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Assessment of biomedical waste management practices and associated factors among healthcare workers in Vijayapur, Karnataka

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Abstract: *Background:* Biomedical waste management (BMWM) is essential for preventing the spread of infections, protecting public health, and minimizing environmental contamination. Despite regulations in India, improper handling remains a concern, particularly in healthcare facilities. *Objectives:* To assess biomedical waste management practices and associated factors among healthcare workers at RKM Hospital and private laboratories in Vijayapur, Karnataka. *Methods:* A cross-sectional study was conducted in 2024 involving 100 healthcare workers selected using simple random sampling. Data were collected through a self-administered questionnaire and observational checklists. The data were cleaned, coded, and analyzed using Epi-Data version 4.6 and SPSS version 20. Logistic regression analysis was performed, with a p-value of <0.05 considered significant. *Results:* The study included 100 respondents, 60% of whom were male and 44% aged under 25 years. About 90% received BMWM training, and 97% had access to color-coded bins. Compliance rates for glove usage, waste segregation, and hand hygiene were 94%, 96%, and 98%, respectively. However, 32% reported delays in disposing of infectious waste. *Conclusion:* Education, training, and infrastructure significantly influence BMWM practices. Addressing delays in waste disposal, enhancing guideline availability, and improving working conditions are crucial for effective BMWM.
Keywords: Biomedical Waste Management, Healthcare Workers, Compliance, Training, Waste Disposal.

Introduction

Biomedical waste (BMW) refers to any waste generated during the diagnosis, treatment, or immunization of humans or animals. Improper handling of biomedical waste poses serious health and environmental risks, including the spread of infectious diseases, cancer, chronic illnesses, and pollution of air, land, and water [1-2].

The Biomedical Waste Management Rules (2016) and subsequent amendments in 2018 and 2019 mandate proper segregation, storage, transportation, and disposal of biomedical waste in India [3-4].

India generates approximately 484 tonnes of biomedical waste per day, with Karnataka contributing the highest amount [5]. The World Health Organization (WHO) classifies healthcare waste into infectious, pathological, and non-biological waste, highlighting the need for systematic management [6]. Despite regulations, challenges such as lack of training, delayed disposal, and inadequate infrastructure persist. This study aims to evaluate biomedical waste management practices and identify factors influencing compliance among healthcare workers in Vijayapur, Karnataka.

Material and Methods

Study Design and Setting: A cross-sectional study was conducted in 2024 at RKM Hospital and selected private laboratories in Vijayapur, Karnataka.

Study Population: The study involved 100 healthcare workers, including doctors, nurses, lab technicians, and support staff. Participants were selected using simple random sampling.

Data Collection Tools:

Self-Administered Questionnaire: Included demographic details, knowledge, and practices related to BMWM.

Observational Checklist: Assessed infrastructure availability, waste disposal timelines, and compliance with BMWM practices.

Data Entry and Analysis: Epi-Data Version 4.6 for data entry and SPSS Version 20 for statistical analysis. Logistic Regression Analysis and p-value <0.05 with adjusted Odds Ratio (AOR) with a 95% confidence interval to measure the strength of associations used in this for analysis.

Ethical Considerations: Ethical approval was obtained from the relevant Institutional Review Board (IRB). Informed consent was obtained from all participants.

Results

The study included 100 respondents, 60% of whom were male and 44% aged under 25 years.

About 90% received BMWM training, and 97% had access to color-coded bins. Compliance rates for glove usage, waste segregation, and hand hygiene were 94%, 96%, and 98%, respectively. However, 32% reported delays in disposing of infectious waste.

The survey revealed that 60% of respondents were male and 40% female, with 44% under 25 years, 34% aged 26-35 years, and 22% over 35 years. Regarding education, 51% held a First Degree, and 24% had an MSc or higher. Training and awareness levels were high, with 90% receiving training on Biomedical Waste Management (BMWM) and 81% having access to updated guidelines.

Infrastructure was generally adequate, with 97% having access to three color-coded bins (red, yellow, and blue), although 32% reported storing infectious waste for more than two days. Compliance practices were strong, with 94% adhering to glove usage, 96% following waste segregation protocols, and 98% maintaining hand hygiene. However, 97% reported experiencing long working hours, leading to fatigue and increasing the risk of errors.

Here is the Figure-1 representing the data on Biomedical Waste Management (BMWM) practices based on the provided information. Each segment indicates the percentage of adherence to each specific practice or variable.

Fig-1: Biomedical waste management (BMWM) Practices
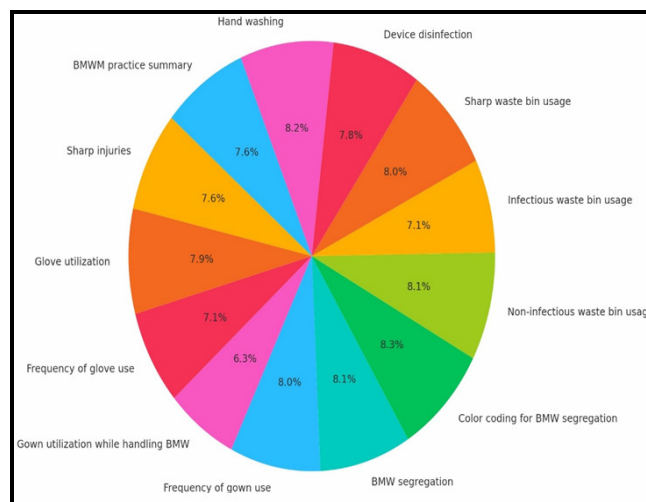
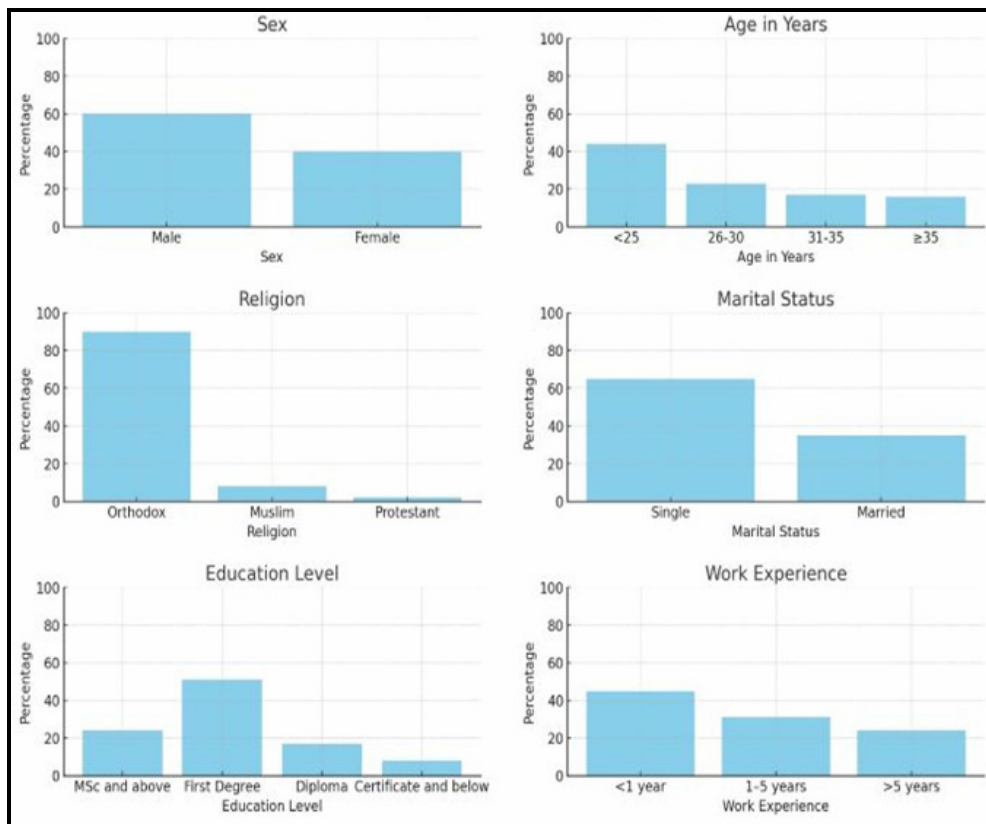**Fig-2:** Demographic Analysis Summary

Figure-2 showing the Frequency of health care workers among BMWM among HCWs at hospitals of vijayapur, November 2024.

Table-1 showing Healthcare Facility-Related Factors Influencing Biomedical Waste Management among Healthcare Workers in Hospitals of Vijayapur.

Table-1: HCF related factors for BMWM among HCWs at hospitals of Vijayapur, November 2024			
Variables	**Response category**	**Frequency (n = 100)**	**Percent**
Taken training on BMWM	Yes	90	90
	No	10	10
Working hours per day	8 hours	3	3
	>8 hours	97	97
Working departments	OPD	15	15
	Ward	22	22
	Laboratory	26	26
	college students	35	35
	Pharmacy	2	2
Glove availability in working department	Yes	98	98
	No	2	2
Guideline availability for BMWM or IPC	Yes	81	81
	No	19	19
Infectious waste stored more than two days	Yes	32	32
	No	68	68
Availability of ≥3 bins	Yes	97	97
	No	3	3
Lebelled bins availability	Yes	97	97
	No	3	3

Table-1 shows, Biomedical Waste Management (BMWM) is a critical aspect of maintaining hygiene and safety in healthcare settings, and its effectiveness largely depends on various factors related to healthcare facilities (HCFs). In hospitals of Vijayapur, these factors play a significant role in shaping the practices and compliance of healthcare workers (HCWs) in managing biomedical waste. Key factors include the availability of adequate waste segregation systems, regular training and awareness programs, provision of personal protective equipment (PPE), and adherence to established BMWM protocols. Additionally, the presence of monitoring mechanisms, waste disposal infrastructure, and the frequency of audits influence the efficiency of waste management practices. The hospital management's commitment to maintaining high standards and ensuring compliance with regulatory guidelines further impacts the attitude and behavior of HCWs toward safe and effective waste handling.

Discussion

Training and Compliance: The study revealed a high level of awareness and compliance with BMWM practices among healthcare workers, consistent with previous studies [2, 7]. Training significantly influenced waste segregation, glove usage, and hand hygiene. Respondents with higher education (MSc and above) showed better adherence, emphasizing the role of educational interventions [8]. Challenges in Waste DisposalDespite high compliance, 32% of participants reported delays in disposing of infectious waste, posing risks of disease transmission and environmental contamination [9-10]. This gap highlights the need for efficient waste disposal systems and timely collection services.

Infrastructure and Guidelines: While 97% reported having access to color-coded bins, 19% lacked availability of updated BMWM guidelines. This gap can affect proper waste segregation and disposal [11-17]. Regular dissemination of guidelines is essential to ensure compliance.[18-21]

Impact of Working Hours: Long working hours reported by 97% of respondents can lead to fatigue, errors, and reduced compliance. Addressing workload issues is critical to maintaining safe BMWM practices [22-23].

Conclusion

This study highlights the importance of education, training, and infrastructure in promoting effective BMWM practices. Key recommendations include:

1. *Mandatory In-Service Training:* Regular training sessions for all healthcare workers.
2. *Enhanced Infrastructure:* Ensuring universal access to color-coded bins and timely waste disposal.
3. *Guideline Accessibility:* Providing updated BMWM guidelines to all staff.
4. *Workload Management:* Reducing working hours to minimize fatigue-related errors.

Implementing these measures can improve compliance and reduce health and environmental risks associated with biomedical waste.

Acknowledgement

Conflicts of interest: There are no conflicts of interest.

References

1. Karmakar N, Datta SS, Datta A, Nag K. A cross-sectional study on knowledge, attitude, and practice of biomedical waste management by healthcare personnel. *J Family Med Prim Care.* 2016; 5(3):653-657.
2. World Health Organization. Fact sheet on healthcare waste management. *WHO.* 2018.
3. Ministry of Environment, Forest and Climate Change. Biomedical Waste Management Rules. *Government of India.* 2016. *https://www.hspcb. org.in/uploads/laws/BMW_Rules.pdf*
4. Ministry of Environment, Forest and Climate Change. Biomedical Waste Management

(Amendment) Rules. *Government of India.* 2018, 2019. Available from: *https://cpcb.nic.in/bio-medical-waste/*

5. Central Pollution Control Board (CPCB). Guidelines for Management of Healthcare Waste. *Central Pollution Control Board, India.* 2020. Available from: *https://cpcb.nic.in/healthcare-waste/*

6. World Health Organization (WHO). Safe management of wastes from healthcare activities. 2nd ed. *Geneva: WHO Press.* 2014. Available from: *https://apps.who.int/iris/handle/10665/85349*

7. Sreejith A, Raghu R. Awareness and practices regarding biomedical waste management among healthcare workers. *Int J Community Med Public Health.* 2021; 8(4):1765-1770.

8. Patil GV, Pokhrel K. Biomedical solid waste management in an Indian hospital: A case study. *Waste Manag.* 2005; 25(6):592-599.

9. Pandey P, Rahi M, Khandekar J. Assessment of knowledge and practices regarding biomedical waste management among healthcare workers in India. *Indian J Public Health.* 2023; 67(2):125-130.

10. Kumar S, Saha A, Singh P. Impact of training on biomedical waste management practices among hospital staff: A systematic review. *J Environ Health Sci Eng.* 2023; 21(1):75-82.

11. Sharma A, Gupta N, Taneja N. Compliance and challenges in biomedical waste disposal: A cross-sectional study in tertiary care hospitals. *Environ Monit Assess.* 2023; 195(8):933.

12. Verma S, Mishra V, Singh S. Role of continuous education in improving biomedical waste management among healthcare personnel in India. *J Hosp Infect Control.* 2023; 10(3):145-51.

13. Singh A, Kumari N, Patel R. Evaluation of color-coded bin usage and waste segregation in Indian healthcare settings. *Int J Health Sci Res.* 2023; 13(4):98-104.

14. Chaudhary M, Mehta P. Awareness and compliance with biomedical waste management guidelines among laboratory technicians. *Indian J Lab Med.* 2023; 48(2):56-61.

15. Yadav S, Jaiswal P, Khanna A. Challenges in the implementation of biomedical waste management rules in Indian healthcare facilities. *J Environ Health Perspect.* 2023; 131(3):350-358.

16. Rajput P, Sharma S, Dubey V. A study on compliance with biomedical waste disposal protocols in private healthcare laboratories. *Int J Environ Sci Technol.* 2023; 20(5):2875-2884.

17. Gupta P, Sharma M. Evaluation of biomedical waste disposal practices in Indian hospitals: A multicenter study. *Indian J Environ Prot.* 2022; 42(9):1157-1163.

18. Thakur R, Kumar R. Impact of periodic training on improving biomedical waste handling practices among healthcare staff. *J Occup Environ Hyg.* 2022; 19(7):563-71.

19. Narang R, Bhardwaj P. Assessment of color-coded bin utilization and waste segregation efficiency in healthcare settings. *J Health Manag.* 2022; 24(4):512-20.

20. Das P, Mukherjee K. Exploring factors affecting compliance with biomedical waste management guidelines among healthcare workers. *Environ Sci Pollut Res.* 2022; 29(12):15627-15635.

21. Aggarwal S, Jain P. Knowledge and practices regarding biomedical waste handling among nursing staff in tertiary care hospitals. *J Nurs Healthc Res.* 2022; 14(3):204-211.

22. Mishra D, Kapoor S. Role of regulatory frameworks in improving biomedical waste management practices in India. *Environ Health Insights.* 2022; 16:1-9.

23. Patel M, Kumar V. Evaluating barriers to compliance with biomedical waste management protocols: A qualitative study. *Indian J Environ Res.* 2022; 39(2):85-91.

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