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Original Research Article

A study to evaluate the impact of training in improving knowledge of health care workers regarding bio-medical waste management in a tertiary care hospital

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ABSTRACT

Background: Biomedical waste (BMW) poses a significant health hazard, especially for healthcare workers directly involved in its generation and handling. Inadequate knowledge and poor practices often result in occupational exposure and environmental risks. This study aimed to assess the impact of structured BMW management training on knowledge and practices among hospital staff in three healthcare facilities in Rajasthan - General, Janana, and Covid Hospitals.
Methods: A total of 156 participants including staff nurses, laboratory technicians, housekeeping staff, and class 4/ward boys were recruited through convenience sampling and trained in batches over one week. A pre- and post-training knowledge assessment (maximum score: 20) was conducted. Self-reported practices and attitudes were also evaluated using a structured questionnaire.
Results: The mean knowledge score significantly improved from 9.2±2.8 (pre-test) to 16.4±2.1 (post-test) ($p<0.001$). The greatest improvement was observed among Class 4 staff and housekeeping personnel. Post-training, self-reported compliance with appropriate BMW segregation rose from 62% to 94%, use of PPE from 69% to 96%, and hand hygiene after waste handling from 72% to 93%.
Conclusions: The training program led to a significant improvement in both knowledge and self-reported practices regarding BMW management across all categories of hospital staff. Targeted, context-specific training can play a crucial role in strengthening hospital waste management systems, particularly in resource-constrained settings. The model used in this study is scalable and can be adopted across similar healthcare institutions.

Keywords: Biomedical waste, Infection control, Hospital staff, Training

INTRODUCTION

Health care waste is a unique category of waste by the quality of its composition, source of generation, its hazardous nature and the need for appropriate protection during handling, treatment and disposal. Mismanagement of the waste affects not only the generators, operators but also the common people too.[1]

The term "bio-medical waste" refers to any waste generated during the diagnosis, treatment, or immunization of humans or animals, or research activities

related thereto, or in the production or testing of biological or in health camps, including the categories mentioned in Schedule I appended to these rules, whereas "management" refers to all steps required to ensure that bio-medical waste is managed in such a way as to protect health and the environment.[1,2]

Excessive waste has been generated at care centres as the number of procedures performed at various health care settings has increased.[3]

India generates approximately 2 kg/bed/day of biomedical waste, which includes wastes such as anatomical waste, cytotoxic wastes, and sharps, which when not properly segregated can cause a variety of deadly infectious diseases such as HIV, hepatitis C and B infections, and others, as well as disruptions in the environment and a negative impact on ecological balance.[4,5]

Adequate knowledge of biomedical waste management rules and regulations, as well as an understanding of segregation, will aid in the competent disposal of waste in their respective organisations.[6]

Acceptable biomedical waste management begins at the waste generation stage. Segregation at the source, on-site storage, disinfection, and transfer to the terminal disposal site all play important roles in waste disposal. As a result, health care institute staff must have adequate knowledge, attitudes, and practises.[7,8]

Objectives

To assess study participants' knowledge of BMW management. To assess the impact of training on their knowledge

Hypothesis

There will be no statistically significant difference between post-test and pretest knowledge scores. There will be a significant difference between the post-test and pretest knowledge scores.

METHODS

Setting for research

The BMW (M and H) rules 2016 training programme was held from November 2021 to March 2022 at a tertiary care teaching and research hospital in south-east Rajasthan. It was a multi-group pre-post intervention study.

Sampling technique

For administrative purposes, we used a convenient sampling technique to include all designated staff posted at all three centres, namely General, Janana, and Covid hospitals. Over the course of a week, 156 participants were trained in batches of 20-30 per day. Participants include staff nurses, laboratory technicians, housekeeping staff, and Class 4/Ward Boys. They are directly involved in both patient care and BMW production in the hospital setting.

Study aid

A pilot study of 30 candidates was used to create and validate a structured questionnaire. Expert opinions on the importance and feasibility of the questions were considered before the final version was distributed through paper in local language. The participants fill up the self-administered questionnaires without scope for undue help before starting and after training.

The questionnaire was adapted from English to local language by an experienced professional who is involved in translating of health survey questionnaires to accommodate the housekeeping staff. The questionnaire was also back translated to English for checking of possible discrepancies and incorporating if any changes were required. The identity of the study respondents were maintained anonymous at various stages of the study. Written informed consent was taken from each study participant before starting this training cum orientation program.

The questionnaire contains 2 parts

Baseline questions - name, age, marital status, address, qualification

BMW management rules: questions to assess knowledge of BMW (M& H) rules.

The questions on knowledge appraised the participant’s knowledge on attributes related to the colour coding and their implications, identification of biomedical hazard symbol, waste categories, and hospital policies for biomedical waste management.

Ethical consideration and data analysis

This study has been approved by the institutional ethical review board of our medical college. Data was coded, tabulated, and statistically analyzed using the Microsoft Excel 10 and Statistical Package for the Social Sciences (SPSS) version 27 (TRIAL version). Several inferential and descriptive statistical tests were used, as well as category wise subgroup analysis.

Descriptive statistics were used to summaries demographics and key variables. Inferential statistics were applied (Pearson chi-square test and paired t-test). The level of statistical significance for all tests was set at $P<0.05$; otherwise, the tests were considered insignificant. The mean score difference between pre and posttest was calculated overall.

RESULTS

As per the sample the participants were 94 (60.3%) were female; 62 (39.7%) were male with median work experience was 5 years (range: 1–22 years).

Table 1: Demographics of participants (n=156).

Category	Frequency (N)	Percentage (%)
Staff nurses	55	35.3
Laboratory technicians	22	14.1
Housekeeping staff	46	29.5
Class 4/ward boys	33	21.2

Hospital distribution

60 from General Hospital, 52 from Janana Hospital, and 44 from Covid Hospital.

Table 2: Knowledge assessment on BMW management.

Knowledge score	Pre-test mean±SD	Post-test mean±SD
Overall (n=156)	9.2±2.8	16.4±2.1
Staff nurses	10.4±2.3	17.3±1.8
Lab technicians	9.8±2.1	17.0±1.6
Housekeeping staff	7.8±2.9	15.2±2.3
Class 4/ward boys	7.1±3.1	14.8±2.5

Participants were assessed before and after training using a structured questionnaire (20 points max).

Statistical analysis

A paired t-test showed a significant improvement in knowledge scores post-training ($p<0.001$ across all groups).

Table 3: Attitude and practice change (self-reported).

Indicator	Pre (%) positive	Post (%) positive
Willingness to segregate waste correctly	62	94
Awareness of color-coded bins	58	91
Use of PPE while handling BMW	69	96
Reporting of needle-stick injuries	48	89
Hand hygiene compliance post-waste handling	72	93

Measured 1 week after training (Likert-scale based):

Interpretation of results

Significant knowledge gain

The training program showed a statistically significant increase in knowledge scores across all staff categories, with the highest gains observed among Class 4/Ward Boys and Housekeeping staff who traditionally have less formal education on BMW.

Improved attitudes and practices

Post-training, there was a marked improvement in correct BMW segregation, PPE usage, and safety behavior, indicating the effectiveness of interactive, hands-on training.

Targeted impact

Housekeeping and class 4 workers showed the most dramatic improvement, underlining the importance of regularly including them in such training as frontline workers handling biomedical waste.

Program feasibility

Training 156 individuals over a week in manageable batches proved logistically feasible, making this model scalable for other healthcare institutions.

DISCUSSION

The present study showed a statistically significant improvement in knowledge scores post-training across all staff categories. The mean knowledge score increased from 9.2±2.8 to 16.4±2.1 ($p<0.001$). These findings align with Mathur et al who also reported significant knowledge gains after targeted training interventions.[9] Specifically, class 4/ward boys and housekeeping staff showed the most improvement, which is consistent with findings from Radha where baseline knowledge was lower in these groups but significantly improved post-training.[10] Our results also mirror Kini et al who emphasized the effectiveness of context-specific training in improving compliance with PPE use and waste segregation protocols.[7]

In terms of self-reported practices, there was marked improvement in key behavior indicators willingness to segregate waste (62% to 94%), use of PPE (69% to 96%), and reporting needle-stick injuries (48% to 89%). Similar behavior shifts were noted in studies by Verma et al and Kumar et al who highlighted how improved knowledge correlates with better waste management behavior among staff.[11,12]

Limitations

This study was limited by its reliance on self-reported practices, which may be subject to social desirability bias.

The short follow-up period also limits the ability to assess long-term retention of knowledge and sustained behavior change. Additionally, the convenience sampling method and single-institutional setting limit the generalizability of the findings to other healthcare settings.

CONCLUSION

The study demonstrates that structured, context-appropriate training programs significantly enhance healthcare workers' knowledge and self-reported practices related to biomedical waste management. The scalable model implemented in this study offers a viable approach for strengthening hospital waste management systems, particularly in resource-limited settings. This research contributes to existing literature by emphasizing the importance of including all tiers of healthcare staff in BMW management interventions to achieve comprehensive compliance and safety.

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