

# Awareness of Biomedical Waste Management Among Health Care Personnel in Jaipur, India

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## Abstract

**Aims:** The study aimed to determine the following among the workforce of the Jaipur Dental College, India: their awareness regarding biomedical (BM) waste management policy and practices, their attitude towards biomedical waste management, and their awareness regarding needle-stick injury and its prevalence among different categories of health care providers.

**Methods:** A cross-sectional study was conducted using a questionnaire with closed-ended questions. It was distributed to 144 dentists, nurses, laboratory technicians and Class IV employees (cleaners and maintenance personnel) at Jaipur Dental College. The questionnaire was used to assess their knowledge of biomedical medical waste disposal. The resulting answers were graded and the percentage of correct and incorrect answers for each question from all the participants was obtained.

**Results:** Of the 144 questionnaires, 140 were returned and the answers graded. The results showed that there was a poor level of knowledge and awareness of biomedical waste generation hazards, legislation and management among health care personnel. It was surprising that 36% of the nurses had an extremely poor knowledge of biomedical waste generation and legislation and just 15% of the Class IV employees had an excellent awareness of biomedical waste management practice.

**Conclusions:** It can be concluded from the present study that there are poor levels of knowledge and awareness about BM waste generation hazards, legislation and management among health care personnel in Jaipur Dental College. Regular monitoring and training are required at all levels.

*Key Words:* Dental Practice, Biomedical Waste, Hazards

## Introduction

The term “biomedical waste” has been defined as “any waste that is generated during diagnosis, treatment or immunisation of human beings or animals, or in the research activities pertaining to or in the production or testing of biologicals and includes categories mentioned in schedule I of the Government of India’s Biomedical Waste (Management and Handling) Rules 1998” [1,2].

Dental waste is a subset of hazardous biomedical (BM) waste. Dental practices generate large amounts of cotton, plastic, latex, glass, sharps, extracted teeth and other materials, much of which may be contaminated with body fluids [3].

Hazards arising from waste disposal from dental practices can be divided into two main areas. First, there is the environmental burden of a variety

of hazardous products and second, the more immediate risks of potentially infectious material that may be encountered by the individuals handling waste [4].

Indiscriminate disposal of BM or hospital waste and exposure to such waste poses a serious threat to the environment and to human health. BM waste requires specific treatment and management prior to its final disposal. The severity of the threat is further compounded by the high prevalence of diseases such as human immunosuppressive virus (HIV) and hepatitis B and C [5].

Hospital-acquired infections have been estimated at 10% of all fatal/life-threatening diseases in the South-East Asia region and have been identified as one of the indicators for the management of waste [6]. Alarmingly, the World Health Organization

(WHO) reported a 50% re-use in India of syringes and needles that are meant for single use [7].

In India, the Ministry of Environment and Forests has promulgated the Biomedical Waste (Management and Handling) Rules 1998 for proper management of BM waste. These rules are meant to improve the overall waste management of health care facilities in India [1,2]. However, the introduction of laws is not sufficient for proper disposal of BM waste. The awareness of these laws among the general public as well as development of policies and enforcement that respect those laws are essential [8].

The absence of proper waste management, lack of awareness about the health hazards from BM waste, insufficient financial and human resources, and poor control of waste disposal are the most critical problems connected with health care waste [9].

Although there is increased global awareness among health care professionals about hazards and also appropriate management techniques, the level of awareness in India has been found to be unsatisfactory [10-12]. Therefore, the present study was conducted to assess the level of awareness and attitude among health care workers in a private dental college in Rajasthan, India.

### Aims

The study had the following aims relating to the workforce of the college:

1. To determine their awareness regarding BM waste management policy and practice.
2. To determine their attitude towards BM waste management.
3. To determine their awareness regarding needle-stick injury and its prevalence among different categories of health care providers.

### Methods

The study involved the use of a questionnaire (*Figure 1*) with closed-ended questions, which was distributed to 144 staff members. The study population included 50 dentists, 52 nursing staff, 20 laboratory technicians and 22 Class IV employees (cleaners and maintenance personnel). Two nursing staff and two Class IV employees did not complete the questionnaire, therefore 140 subjects participated in the study. All of these subjects were volunteers and they comprised of 70% of the total workforce (200 subjects) at the institution.

The study was approved by the ethical committee of Jaipur Dental College, Jaipur, Rajasthan, India and written consent was taken from all the subjects before they were given the questionnaire.

This questionnaire consisted of 40 questions and was designed to obtain information about knowledge of BM waste generation and waste management practices. The questions were grouped under four headings: (a) biomedical waste generation, health hazards and legislation, (b) waste management practices, (c) attitude assessment, and (d) needle-stick injuries.

The questionnaire was pilot-tested on a small group of staff that included five dentists, five nursing staff, five laboratory technicians and five Class IV employees. They were requested to complete it and indicate any questions that they found to be unclear. Confidentiality of the participants was maintained.

The percentage of correct and incorrect answers for each question from all the participants was obtained.

### Results

Out of 144 subjects, as mentioned above, two nurses and two Class IV employees failed to respond to

*Table 1. Level of knowledge of biomedical waste generation, hazards and legislation among health care personnel*

Health care personnel	Scoring criteria		
	Excellent	Good to average	Poor
Dentists	30%	45%	25%
Nurses	14%	50%	36%
Lab technicians	15%	45%	40%
Class IV employees	5%	50%	45%

Excellent: 8 correct answers out of 10

Good to average: 4-7 correct answers out of 10

Poor: <4 correct answers out of 10

### Assessment of Biomedical Waste

*Tick the appropriate answer:*

**Your position:**

- Doctor / Dentist     
  Class IV employee     
  Nurse     
  Lab technician

**Section 1: Knowledge of biomedical (BM) waste generation, hazards and legislation**

1. Do you know about BM waste generation and legislation?  
 Yes       No       Not sure
2. What agency(ies) regulate(s) wastes generated at health care facilities?  
 State       Private       Do not know
3. Do you think it is important to know about BM waste generation, hazards and legislation?  
 Yes       No       Somewhat
4. Biomedical Waste (Management & Handling) Rules were first proposed in:  
 1997       1998       1999       2000
5. Amendments to the Biomedical Waste (Management & Handling) Rules were made in:  
 2000       2001       2003       2004
6. Which statement describes one type of BM waste:  
 Materials that may be poisonous, toxic, or flammable and do not pose disease-related risk.  
 Waste that is saturated to the point of dripping with blood or body fluids contaminated with blood.  
 Waste that does not pose a disease-related risk.
7. According to the Biomedical Waste (Management & Handling) Rules, waste should not be stored beyond:  
 12 hours       48 hours       72 hours       96 hours
8. One gram of mercury (source from dental amalgam) is enough to contaminate the following surface area of a lake:  
 20 acres       30 acres       25 acres       15 acres
9. Who regulates the safe transport of medical waste?  
 Pollution Control Board of India.  
 Transport Corporation of India.  
 College Administration.
10. Do you need a separate permit to transport biomedical waste?  
 Yes       No       Cannot say

**Section 2: Level of awareness on biomedical waste management practice**

11. Do you know about colour-coding segregation of BM waste?  
 Yes       No       Not sure
12. Do you follow colour-coding for BM waste?  
 Yes       No       Sometimes
13. Is the waste disposal practice correct in your hospital?  
 Yes       No       Cannot comment
14. Objects that may be capable of causing punctures or cuts, that may have been exposed to blood or body fluids including scalpels, needles, glass ampoules, test tubes and slides, are considered biomedical waste. How should these objects be disposed of?  
 Black bags       Yellow bags       Clear bags       Sharps container
15. Documents with confidential patient information are to be disposed of into the paper recycling bins.  
 True       False       Do not know

*Figure 1. The questionnaire (continued over).*

16. The colour code for the BM waste to be autoclaved, disinfected is:  
 Red                       Black                       Yellow                       Blue/white

17. The approximate proportion of infectious waste among total waste generated from a health care facility is:  
 10-20%                       30-40%                       50-60%                       80-90%

18. The colour code for disposal of normal waste from the college is:  
 Red                       Black                       Yellow                       Blue

19. All the following steps should be followed after an exposure with infected blood/body fluid and contaminated sharps EXCEPT:  
 Exposed parts to be washed with soap and water.  
 Pricked finger should be kept in antiseptic lotion.  
 Splashes to eyes should be irrigated with sterile irrigants.  
 Splashes to skin to be flushed with water.

20. All of the following statements about hazardous waste containers are true, except for:  
 Containers must be closed except when removing or adding waste.  
 Containers must be clean on the outside.  
 Contents must be compatible with the type of waste containers.  
 Any type of container, including food containers, can be used to contain hazardous waste.

**Section 3: Attitude/behaviour assessment towards biomedical waste**

21. Safe management of health care waste is not an issue at all.  
 Agree       Disagree       Cannot comment

22. Waste management is team work/no single class of people is responsible for safe management.  
 Agree       Disagree       Cannot comment

23. Safe management efforts by the hospital increase the financial burden on management.  
 Agree       Disagree       Cannot comment

24. Safe management of health care waste is an extra burden on work.  
 Agree       Disagree       Cannot comment

25. Do you think that the college should organise separate classes or a continuing dental education programme to upgrade existing knowledge about biomedical waste management?  
 Yes       No       Cannot comment

26. Will you like to attend voluntarily programmes that enhance and upgrade your knowledge about waste management?  
 Yes       No       Cannot comment

27. Do you think that infectious waste should be sterilised from infections by autoclaving before shredding and disposal?  
 Yes       No       Cannot comment

28. Do you think that an effluent treatment plant for disinfection of infected water should be set up in dental colleges?  
 Yes       No       Cannot comment

29. Do you think it is important to report to the Pollution Control Board of India about a particular institution if it is not complying with the guidelines for biomedical waste management?  
 Yes       No       Cannot comment

30. Do you think that labelling the container before filling it with waste is of any clinical significance?  
 Yes       No       Cannot comment

*Figure 1. (continued)*

**Section 4: Level of knowledge among nurses, doctors, attendants, lab technicians on needle-stick injuries**

31. Is needle-stick injury a concern?  
 Yes  No  Do not know

32. Do you re-cap the used needle?  
 Yes  No  Do not bother

33. Do you discard the used needle immediately?  
 Yes  No  Have not noticed

34. Are you aware of consequences of needle-stick injury?  
 Yes  No  Not concerned

35. Have you sustained a needle-stick injury during the last 12 months?  
 Yes  No  Do not remember

36. If yes, how many injuries?

37. How did the most recent incident happen?  
 Poor disposal of needle  Individual carelessness/accident   
 Cannot remember  Other (specify)

38. To whom did you report the injury?  
 Line manager  Occupational health   
 Infection control  Nobody   
 Cannot remember  Other (specify)

39. Did you fill in an incident report?  
 Yes  No  Cannot remember

40. Have you been fully inoculated against hepatitis B?  
 Yes  No  Not sure

**Thank you for your valuable time and cooperation.**

**Figure 1. (continued)**

**Table 2. Level of awareness of biomedical waste management practices**

Health care personnel	Scoring criteria		
	Excellent	Good to average	Poor
Dentists	20%	45%	35%
Nurses	16%	48%	36%
Lab technicians	5%	60%	35%
Class IV employees	15%	50%	35%

Excellent: 8 correct answers out of 10

Good to average: 4-7 correct answers out of 10

Poor: <4 correct answers out of 10

the questionnaire. It was surprising that only 15 (30%) dentists had excellent knowledge about bio-medical waste generation and legislation while 18 (36%) of nurses had extremely poor knowledge about it (Table 1).

Only 3 (15%) Class IV employees had an excellent awareness of BM waste management practice (Table 2).

Of the 140 subjects who completed the study, 41 (29%) subjects agreed that safe management of health care waste was not an issue at all whereas 57 (41%) subjects disagreed and 42 (30%) subjects did not comment. Ninety-one (65%) health care personnel agreed that waste management requires team work and no single team member is responsible. Safe management efforts by hospital staff were

considered to be an extra work burden and 70 (50%) respondents agreed that it increased the financial burden on management.

When the level of knowledge of needle-stick injuries was assessed, it was seen that only 10 (20%) dentists, 7 (14%) nurses, 2 (10%) laboratory technicians and 2 (10%) Class IV employees had an excellent knowledge of this problem. Ten (50%) Class IV employees, 2 (5%) dentists and 1 (2%) nursing staff had experienced a needle-stick injury in the past 12 months but none of them had taken any action following this injury (*Table 3*).

### Discussion

The success of a study based on a self-administered questionnaire essentially depends on the manner in which the questions are formatted, their content, the analysis and the response rate. In order to avoid any recall bias, most of the questions were of closed-end type [13]. Such questions are easy to analyse and may achieve a quicker response from participants. A further advantage for this study was that all the participants were based at the same workplace, so all were following similar guidelines from a waste management protocol.

The present study was conducted in a private dental college in Jaipur City, India. It showed that there was a poor level of knowledge and awareness about BM waste generation hazards, legislation and management among dentists, nurses, dental technicians and Class IV employees. Even the level of knowledge and awareness about needle-stick injury was highly inadequate.

The results of the study are in accordance with previous studies. A study [12] conducted in New Delhi, India, among the 64 dentists who were teachers in Government institutions reported that the majority of the respondents were not aware of the proper clinical waste management regulations. Similar results were found in a study of hospital

medical personnel in Agra [14], which indicated a lack of knowledge and awareness towards legislation on BM waste and even more recently in a study in a dental hospital/clinics in Amritsar [15]. The same problem may exist even at more specialised medical institutions because in another study, one-third of the staff of a tertiary level hospital in Visakhapatnam were not aware of where the waste from the hospital was ultimately treated and disposed of [16]. According to the others, the waste was collected in bags and dumped at an open space inside the hospital premises prior to collection by a private agency of which they were not sure.

However, a study [17] carried out to assess the dental BM waste management and awareness of waste management policy among private dental practitioners in Mangalore city, India, revealed that a large number of practitioners were aware of the legislation policy but had failed to contact and register their clinic with the certified waste management services of the city.

Another recent Indian study compared the BM waste knowledge, attitude and practices among health care personnel and showed that doctors, nurses and laboratory technicians had a better knowledge than the cleaning (sanitary) staff regarding biomedical waste management [18]. In contrast, another recent study suggested that many dentists had knowledge about waste management but they lacked an appropriate attitude to and practices for the problem [19].

The problem is not unique to India: a descriptive cross-sectional study to assess the mechanisms and knowledge on BM waste management in five hospitals in Dakar, Senegal, reported that working conditions were deemed poor by 81.3% (n=61) of employees interviewed and personal protection equipment was available in only 45.3% (n=39) of services [20]. Knowledge about BM waste management was deemed satisfactory by 62.6% (n=47) of

*Table 3. Level of knowledge of needle-stick injuries among health care personnel*

Health care personnel	Scoring criteria		
	Excellent	Good to average	Poor
Dentists	20%	55%	25%
Nurses	14%	66%	20%
Lab technicians	10%	60%	30%
Class IV employees	10%	55%	35%

Excellent: 8 correct answers out of 10

Good to average: 4-7 correct answers out of 10

Poor: <4 correct answers out of 10

interviewees and 80% (n=60) were aware of the health risks related to biomedical waste [19]. It was concluded that poor management of BM waste was a reality in hospital facilities in Dakar. The authors emphasised the need for increasing the awareness of managers for effective application of the legislation, implementing realistic management programmes and providing the appropriate on-the-job training to staff members [20].

A study [21] conducted in a tertiary care hospital of West Bengal to assess the knowledge and awareness about various aspects of BM waste management among junior doctors (future physicians) showed that only 29.5% had knowledge of the various methods of final disposal of BM waste and only 76.4% knew about various types of colour-coded bags for collection of BM waste. Thus the authors concluded that intensive training programmes and monitoring at regular time intervals are needed for all staff, with special emphasis on junior doctors [21].

An Iranian survey performed on the collection and disposal of waste in the university hospitals of the Fars province found insufficient training of personnel, insufficient personal protective equipment and lack of knowledge regarding the proper use of such equipment. It recommended the compilation of rules and the establishment of standards, along with effective training for personnel [22].

A study [23] conducted in a Palestinian hospital in the West Bank showed that there was insufficient separation between hazardous and non-hazardous wastes and there was an absence of necessary rules and regulations for the collection of waste materials from the hospital wards.

The same author [24] conducted a study to assess the occupational safety among cleaning workers in Palestinian hospitals and its relation with the medical waste management in these hospitals. They observed that the level of occupational safety was below standard requirements, as protective equipment and clothes are not available for most workers. Similar results were reported in Iran [25], where the authors investigated solid waste management in the eight teaching hospitals of Iran University of Medical Sciences.

Assessment of medical waste management practice in the northern part of Jordan [26] showed that there are no defined methods for the handling and disposal of these wastes. Moreover, there were no specific regulations or guidelines for segregation or classification of these wastes.

Lack of awareness, appropriate policy and laws, and willingness have been responsible for the improper management of medical waste in Dhaka City [27]. A Turkish study also reported inappropriate handling of BM waste at the institutions concerned and that there was no systematic program for the transportation of the health care waste to the final disposal sites [28].

A study [29] of medical waste management in the south of Brazil revealed that all the health care facilities promoted segregation of Group A wastes, especially sharps waste. However, not much attention was given to other types of waste, which were usually managed without a perspective for recycling and collected through the municipal collection system.

Thus, it can be demonstrated that for proper disposal of BM waste, the introduction of laws is insufficient. The awareness of these laws among the public, as well as development of policies and enforcement that respect those laws, is essential.

Appropriate measures should be taken to minimise hazardous waste where possible or action should be taken to ensure that all generated waste is disposed of in accordance with environmental legislation [30].

All measures should be adopted to inform the public about legislation regarding BM waste management, including the risks involved in scavenging discarded needles and other sharp items. This may not be easy as often it is illiterate and very poor people who are the scavengers.

Information about the risks linked to BM waste can be displayed on posters in hospitals and primary health care clinics and at strategic points (such as near waste bins), giving instructions on waste segregation. Collated information on various methods of disposal and updated technology should be made available to all categories of health care personnel.

Some of the common barriers that need to be addressed include staff habits and public perception. It is recommended to make improvements in the overall organisational infrastructure and increased localised control. The recommendations also centre on the formation of strategic partnerships within the various departments in the institution and the government. An important challenge to be overcome is the need to progress from the concept of "waste management" to one of sustainable decision making regarding resource use, including methods of waste minimisation at source and recycling [31]. It is therefore strongly recommended that waste management programmes should be a

part of academic curricula for all health care workers and in continuing dental education.

The present study was conducted among a small group of subjects and in just one dental college out of 289 dental institutions in the country [32]. Therefore the authors recommend that similar studies should be performed and more subjects should be included. The need for more research and accurate data to provide an evidence-base for future decision-making is highlighted.

### Conclusion

It can be concluded from the present study that there is poor level of knowledge and awareness about BM waste generation hazards, legislation and management among health care personnel in Jaipur Dental College, India. A subsequent literature review suggests that this is a common problem in many other health care institutions in both India and other countries. It is imperative that waste should be segregated and disposed of in a safe manner to protect the environment as well as human health. Regular monitoring and training are required at all levels.

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nurses, laboratory technicians and Class IV employees who participated in the Jaipur survey.

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### Contributions of each author

AS conceived and designed the study, performed the literature search, was responsible for carrying out the study, acquiring the data, statistical analysis, and writing the paper.

VS was responsible for the clinical and experimental studies, acquisition and analysis of data, and reviewing the manuscript.

SS conceived and designed the study, and was responsible for the literature search, data analysis and statistical analysis, and the preparation, editing and review of the manuscript.

PS conceived and designed the study, performed the literature search, and was responsible for data acquisition and analysis, and the preparation, editing and review of the manuscript

### Statement of conflict of interest

The authors declare that there is no conflict of interest associated with this study.

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