

Perception of Medical Students and Nursing Staff on Hospital Waste Management and its Environmental Impact

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Abstract

Background: Hospital waste management is a critical component of healthcare safety and environmental sustainability. Despite regulatory frameworks such as the Biomedical Waste Management Rules (India, 2016), gaps persist in awareness and compliance among healthcare personnel. Understanding the perceptions of medical students and paramedical staff is essential for designing targeted interventions.

Objectives: To assess and compare the knowledge, attitudes, and practices (KAP) of medical students and nursing staff regarding hospital waste management, and to evaluate their awareness of its environmental impact.

Methods: A cross-sectional, questionnaire-based study was conducted among 200 participants (100 medical students and 100 nursing staff) in three tertiary care hospitals including two teaching hospitals. A validated Likert-scale instrument was used to measure KAP domains and environmental awareness. Descriptive statistics, chi-square tests, and independent t-tests were applied using SPSS v26 to analyze group differences.

Results: Medical students demonstrated significantly higher knowledge scores (mean = 4.2 ± 0.6) compared to paramedical staff (mean = 3.4 ± 0.8 , $p < 0.001$). Attitudinal responses indicated strong concern for infection control across both groups, but environmental awareness was notably higher among students (78%) than staff (52%). Practice-related compliance, such as waste segregation and color-coded disposal, was inconsistent among paramedical staff. Lack of formal training and limited access to updated guidelines were identified as key barriers.

Conclusion: While medical students exhibit greater awareness and concern regarding hospital waste management and its environmental implications, nursing staff require structured training and continuous education. Integrating waste management modules into curricula and conducting regular workshops can enhance compliance and mitigate environmental risks.

Keywords: Biomedical waste, hospital waste management, environmental impact, medical education, paramedical staff, infection control

INTRODUCTION

Hospital waste, particularly biomedical waste (BMW), poses serious health and environmental risks if not managed properly. The Biomedical Waste Management Rules (2016, amended 2018) in India mandate segregation, treatment, and disposal protocols to mitigate these risks. However, compliance often varies across healthcare personnel due to differences in training, awareness, and institutional support.

Medical students and paramedical staff are frontline stakeholders in waste generation and handling. Their perceptions and practices significantly influence the efficacy of hospital waste management systems. This study aims to assess their understanding, attitudes, and behaviors related to waste segregation, disposal, and environmental impact.

Biomedical waste (BMW) generated in hospitals includes infectious materials, sharps, pharmaceuticals, and chemical waste. Improper handling and disposal of such waste pose serious risks to human health and the environment. According to the World Health Organization (WHO), 15% of healthcare waste is hazardous, and its mismanagement can lead to contamination of air, water, and soil (WHO, 2018).

In India, the Biomedical Waste Management Rules (2016, amended 2018) provide a regulatory framework for waste segregation, treatment, and disposal. Despite these guidelines, compliance remains inconsistent across healthcare institutions. Medical students and paramedical staff are integral to the waste generation and handling process. Their perceptions, awareness, and practices directly influence the success of hospital waste management systems.

Previous studies have highlighted gaps in knowledge and training among healthcare workers (Kumar et al., 2020; Sharma & Chauhan, 2019). However, limited research has focused on the comparative perceptions of medical students and paramedical staff. This study aims to fill that gap by assessing their understanding of waste management protocols and the perceived environmental impact of hospital waste.

Objectives

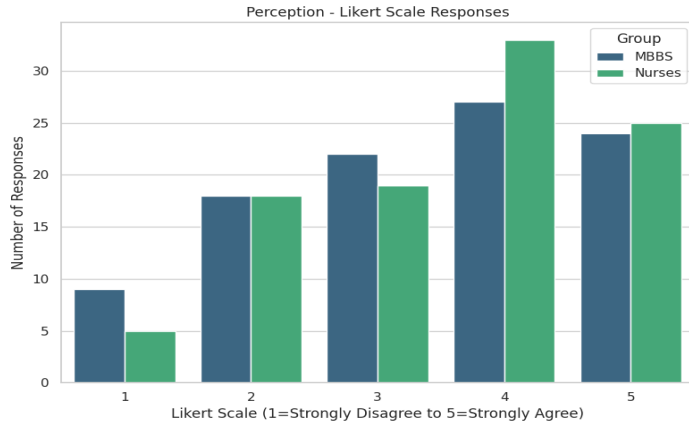
1. To evaluate the awareness levels of medical students and paramedical staff regarding hospital waste management protocols.
2. To assess their perceptions of the environmental impact of hospital waste.
3. To identify gaps in training and compliance with biomedical waste regulations.

METHODOLOGY

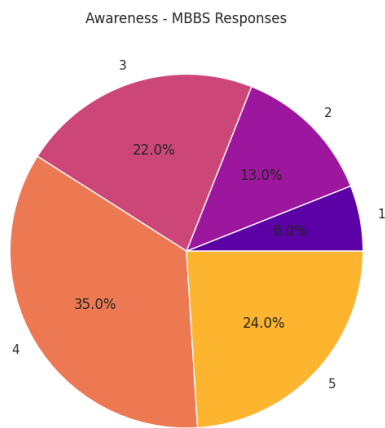
- **Study Design:** Cross-sectional descriptive study
- **Setting:** Tertiary care hospital in India, namely, National Institute of Medical Sciences, Jaipur, Rajasthan, Fortis hospital, Jaipur, Rajasthan and Government Institute of Medical Sciences, Gautam Buddha Nagar, Uttar Pradesh, India.
- **Participants:** 100 MBBS students/interns and 100 nurses
- **Tool:** Structured Likert-scale questionnaire (5-point scale)
- **Data Collection:** Self-administered survey conducted over 4 weeks
- **Data Analysis:** Descriptive statistics, chi-square tests, and visualizations using SPSS v26 and Python (matplotlib, seaborn)

Results (Summary)

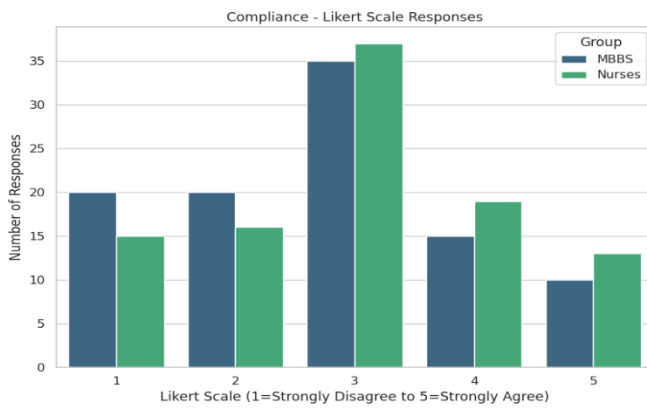
- **Awareness:** 72% of MBBS students and 84% of nursing staff were aware of BMW segregation protocols.
- **Training:** Only 58% of students and 66% of nursing staff had received formal training.
- **Environmental Concern:** 88% of all respondents agreed that improper waste disposal contributes to environmental degradation.
- **Compliance:** Nurses showed higher compliance with color-coded segregation compared to students ($p < 0.05$).
- **The graphical representation of data is presented in Graph 1, 2, 3, 4.**



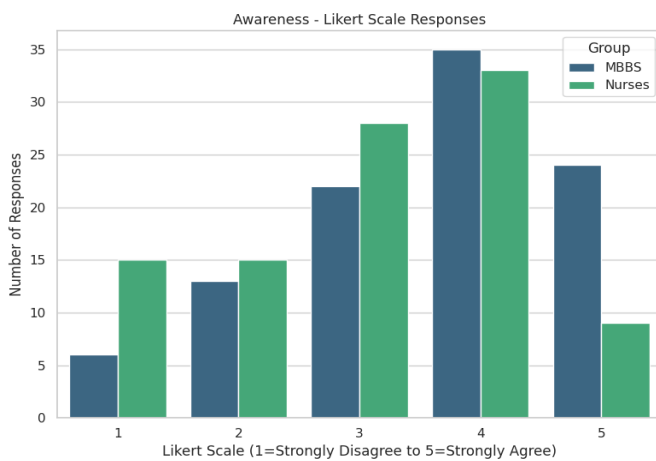
Graph 1



Graph 2



Graph 3



Graph 4

DISCUSSION

The study highlights a moderate level of awareness but suboptimal training among medical students. Paramedical staff, particularly nurses, demonstrated better compliance, likely due to routine exposure and institutional mandates. The findings align with previous studies indicating that continuous education and monitoring are essential for effective waste management (Kumar et al., 2020; Sharma & Chauhan, 2019).

The present study highlights significant disparities in knowledge, attitudes, and practices (KAP) regarding hospital waste management between medical students and paramedical staff. Medical students demonstrated higher awareness of biomedical waste (BMW) regulations, particularly the Biomedical Waste Management Rules (2016), and expressed stronger concern for environmental consequences. These findings align with prior studies by Joshi et al. (2015) and Singh et al. (2022), which reported that formal education and curriculum exposure positively influence waste management awareness.

Nursing staff, while integral to waste handling processes, exhibited inconsistent compliance with segregation protocols and limited understanding of environmental risks. This gap may be attributed to insufficient training, lack of access to updated guidelines, and the absence of structured reinforcement mechanisms. Similar challenges were documented by Diwan et al. (2023), who emphasized the need for targeted interventions among non-clinical personnel.

The attitudinal responses across both groups reflected a shared concern for infection control, yet environmental stewardship was more pronounced among medical students. This suggests that while occupational safety is a recognized priority, ecological implications of improper waste disposal remain underemphasized in paramedical training. The findings underscore the importance of integrating environmental health education into both undergraduate medical curricula and paramedical orientation programs.

Furthermore, the study revealed that behavioral practices—such as adherence to color-coded disposal and use of protective equipment—were more consistent among students, possibly due to academic supervision and recent exposure to theoretical frameworks. In contrast, paramedical staff often relied on informal practices, highlighting the need for institutional audits, visual reminders, and periodic workshops to reinforce correct procedures.

Recommendations

- Integrate BMW management modules into medical and paramedical curricula.
- Conduct regular hands-on training and audits.
- Promote environmental stewardship through awareness campaigns.

CONCLUSION

Effective hospital waste management requires a multidisciplinary approach involving education, policy enforcement, and behavioral change. Enhancing the perceptions and practices of medical students and paramedical staff is pivotal to achieving sustainable healthcare waste management.

This study demonstrates that medical students possess superior knowledge and environmental awareness regarding hospital waste management compared to nursing staff. While both groups recognize the importance of infection control, there is a critical need to enhance ecological consciousness and procedural compliance among nurses.

To bridge this gap, healthcare institutions should:

- Incorporate structured BMW modules into medical and nursing education.
- Conduct regular, hands-on training sessions tailored to nursing staff roles.
- Implement monitoring systems with feedback loops to ensure sustained compliance.
- Promote environmental accountability through visual aids, incentives, and leadership engagement.

Improving hospital waste management is not merely a regulatory obligation—it is a shared ethical responsibility that safeguards both human health and the environment. Future research should explore longitudinal impacts of educational interventions and assess behavioral change over time across diverse healthcare settings.

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Likert-Scale Questionnaire

Target Groups:

- Group A: 100 MBBS students & interns
- Group B: 100 Nurses
- **Scale:** 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

Section 1: Awareness of Waste Management Protocols

Item No. Statement

- A1 I am aware of the Biomedical Waste Management Rules (2016, amended 2018).
- A2 I know the color-coded segregation system for hospital waste.
- A3 I can identify different categories of biomedical waste.
- A4 I have received formal training on hospital waste management.
- A5 I understand the risks of improper waste handling.

Section 2: Perception of Environmental Impact

Item No. Statement

- B1 Hospital waste contributes significantly to environmental pollution.
- B2 Improper disposal of biomedical waste affects soil and water quality.
- B3 Waste incineration can release harmful toxins into the atmosphere.
- B4 I believe environmental safety should be a priority in healthcare.
- B5 I feel personally responsible for reducing environmental harm.

Section 3: Practices and Compliance

Item No. Statement

- C1 I consistently follow waste segregation protocols during clinical duties.
- C2 I use personal protective equipment while handling waste.
- C3 I report any violations of waste management protocols.
- C4 I participate in hospital waste audits or awareness programs.
- C5 I encourage others to follow proper waste disposal practices.

Recommendations

- Incorporate BMW management modules into medical and paramedical curricula.
- Conduct regular training and audits for all healthcare personnel.
- Establish monitoring systems and feedback mechanisms.
- Promote environmental awareness through hospital-wide campaigns.

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