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## Research Article

# A Study on Knowledge and Awareness about Management of Biomedical Waste in Multi-specialty Hospitals

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## Abstract

Biomedical waste management (BMWM) is a critical component of healthcare systems, as improper handling and disposal of biomedical waste can lead to serious health and environmental hazards. This study aimed to assess the knowledge and awareness regarding biomedical waste management among medical professionals working in multi-speciality hospitals in Jammu, India. A descriptive cross-sectional study was conducted among 100 healthcare workers, including doctors, nurses, laboratory technicians, and housekeeping staff, selected from four multi-speciality hospitals. Data were collected using a pre-tested structured questionnaire covering knowledge, attitudes, and practices related to BMWM. The findings revealed that the majority of participants demonstrated adequate awareness regarding infections transmitted through biomedical waste, disease risks, and the importance of personal protective equipment, with awareness levels ranging from 73% to 75%. However, gaps were identified in specific operational and regulatory aspects, particularly regarding permissible storage duration of untreated biomedical waste and major sources of occupational infection, where only 44% responded correctly. Nurses constituted the largest participant group (38%), and most respondents had 6–10 years of professional experience. The study highlights the need for regular training, continuous monitoring, and strengthened awareness programs to improve compliance with biomedical waste management guidelines and ensure safer healthcare environments.

**Keywords:** Biomedical Waste Management, Healthcare Workers, Knowledge and Awareness, Hospital Waste Disposal, and Occupational Health Hazards.

## Introduction

Bio-medical waste means “any solid and/or liquid waste produced during diagnosis, treatment, health camps, research centres or vaccination of human beings or animals. Biomedical waste creates hazards due to two principal reasons: infectivity and toxicity. All biomedical waste is hazardous. According to WHO1, nearly 85% is general waste of all waste generated by hospitals. About 15% waste is Bio-medical Waste, which includes Infectious waste - 10%. • Non-infectious waste, such as radioactive & chemical wastes - 5% .(Wang, Y., Kung, L., & Byrd, T. A et.al. (2018).

## Sources of Biomedical Waste

Biomedical waste is generated from a variety of healthcare and related facilities where diagnosis, treatment, research, immunization, and healthcare services are provided. Major sources of biomedical waste include hospitals, dialysis centres, blood banks, medical colleges, research laboratories, industries involved in healthcare activities, nursing homes, animal research centres, clinics, immunization session sites, ambulance services, home treatment settings, dispensaries, slaughterhouses, educational institutions, maternity homes, and funeral services.

### Classification of Bio-Medical Waste: According to new guidelines 2016-

The Bio-Medical Waste is classified into the following categories:

**a) Human Anatomical Waste:** Human tissues, organs, body parts and foetus below the viability period (as per the [Medical Termination of Pregnancy Act 1971](#), amended from

time to time). Biomedical waste management (BMWM) is a crucial aspect of healthcare operations, ensuring the safe and environmentally responsible disposal of hazardous waste generated in hospitals. This study aims to provide a comprehensive analysis of BMWM practices in hospital, encompassing waste segregation, collection, transportation, treatment, and disposal. ([Kumar, R., & Singh, P.et.al,2024](#))

#### Animal Anatomical Waste

Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses.

#### b) Soiled Waste

Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components

#### c) Expired or Discarded Medicines

Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.

#### d) Chemical Waste

Chemicals used in production of biological and used or discarded disinfectants

#### e) Chemical Liquid Waste

Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, Silver X-ray film developing liquid, discarded Formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, house-keeping and disinfecting activities etc.

**f) Discarded linen, mattresses, beddings contaminated with blood or body fluid.**

**g) Microbiology, Biotechnology and other clinical laboratory waste:** Blood bags, Laboratory cultures, stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures.

#### h) Contaminated Waste (Recyclable)

Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and fixed needle syringes) and vacutainers with their needles cut and gloves.

**i) Waste sharps including Metals:** Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes used, discarded and contaminated metal sharps

#### j) Glassware

Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes.

#### Health hazards

Health-care waste is a reservoir of potentially harmful micro-organisms which can infect hospital patients, health-care workers and the general public. These risks have been given little importance by the authorities. Improper waste management poses a huge risk towards the health of the public as well as fauna directly or indirectly through environmental degradation. The present major problems of bio-medical waste management are due to the failure in implementation of the rules related to the Bio medical waste. The small clinics and even some multi speciality hospitals are mixing the hospital waste with general waste in order to avoid the expenses of handling the bio medical waste. The bio-medical waste which is kept in a place for long time may result in transmission of infections to the people who ever get contacted with it. It not only

Creates unpleasant odour but also the chance of micro-organisms development which further leads to transmission of communicable diseases like AIDS, hepatitis - A and B, respiratory infections, typhoid, hepatitis, jaundice, plague, rabies, skin irritation and allergies etc. ([Sharma, R.K., Gupta, R.K., Kour, H., Mahajan, R., Manhas, S., Zaffer, I., & Hassan, Z. U. et.al 2022](#)). Wastes and by-products can also cause injuries. For example, radiation burns or sharps-inflicted injuries, poisoning and pollution, whether through the release of pharmaceutical products like antibiotics and cytotoxic drugs or through the wastewater or by toxic elements or compounds such as mercury or dioxins.

Incinerators operating at sub-optimal conditions are also an added environmental and health hazard as they cause pollution 4. The potential risk to health care workers comes from the handling of infected sharps and it is estimated that 60 percent of them sustain an injury from sharps knowingly or unknowingly during various procedures. The practice of resheathing the needle after use is the major factor for needle stick injuries. Through improper waste management practices, all health care workers (nurses, doctors, and lab technicians), service personnel, rag pickers and the general public are at risk of contracting infections while handling storage and treatment.

**Waste is collected in different colored bags as mentioned below:**

- a) Yellow plastic bags are used for segregating Human anatomical waste, dissected parts, tissue removed at surgery, laboratory cultures and specimens etc.
- b) Red plastic bags are used for segregating laboratory waste, culture plates, items contaminated with blood, non-sharp disposable items like gloves, intravenous sets, etc.
- c) White/ translucent puncture or leak proof containers used for needles, syringes, scalpels, blades, etc.
- d) Blue cooler marked cardboard boxes used for glassware.
- e) Black plastic bags are used to segregate discarded medicines, cytotoxic drugs, chemicals which have been used for disinfection, insecticides and incineration ash.

**Disinfection:**

To render infectious items free from pathogenic organisms and to prevent the risk of infection to health care workers, disinfection is carried out before transporting and disposing them. There are various methods to carry out disinfection like thermal, chemical, microwaving, irradiation and exposure to ultra violet rays

**Collection**

The collection and transportation of bio-medical waste shall be carried out in a manner so as to avoid any possible hazard to human health and environment. Collection and transportation are two operations where the chances of segregated bio-medical waste coming in contact with the public, rag pickers, animals/birds, etc are high. Therefore, all care shall be taken to ensure that the segregated bio-medical waste, handed over by the different departments, reach local storage place without any damage, spillage or unauthorized access by public, animals etc.

**Storage**

It is necessary to use coloured bags and also label them at the time of storage of the waste. Waste bags or containers are

carried to specific local storage places. It is necessary to have security at this place to prevent unauthorized persons and rag pickers handling waste material.

**Transport**

For internal transportation, trolleys and carts are used. For external transportation, vehicles are used to transport waste from hospital dumping place to the appropriate place for final disposal. Vehicles carrying the Hospital waste should have labels as prescribed by the appropriate authority and should not carry general municipal garbage.

Treatment of BMW

**1-Incinerators**

This is a process of burning waste at a high temperature. The temperature in incinerators ranges from 1,800 degrees F to 2,000 degrees F (982 degrees C to 1093 degrees C). Incinerators have the advantage of quick, easy disposal methods.

**2-Autoclaving**

Autoclaving is comparable to steam sterilization. It is the most used alternative to incineration. It is cost-effective as well as has no reported health impacts. Waste is sterilized or disinfected before being dumped in landfills. Waste bags are placed in chambers. Then steam starts for a specific time at a definite temperature and pressure.

**3-Gas sterilization**

This process, medical waste is placed into an empty air-tight chamber. Treated with a sterilizing agent (such as ethylene oxide or formaldehyde). Gas emitted from these chemicals comes in contact with waste. In turn it kills harmful, infectious agents.

**4-Chemical disinfection**

This method is preferred for liquid waste; it can also be used for solid waste. In this method chemical agents are used for disinfection of wastes like chlorine.

**5- Microwave**

Microwave technology can also disinfect waste. Wastes are first placed into a shredder. These wastes are mixed with water and internally heated, which neutralizes present biologicals. Microwave units are controlled through computers. That ensures the least parameters of infection and proper equipment function. 90% of medical wastes can be autoclaved.

## 6-Irradiation

This method involves waste sterilization by exposing waste to cobalt sources. Cobalt emits gamma rays that kill all the microbes in waste.

## 7-Thermal Inactivation

This process involves heat waste at high temperatures resulting in the killing of microbes. These methods are advised for treating large amounts of liquid waste. A chamber is preheated to an intense specific temperature at a specific amount of time and then released.

## 8- Land filling/Deep Burial method-least option of BMW.

1. AIM-A study on Knowledge and awareness about management of Biomedical waste in Multi-speciality Hospitals in Medical professionals. Objectives of the study was To assess the knowledge and awareness about BMW according to new guidelines in hospital staff and To Find-out the causes of improper management in the hospitals. (Sharma,R.K.,Gupta,R.K.,Kour,H.,Mahajan,R.,Manhas,S.,Zaffer,I.,&Hassan,Z. U. et.al 2022).

Review of literature-According to ADV ARPITA ANIL PITALE, "LEGAL FRAMEWORK FOR BIOMEDICAL WASTE MANAGEMENT IN INDIA :GAPS AND CHALLENGES", INDIAN JOURNAL OF LEGAL REVIEW (IJLR), 5 (12) OF 2025, PG. 140-148, APIS- 3920 – 0001 & ISSN - 2583-2344.Biomedical waste is one of the most rapidly expanding public and environmental health threats. In India, the Biomedical Waste Management Rules of 2016 came into being to govern the management of such waste by hospitals and clinics. But on the ground, the system has serious lacunas-insufficient segregation, no proper disposal facilities in place, lax enforcement, and insufficient awareness among healthcare professionals. The COVID-19 pandemic exposed these deficiencies further because the increased medical waste overpowered the existing infrastructure. This article discusses the legal regime for biomedical waste management in India, maps out the key challenges in its enforcement, and compares Indian practice with international standards. It contends that while the law on paper is robust, its effectiveness is diminished by weak implementation and narrow accountability. The article proposes practical reform, enhanced monitoring, and green practices to make biomedical waste management *both legally effective as well as environmentally safe.*( Sharma, S., & Gupta, V. et.al 2024).

According to Ketul Patel 2024, Healthcare saves lives—but it also generates waste that can harm people, ecosystems, and cities if not managed correctly. Biomedical waste management in India is therefore not a backend operational task; it is a public health safeguard, an environmental protection system, and a legal obligation.India generates hundreds of tonnes of biomedical waste every day, from hospitals, clinics, diagnostic laboratories, vaccination camps, veterinary centres, and

research institutions. This waste is different from regular municipal waste because it carries pathogens, toxic chemicals, sharp objects, and pharmaceutical residues. Without a structured system, biomedical waste can lead to disease transmission, groundwater contamination, illegal recycling of medical plastics, and long-term ecological damage. (Central Pollution Control Board (CPCB) et.al 2020).

## Research methodology

### Research Design

A descriptive cross-sectional study design is used for this research.

### Study Setting

The study is conducted in selected healthcare facilities such as:

- 1-Narayan hospita,Jammu
- 2-K.D Multispeciality Hospital
- 3-M.M.Medical Centre
- 4-Ujala Cygnus JK Medicity Hospital

### Study Population

The study population includes healthcare personnel who are directly or indirectly involved in biomedical waste handling:

- \* Doctors,Nurses,Laboratory technicians, Sanitary/waste handlers

### Inclusion and Exclusion Criteria Inclusion Criteria:

- \* Healthcare workers involved in patient care or waste handling
- \* Those willing to participate in the study

### Exclusion Criteria:

- \* Staff not available during data collection
- \* Participants unwilling to give consent

### Sample Size

A sample size of (100 participants) is selected for the study.

### Sampling Technique

A simple random sampling or stratified random sampling technique is used to select participants from different categories of healthcare workers.

## Data Collection Methods

### 1 Primary Data

Primary data is collected using:

\* Structured questionnaire, Interview method (if needed), Observation checklist The questionnaire includes: Knowledge-based questions, Attitude-related statements, Practice-related questions

\* Data is used strictly for academic purposes

## 2 Secondary Data-

Secondary data is collected from:Books and journals, Government guidelines, Previous research studies, Reports from organizations like World Health Organization

## Limitations of the Study

\* Small sample size, Limited to selected healthcare facilities, Possibility of response bias, Time constraints.

## Research Tool-

A pre-tested structured questionnaire is used as the main research instrument.

Sections of the Tool:

1. Demographic information (age, gender, profession, experience)
2. Knowledge regarding biomedical waste management
3. Attitude towards waste management practices
4. Actual practices followed

## Results

### 1-Health Hazards related to biomedical waste

In the present study, health hazards related to Biomedical waste were been identified and the level of its awareness was assessed using ten key indicators. The findings show that participants demonstrated high awareness in several fundamental aspects of BMW related risks, while notable gaps persisted in specific technical areas (refer to table 4.5), Overall, 73% of the participants correctly identified the infections that could be transmitted through BMW (Q1), including hepatitis B and C, HIV/ AIDS, tetanus and tuberculosis. A similar level of awareness (73%) was observed regarding diseases associated with poor BMW practices(Q2) and the risks associated with handling sharps and contaminated materials (Q3). Awareness about groups at risk from improper BMW management (Q4) and the impact of incorrect BMW disposal on increasing healthcare- associated infections (Q5) was also comparatively high (73%). Moderate levels of awareness were seen in recognizing the universally accepted biohazard symbol (56%, Q6) and understanding that BMW hazards can be reduced through proper segregation at source. (56%, Q9). However, the study identified substantial gaps in two critical operational areas. Only 44% of participants were aware of the permissible duration for which untreated BMW can be stored within hospital premises (Q7). Similarly, only 44% correctly identified the predominant source of infection for healthcare workers (Q8), such as contaminated linen, sharps and dressings. These findings indicate insufficient knowledge of procedural and regulatory aspects of BMW handling. Finally, 73% of respondents recognized the hazards associated with handling blood or secretions without PPE, indicating strong understanding of personal exposure risks (Q10).

## Data Collection Procedure-

- \* Formal permission is obtained from hospital authorities
- \* Participants are informed about the study objectives
- \* Informed consent is obtained
- \* Questionnaires are distributed and collected after completion
- \* Confidentiality and anonymity are maintained

## Data Analysis-

### Data is analyzed using:

- \* Descriptive statistics (frequency, percentage, mean)
- \* Tables, charts, and graphs

*Statistical tools such as:*Microsoft Excel,SPSS

## Ethical Considerations

- \* Informed consent is obtained from all participants.Participation is voluntary,Privacy and confidentiality are maintained.

**Table 1 Health Hazards related to biomedical waste**

Sr. No	Health Hazard Awareness	Responded Correctly
1	Aware of infections that could be transmitted through BMW?	75%
2	Which diseases can be transmitted due to poor BMW management? (Hepatitis B&C, HIV/ AIDS, Tetanus, Tuberculosis and above all)	73%
3	Awareness of the risks associated with handling sharps and contaminated material.	73%
S4	Groups at risk from improperly BMW	75%
5	HAI cases increase due to improper BMW management	74%
6	Do you know the universally accepted symbol for biohazard	56%
7	How long can untreated BMW be stored within hospital premises?	75%
8	What is the predominant source of infection for healthcare personnel through BMW? (infected linen, waste sharps, contaminated dressing, specimens)	44%
9	Can BMW hazards can be reduced if segregation is done at its source	56%
10	Handling waste like blood or secretions without PPE can lead to exposure through cuts or mucous membrane	73%

**2- Distribution of Participants According to Experience**

The distribution of participants with regard to years of professional experience: 22% (n=22) had 1-5 years of experience, 46% (n= 46) had 6-10 years of experience, 21% (n=21) had 11 -15 years of experience and 11% (n=11) had 16-20 years of experience.

Thus, majority of participants (46%) possessed 6-10 years of experience indicating that the study sample consisted largely of moderately experienced healthcare providers.

Sr.no.	Experience (in yrs)	Frequency	Percentage
1	1-5	22	22%
2	6-10	46	46%
3	11 -15	21	21%
4	16-20	11	11%
Total		100	100%

**3- Participants Professional Categories**

The distribution of 100 participants by professional role revealed that Doctors constituted 27% of the sample, Nurses formed the largest group with 38%, Lab Technicians accounted for 22% and housekeeping staff contributed 13%. Nurses represented the largest proportion of the sample, followed by doctors and lab technicians (refer to table 4.5).

Sr no.	Participants	Percentage
1	Doctors	27%
2	Nurses	38%
3	Paramedics	22%
4	Housekeeping staff	13%

**Discussion**

The current study identified certain knowledge gaps among the various health care worker cadres, however more than 50% of study participants showed adequate or good knowledge, attitudes, and practices across all cadres. While this was not the case for nurses and lab workers, doctors were valued more for their knowledge than their practices. The cleaning personnel had a low knowledge component, which was consistent with findings from earlier research of a similar nature. The cleaning personnel had a negative attitude towards the BMW management. The primary causes of the poor level of expertise were the new employees who were rotating through the hospital and the housekeeping staff's relatively low educational backgrounds. All staff members' training will support analytical assessments for appropriate and relevant biological waste management. Across cadres, recapping the needles was a fairly uncommon activity. One significant risk factor for needle stick injuries is needle recapping, which was extremely uncommon in the organization. This might be attributed to staff awareness as well as the fact that the hospital's various patient care sections have an appropriate supply of needle cutters.

**Conclusions**

Finally, after discussing a number of waste management concerns and outlining the shortcomings of the District Hospital's existing waste management practices in Gandhi Nagar, Jammu, some conclusions may be drawn. Waste management is essentially still done by hand, although there will need to be updates made to the logistical aspects. Since the hospital facility is already very old, several of its logistical operations are antiquated. (Nema,A.,Pathak,A.,Bajaj,P.,Singh,H.,&Kumar,S. et.al 2011).

The hospitals located in the Gandhi Nagar District have already experienced a positive shift in the logistics of waste disposal. First, using theoretical analysis from many sources, the study defines what biomedical waste is. All waste produced at medical institutions, research facilities, and labs is referred to as healthcare waste. This refers to several waste types, including sharp, toxic, and basic energy waste, among others. These chapters of the thesis addressed waste kinds and their various forms. When considering hospital waste, the sorts of waste discovered throughout the inquiry did not provide any new insights. Healthcare institutions are familiar with the sorts of waste generated in hospitals since they follow the World Health Organization's guidelines and classification system. WHO (2015)

Certain hospitals use multiple staff members to handle and sort their garbage. The waste management worker at the District Hospital in Gandhi Nagar mostly moved the garbage manually and with the use of carts. Overall, we can say that hospitals handle their waste management procedures with a certain level of care and skill. Nevertheless, there have also been a few waste management mishaps, indicating that the procedure might be risky if carried out incorrectly. This refers to the manner in which garbage is sorted at the outset of the logistic process, such as at the emergency department, surgery center, and so on. Lastly, we spoke about how hospitals may handle this waste more effectively in the future.

There are a few responses to this query. There are variations throughout hospitals when it comes to the waste management scenario that Jammu hospitals are no win. essential for certain smaller hospitals to employ manual waste logistics, which details moving the garbage-in waste trolleys by hand. There are no easy answers to this topic, so it took some further consideration.

### Recommendations

Training programs in biomedical waste management should focus on empowering healthcare professionals with comprehensive and practical knowledge. Ethical requirements and institutional policies serve as guiding principles for the practical implementation within organizations. Emphasizing right practices, such as avoiding injuries, recognizing the importance of vaccinations, and adhering to universal precautions, can be achieved through effective information, education, and communication (IEC) strategies.

Utilizing tools like handouts, stickers, charts, and celebrating awareness days (e.g., Hand Hygiene Day) can enhance employee practices. Implementing checklists, along with regular inspections, contributes to accountability among staff. It is crucial to involve all healthcare professionals, regardless of their designation, experience, or qualification, in these interventions. This inclusive approach helps prevent cross-infections among professionals and patients within the healthcare sector.

### Author Contributions

The author has significantly contributed to the study's conception, design, data collection, analysis, and interpretation. All authors were involved in writing the manuscript or critically reviewing it for its intellectual value. They have reviewed and approved the final version for submission and publication and accept full responsibility for the content and integrity of the work.

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The authors declare that no external funding was received for this study.

### Conflicts of Interest

The authors state that there are no financial, personal, or professional conflicts of interest associated with this research.

### Ethical Approvals

This research did not involve the use of human participants or animal subjects and therefore did not require ethical clearance

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