

Awareness of Biomedical Waste Management Among Dental Professionals and Auxiliary Staff in Amritsar, India

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Abstract

Aim: The aim of this study was to determine awareness of biomedical waste (BMW) management policies and practices among dental professionals and auxiliary staff in a dental hospital/clinics in Amritsar, India, to inform the development of future policies for effective implementation of BMW rules.

Method: The study involved 160 staff members at the Amritsar hospital/clinics (80 dentists and 80 auxiliary staff) to whom a questionnaire was distributed regarding policies, practices and awareness relating to BMW. The questionnaire was first piloted. Completed questionnaires were returned anonymously. The resulting data were statistically tested using the chi-square test for differences between the dentists and auxiliary staff.

Results: In respect of BMW management policies, there was a highly significant difference in the responses of the dentists, whose answers suggested far greater knowledge than that of the auxiliaries ($P<0.001$). Regarding BMW management practices, the dentists were significantly more aware ($P<0.001$) of the method of waste collection in the hospital and the disposal of various items into different colour-coded bags. As for employee education/awareness, there was a significant difference ($P<0.05$) between the dentists and the auxiliaries on the question regarding records of BMW maintained in the hospital and the other responses to questions on these topics had a highly significant ($P<0.001$) difference between the two groups in favour of the dentists.

Conclusion: The results of this study have demonstrated a lack of awareness of most aspects of BMW management among dental auxiliary staff in the dental hospital/clinics in Amritsar and a lack of awareness of some aspects among dentists who work in the hospital/clinics. The results provide the hospital authorities with data upon which they can develop a strategy for improving BMW management.

Key Words: Biomedical Waste, Dentists, Dental Auxiliaries

Introduction

Over the years, there have been tremendous advances in the health care system so it is ironic that health-care settings, which restore and maintain community health, also threaten patients' well-being. One major threat arises from poor waste management practices, which pose a huge risk to the health of the public, patients, and professionals and contribute to environmental degradation.

Biomedical waste (BMW) is a global issue today [1]. In a layperson's language, BMW means any waste that is generated during the process of

diagnosis, treatment and immunisation of human beings or animals. These wastes are also generated during research activities or in the production or testing of biological material. Redefining it scientifically, BMW is defined as "any solid, fluid or liquid waste, including its container and any intermediate product, which is generated during its diagnosis, treatment or immunisation of human beings or animals, in research pertaining thereto, or in the production or testing of biological and the animal wastes from slaughter houses or any other like establishments" [2].

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These waste materials could cause serious hazards to health and the environment in cases of indiscriminate management. All hospital personnel are at a risk from many potentially fatal infections such as human immunodeficiency virus (HIV) and hepatitis B (HBV) and C (HCV). To avoid these hazards, a rigorous waste management system should be implemented in hospital infrastructure [3].

Hospital waste is generated and discarded [4] and is not intended for further use in a hospital. It is of paramount importance that a number of key aspects of BMW are addressed. These include efficient segregation of different types of BMW, use of coded and coloured bags, and excellent handling and transfer. To address these requirements, adequate training and awareness programmes for medical and paramedical personnel are necessary [5]. Nearly 40 years ago, it was suggested that in developed countries approximately 1-5 kg of waste were generated per bed per day, whereas in developing countries the figure was 1-2 kg/bed/day [6]. In a study undertaken in an Indian hospital and published in 2005, BMW generated was 2.31 kg/bed/day, indicating a rise in waste generated in recent years [7].

Dental hospitals use instruments and materials that are directly exposed to blood and saliva and are therefore potential sources of infection. The relatively few studies that have been conducted in the past among dental professionals have reported a poor to good level of awareness of waste disposal among dentists [8,9]. One of these was in India [10]. More studies have been carried out among medical professionals [11,12]. Thus it was deemed necessary to investigate the level of ignorance/awareness among dental professionals and auxiliary staff working in a dental hospital in Amritsar, India, as a first step to minimising the threat from BMW.

Aim

The aim of this study was to determine awareness of BMW management policies and practices among dental professionals and auxiliary staff in a dental hospital/clinics in Amritsar, India, to inform the development of future policies for effective implementation of BMW rules.

Methods

This study was conducted in a dental hospital/clinics in Amritsar district, Punjab, India. A total of 80 dentists and 80 auxiliary staff (dental assistants, nurses, and employees of operation theatres, labo-

ratories, laundry and central sterilisation departments of the hospital/clinic) were involved in the study. The respondents were selected by a simple random sampling method by asking for volunteers until two groups of 80 each had been attained.

A questionnaire (*Figure 1*) was designed to assess the awareness of BMW management among these dentists and dental auxiliary staff. The questionnaire was designed to assess the knowledge of the personnel about intrinsic factors, beliefs and values with respect to the BMW management system. It was categorised into BMW management policies, practices and employee education/awareness. The first version of the questionnaire was piloted among 15 staff members and was then refined in the light of this pilot.

Two examiners conducted the study between October 2011 and January 2012. The questionnaire was distributed among the 160 staff members (80 dentists and 80 auxiliary staff). They were asked to complete it without discussing their answers with anyone. The identity of the respondents was not disclosed.

A full description of the study protocol was submitted to the ethical review committee of the dental hospitals/clinic. Written notification was received from them, confirming that, because there would be no pressure on the respondents to participate in the survey and their anonymity would be maintained, no formal ethical approval was necessary. Informed consent was given by each respondent included in the study.

Data were collected and statistically analysed using the chi-square test. The tabulated chi-square values were calculated. The P -values of $P < 0.05$ and $P < 0.001$ were considered to be significant and highly significant, respectively.

Results

The results revealed that in respect to BMW management policies there was a highly significant difference in the responses of the dentists and the auxiliaries (*Table 1*). All the 80 dentists were aware that the Government of India has promulgated guidelines regarding BMW management, whereas only 10 auxiliary staff (12.5%) were aware of this ($P < 0.001$). Sixty-six (82.5%) dentists, as against 10 (12.5%) auxiliary staff, were aware of the waste management policies in the hospital ($P < 0.001$). Concerning responsibility for safe management of BMW, 62 (77.5%) dentists but only 30 (37.5%) auxiliaries were aware of their responsibilities

whereas 16 (20%) dentists and 32 (40%) auxiliary staff thought it to be the responsibility only of government ($P<0.001$) (Table 1).

Regarding BMW management practices, more dentists reported that they were aware of the method of waste collection in the hospital/clinics and the disposal of various items into different colour-coded bags (Table 2). Sixty-eight (85%)

dental surgeons, as compared to 44 (55%) dental auxiliaries, were aware that colour-coded bags are used for the disposal of waste ($P<0.001$) (Table 2).

The difference in the responses to the questions on the correct disposal of plastic items and plaster of Paris was significant ($P<0.05$), with 20 (25%) and 22 (27.5%) dentists and 6 (7.5%) and 8 (10%) auxiliaries, respectively, being aware of it.

Awareness of Biomedical Waste Management (BMW)

Please: Answer all questions. Tick best choice (only one choice). Your identity and answers will be kept confidential.

Dental surgeon/auxiliary staff

A. BMW management policies

1. Are there any guidelines laid down by Government of India for BMW management?
 - a) Yes
 - b) No
 - c) Don't know
2. Is there any biomedical waste disposal policy in your hospital/clinic?
 - a) Yes
 - b) No
 - c) Don't know
3. Safe management of biomedical waste is the:
 - a) Responsibility of only government
 - b) Team work of dental surgeons & auxiliaries
 - c) Don't know

B. BMW management practices

1. Are different coloured bags used to dispose different types of waste?
 - a) Yes
 - b) No
 - c) Don't know
2. Used disposable plastic items (e.g., catheter) are disposed of in:
 - a) Yellow bags
 - b) Red bags
 - c) Black bags
 - d) Don't know
3. Soiled dressings and used impression materials are disposed of in:
 - a) Blue/ white bags
 - b) Red bags
 - c) Black bags
 - d) Don't know
4. Used sharps and needles are disposed of in:
 - a) Yellow bags
 - b) Rigid/puncture-proof container
 - c) Red bags
 - d) Don't know
5. Extracted teeth and human tissue are disposed of in:
 - a) Yellow bags
 - b) Red bags
 - c) Black bags
 - d) Don't know
6. Plaster of Paris is disposed of in:
 - a) Yellow bags
 - b) Red bags
 - c) Black bags
 - d) Don't know

C. Employee education/awareness

1. Can improper waste management cause various health hazards?
 - a) Yes
 - b) No
 - c) Don't know
2. Is maintaining BMW records mandatory in your hospital/clinic?
 - a) Yes
 - b) No
 - c) Don't know
3. Does your hospital/clinic generate biomedical waste?
 - a) Yes
 - b) No
 - c) Don't know
4. Should there be regular educational programmes on biomedical waste management?
 - a) Yes
 - b) No
 - c) Don't know

----- Thanks for your cooperation -----

Figure 1. Questionnaire on awareness on biomedical waste management.

Concerning disposal of impression material, sharps and needles, and extracted teeth, a total of 42 (52.5%), 48 (60%), and 38 (47.5%) dentists were aware of their correct disposal whereas 16 (20%), 20 (25%), and 12(15%) auxiliaries were aware of them ($P<0.001$) (Table 2).

The questions in third section of the questionnaire related to employee education/awareness. All 80 (100%) dentists responded correctly to the questions on generation of BMW, health hazards with improper disposal, and the need for regular educational programmes. In contrast, only 52 (65%), 36 (45%) and 60 (75%) auxiliaries answered these questions correctly ($P<0.001$). As for the questions on maintenance of BMW records in the hospital, only 12 (15%) dental surgeons and 4 (5%) auxil-

aries responded correctly (Table 3).

Discussion

Today, hospitals/clinics use a wide variety of drugs including antibiotics, cytotoxics, corrosive chemicals, radioactive substances, which ultimately become part of hospital waste. The introduction of disposables in hospitals has brought in its wake many ills such as inappropriate recycling, unauthorised and illegal re-use, and an increase in the quantity of waste.

Concern regarding BMW is mainly due to the presence of pathogenic organisms and organic substances having adverse effect on human health. There could be significant numbers of organisms in the waste, including virulent strains of viruses and pathogenic bacteria. Dental practice involves many hazardous exposures and this calls for proper seg-

Table 1. Biomedical waste management policies

Survey question		Correct		Incorrect		No response		χ^2	P-value
		Dent	Aux	Dent	Aux	Dent	Aux		
		(%)	(%)	(%)	(%)	(%)	(%)		
1.	Guidelines laid by Govt. of India	80 (100)	10 (12.5)	0 (0)	30 (37.5)	0 (0)	40 (50)	124.44	<0.001**
2.	Waste management policy in hospital	66 (82.5)	10 (12.5)	8 (10)	20 (25)	6 (7.5)	50 (62.5)	80.977	<0.001**
3.	Responsibility for safe management of BMW	62 (77.5)	30 (37.5)	16 (20)	32 (40)	2 (2.5)	18 (22.5)	29.264	<0.001**

*** $P<0.001$; highly significant

Table 2. Biomedical waste management practices

Survey question		Correct		Incorrect		No response		χ^2	P-value
		Dent	Aux	Dent	Aux	Dent	Aux		
		(%)	(%)	(%)	(%)	(%)	(%)		
1.	Colour-coded bags used for waste disposal	68 (85)	44 (55)	6 (7.5)	24 (30)	6 (7.5)	12 (15)	17.943	<0.001**
2.	Disposal of plastic item	20 (25)	6 (7.5)	46 (57.5)	54 (67.5)	14 (17.5)	20 (25)	9.237	0.010*
3.	Disposal of impression material, soiled dressings	42 (52.5)	16 (20)	28 (35)	42 (52.5)	10 (12.5)	22 (27.5)	18.955	<0.001**
4.	Disposal of sharps, needles	48 (60)	20 (25)	28 (35)	40 (50)	4 (5)	20 (25)	24.314	<0.001**
5.	Disposal of extracted teeth, human tissues	38 (47.5)	12 (15)	34 (42.5)	44 (55)	8 (10)	24 (30)	22.802	<0.001**
6.	Disposal of plaster of Paris	22 (27.5)	8 (10)	42 (52.5)	46 (57.5)	16 (20)	26 (32.5)	9.096	0.011*

* $P<0.05$; significant at 5%; ** $P<0.001$; highly significant

Table 3. Employee education/awareness

Survey question	Yes		No		No response		χ^2	P-value
	Dent	Aux	Dent	Aux	Dent	Aux		
	(%)	(%)	(%)	(%)	(%)	(%)		
1. Health hazards with improper BMW	80 (100)	36 (45)	0 (0)	20 (25)	0 (0)	24 (30)	60.690	<0.001**
2. Record of BMW maintained in hospital	12 (15)	4 (5)	20 (25)	36 (45)	48 (60)	40 (50)	9.299	0.010*
3. Generation of BMW in hospital	80 (100)	52 (65)	0 (0)	12 (15)	0 (0)	16 (20)	33.939	<0.001**
4. Regular programmes on BMW needed	80 (100)	60 (75)	0 (0)	14 (17.5)	0 (0)	6 (7.5)	22.857	<0.001**

* $P < 0.05$; significant at 5%; ** $P < 0.001$; highly significant

regation and disposal of biomedical waste.

BMW generated by health care establishments can be broadly categorised as general waste, infectious waste, and non-infectious but hazardous waste [13]. Almost 75-85% of waste generated in health-care establishments is non-risk or general waste, which constitutes paper, cardboard boxes, plastic packaging, and kitchen waste [13]. Infectious waste, which includes human anatomical wastes, infectious disposable plastic items and sharps (e.g., needles, razors, scalpels), accounts for only a small fraction, comprising about 10-15% of the total volume of waste generated in a hospital. However, this small fraction is of the greatest concern because it poses a direct threat to the health and hygiene of human beings by transmitting viral, bacterial, fungal or parasitic diseases [13].

Non-infectious but hazardous waste includes chemical waste, genotoxic waste, and radioactive waste. This type of waste does not contain any infectious (disease-causing) component, and comprises about 5-10% of the total volume of waste generated in a hospital. However, it can cause serious health hazards such as burns, corrosions, genotoxicity, chromosomal aberrations, toxicity, and carcinogenic effects [13].

Improper segregation and disposal of BMW and mixing it with municipal waste can result in possible exposure of the health care workers, waste handlers, waste pickers, and the general public to the microorganisms [6], which are responsible for highly infectious and fatal diseases.

In India, to protect the environment and community health from hazards of infected waste, the BMW rules were promulgated in 1998 by the Ministry of Environment and Forest, Government of India, under *Environment Protection Act 1986*

[14-16]. For effective implementation of these rules in health care settings, the health care professionals and auxiliary staff should possess adequate knowledge with respect to the source of BMW and its appropriate disposal [5].

In the current study, as far as the guidelines laid down by Government of India for BMW management were concerned, it was reassuring to note that all the dentists were aware of the legislation applicable to hospital waste management, whereas in a previous study, conducted in a teaching hospital in New Delhi some 12 years ago, only 35.9% of respondents were aware of this [10]. However, it was alarming to note that in the present study only 12.5% of the auxiliary staff were aware of the legislation applicable to hospital waste management.

In the same study in New Delhi [10], only 50% of the dentists knew that their hospital had a waste management policy whereas in the current study 82.5% of dentists but only 12.5% of auxiliary staff were aware of this. Thus, awareness of the waste management policy was found to be very low among the auxiliary staff, which could be due to lack of proper educational programmes.

Regarding safe management of BMW it was noted that an overwhelming percentage of dentists agreed that safe management of BMW is an issue that needs to be tackled by team-work of doctors and auxiliaries. However, considering the views of the auxiliary staff, it appears that safe management of BMW could also be recognised as being more a problem of attitude rather than just providing the technology or facilities.

According to national guidelines of BMW rules promulgated by the Government of India [15,16], different wastes must be disposed of in different colour-coded bags (*Figure 2*). In the present

study, as reported in the results section, 85% of dentists and 55% of auxiliary staff were aware of the fact that different types of waste are disposed of in different coloured bags whereas only 27.4% of respondents in a study of private dentists conducted in Bangkok were aware of this practice [8].

It was surprising to observe that only 25% of dentists and 7.5% of the auxiliary staff were able to answer correctly that used plastic items such as catheters should be disposed of in a red-coloured bag. In the present study, the questions on different types of infected wastes such as extracted teeth/dissected human tissue, soiled dressings being disposed in a yellow-coloured bag were answered correctly by 47.5% and 52.5% of dentists and 15% and 20% of auxiliary staff, respectively. In a study conducted in Indian hospitals in 2006, a higher level of awareness was observed and the questions were answered correctly by all the doctors (100%) and about 60% of the auxiliary staff [3]. It was suggested that this variation in level of awareness was due to the training that the staff received in their hospital [3].

In the same study [3], it was observed that all the dentists and 61% of auxiliary staff were aware of the fact that plaster of Paris should be disposed in a black-coloured bag whereas it was alarming to observe that in the present study only 27.5% of dentists and only 10% of auxiliary staff gave the correct answer to this question.

In the present study, it was found that all the dentists were well aware of the various health hazards caused by improper BMW management. The auxiliary staff (45%) had an average knowledge about this subject, which is in accordance with the findings of a study in hospitals in Gujarat in 2005 where 43% of auxiliary staff had knowledge of this subject [17].

It was alarming that in the present study only 12 (15%) dental surgeons and 4 (5%) auxiliary staff reported that maintaining a record of biomedical waste disposal is mandatory. This may be due to

ineffective implementation of rules in various hospitals/clinics by the monitoring authorities. However, it was good to observe that all the dentists and a majority (75%) of auxiliaries agreed that there should be regular educational programmes on BMW management.

The results of the study revealed that the dentists were well aware that the dental hospitals/clinics generate BMW and that improper waste management can cause various health hazards, whereas the auxiliary staff had an inadequate knowledge of these issues. Although their answers indicated that the dentists and the auxiliary staff knew that different types of biomedical waste should be disposed of in different coloured bags, they often did not know which coloured bags were for which forms of BMW.

The findings of the present study suggest that there is an urgent need to train and educate the dentists and auxiliaries in the dental hospital/clinics of Amritsar through extensive training and re-training programmes. Furthermore, it is also suggested that a proper waste management educational programme should be included in the curriculum for dental education so as to give due importance to this vital issue. Because the study was confined to one major region of North India, further regional studies are required on a larger population to generalise the results, in the formulation and implementation of BMW guidelines. The topic is very relevant to all countries and it is suggested that all public and private healthcare providers should audit the BMW knowledge and practices of their staff at regular intervals.

The results of this study will help the hospital authorities to develop a strategy for improving BMW management. BMW management programmes cannot be successfully implemented without the effective knowledge, willingness, motivation, and co-operation from all sections of employees of any health care setting. A “cradle to

Colour-coding	Type of container	Waste category
Yellow	Plastic bag	Human and animal waste, soiled dressing (impression material)
Red	Disinfected container/plastic bag	Microbiology and biotechnology waste, solid waste (disposal items other than sharps such as tubings, catheters, intravenous sets)
Blue/white translucent	Plastic bag/puncture-proof container	Waste sharps
Black	Plastic bag	Discarded medicines and cytotoxic drugs, incineration ash, chemical waste, liquid waste

Figure 2. Schedule I and II of Biomedical Waste (Management and Handling Rulings) 1998.

grave" approach should be followed in regard to the collection, transportation, treatment and disposal of BMW. There needs to be a sensitisation of employees to this issue coupled with effective implementation of rules (such as surprise visits from monitoring authorities and performance-based incentives that will facilitate successful implementation of the programme), which is vital for better outcome in future.

Conclusion

The results of this study have demonstrated a lack of awareness of most aspects of BMW management among dental auxiliary staff in the dental hospital/clinics in Amritsar and a lack of awareness of some aspects among the dentists who work in the hospital/clinics. They provide the hospital authorities with data upon which they can develop a strat-

egy for improving BMW management.

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Contributions of each author

- RSN and AM were responsible for the conception and design of this work, the analysis and interpretation of the data, and writing the manuscript.
- SS, NV and SP were responsible for writing the manuscript and checking the drafts.

Statement of conflict of interest

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