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Awareness And Health Impacts Of Improper Biomedical Waste Management: A Preventive Approach

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Abstract:
Biomedical waste has now become a global issue. Due to the presence of infectious and hazardous content, improper biomedical waste management can be harmful to human health and the environment. It was necessary to spread awareness among health professionals regarding the hazardous effects of improper biomedical waste management. This study aimed to assess the awareness of health risks due to improper Biomedical waste handling, understanding of infection transmission, knowledge of protective and preventive practices, and training and hospital safety practices. A cross-sectional study was conducted among 450 healthcare workers. A high awareness (92%) regarding infections, HAI, and other risks was found among the participants. A significant association was found between awareness and risk indicators of BMW. A significant gap was found in the implementation of preventive approaches for biomedical waste management. Healthcare workers need better instruction and guidance on preventive approaches and biomedical waste management practices.
Key words: *Bio-medical waste management, health hazards, awareness, healthcare workers, Preventive approach*

INTRODUCTION

Bio-medical waste has now emerged as a global issue. The daily production and disposal of biomedical waste negatively impact human health and the environment. Hepatitis B, C, E, dengue, and HIV, etc, could be transmitted through improperly contained contaminated waste. Dumping of untreated biomedical waste increases the pathogenic microbial population in the municipal waste, which in turn leads to many health hazards. Negligent disposal of waste leads to environmental degradation, which in turn negatively affects public health. Improper biomedical waste management elevates the risk of HAI, alters the microbial ecosystem, contributes to the emergence of antibiotic-resistant organisms, and increases vector population density, thereby facilitating the spread of infectious diseases. Raising awareness and fostering public engagement are essential for safeguarding integrity and global public health (Chakraborty et al.,2013). Exposure to medical waste heightens the likelihood of infectious disease in healthcare workers. A study in a South Asian city found 35.4% of BWM awareness among healthcare professionals (Nosheen et al.,2015). Annually, nearly 3 million people handling BMW come into contact with bloodborne infectious agents, including 2 million with Hepatitis B, 9000000 with Hepatitis C, and approximately 170,000 with HIV. Furthermore, personnel engaged in handling and disposing of biomedical waste are at elevated risk of occupational exposure and health hazards (Mastorakis et al., 2010).The dangerous and harmful components of waste generated by healthcare facilities, including infectious, biomedical, radioactive substances, and sharp objects, pose a serious threat to human health and the environment if not adequately managed, treated, or if they are improperly mixed regularly mixed with regular municipal waste (Babanyara et al., 2013).As per the study, biomedical waste dispersed in and around hospital premises attracts flies, insects, rodents, cats, and dogs, which are known as carriers of diseases such as plague and rabies (Husain & Mushtaq et al., 2014).Another research indicated a rise in cases of workplace exposure to blood and bodily fluids caused by improper biomedical waste separation methods, as documented in reports from hospital monitoring departments (Sahoo et al., 2024).Refuse produced during medical procedures is responsible for over fifty percent of fatalities linked to waste-induced illness. The byproduct of healthcare operations encompasses a range of biomedical substances such as discarded needles and syringes, bodily fluids, medicinal drugs and anatomical remains, harmful chemicals, and more. These pose a significant threat of infections to humans owing to their extremely contagious and dangerous nature (Odumosu , 2015)

A case analysis revealed that, at present, a large portion of biomedical waste produced in healthcare institutions is gathered without being separated into infectious and non-infectious types and is discarded in public waste containers placed either within or outside the hospital premises. Waste materials from surgical units, patient wards, and diagnostic labs are eliminated without undergoing any sanitization or sterilization. Removed body parts, biological remains, and other highly contagious materials are incinerated where incineration facilities exist; the rest is typically burned in remote areas of the hospital compound, often in open trenches (Radha et al., 2009). It was noted that the biomedical waste (BMW) produced during the pandemic required secure handling and disposal, as the virus persisted for 6–8 hours on plastic, 5–6 hours on stainless steel, and up to 7 days on surgical masks. The research further revealed that among Indian metropolitan areas, only Chennai and Mumbai had relatively more efficient biomedical waste management systems. Key updates in Covid-19-related BMW handling included distinct segregation, proper labeling of waste bags with Covid-19 tags, designated storage zones, and the application of 1% sodium hypochlorite solution to disinfect waste containers (Gowd et al.2021), Amid the pandemic, biomedical waste production in India was reported to exceed 3.4 kilograms per bed per day. Therefore, this review seeks to analyze the contributing factors behind inadequate biomedical waste management (Kothari et al., 2021) In the Southeast Asia region, around 10% of deadly or severe illnesses are linked to infections contracted in healthcare settings, highlighting the importance of these cases as indicators of the effectiveness of waste management practices. Alarmingly, the World Health Organization (WHO) reported that in India, half of the syringes and needles meant for single use were being reused. To address such issues, the Ministry of Environment and Forests in India introduced the Biomedical Waste (Management and Handling) Rules in 1998, aimed at strengthening the overall management of biomedical waste across the country's healthcare facilities (BMW rules,1998). Job tenure and category of hospital were strongly linked to public health dangers posed by improper handling of biomedical waste ($p < 0.0001$). Educating healthcare personnel on correct safety protocols for biomedical waste disposal is vital to avoid occupational health risks, ensure a secure workplace, and maintain effective healthcare services. Authorities and hospital administrators must implement suitable safety regulations (Okechukwu et al.,2021).In China, hospitals report nearly one million accidental needlestick injuries (NSIs) annually, indicating that a healthcare worker is exposed to an NSI approximately every 30 seconds (Yao et al., 2010).While in India, 66.3% of healthcare workers experienced needlestick injuries as a result of needle recapping (Baburao et al., 2013).A study revealed that 10% of participants experienced a needlestick injury in the past year, with 40% attributing the incidents primarily to personal negligence and improper needle disposal (Verma et al., 2024).Needlestick injuries pose a significant health risk during the waste segregation process. Inadequate segregation practices often result in biomedical waste being mixed with municipal solid waste. Therefore, it is essential to provide proper training on current biomedical waste regulations, with particular emphasis on segregation at the point of generation. Every stage of biomedical waste management can negatively affect both the environment and human health if not properly handled. The study identifies the consequences and shortcomings in biomedical waste handling from its generation to final disposal. It advocates for regular awareness initiatives and capacity-building efforts to ensure effective waste management and reduce related health and environmental hazards. These risks can be further mitigated by adopting scientifically sound and methodical approaches, along with strict adherence to regulatory standards (Ravindra et al., 2023).According to a study, the foremost threat posed by biomedical waste is the potential spread of infectious diseases, which can result in hospital-acquired infections and outbreaks in the community if not properly controlled. Additionally, the rise of antibiotic-resistant bacteria—an escalating global issue—is often fuelled by poor waste management in healthcare facilities. Another critical consequence of improper biomedical waste disposal is environmental pollution. Healthcare workers, who are directly involved in handling such waste, are particularly vulnerable. They face immediate risks such as accidental needlestick injuries and contact with hazardous substances, as well as long-term health issues like respiratory problems caused by exposure to toxic fumes. A lack of adequate training and awareness significantly increases these dangers, putting medical staff at greater risk. To reduce these threats, robust biomedical waste management practices are essential. Enforcing strict regulations, ensuring proper segregation, and adopting safe disposal methods are vital measures. Ultimately, addressing this urgent issue requires a collaborative effort from healthcare providers, regulatory authorities, and the public to protect both current and future generations (Babanyara et al.,,2014). A study enhanced awareness of the potential issues and hazards linked to biomedical waste, thereby promoting better understanding of how to improve its management to safeguard healthcare workers, the general public, and the environment (Chen et al., 2017).Improper waste

management by these institutions leads to serious health risks and environmental damage. There is a pressing need to re-evaluate the processes of identifying, handling, and disposing of biomedical waste to develop more effective management practices and protocols (Manzoor et al., 2019).An evidence-based review highlighted that collaborative efforts, backed by strong government commitment in terms of funding and infrastructure, are essential for the efficient disposal of biomedical waste. The dedication of healthcare workers and the availability of adequate facilities also play a crucial role. Moreover, consistent and effective monitoring of biomedical waste is imperative. To promote a cleaner and greener environment, it is vital to establish eco-friendly disposal methods along with well-structured plans and protocols (Bansod et al., 2023).

METHODOLOGY

Study design:

A cross-sectional descriptive study was conducted to assess the awareness of health hazards associated with improper Biomedical Waste management (BMW).

Study setting:

The study was conducted across 10 private hospitals in Dehradun city of Uttarakhand.

Study population:

The study population included health care workers such as doctors, nurses, lab technicians, and housekeeping staff. All participants were currently employed in the selected hospitals during the study period.

Sample Size :450 participants were taken for this study.

Sampling Method:

Stratified convenience sampling technique was used to collect the data. Participants were stratified by profession (doctors, nurses, lab technicians and housekeeping staff). Then selected based on availability and willingness to participate.

Table 2.1 Sample Distribution Table

Category	**Number of Participants (n=450)**	**Percentages** (%)
Doctors	280	62%
Nurses	100	22%
Lab technicians	49	11%
Housekeeping Staff	21	5%
Total	**450**	**100**%

Inclusion Criteria:

Freshers and experienced staff who were willing to participate in the study were included.\

Exclusion Criteria:

Interns , Pharmacist and administrative staff were excluded in the study.

Data Collection Tool:

A structured, close ended questionnaire was used. The Questionnaire included sections on:

- Demographics
- Awareness about health hazard
- Knowledge about preventive approaches.
- Challenges faced during BMW management

The tool was pretested and modified for clarity and reliability.

Data Collection Procedure:

Participants were approached during their work shifts with prior permission from hospital administration. Data were collected over 3 months period. Anonymity and confidentiality were maintained throughout the study.

Ethical Consideration:

Prior consent was taken from hospital authority.

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RESULTS

An assessment of risk factors associated with poor biomedical waste practices was done. It was found that 98% of the participants were aware of the infections that can be transmitted through biomedical waste. 84% of the participants stated there would be chances of Hepatitis B and C, HIV, Tetanus, and tuberculosis to spread among healthcare workers due to improper handling of Biomedical waste. 96% of the participants were aware of the risks associated with handling of sharps. 81% of the participants stated that healthcare workers, patients, cleaning staff, wast handlers, and the general public all would be at risk due to improper biomedical waste management. 98% of the participants were aware that HAI cases could increase due to improper BMW management. When it was asked about biggest challenge in managing BMW then, 32% of the participants stated lack of training, while 12% of the participants stated lack of supervision,15% of the participants stated lack of interest and 29% of the participants stated inadequate storage or disposal facilities and 12 % of the participants stated lack of time. 64% of the participants had reported improper waste management practices in their hospital. 46% of the participants always use PPE kits while handling waste. 57% of the participants stated that they had received post-exposure prophylaxis after waste-related injury. 86% of the participants stated that their hospital conducts health checkups for its healthcare workers regularly.

Table 3.1 Assessment of awareness of health risk associated with poor BMW practices

Awareness Risk Indicators	% of participants (n=450)
Infection from BMW	98% (441)
Awareness of disease transmission (Hepatitis B, C, HIV, etc.)	84% (378)
Risks of handling sharps	96 % (432)
Risks to healthcare workers, patients, public	81% (360)
Awareness of HAI risk	98% (441)

91% of the average awareness was found among 450 participants, which was considered to be high. Among the participants highest infection risk was considered to be due to poor handling of sharp things like needles.

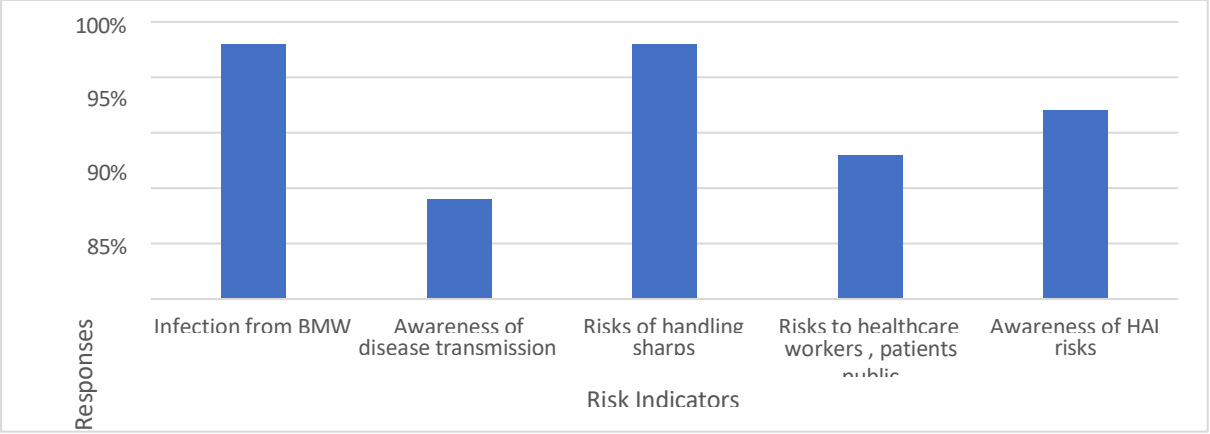

Fig 3.1Awareness of risk indicators associated with poor biomedical waste management

A Chi-square test of independence was conducted to examine the association between awareness level and risk factor identification regarding biomedical waste. The results indicated a statistically significant association, χ^2 (df = 4, N = 450) = 88.65, $p < 0.001$. This suggests that awareness significantly influences the perception of risk related to biomedical waste. It indicates that as awareness improves, recognition of risks also increases.

Table 3.2 Preventive Approach Assessment

PREVENTIVE APPROACH	% OF THE PARTICIPANTS (n=450)	INDICATES
Use of PPE Kits	46% (207)	Gaps
Post–exposure prophylaxis	57% (252)	Partial coverage

Health checkups by the hospital	86% (387)	Good institutional support
Reported Poor BMW practices	64% (288)	Need for improvement
Training as challenge	32% (144)	Need for Capacity Building

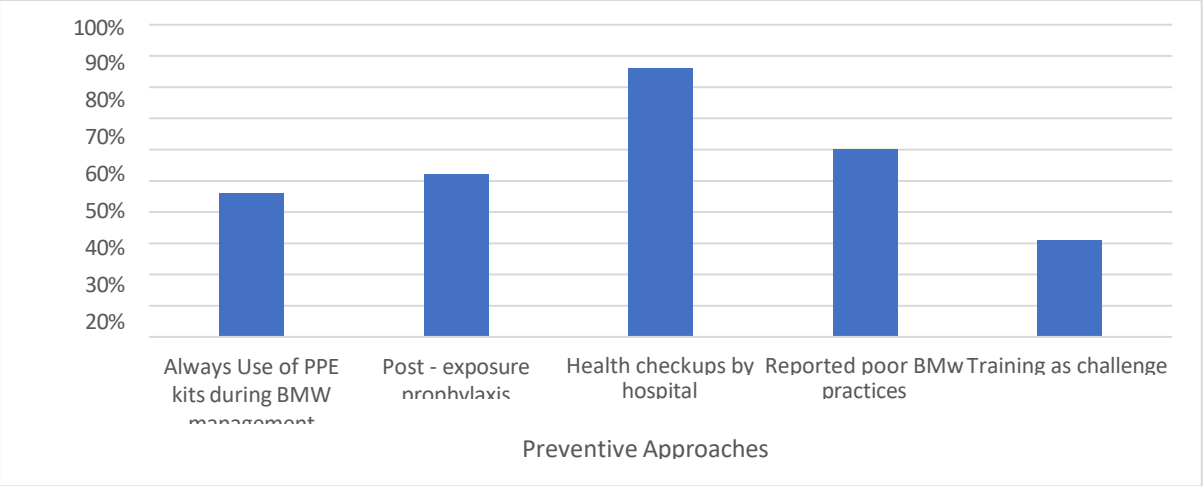

Figure 3.2 Implementation of Preventive Approaches for BMW management

A chi-square test was used to find out the significant gap in the implementation of preventive approaches for biomedical waste management in hospitals. As findings of the chi-square test were 1891.500, df=4, and p< 0.000, suggesting a significant gap. Some measures (such as routine health checkups and post-exposure prophylaxis) were more commonly implemented than others (such as training or PPE usage). This suggests a need for more uniform implementation of all preventive strategies to enhance safety and compliance in biomedical waste handling.

DISCUSSION:

The present study found that 96% of participants were aware of the risks associated with handling sharps. This level of awareness is comparable to findings from studies conducted in tertiary care hospitals in Chennai and Srikakulam, South India (Neelima et al., 2024) However, a higher incidence of sharp injuries (11%) among medical students in a related study suggests a gap in their awareness and knowledge regarding safe sharp-handling practices. Another study showed low level of awareness about needle stick injury (54%) shown in dental college Jaipur (Sharma, et al., 2013).The present study revealed that 84% of the staff were aware of disease transmission risks associated with poor biomedical waste management. In contrast, a study conducted in a hospital with a bed capacity exceeding 100 in Allahabad city reported that only 27% of the staff were aware of the potential for disease transmission through biomedical waste (Neelima et al.,2024).

In the current study, nearly 98% of participants were aware of the risk of healthcare-associated infections (HAIs) resulting from poor biomedical waste management. In comparison, a separate study reported that only 44% of medical interns were aware of HAI risks linked to improper biomedical waste practices. In comparison, a separate study reported that only 44% of medical interns were aware of HAI risks linked to improper biomedical waste practices (Mathur et al.,2011).

CONCLUSION:

The majority of participants (over 90%) are aware of serious health risks related to improper biomedical waste management, particularly infection transmission. However, only about half of the participants consistently use PPE kits or receive post–exposure prophylaxis, and a significant number report improper waste handling practice. This indicates a strong awareness of the problem, but gaps remain in preventive measures and institutional practices, especially around training, storage, and PPE adherence. This study states that participants with higher

awareness are significantly more likely to recognize key BMW risks**.** Participants with higher awareness are significantly more likely to recognize key BMW risks.

RECOMMENDATIONS

- Mandatory training programs on BMW handling.
- Strict enforcement of PPE usage.
- Regular audits on BMW disposal practices.
- Improved access to post–exposure prophylaxis.
- Engagement campaigns to improve interest and participation.

REFERENCES

1. Babanyara, Y. Y., Ibrahim, D. B., Garba, T., Bogoro, A. G., & Abubakar, M. Y. (2014). Poor Medical Waste Management (MWM) practices and its risks to human health and the environment: a literature review. SSRN.
2. Baburao, B., & Syam Sundar, J. (2013). Study of Prevalence & Reponse to Needlestick injuries among health Care Workers in a Tertiary Care Hospital in Hyderabad India. J Evol Med Dent Sci, 2(23), 4199-204.
3. Bansod, H. S., Deshmukh, P., & Bansod, H. (2023). Biomedical waste management and its importance: a systematic review. Cureus, 15(2).
4. Chakraborty, S., Veeregowda, B., Gowda, L., Sannegowda, S. N., Tiwari, R., Dhama, K., & Singh, S. V. (2013). Biomedical waste management. Advances in Animal and
5. veterinary Sciences,2(2). http://www.nexusacademicpublishers.com/journal/4.
6. Chen, Y. C., & Tsai, P. Y. (2017). Evaluating the operational risks of biomedical waste using failure mode and effects analysis. Waste Management & Research, 35(6), 593-601.
7. Gowd, K. K., Veerababu, D., & Reddy, V. R. (2021). COVID-19 and the legislative response in India: The need for a comprehensive health care law. Journal of Public Affairs, 21(4), e2669.
8. Hussain, M., & Mushtaq, M. M. (2014). Awareness about hospital wastes and its effects on the health of patients in District Dera Ghazi Khan. Asian Journal of Applied Science and Engineering, 3(3), 301-308.
9. Kothari, R., Sahab, S., Singh, H. M., Singh, R. P., Singh, B., Pathania, D., & Tyagi, V. V. (2021). COVID-19 and waste management in Indian scenario: challenges and possible solutions. Environmental Science and Pollution Research, 28(38), 52702-52723.
10. Manzoor, J., & Sharma, M. (2019). Impact of biomedical waste on environment and human health. Environmental Claims Journal, 31(4), 311-334.
11. Mathur, V., Dwivedi, S., Hassan, M. A., & Misra, R. P. (2011). Knowledge, attitude, and practices about biomedical waste management among healthcare personnel: A cross- sectional study. Indian Journal of Community Medicine, 36(2), 143-145.
12. Mastorakis, N. E., Bulucea, C. A., Oprea, T. A., Bulucea, C. A., & Dondon, P. (2010). Environmental and health risks associated with biomedical waste management. Develop Energy Environ Economics, 2010, 287-94.
13. Nosheen, F., Malik, N., Mehmood, Z., Jabeen, F., Mahmood, A., Ibrahim, M., & Show, P.
14. L. (2022). Biomedical waste management associated with infectious diseases among health care professionals in apex hospitals of a typical south Asian city. Environmental research, 215, 114240.
15. Neelima, Y., Surendra, C. B. S., & Manoj, P. (2024). Awareness About Biomedical Waste Management among Health Care Personnel in a Tertiary Care Hospital in Srikakulam, South India. Res. J. Med. Sci, 18, 468-473.
16. Okechukwu, E. C., Oparah, A. C., Aguora, S. O., & Soni, J. S. (2021). Evaluation of Health Risks of Improper Biomedical Waste Management among Health Workers in Selected Hospitals in Abuja, Nigeria. management, 11, 12.
17. Odumosu, B. T. (2015). Biomedical waste: Its effects and safe disposal. Appl Environ Microbiol, 37(3), 550-553.
18. Patil, A. D., & Shekdar, A. V. (2001). Health-care waste management in India. Journal of environmental management, 63(2), 211-220.
19. Radha, K. V., Kalaivani, K., & Lavanya, R. (2009). A case study of biomedical waste management in hospitals. Global journal of health science, 1(1), 82-88.
20. Ravindra, K., Sareen, A., Dogra, S., & Mor, S. (2023). Appraisal of biomedical waste management practice in India and associated human health and environmental
21. risk. Journal of Environmental Biology, 44(4), 541-551.
22. Sharma, Alok, Varsha Sharma, Swati Sharma, and Prabhat Singh. "Awareness of biomedical waste management among health care personnel in Jaipur, India." Oral Health Dent Manag 12, no. 1 (2013): 32-40.
23. Sahoo, M. C., Pillai, J. S. K., Sahoo, B., Pillai, J. S., & SAHOO, B. (2024). Exploring Biomedical Waste Management Practices Among Healthcare Professionals: A Study from a Tertiary Care Teaching Hospital in Eastern India. Cureus, 16(6).
24. Yao, W. X., Yang, B., Yao, C., Bai, P. S., Qian, Y. R., Huang, C. H., & Liu, M. (2010).
25. Needlestick injuries among nursing students in China. Nurse education today, 30(5), 435-437.
26. Verma, P., Thakur, A., & Tiwari, R. (2024). Assessment of biomedical waste management awareness, practices, and needle stick injuries among healthcare workers in government hospitals of Jabalpur, Madhya Pradesh. International Journal of Medicine & Public Health, 14(2).