

Research Article

# Impact of Training Program in Improving Knowledge of Healthcare Personnel Regarding Biomedical Waste Management in Government Medical College and Associated Hospital

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## ABSTRACT

**Background:** Biomedical waste (BMW) poses significant risks to healthcare workers and the environment if not managed properly. Despite the existence of comprehensive Biomedical Waste Management Rules (2016) in India, knowledge gaps among healthcare personnel continue to hinder safe practices. Structured training programs are critical for enhancing compliance and awareness.

**Aims/Objectives:** To evaluate the impact of a structured training program on the knowledge of paramedical healthcare workers regarding biomedical waste management in a government medical college and associated hospital.

**Settings and design:** A before-and-after interventional study was conducted among 112 paramedical staff at associated hospital of a newly established Government Medical College. Participants underwent a three-day structured training program on BMW management.

**Material and methods:** A pre-tested questionnaire assessed knowledge before and after the intervention. Data were analyzed using SPSS v20, with the chi-square test applied to determine statistical significance ( $p < 0.05$ ). Practices of the paramedical staff were assessed by observational visits to check adherence to the biomedical waste management guidelines which got polished by training program.

**Results:** Post-training, a statistically significant improvement was observed in ten out of thirteen knowledge variables. Notably, knowledge regarding sharp disposal increased from 36.6% to 76.8% ( $p < 0.00001$ ), and awareness of disease transmission risks improved from 10.5% to 85.6% ( $p < 0.00001$ ). Overall, the intervention led to a marked enhancement in participants' understanding of BMW segregation and safe disposal practices.

**Conclusion:** Structured training programs significantly improve healthcare workers' knowledge of biomedical waste management. Regular refresher courses and integration of BMW training into institutional policy and healthcare curricula are recommended to ensure sustained compliance and safer healthcare environments.

**Keywords:** Biomedical Waste, Healthcare Personnel, Training Program, Infection Control, Waste Segregation, India.

**Key Message:** Structured training improves knowledge and practices of healthcare personnel regarding biomedical waste management.

## INTRODUCTION

Biomedical waste (BMW) comprises any waste generated during the diagnosis, treatment, or immunization of human beings or animals, and in related research activities or the production and testing of biological [1]. The safe management of this waste is crucial due to its potential to transmit infectious diseases and pose environmental hazards when improperly

handled. Inadequate biomedical waste management remains a persistent concern globally and particularly in developing countries, where enforcement of regulations and training of personnel may be suboptimal [2].

In India, the Ministry of Environment and Forests introduced the Biomedical Waste (Management and Handling) Rules in 1998,

which have since undergone significant revisions, including the comprehensive Biomedical Waste Management Rules (BMW) 2016. These rules mandate systematic segregation, handling, and disposal of biomedical waste using color-coded bins, and stress the need for training of healthcare personnel at all levels to ensure compliance [3]. However, various studies have highlighted persistent gaps in knowledge and practice among healthcare workers, leading to potential health risks to workers and the community[4][5].

Healthcare personnel, particularly paramedical staff who are directly involved in Biomedical waste handling, require adequate training to implement BMW rules effectively. Research indicates that structured training programs can substantially improve knowledge and practices regarding BMW segregation, disposal, and safety measures [6] [7]. Despite this, training is often insufficient or inconsistent, especially in newly established medical colleges and district hospitals.

In this context, the present study was conducted to assess the impact of a structured training program on the knowledge of paramedical healthcare workers at a government medical college and associated district hospital. By identifying knowledge gaps and measuring improvements post-intervention, the study aims to provide evidence to support institutional policies promoting regular training and compliance with national biomedical waste management standards.

#### **Rationale**

For smooth functioning of the hospitals, it is imperative for each medical institution to keep its hospital staff updated about the new BMW rules (2016). Arrangements for the awareness of the providers about various provisions of BMW (Management and Handling) rules will help in improving the BMW management.

The present study was undertaken to measure the impact of training program in improving the knowledge of paramedical healthcare workers of a district hospital associated with a new Government Medical College.

Research question: Does a training program on BMW improve the knowledge of Health care workers?

#### **Objectives**

1. To estimate the baseline knowledge of healthcare workers regarding BMW management rules 2016.
2. To determine the effect of training program on their knowledge.

#### **METHODS**

The study design was before and after workshop based intervention study. Study participants were paramedical staff of associated hospital of a newly established Government Medical college. After seeking ethical clearance, a training program was organized by the Department of Community Medicine.

After taking informed consent from healthcare personnel, structured training was imparted by the faculty of community Medicine for three days which was supported by audio-visual display. A total of 112 participants were registered. Knowledge about BMW segregation and management was assessed using a pre-tested questionnaire with a total of 20 questions. The same set of questions was repeated after the training was over.

In addition to assessing knowledge through pre- and post-training questionnaires, observational visits were conducted to various sections of the hospital one week after the training. These visits aimed to assess any observable changes in the practices of the participants concerning biomedical waste management. Observations focused on waste segregation at source, use of personal protective equipment (PPE), adherence to color-coded disposal systems, and reporting of sharps injuries. A Checklist was framed based on National Quality Assurance Standards [8] assessing biomedical waste management of district hospitals for observing practices. The observation questionnaire was used to assess the practice of HCWs in healthcare sectors. It contained fifteen questions with the options "Yes" "No," and "Not applicable".

The data was entered in MS Excel and analyzed in SPSS 20. The data was summarized in the form of tables and responses were summarized in the form of frequency and proportions. For Knowledge part Chi-square test was used to test association between quantitative variable which measured statistically significant differences ( $p < 0.050$ ) before and after the training. The overall practice was calculated and interpreted using the frequency distribution table.

**RESULTS**

A total of 112 participants were included in the study from different cadres of healthcare workers with majority being permanent staff nurses (Figure: 1) with less than ten years of working experience (Figure: 2). After providing training regarding biomedical waste

management significant improvement was seen in overall knowledge of Healthcare workers with highly significant improvement in their knowledge regarding disposal of different categories of waste and disease transmitted through improper management (Table 1).

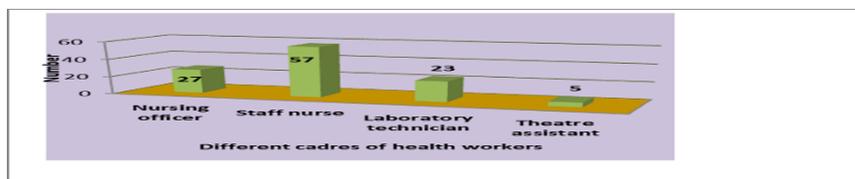


Figure 1: Distribution of Study Participants as Per Cadre

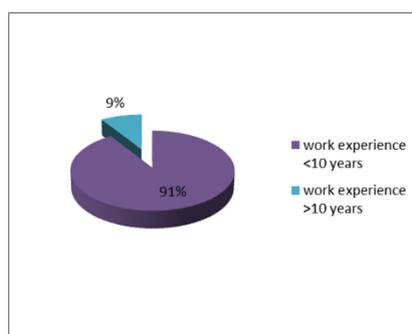


Figure 2: Distribution of Study Participants as Per Years of Experience

Table 1: Awareness of Healthcare Personnel Regarding Bio-Medical Waste Management (N=112)

Sr.No	Knowledge Variables	Pre Training(% Correct Responses)	Post Training(% Correct Responses)	Chi-Square Test (P-Value)
1.	Knowledge about number of color coded bins	92.9%	96.4%	0.373359
2.	Knowledge about color coded bin for sharp disposal	36.6%	76.8%	<0.00001
3.	Knowledge about color coded bin for disposal of tubes and catheters	68.8%	83.9%	0.0075
4.	Knowledge about disposal of discarded medicine	48.2%	87.5%	<0.00001
5.	Knowledge regarding soiled waste disposal	75.0%	91.1%	<0.00001
6.	Knowledge about disinfection of needles	74.1%	94.6%	0.000052
7.	Knowledge regarding disease transmitted through improper waste disposal	10.5%	85.6%	<0.00001
8.	Knowledge about reporting of injury due to sharps	69.2%	85.6%	0.00012
9.	Knowledge about proper use of personnel protective equipment during handling of waste	70.5%	83.2%	0.01649
10.	Knowledge regarding filling capacity of BMW bags	44.6%	93.8%	<0.00001
11.	Knowledge about disposal of food and paper waste	92.9%	97.3%	0.21616
12.	Knowledge about disposal of blood bags	53.6%	56.2%	0.78826
13.	Knowledge about management of needle stick injury	76.8%	90.2%	0.0117

Ning program, informal observational rounds were carried out in different wards and departments of the hospital. These visits revealed a visible improvement in the application of biomedical waste management practices. Table 2 describes the observation of the current practice on medical waste management for three categories; a). Segregation of waste, b) Transportation of medical waste, c) Appropriate use of PPE. On

an average, 75.96 % of the observed units have correctly segregate waste as per colour coded bins. Around 76% of the waste generated is transported in accordance with the transportation guideline with 20% of the waste not segregated into infectious and general wastes. About 70% were found to be using appropriate PPE with 13.3% not following needle stick injury protocol.

Table 2: Observation of Practices of Biomedical Waste Management

Parameters		Yes	No	NA
		(%)	(%)	(%)
<b>A.</b>	<b>Segregation of waste</b>			
1.	Does yellow bag contain only soiled infectious waste	10(66.6%)	4(26.6%)	1(6.6%)
2.	Does white container contain only sharp waste	13(86.6%)	2(13.3%)	0(0.0%)
3.	Does blue bag contain only glass waste	11(73.3%)	3(20.0%)	1(6.6%)
4.	Does red bag contain only plastic infectious waste	12(80.0%)	2(13.3%)	1(6.6%)
5.	Does black bag contain only food waste	11(73.3%)	2(13.3%)	2(13.3%)
<b>B.</b>	<b>Transportation of segregated waste</b>			
1.	Bags filled to 2/3 <sup>rd</sup> capacity of bag	12(80.0%)	2(13.3%)	1(6.6%)
2.	Bags tied properly before transportation	9(60.0%)	4(26.6%)	2(13.3%)
3.	Bags tagged before transportation	10(66.6%)	3(20.0%)	2(13.3%)
4.	Is transportation of waste done during non-busy hours	13(86.6%)	2(13.3%)	0(0.0%)
5.	Are infectious and general waste transported separately	12(80.0%)	3(20.0%)	0(0.0%)
<b>C.</b>	<b>Appropriate use of personal protective equipment(PPE)</b>			
1.	Are personal protective equipment used	11(73.3%)	3(20.0%)	1(6.6%)
2.	Are sanitizers used for hand hygiene	10(66.6%)	3(20.0%)	2(13.3%)
3.	Following needle stick injury protocol	11(73.3%)	2(13.3%)	2(13.3%)

Segregation of waste at the source was proper, color-coded bins were appropriately used in most units, and healthcare workers were more consistently seen using PPE during waste handling. There was also an increased tendency to report needle-stick injuries and use designated containers for sharps. These behavioral changes were in alignment with the knowledge gains reflected in the post-training assessments.

## DISCUSSION

The present study demonstrated a significant improvement in the knowledge of paramedical healthcare workers following a structured training program on biomedical waste (BMW) management. These findings affirm the critical role of targeted educational interventions in addressing knowledge gaps and enhancing compliance with the Biomedical Waste Management Rules, 2016.

Before the training, the data revealed suboptimal knowledge in several key areas of BMW management, particularly regarding

sharp disposal, discarded medicines, and disease transmission associated with improper waste handling. For instance, only 36.6% of participants correctly identified the bin for sharp disposal pre-training, which improved markedly to 76.8% post-training ( $p < 0.00001$ ). Likewise, knowledge regarding diseases transmitted through biomedical waste increased dramatically from 10.5% to 85.6% ( $p < 0.00001$ ). These findings highlight how poorly understood but crucial aspects of waste management can be addressed effectively through focused instructional sessions.

The improvements seen across most parameters, particularly in the disposal practices of soiled waste, medicines, and the proper use of personal protective equipment (PPE), reinforce earlier studies that advocate for continuous training to ensure staff competence in infection control and environmental safety protocol [6][7]. Similar study conducted by Mathur et al showed the impact of training in improving knowledge of the staff regarding waste management was

appreciable [9]. Moreover, the knowledge gains observed in areas with initially high correct response rates (e.g., color-coded bins for food/paper waste and bag filling capacity) suggest that refresher training can also reinforce existing understanding and promote best practices.

However, not all areas showed marked improvement. For example, knowledge regarding the disposal of blood bags remained low, increasing only slightly from 53.6% to 56.2% ( $p = 0.78826$ ), a non-significant change. This suggests a possible need for enhanced emphasis or alternative instructional methods—such as hands-on demonstrations or case-based learning—for more complex or less commonly encountered waste categories.

The predominance of staff with less than 10 years of experience could also indicate a need to integrate BMW training into induction programs and continue it at regular intervals. The training's success underscores the importance of institutional commitment to regular capacity building and resource allocation for such programs.

Importantly, the improvement in knowledge also appeared to translate into positive changes in attitudes and day-to-day practices among the staff. Observational visits following the training indicated increased compliance with BMW guidelines, including the appropriate use of color-coded bins, better use of PPE, and proactive reporting of injuries. These findings align with studies by Anirban D et al and Letho Z et al [10][11], which found that structured training not only enhances knowledge but also leads to a shift in workplace behavior and safety culture regarding biomedical waste management. This behavioral translation is a crucial outcome, as mere knowledge enhancement without corresponding practice change limits the real-world impact of training programs.

This study's strength lies in its robust before-and-after design and its inclusion of a diverse group of paramedical staff. However, its limitations include the lack of a long-term follow-up to assess retention of knowledge and translation into practice, as well as the single-institution setting which may limit generalizability.

In conclusion, this study provides strong evidence that structured training programs significantly improve healthcare workers' knowledge regarding BMW management. The training not only improved knowledge but also contributed to observable improvements in the

attitudes and practices of healthcare workers, emphasizing the importance of integrating practical reinforcement and periodic audits into institutional training programs. To ensure sustained compliance with national regulations and to protect healthcare workers and the environment, institutional policies must incorporate routine, mandatory training and continuous evaluation mechanisms.

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