control but also a legal and ethical

responsibility as per the Biomedical Waste Management Rules, 2016.^[2]

Despite the availability of guidelines, gaps in knowledge, compliance, and behaviour persist among healthcare workers. Previous studies have highlighted the need for regular training, awareness programs, and strict adherence to protocols.^[3-5] In this context, assessing the level of awareness and practices related to BMW management is crucial to identifying areas for improvement. This study aims to evaluate the awareness, practical application, and behaviour related to BMW management among interns, residents, and nursing staff in the ENT ward of a tertiary care hospital. The findings from this survey will provide insight into existing practices and suggest measures for enhancing compliance with BMW protocols.

Objectives

1. To assess the level of awareness of biomedical waste management rules among healthcare staff in the ENT ward.
2. To evaluate the practical behaviour of healthcare workers regarding BMW segregation and disposal.
3. To identify gaps in training and resources that contribute to non-compliance with BMW protocols.

MATERIALS AND METHODS

***Study Design**

A cross-sectional, descriptive study was conducted using a structured questionnaire to evaluate the awareness, attitudes, and behaviours related to BMW management among healthcare workers in the ENT ward of a tertiary care hospital. The study focused on assessing how well interns, residents, and nursing staff understood and practiced BMW protocols in their daily duties.

***Study Setting and Population**

The study took place in the ENT ward, with participants consisting of interns, residents, and nursing staff. Healthcare personnel who had worked in the ward for at least one month were eligible. The inclusion criteria required their active involvement in handling BMW, and their willingness to participate. Those not directly involved in BMW handling or unwilling to provide consent were excluded from the study.

***Sample Size**

To determine the appropriate sample size, previous studies estimating awareness levels at around 70% were used. Assuming a 10% margin of error and a 95% confidence level, the sample size calculation for cross-sectional studies was performed using the formula:

$$n = [Z^2 \times P \times (1-P)] / E^2$$

Where:

- Z = 1.96 (for 95% confidence level)
- P = 0.70 (proportion of awareness)
- E = 0.10 (margin of error)

Thus, the minimum required sample size was calculated to be 81 participants. However, the study ultimately included 89 participants, encompassing a broad range of experience levels.

***Data Collection Tool**

A structured, self-administered questionnaire, developed in line with the BMW Management Rules, 2016, and based on previous studies, was used. It included four sections:

1. Demographics: Information about participants' designation, department and years of experience.
2. Knowledge: Questions related to awareness of BMW rules, penalties, colour coding and responsibilities.
3. Practical Application: Assessment of practices such as waste segregation, personal protective equipment (PPE) usage, and disposal methods.
4. Feedback and Evaluation: Participants' feedback on the current state of BMW management in the ward and their suggestions for improvements.

The questionnaire was validated by experts in BMW management before being distributed.

***Data Collection Procedure**

The questionnaire was distributed during working hours in the ENT ward. Participation was voluntary, and informed consent was obtained from each respondent and responses were collected anonymously over a two-month period.

***Data Analysis**

Responses were entered into a Microsoft Excel sheet and analyzed using SPSS version 25.0. Descriptive statistics, number and percentage, were used to summarize variables related to awareness, PPE usage, and segregation protocols. Inferential statistics were employed to explore relationships between key variables. Chi-square tests were used to assess associations between years of experience and awareness levels of biomedical waste management among healthcare workers. A p-value less than 0.05 was considered statistically significant.

RESULTS

The study was conducted with 89 participants to evaluate awareness and behaviour related to BMW management in the surgical ward. The Demographic profile of study participants is given in Table 1. [Table 1]

A) Knowledge and awareness

An overwhelming majority, 80 respondents, correctly identified what constitutes biomedical waste. Table 2 gives a summary of knowledge and awareness about BMW in participants. [Table 2]

An impressive 83 (93.2%) respondents correctly understood that the responsibility for BMW management lies with all staff—doctors, nurses, and administrators alike. However, 6 (6.7%) respondents believed it to be solely the responsibility of nursing staff.

B) Waste Segregation Practices

When it came to practical application, responses were mixed. Table 3 tabulates the responses of participants regarding specific waste segregation practices. [Table 3]

C) Training and Reading Guidelines

While 59 respondents reported regularly referring to BMW management guidelines, 24 referred to them only occasionally, and 6 respondents never did. In terms of training frequency, the responses varied: 32 respondents said they receive training monthly, 13 said quarterly, 5 reported annual training, and 39 indicated no specific training schedule. Despite these variations, 80 respondents knew where the color-coded bins were located in the ward, although the remainder, mostly newer nursing staff, did not.

D) Behaviour and Challenges

Notably, 68 respondents had received BMW training in the past 12 months, while 31 had not. When asked if they had ever witnessed mixing of biomedical and general waste, 53 respondents reported that they had never seen such incidents, while 23 observed it rarely. However, 9 respondents admitted to seeing it often, and 4 said it happened consistently. This behaviour underscores the importance of ongoing training and supervision. Regarding PPE use, 46(51.7%) respondents said they would use gloves, a mask, and an apron while handling biomedical waste. However, 26 said they would use only gloves, and 10 said they would wear both gloves and a mask. This indicates varying levels of compliance with full PPE recommendations.

E) Needle Handling and Liquid Waste Disposal- illustrated in Table 4.

F) Injury and Spill Management

Regarding BMW-related injuries, 31 respondents had encountered needle-stick injuries or similar incidents in the past year, and all reported them to a supervisor. Additionally, 79 respondents were aware of the hospital's protocol for handling spills, such as broken vials or blood spills, demonstrating relatively high awareness of critical emergency procedures.

G) Confidence and Challenges in BMW Management

The study also revealed a range of confidence levels regarding adherence to BMW segregation practices in the ENT ward, with 69 respondents feeling that proper segregation was strictly followed. On a confidence scale of 5, 73 participants rated themselves as quite confident about their BMW management knowledge. In terms of perceived challenges, 31 respondents felt that lack of training was the biggest challenge to proper BMW management in the ward, 14 cited deficiencies in supervision, 8 pointed to insufficient bins or bags, and another 8 mentioned a lack of cooperation among staff. A significant proportion (46) recommended improvements to BMW management in the form of structured training in the first week of joining, accompanied by formal evaluations to ensure seriousness in adherence to protocols. A total of 79 respondents believed that more training was required for staff on biomedical waste management.

H) Association Between Years of Experience and Awareness Levels of Biomedical Waste Management Among Healthcare Workers- The association between years of experience and awareness and behaviour among healthcare workers was calculated, as illustrated in Table 5.

Table 1: Demographic profile summarising the experience and distribution of participants

Category	<1 year	1-3 years	3-5 years	>5 years	Total
Medical Interns	16	1	-	-	17 (19.1%)
ENT residents	4	2	2	1	9 (10.1%)
Nursing Staff	29	3	10	21	63 (70.8%)
Total	49	6	12	22	89

Table 2: Knowledge and awareness of about BMW in participants

AWARENESS AREA	AWARE	NOT AWARE
Correctly identifies BMW	80 (89.9%)	9 (10.1%)
BMW Rules 2016	79 (88.8%)	10 (11.2%)
Penalties for improper disposal	45 (50.6%)	44 (49.4%)

Table 3: Specific BMW segregation practices amongst participants

CATEGORY	CORRECT RESPONSE	INCORRECT RESPONSE
Soiled dressings and gloves	51 (yellow bin)	38 (red bin)
Time of segregation (at time of generation)	39 (at time of generation)	49 (daily), 1 (weekly)
Confidence in waste bin identification	Very confident: 43, Confident: 38, Somewhat confident: 8	

Table 4: Needle handling and liquid waste disposal

Practice	Correct	Incorrect
Disposal of needles into sharps containers	84 (94.4%)	5 (5.6%)
Liquid medical waste disposal	Separate container-61 (68.5%)	Flushed in drain-18 (20.3%), unsure-10 (11.2%)

Table 5: Association between years of experience, and awareness and behaviour patterns of healthcare workers

Association Tested	Chi-square Value	p-value	Significance
1. Experience Levels and Awareness of BMW Rules, 2016	1.73	0.63	Not Significant
2. Experience Levels and Correct Identification of Hazardous Waste	5.49	0.36	Not Significant
3. Experience Levels and Adherence to Segregation Practices	7.58	0.19	Not Significant
4. Experience Levels and Training Participation	11.06	0.048	Significant (p < 0.05)

DISCUSSION

The findings from this study emphasize the existing strengths and gaps in biomedical waste (BMW) management knowledge, attitudes, and practices among healthcare workers in the ENT ward. The overall awareness of BMW Management Rules, 2016,^[2] is encouraging, with 89.9% of respondents aware of the regulations. However, awareness alone has not translated into uniformly safe practices, as evidenced by discrepancies in BMW segregation, personal protective equipment (PPE) usage, and disposal methods for liquid waste. This pattern resonates with findings from Patil and Shekdar, who noted that awareness of guidelines does not necessarily lead to compliance without consistent reinforcement through training and monitoring.^[6]

Among respondents, a significant portion demonstrated insufficient understanding of hazardous biomedical waste items. While 25 respondents correctly identified used syringes, blood-soaked gauze, and expired medication as hazardous, others only partially recognized these items, which could lead to improper handling. Such gaps in knowledge have been documented in similar studies in both national and international settings, where staff members often fail to distinguish between general and hazardous BMW.^[6-7] Gupta et al⁸ and Conti et al,^[9] also emphasize that such misclassifications are common, underscoring the need for consistent training to enhance waste-handling practices and reduce contamination risks. Targeted training on waste categorization has proven effective, as shown by Singh et al,^[10] who found improved compliance post-training.

Responsibility allocation emerged as an area needing improvement. While most respondents recognized BMW management as a collective responsibility, a few viewed it as the sole duty of nursing staff. Such role-based misunderstandings can hinder a cohesive, team-based approach essential for effective management. Studies by Pandit et al,^[11] and Soko et al,^[12] highlight that unclear responsibility often leads to inconsistent adherence to waste protocols, uneven accountability, and decreased compliance. This indicates a pressing need for clearer role definitions and regular team-based training to reinforce the collective responsibility for BMW management.

Training frequency and access to guidelines were noted as significant factors impacting BMW management efficacy. While monthly or quarterly training schedules were reported by 50.5% of

respondents, nearly 44% indicated that no specific training frequency was followed. Moreover, a significant minority admitted they seldom or never refer to BMW management guidelines, which may impact adherence to best practices. These findings align with previous studies emphasizing the importance of regular training and guideline reinforcement in fostering long-term compliance.^[11,13] A structured, routine approach to training, particularly for new staff members, could enhance both knowledge retention and practical application of BMW protocols, ultimately fostering a safer hospital environment.

The study also revealed variability in PPE usage and liquid waste disposal practices. Although the majority (51.7%) reported using gloves, masks, and aprons, a substantial number only used gloves or gloves and masks. This incomplete adherence raises concerns, particularly in environments with high exposure risk, where full PPE usage is necessary. Similar trends in PPE compliance have been observed in a Saudi Arabian study, which found that insufficient PPE usage increased contamination risks, suggesting the need for strict adherence policies.^[7] In addition, the variability in liquid waste disposal methods—such as 20.3% of respondents flushing waste down drains—points to a lack of standardized practices. Studies by Patil and Shekdar,^[14] and Ananth et al,^[15] found that inadequate disposal protocols for liquid biomedical waste can lead to environmental contamination, stressing the need for stricter training on safe liquid waste handling.

Notably, respondents with less than a year of experience were often less confident in their knowledge of BMW management. This aligns with findings from Patil and Shekdar, who observed that experience can enhance familiarity with protocols but is not a substitute for formalized training programs.^[14]

In our study, chi-square analysis revealed key insights into the influence of experience on BMW management knowledge and practices. Notably, experience levels did not significantly impact awareness of the BMW Management Rules, 2016, or the ability to correctly identify hazardous waste items. This aligns with findings from Gupta et al⁸, suggesting that awareness gaps exist across all experience levels, indicating a need for widespread training interventions. However, a significant association was found between experience levels and training participation (p = 0.048), with junior staff reporting lower training attendance. This

suggests that targeted efforts to include newer staff in BMW management training sessions could enhance overall compliance and reduce errors. Regular, inclusive training has been shown to improve adherence and reduce knowledge discrepancies, as corroborated by previous studies.^[7,10]

CONCLUSION

In conclusion, this study underscores both strengths and gaps in BMW management among healthcare workers in the ENT ward of a tertiary hospital. While awareness of BMW rules is high, gaps in practical application and adherence to best practices—particularly concerning PPE usage, waste segregation, and liquid waste disposal—suggest the need for enhanced, continuous training. The lack of a statistically significant relationship between experience and awareness indicates that focused interventions across all experience levels, particularly for new staff, are essential. Implementing mandatory, routine BMW training and periodic evaluations for all staff could improve compliance and promote a culture of safety in healthcare waste management.

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