

# Knowledge, Attitude, and Practices of Biomedical Waste Management Among CRMIs in a Tertiary Care Hospital

Shanmathi KA<sup>1\*</sup>, Logeshwari B.M<sup>2</sup>, Niveditha<sup>3</sup>, Veena<sup>4</sup>

<sup>1\*</sup>Post Graduate, Department of Obstetrics and Gynaecology, Sree Balaji Medical College and Hospital, Chennai

<sup>2</sup>Assistant Professor, Department of Obstetrics and Gynaecology, Sree Balaji Medical College and Hospital, Chennai

<sup>3</sup>Assistant Professor, Department of Obstetrics and Gynaecology, Sree Balaji Medical College and Hospital, Chennai

<sup>4</sup>Assistant Professor, Department of Obstetrics and Gynaecology, Sree Balaji Medical College and Hospital, Chennai

## KEYWORDS

Knowledge, Attitude, Practices, Biomedical waste, CRMI, Positive attitude

## ABSTRACT

**Background:** Biomedical waste management is crucial for preventing infections and environmental contamination in healthcare settings. This study examines the knowledge, attitude, and practices (KAP) of biomedical waste management among Compulsory Rotatory Medical Interns (CRMIs) in a tertiary care hospital.

**Methods:** The research utilised a survey-based observational approach, employing a structured questionnaire to assess multiple aspects of biomedical waste management among CRMIs actively involved in patient care.

**Results:** 80% of respondents demonstrated awareness of biomedical waste generation and legislation. 60% correctly adhered to the 24-hour waste storage rule, which is better than the guideline. 86.7% understood the primary purpose of sodium hypochlorite pretreatment in reducing infectious load. 66.7% correctly identified proper disposal containers for recyclable glass waste. 86.67% recognised the importance of using needle destroyers before disposing of syringes.

**Conclusions:** The study revealed generally positive attitudes towards biomedical waste management, with 66.7% of respondents associating it with ethical responsibility and professionalism. However, gaps were identified in practical knowledge application and understanding of regulatory responsibilities. Recommendations include implementing comprehensive hands-on training programs, regularly updating educational materials, and strengthening collaboration between medical institutions and regulatory bodies. These measures aim to enhance CRMIs' practical skills and understanding, ultimately contributing to improved healthcare waste management practices and benefiting public health and environmental safety.

## Introduction

Biomedical waste (BMW) includes waste produced during the diagnosis, treatment, or immunisation of humans or animals, as well as during research operations or the manufacturing and testing of biologicals<sup>1</sup>. Hospitals, nursing homes, clinics, dispensaries, veterinary facilities, animal houses, pathological laboratories, blood banks, Ayush hospitals, clinics, research or educational institutions, health camps, medical or surgical camps, vaccination camps, blood donation camps, school first aid rooms, forensic laboratories, and research laboratories are all subject to the regulations governing the generation, storage, transportation, proper disposal, and treatment of biomedical waste<sup>2</sup>. Biomedical waste management is a critical aspect of healthcare that has significant implications for public health and environmental safety.

The proper handling, segregation, and disposal of biomedical waste are essential to prevent the spread of infections and minimize environmental contamination. In healthcare settings, it is crucial for all personnel, including CRMIs, to have adequate knowledge, positive attitudes, and appropriate practices regarding biomedical waste management. Proper biomedical waste management (BMWM) is critical in tertiary care hospitals to mitigate health and environmental risks, yet gaps persist in knowledge, attitudes, and practices (KAP) among healthcare workers (HCWs). Biomedical wastes have not gotten enough attention in developing nations, therefore hospitals continue to face difficulties with BMW management<sup>3</sup>. Studies in India highlight disparities in KAP, with CRMIs having better knowledge than nursing staff and nursing staff often demonstrating better awareness compared to paramedical and support staff, who frequently lack training and adherence to segregation protocols<sup>4-6</sup>. Hep B, HCV, and HIV are among the blood-borne viruses that can be

spread by needle stick injuries. Each year, 3 million healthcare professionals are exposed to these blood-borne illnesses. The frequency of NSIs in hospitals affects the standard of patient care and puts the safety of healthcare workers at risk<sup>7,8</sup>. The majority of medical personnel who worked in emergency rooms, surgery rooms, delivery rooms, and labs were more likely to get needlestick injuries<sup>9</sup>. Even with sufficient knowledge, individuals frequently fall short of the indications because Universal Precautions (UP), which call for using gloves, goggles, and other protective gear when handling specimens or drawing blood and bodily fluids, are not properly followed<sup>10,11</sup>. Regulatory frameworks like India's BMWM Rules first notified in 1998 and updated in 2016 mandate strict segregation, treatment, and disposal, but challenges such as inadequate infrastructure, inconsistent compliance, and insufficient training remain prevalent, particularly in high-risk settings<sup>12,13</sup>. In India, it is estimated that about 0.33 million tons of hospital waste is generated annually<sup>14</sup>. Compulsory Rotatory Medical Interns (CRMIs) play a crucial role in the healthcare system and are frequently involved in the generation and handling of biomedical waste. As future medical professionals, their knowledge, attitude, and practices regarding biomedical waste management are of paramount importance. This study aims to assess the current level of understanding and implementation of biomedical waste management protocols among CRMIs in a tertiary care hospital. By evaluating these aspects, the research seeks to identify gaps in understanding and implementation, which can inform targeted training programs and policy improvements to enhance overall biomedical waste management in healthcare facilities.

### Materials and Methods

A survey-based observational study was conducted at Sree Balaji Medical College and Hospital to assess the knowledge, attitude, and practices of Compulsory Rotatory Medical Interns (CRMIs) regarding biomedical waste management (BMWM). Ethical approval was obtained from the Institutional ethical committee. Data collection was carried out using a structured questionnaire that included multiple-choice and Likert-scale questions to ensure a comprehensive evaluation.

The study participants comprised CRMIs actively involved in direct patient care, with a random selection method used to determine the sample size. The questionnaire was designed to assess multiple aspects of BMWM, including knowledge of relevant regulations such as the Biomedical Waste Management Rules, 2016, proper waste segregation techniques, and disposal methods. Attitudinal aspects were evaluated based on the interns' perception of responsibility in waste management and their compliance behaviour in adhering to protocols. Additionally, self-reported adherence to BMWM guidelines was used to assess practical implementation and handling of biomedical waste. Data obtained from the responses were analysed using descriptive statistics, and the results were presented through tables for clarity and better interpretation. This approach allowed for an in-depth understanding of CRMIs' awareness and compliance with BMWM protocols, identifying areas of strength and potential gaps requiring intervention through targeted training and reinforcement of hospital waste management policies.

### Results

**Knowledge and Awareness :** 80% respondents reported being aware of biomedical waste generation and legislation, while 20% were not. A majority are knowledgeable, indicating good awareness levels.

**Biomedical Waste storage time:** 60% comply with the 24-hour rule for waste storage. 26.7% follow the 48-hour rule. Only 13.3% store waste for up to 72 hours. Most respondents adhere to the shortest recommended storage duration, which minimizes risks of contamination and infection.

**Sodium Hypochlorite Pretreatment:** The primary purpose identified by 86.7% of respondents is reducing infectious load in liquid waste. Recycling and odour elimination were mentioned by 6.7% of respondents each.

**Microbiology and Laboratory waste:** Equal percentage of people suggested incineration and autoclave as the method of disposal for microbiological and laboratory wastes. However, few are not knowledgeable enough and believe cutting and shredding can be used as method to dispose of these wastes.

**Table 1: Knowledge, Attitude and Practices of Bio-Medical Waste Management**

Questions	Responses
Do you know about biomedical waste generation and legislation?	Yes – 80% No – 20%
According to Biomedical waste management rules, wastes should not be stored beyond?	24 hours – 60% 48 hours – 26.67% 72 hours – 13.33%
What is the purpose of Sodium Hypochlorite pretreatment?	Reducing infectious load in liquid Waste - 86.67% Recycling the waste material – 6.67% Eliminating odour – 6.67%
What is the recommended method for treating microbiological and laboratory waste before disposal?	Incineration – 40% Pre-treatment with autoclave – 40% Cutting/mutilation – 13.33% Shredding – 6.67%
Recyclable waste made of glass is disposed of in which container?	Cardboard box with blue marking – 66.67% White punctured proof – 20% Non chlorinated yellow bag – 6.67% Red bag – 6.67%
Which of the following is disposed of in blue bin?	Glassware and metallic implants – 60% Sharps like needles – 26.67% Plastic syringes – 6.67% Human tissue – 6.67%
Which colour coded bin is used for collecting human anatomical waste, such as body parts?	Yellow – 73.3% Red – 13.3% Blue – 13.3% Black – 0%
What method is commonly used for safe disposal of sharps?	Autoclaving – 40% Shredding – 26.67% Incineration – 26.67% Chemical disinfection – 6.67%
What should be done with used syringes before disposal?	Cut the needle with needle destroyer – 86.67% Wash and reuse – 6.67% Dispose it of directly in black bag – 6.67%
Which symbol is used for recyclable waste?	 - 100%  - 0%  - 0%  - 0%
Which of the following is environmental friendly alternative for waste treatment?	Incineration – 40% Deep Burial – 40% Autoclave – 20%
What does a positive attitude towards biomedical waste management reflect?	Ethical responsibility and professionalism – 66.67% Indifference to workplace hazards – 20% Fear of penalties – 6.67% Desire to avoid extra work – 6.67%
What is the ideal attitude towards biomedical waste management in health care settings?	Shared responsibility of all health care workers – 80% Only necessary during inspection – 13.33 % Primarily the job of waste management staffs – 6.67%
What is the primary objective of biomedical waste management?	Prevent infection and contamination – 66.67% Ensure proper storage of waste – 26.67% Save costs in waste disposal – 6.67%
What is proactive attitude towards biomedical waste management?	Reporting and addressing improper waste disposal practices – 80% Ignoring improperly disposed waste to avoid conflicts – 13.33% Handling waste without following guidelines if convenient – 6.67%
What agency is responsible for monitoring biomedical waste management in India?	Ministry of Health and family welfare – 46.67% Indian Medical Association – 33.33% Central Pollution control board – 20%

**Recyclable glass:** The majority (66.7%) correctly identified the cardboard box with blue marking as the container for recyclable glass waste. Other responses included white puncture proof containers (20%), red bags (6.7%), and non-chlorinated yellow bags (6.7%). While most responses are accurate, some confusion exists regarding proper disposal containers.

**Waste Disposed in Blue bin:** 60% correctly identified glassware and metallic implants should be disposed of in puncture proof blue cardboard box whereas about 40% have other ideas which shows there is still room for improvement in awareness.

**Anatomical waste:** Majority interns know that anatomical wastes such as body parts should be disposed in yellow bag.

**Disposal of sharps:** Majority said safe disposal method for Sharps is autoclaving (40%). Other responses include shredding (33%), followed by incineration (20%). Chemical disinfection was rarely mentioned.

**Used syringe disposal:** About 86.67% feels needles should be cut with needle destroyer before disposing off as a safety measure to avoid needle stick injury.

**Symbol of Recyclable waste:** All interns participated in this study are aware of the symbol of recyclable waste but still there is lack of application of this knowledge practically as many are not able to segregate recyclable and non-recyclable waste when presented.

**Alternatives:** When asked about environmentally friendly alternatives, responses were evenly split between incineration and deep burial, with autoclaving being less common.

**Positive attitude reflection:** Most respondents (66.7%) associate a positive attitude with ethical responsibility and professionalism. Other motivations include indifference to workplace hazards (20%), desire to avoid extra work (6.7%), and fear of penalties (6.7%). Ethical responsibility is the dominant driver for proper waste management, but some respondents are motivated by less ideal factors.

**Ideal attitude towards BMWM:** 80% are of opinion that Biochemical waste management is a shared responsibility of all health care workers.

**Primary Objective of BMW:** The primary objective cited by most respondents (66.7%) is to prevent infection and contamination. Other objectives include ensuring proper storage of waste (26.7%) and saving costs in disposal (6.7%).

**Proactive attitude towards handling BMW:** Majority of interns are proactive towards reporting improper waste disposal except a few.

**Responsibility of monitoring BMWM:** Most respondents identified the Ministry of Health and Family Welfare as responsible for monitoring waste management, followed by the Indian Medical Association and Central Pollution Control Board.

## **Discussion**

The study indicates that majority of the interns are aware of the biomedical waste management rules which is in accordance with other studies<sup>15-17</sup>. Even though Biomedical-waste management regulations 2016 allows 48 hours to store waste in the facility<sup>13</sup> majority of interns said 24 hours is the maximum time allowed which is similar to study done by Prakash Rao et al<sup>18</sup> but in a study done by Mahesh et al 56% correctly said 48 hours is the maximum time allowed for storage of Bio medical waste in a facility<sup>19</sup>. This shows there has been discrepancy in knowledge regarding storage norms. Majority of interns are aware that pretreatment with sodium hypochlorite solution is to reduce infectious load in liquid waste. No other studies have exclusively dealt with pretreatment but generally doctors have less knowledge in preparing sodium hypochlorite solution than nurses according to study done by Sahoo et al<sup>20</sup>. Only 40% think that Microbiological and Laboratory wastes should be pretreated in an autoclave before disposal. While equal percentage of interns said incineration

as an option, the right method according to 2016 guidelines is pretreatment in autoclave/microwave/hydroclave and also non-chlorinated chemical disinfectant<sup>13</sup>. Most interns who participated in this study have sound knowledge about segregation of waste with 73.3% knows to anatomical wastes should be disposed in yellow bags and 60% of them correctly saying glassware should be disposed in puncture proof blue cardboard box which is similar to study done by Prakash Rao et al<sup>18</sup>. The proper method for disposal of sharps according to 2016 guidelines is to disinfect either with autoclaving or dry-heat sterilization or a combination of autoclaving cum shredding. About 40% are in favour of autoclaving and 26.27% are in favour of shredding which shows most interns are aware of sharps disposal but when the question includes both autoclave and shredding the respondents were split in their opinions which shows still there is space for improvement of knowledge. CRMIs participated in this study are well aware of the use of needle cutter and many are sure that needle cutter should be used before disposing of needles but study done by Sanker et al in North Karnataka shows interns have poor knowledge about needle disposal with only 50% used needle cutters<sup>21</sup>. Interns generally have positive attitude towards biomedical waste management with more than 60% said it's an ethically responsible activity and about 80% accept it's a shared responsibility of all health care workers in a hospital which is similar to studies done by Prakasa Rao et al<sup>18</sup>, Sanker et al<sup>21</sup>, Pandey A et al<sup>22</sup>, and similar study done in the same Sree Balaji Medical college and hospital in 2019 by Mohan Kumar P<sup>16</sup> yielded similar results which shows consistency in attitude towards biomedical waste management among interns. The study measured the proactiveness of interns especially on reporting improper BMW management practices either by hospital or by other health care workers and found that majority will report in case of any incident. This in turn put pressure on other health care workers to follow proper rules and regulations and work as a team. Although not directly comparable, study done by Sanker et al also found that most interns will report needle stick injury without fail<sup>21</sup>. The study found that interns are not aware of who is responsible for monitoring Biomedical waste management. According to 2016 guidelines it's clearly mentioned that Central Pollution Control Board (CPCB) is responsible for monitoring BMW management. However only 20% said that CPCB is responsible which is similar to the findings of study done by Mahesh et al<sup>19</sup>. The application of knowledge among interns is very low especially when 40% choose incineration (produces toxic gases like dioxins, furans and mercury) as an alternative environmental healthy process of disposing waste while better process like autoclave got only 20% approval. Studies done by Su et al shows that microwave disinfection and autoclave are cost effective as well as efficient where newer methods like pyrolysis though highly effective and efficient with lower environmental impact, high pretreatment costs and high energy consumption makes them practically not feasible<sup>23</sup>. The entire study population identified the symbol of recyclable waste similar to study done by Prakash Rao et al where 88% interns identified the symbol of bio-hazard correctly<sup>18</sup>.

## **Conclusion**

This study on biomedical waste management among Compulsory Rotatory Medical Interns (CRMIs) at Sree Balaji Medical College and Hospital reveals several key findings and implications for future practice and policy. The majority of CRMIs demonstrated a good understanding of biomedical waste generation and legislation. This indicates a solid foundation of knowledge among future medical professionals. However, there is still room for improvement to ensure universal understanding and compliance with biomedical waste management protocols. While theoretical knowledge was generally strong, some gaps were identified in the practical application of biomedical waste management principles. 60% of respondents correctly adhered to the 24-hour waste storage rule, indicating a cautious approach to waste management. There was some confusion regarding the proper disposal containers for different types of waste, suggesting a need for more hands-on training. Knowledge of proper sharps disposal methods was mixed. The study revealed positive attitudes towards biomedical waste management among CRMIs. Most interns demonstrated a proactive attitude towards reporting improper waste disposal practices. Despite the overall positive findings, several areas require attention. Enhancing practical knowledge of waste segregation and disposal methods. Clarifying the roles and responsibilities of regulatory bodies in monitoring biomedical waste management. Increasing awareness of environmentally friendly alternatives to incineration for waste disposal. Implement more comprehensive, hands-on training programs for CRMIs on biomedical waste management. Regularly update educational materials to reflect the latest guidelines and best practices. Encourage a culture of continuous learning and improvement in biomedical waste management practices. Strengthen collaboration between medical education institutions and regulatory bodies to ensure alignment of training with current regulations. In conclusion, while CRMIs demonstrate a strong foundation in biomedical waste management knowledge and attitudes, targeted interventions can further enhance their practical skills and understanding. This will contribute to improved healthcare waste management practices, ultimately benefiting public health and environmental safety.

**Conflicts of Interest:** Nil

**Funding:** Not applicable.

**Approval of Institutional Ethical Review Board:**

Institutional Human Ethics Committee, Sree Balaji Medical College and Hospital

Ref .No. 002/SBMCH/IHEC/2024/2303

5/10/2024

**Acknowledgements:**

We want to express our deepest gratitude to all those who contributed to the success of this study. First and foremost, we extend our heartfelt thanks to the CRMIs of Sree Balaji Medical College and Hospital who participated in the survey and shared their valuable insights. We sincerely appreciate the Department of Obstetrics and Gynaecology at Sree Balaji Medical College and Hospital for providing the necessary resources and support for this research. Special thanks to Prof Dr Meena TS, Head of the department, Department of Obstetrics and Gynaecology, Sree Balaji Medical College and Hospital for the guidance and unwavering support throughout the study. Finally, we are grateful to our families and colleagues for their continuous encouragement and understanding during the course of this study

**References**

1. BIO MEDICAL\_WASTE\_MANAGEMENT\_\_HANDLING\_RULE\_-\_1998.pdf [Internet]. [cited 2025 Feb 4]. Available from: [https://igims.org/DataFiles/CMS/file/waste%20management/BIO-MEDICAL\\_WASTE\\_MANAGEMENT\\_\\_HANDLING\\_RULE\\_-\\_1998.pdf](https://igims.org/DataFiles/CMS/file/waste%20management/BIO-MEDICAL_WASTE_MANAGEMENT__HANDLING_RULE_-_1998.pdf)
2. Sharma Madhuri. Hospital waste management and its monitoring. 1st ed. JAYPEE BROTHERS MEDICAL PUBLISHERS PRIVATE LIMITED; 2002.
3. Da Silva CE, Hoppe AE, Ravello MM, Mello N. Medical wastes management in the south of Brazil. *Waste Manag.* 2005;25(6):600–5.
4. Gupta NK, Shukla M, Tyagi S. Knowledge, attitude and practices of biomedical waste management among health care personnel in selected primary health care centres in Lucknow. *International Journal Of Community Medicine And Public Health.* 2016;3(1):309–13.
5. Dhole KS, Bahadure S, Bandre GR, Noman O. Navigating Challenges in Biomedical Waste Management in India: A Narrative Review. *Cureus.* 16(3):e55409.
6. Lavanya K. M., Padmavati Majhi. Knowledge, Attitude and Practices (KAP) about biomedical waste management among hospital staff – A cross-sectional study in a tertiary care hospital, Andhra Pradesh, India. *JCHM.* 2020 Dec 28;5(1):32–6.
7. Kutubudin AFM, Shafei MN, Ibrahim MI, Yaacob NM, Kutubudin AFM, Shafei MN, et al. Development and Validation of the Needlestick Injury Prevention (N-SIP) Module. *Cureus* [Internet]. 2024 Jul 13 [cited 2025 Feb 5];16. Available from: <https://www.cureus.com/articles/270744#!/>
8. Kebede A, Gerense H. Prevalence of needle stick injury and its associated factors among nurses working in public hospitals of Dessie town, Northeast Ethiopia, 2016. *BMC Res Notes.* 2018 Jun 28;11(1):413.
9. Amira CO, Awobusuyi JO. Needle-stick injury among health care workers in hemodialysis units in Nigeria: a multi-center study. *Int J Occup Environ Med.* 2014 Jan;5(1):1–8.
10. Thakur A, Toppo M, Pal DK. Occupational Exposure to Needlestick and Sharp Injuries among Hospital Waste Handlers in Selected Government Health Facilities of Bhopal District. 2015;(5).
11. Lee LK, Hassim IN. Implication of the prevalence of needlestick injuries in a general hospital in Malaysia and its risk in clinical practice. *Environ Health Prev Med.* 2005 Jan;10(1):33–41.
12. Somasundaram N, Vidhya SK, Vijayashree V, Selvakumari RS, Vasudevan M. AWARENESS ON BIOMEDICAL WASTE MANAGEMENT AND NEEDLE STICK INJURY AMONG HEALTH CARE WORKERS IN A TERTIARY CARE HOSPITAL.
13. [guidelines\\_healthcare\\_june\\_2018.pdf](https://cpcb.nic.in/uploads/projects/bio-medical-waste/guidelines_healthcare_june_2018.pdf) [Internet]. [cited 2025 Feb 4]. Available from: [https://cpcb.nic.in/uploads/projects/bio-medical-waste/guidelines\\_healthcare\\_june\\_2018.pdf](https://cpcb.nic.in/uploads/projects/bio-medical-waste/guidelines_healthcare_june_2018.pdf)
14. Sekar M, M S, Easow JM. A study on knowledge, attitude and practice of biomedical waste management among health care workers in a Tertiary Care Hospital in Puducherry. *Indian Journal of Microbiology Research.* 5(1):57–60.
15. Basu M, Das P, Pal R. Assessment of future physicians on biomedical waste management in a tertiary care hospital of West Bengal. *J Nat Sci Biol Med.* 2012;3(1):38–42.

16. Mohan Kumar P. Knowledge, attitude and practice study on bio-medical waste management among interns in a tertiary care hospital in Kancheepuram, Tamil Nadu. *International Journal Of Community Medicine And Public Health*. 2019 Jul 26;6(8):3354–7.
17. Madhavi KVP, Reddy BC, B. P. R. AWARENESS REGARDING BIOMEDICAL WASTE MANAGEMENT AMONG INTERNS IN A TERTIARY HEALTH CARE HOSPITAL, KHAMMAM. *jemds*. 2013 Jul 18;2(29):5360–5.
18. Prakasa Rao SS, Ramani SS, Bharathi K, Shravani Reddy N, Vignatha A, Virajitha VD. KNOWLEDGE, ATTITUDE AND PRACTICE OF MEDICAL INTERNS REGARDING BIOMEDICAL WASTE MANAGEMENT. *ijsr*. 2024 Jul 1;70–2.
19. Mahesh DJ, Sindhu DJ, Iswarya DR, Rao DJN. STUDY TO ASSESS THE ATTITUDE AND PRACTICES OF BIO-MEDICAL WASTE MANAGEMENT AMONG INTERNS IN A TERTIARY CARE TEACHING INSTITUTE IN SOUTHERN INDIA. 2023;8(3).
20. Sahoo MC, Pillai JSK, Sahoo B. Exploring Biomedical Waste Management Practices Among Healthcare Professionals: A Study From a Tertiary Care Teaching Hospital in Eastern India. *Cureus*. 16(6):e61823.
21. Sankar AJ, IAS, Kardalkar S, B SR. KNOWLEDGE, ATTITUDE, AND PRACTICES ON BIOMEDICAL WASTE MANAGEMENT AMONG MEDICAL INTERNS OF A TERTIARY CARE HOSPITAL IN NORTH KARNATAKA. *Asian Journal of Pharmaceutical and Clinical Research*. 2024 Oct 7;150–2.
22. Pandey A, Dardi CK. KAP study on bio-medical waste management among interns in a tertiary care hospital in Maharashtra. *International Journal Of Community Medicine And Public Health*. 2017 Oct 25;4(11):4174–7.
23. Su G, Ong HC, Ibrahim S, Fattah IMR, Mofijur M, Chong CT. Valorisation of medical waste through pyrolysis for a cleaner environment: Progress and challenges. *Environ Pollut*. 2021 Jun 15;279:116934.