



## Biomedical Waste Management: A Study of Knowledge, Practices and Attitude among Health Care Personnel at a Tertiary Care Hospital in Bhopal, Central India

Authors

Dr. Shashwati Nema<sup>1</sup>, Ms. Akansha Singh<sup>2</sup>, Dr. Kiran Tripathi<sup>3</sup>, Dr. Pallavi Shidhaye<sup>4</sup>,

Dr. Ashok Kumar Dhanvijay<sup>5</sup>

<sup>1, 3, 5</sup>Dept. of Microbiology, LNMC Bhopal

<sup>2</sup>Second MBBS student, LNMC Bhopal

<sup>4</sup>Dept. of PSM, LNMC Bhopal

Corresponding Author

**Dr. Shashwati Nema**

Associate Professor, Dept. of Microbiology, LNMC, Bhopal (M.P.) India - 462042

Email: [nema\\_shashwati@rediffmail.com](mailto:nema_shashwati@rediffmail.com), Tel. No : +91 8085850616

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### ABSTRACT

*Inadequate and inappropriate knowledge of handling biomedical waste (BMW) among health care personnel may have serious health consequences and a significant impact on the environment as well. In view of this, present study was planned to assess knowledge, practices and attitude (KPA) regarding BMW management among our hospital staff. A questionnaire containing 32 questions based on KPA regarding BMW management was filled by 125 study participants [25 each of doctors, interns, nurses, technicians, class IV employees]. Data was analyzed using Stata 11.0. Chi-square test was applied and p value was obtained. Only 15.2% participants could correctly answer about BMW categories. Doctors were found to have significantly better knowledge than auxiliary staff about measures to be taken following accidental exposure to infected blood or sharps ( $p=0.007$ ). Less than 65% of them could correctly answer use of each colour coded bags. A favorable positive attitude was found among study participants on BMW management. Our study revealed that although attitude about BMW management was high among health care personnels of our hospital, the knowledge and practice was comparatively low. Therefore, all health care personnel must undergo regular training in BMW management. This should be coupled with effective implementation of rules and regular monitoring by authorities.*

**Key words:** Attitude, Biomedical waste, Knowledge, Practices

## INTRODUCTION

Biomedical waste (BMW) is defined as “any waste that is generated during diagnosis, treatment or immunization 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”.<sup>[1]</sup> 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.<sup>[2]</sup> 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.<sup>[3]</sup>

Indiscriminate disposal and exposure to BMW poses a serious threat not only to environment but also to human health. The spectrum of hazards due to BMW can range from diseases like gastroenteritis, tuberculosis, septicemia, tetanus and skin infectious to more deadly disease such as HIV/AIDS and Hepatitis.<sup>[4,5]</sup> Estimates of the probability of infection by accidental exposure to blood and needle –stick injury for HIV infection range from 0.2 -0.5%, for Hepatitis B virus 5-40 % and for Hepatitis C virus 3 to 10%.<sup>[6]</sup> Patwary et al<sup>[7]</sup> pointed out in their studies that improper clinical solid waste management practice impacts both directly and/or indirectly to healthcare staffs, patients and hospital environments. Therefore, segregation, collection, treatment and disposal of BMW in an appropriate manner are of great importance.

Though legal provision exist for BMW handling and management and even after a decade of its implementation, most Indian hospitals are yet to achieve the described standards of BMW management practices.<sup>[8,9]</sup> Singh K et al<sup>[9]</sup> from Chandigarh, India found that medical establishments in the rural area and smaller ones in the urban area dispose off their BMW along with municipal solid waste and no management system exists. The hepatitis outbreak in Modassa, Gujarat 2009, pointed towards the core issue of poor BMW management in the country.<sup>[10]</sup> Lack of awareness about the health hazards related to health care waste, inadequate training in proper waste management disposal systems, insufficient financial and human resources and the low priority given to the topic are the most common problems associated with BMW. Sharma A et al<sup>[11]</sup> concluded from his study that there were poor levels of knowledge and awareness about BMW generation, hazards, legislation and management among health care personnels in Jaipur, India. Apart from lack of awareness, hospital personnels seem to ignore standard procedures.

The above studies and the survey of other hospitals show that BMW is posing serious threat to the environment and the people associated with it largely due to lack of knowledge, practices and attitude (KPA) regarding safe BMW management both in public and healthcare professionals. Therefore, present study was planned to assess KPA regarding BMW management among health care personnel working in our hospital with the view to provide data for development of effective BMW management strategies.

## MATERIALS AND METHODS

Study was carried out after obtaining permission from institutional ethics committee

1. **Type of study:** Cross –sectional
2. **Study period:** 2 months (July 2014 – August 2014)
3. **Study participants:** 125 health –care personnels working in our hospital

[25 doctors, 25 interns, 25nurses, 25 laboratory/OT technicians, 25 class IV employees]

### 4. Inclusion criteria

Participants who were working in the hospital for more than three months

Participants who gave oral consent

### 5. Exclusion criteria

- Participants who were working in the hospital for less than three months
- Participants who were not willing to participate.

### 6. Assessment of awareness about BMW management

A close ended questionnaire consisting 32 questions was designed in English and local language, Hindi. The questions were grouped as follows

- a. Assessment of knowledge regarding BMW generation and legislation
- b. Assessment of knowledge about needle – stick injury and health hazards due to BMW
- c. Practices regarding BMW segregation, disposal and treatment
- d. Attitude assessment

Questionnaire was distributed among study participants. They were requested to complete it and indicate any questions that they found to be unclear. Confidentiality of the participants was maintained.

7. **Statistical Analysis:** Data were entered in MS Excel and analyzed using Stata 11.0. For the categorical variables, one-way and two-way frequency tables were used. Descriptive statistics such as frequencies (percentage) were used. Chi-Square estimates assessed variance and significance was determined at  $p < 0.05$ . For analysis, the respondents were classified into two groups, doctors and auxiliary staff. Doctors group included both doctors and interns. The auxiliary staff group included the nurses, Lab technicians and class IV employees. Chi square test was applied to check the association between the profession and the response given by the respondents of two groups.

## RESULTS

Majority (92.8%) of study participants heard about BMW and 85.6% knew its different sources. But only 15.2% participants could correctly answer about BMW categories. Auxiliary staff answered significantly better than doctors ( $p$  value  $< 0.001$ ). Most of study participants were aware of the legislation applicable to BMW management and handling. [Table 1]

95.2% of our study participants were concerned about needle-stick injury; but only 61.6%

correctly knew to whom report when injury occurs. 60% of respondents agreed that needle should not be recapped after use and 68% knew exact method of discarding used needles. More than 75% study participants correctly answered the questions related to BMW health hazards. Doctors were found to have significantly better knowledge than auxiliary staff about measures to be taken following accidental exposure to infected blood, body fluids or sharps ( $p=0.007$ ) [Table 2]

Table 3 highlights response to practice based questions regarding BMW segregation, disposal and treatment. 68% respondents were aware that BMW should be segregated at source of generation. Although 96% respondents agreed to follow colour coding of BMW, less than 65% of them could correctly answer use of each colour coded bags. Only 12.8% respondents knew use of red bag. Regarding use of blue puncture proof container, doctors responded more correctly than auxiliary staff ( $p = 0.002$ ). Doctors had better knowledge regarding storage period of BMW ( $p<0.001$ ). Only half of the study participants (52%) were aware of the different methods used for treatment of BMW. 60% study participants correctly answered method of disposal of incineration ash. Response among doctor was significantly better ( $p<0.001$ ).

As shown in Table 4, a favorable positive attitude was found among study participants on BMW management.

**Table 1:** Response to knowledge based questions regarding BMW generation & legislation

Questions	Correct			Incorrect			No response			X <sub>2</sub>	P
	D	A	Total n (%)	D	A	Total n (%)	D	A	Total n (%)		
1.Have you heard about biomedical waste?	50	66	116 (92.8)	0	8	8 (6.4)	0	1	1 (0.8)	-	-
2.Sources of Bio-medical wastes are-	46	61	107 (85.6)	3	14	17 (13.6)	1	0	1 (0.8)	-	-
3.How much waste is generated by patient per bed per day?	20	21	41 (32.8)	24	40	64 (51.2)	6	14	20 (16)	2.32	0.314
4.The approximate proportion of infectious waste among total waste generated from a health care facility is	7	6	13 (10.4)	38	61	99 (79.2)	5	8	13 (10.4)	1.16	0.56
<b>5. How many categories of BMW are there?</b>	<b>3</b>	<b>16</b>	<b>19</b> <b>(15.2)</b>	<b>45</b>	<b>35</b>	<b>80</b> <b>(64)</b>	<b>2</b>	<b>24</b>	<b>26</b> <b>(20.8)</b>	<b>24.75</b>	<b>&lt;0.001*</b>
6.Biomedical waste (Management and handling ) Rules were first proposed in –	24	25	49 (39.2)	16	24	40 (32)	10	26	36 (28.8)	3.88	0.143
7.Who regulates the safe transport of medical waste?	30	42	72 (57.6)	18	27	45 (36)	2	6	8 (6.4)	0.833	0.659
8.Do you need a separate permit to transport Biomedical waste?	48	65	113 (90.4)	2	6	8 (6.4)	0	4	4 (3.2)	-	-

**Table 2:** Response to knowledge based questions on needle – stick injury and BMW related health hazards

Questions	Correct			Incorrect			No Response			X <sup>2</sup>	P
	D	A	Total n (%)	D	A	Total n (%)	D	A	Total n (%)		
1.Is needle – stick injury a concern?	49	70	119 (95.2)	0	4	4 (3.2)	0	2	2 (1.6)	-	-
2.To whom will you report needle stick injuries?	30	47	77 (61.6)	18	18	36 (28.8)	2	10	12 (9.6)	4.25	0.119
3.Do you re-cap the used needle?	38	37	75 (60)	12	36	48 (38.4)	0	2	2 (1.6)	-	-
4.How do you discard the used needle?	48	37	85 (68)	2	33	35 (28)	0	5	5 (4)	-	-
5.Which of the following infection transmitted by needle – stick injury?	50	70	120 (96)	0	1	1 (0.8)	0	4	4 (3.2)	-	-
6.Which of the following diseases transmitted by Bio-medical waste?	38	57	95 (76)	8	14	22 (17.6)	4	4	8 (6.4)	0.45	0.79
7.All of the following steps should be followed after an exposures with infected blood /body fluid and contaminated sharps except –	21	13	34 (27.2)	25	49	74 (59.2)	4	13	17 (13.6)	9.82	0.007*

**Table 3:** Response to practice based questions regarding BMW segregation, disposal and treatment

Questions	Correct			Incorrect			No Response			X <sup>2</sup>	P
	D	A	Total n (%)	D	A	Total n (%)	D	A	Total n (%)		
1.Biomedical wastes are segregated at –	36	49	85 (68)	14	18	32 (25.6)	0	8	8 (6.4)	-	-
2.Do you follow colour –coding of BM waste?	47	73	120 (96)	3	0	3 (2.4)	0	2	2 (1.6)	-	-
3.How many colour coding bags are recommended for segregation of biomedical waste?	41	49	90 (72)	9	23	32 (25.6)	0	3	3 (2.4)	-	-
4.Which biomedical waste is collected in Black Bag?	25	56	81 (64.8)	25	18	43 (34.4)	0	1	1 (0.8)	-	-
5.Which biomedical waste is collected in Yellow Bag?	25	55	80 (64)	25	19	44 (35.2)	0	1	1 (0.8)	-	-
6.Which biomedical waste is collected in red bag?	9	7	16 (12.8)	39	56	95 (76)	2	7	9 (7.2)	2.85	0.245
7.Which biomedical waste is collected in blue puncture Proof bag?	39	36	75 (60)	5	25	30 (24)	6	14	20 (16)	12.4	0.002
8.According to the Biomedical waste (Management & Handling) Rules; waste should not be stored beyond-	31	9	40 (32)	15	48	63 (50.4)	4	18	22 (17.6)	34.8	< 0.001
9.Which of the following methods are used for treatment of biomedical waste?	28	37	65 (52)	15	31	46 (36.8)	7	7	14 (11.2)	1.887	0.389
10.Method of disposal of incineration ash is-	43	32	75 (60)	4	31	35 (28)	3	12	15 (12)	23.79	< 0.001
11.All of the following statement about hazardous waste containers are true except-	37	41	78 (62.4)	8	24	32 (25.6)	5	10	15 (12)	5.074	0.079
12.Tick the correct statement –	42	46	88 (70.4)	7	21	28 (22.4)	1	8	9 (7.2)	7.994	0.019

**Table 4:** Response to attitude based questions on BMW management

Questions	Correct			Incorrect			No Response			X <sup>2</sup>	P
	D	A	Total n (%)	D	A	Total n (%)	D	A	Total n (%)		
1.Do you think that safe – Management of biomedical waste is an important issue?	49	73	122 (97.6)	0	1	1 (0.8)	1	1	2 (1.6)	-	-
2.Do you think that the college should organize separate training programme for BM waste management?	50	70	120 (96)	0	1	1 (0.8)	0	4	4 (3.2)	-	-
3.Will you like to attend voluntarily the programme that enhances your knowledge about waste management?	48	65	113 (90.4)	1	4	5 (4)	1	6	7 (5.6)	3.051	0.218
4.Do you think there is a need of sterilization of infectious waste by autoclaving before shredding and disposal?	45	66	111 (88.8)	3	2	5 (4)	2	7	9 (7.2)	2.032	0.362
5.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 BM waste management?	50	68	118 (94.4)	0	2	2 (1.6)	0	5	5 (4)	-	-

## DISCUSSION

Adequate knowledge about the health hazard of BMW, proper technique and method of handling the waste and positive attitude of health care providers of any hospital is an important pre-requisite for effective management of BMW and its safe disposal. The present study aimed to find out KPA regarding BMW management among staff of our tertiary care hospital.

Table 1 highlights response to knowledge based questions regarding BMW generation and

legislation. 92.8% of study participants heard about BMW and 85.6% knew its different sources. However, only 10.4% respondents could correctly answer the approximate proportion of infectious waste generated from a health care facility. As per BMW (Management & Handling) rules 2011, there are eight categories of BMW instead of ten categories under the earlier rules. <sup>[12]</sup> Only 15.2% participants could correctly answer about BMW categories. To our surprise, auxiliary staff could answer better than doctors ( $p < 0.001$ ). This may be



attributed to fact that most of our study participants were unaware of this new amendment. Our finding coincides with study conducted by Madhukumar S et al.<sup>[13]</sup> This is an important finding as it highlights importance of periodic BMW training programme for hospital staff so that everyone working in hospital remains equipped with latest information and skills. Only 39.2% of our study participants knew exact year of formulation of BMW (Management and Handling) rules. Although 90.4% of respondents were aware that separate permission is required for transportation of BMW, only 57.6% knew that pollution control board of India regulate safe transport of BMW. Nagaraju B et al<sup>[14]</sup> also found that 57% of his study participants had knowledge related to correct method of BMW transportation and disposal.

Majority (95.2%) of our study participant showed concern about needle stick injury. However, only 61.6% correctly knew to whom report when needle –stick injury occurs [Table 2]. Madhukumar S et al<sup>[13]</sup> revealed that none of their study participants ever reported any injury to medical superintendent or casualty medical officer. In the present study 60% of health care personnel agreed that needle should not be recapped after use and 68% knew exact method of discarding used needles. [Table 2] Stein et al<sup>[15]</sup> in their study reported that among doctors and nurses, only 37% reported that they ever suffered needle –stick injury. Low reporting of injuries may be attributed to the fact that most of the doctors and other technical and nontechnical staff are unaware about a formal system of injury

reporting which should be established within all the health facilities. In the present study, 60% of health care personnel agreed that needle should not be recapped after use and 68% knew exact method of discarding used needles. More than 75% of our study participants knew health hazards due to improper BMW management [Table 2]. Pandit et al<sup>[16]</sup> conducted similar study and reported that doctors were aware of risk of HIV and Hepatitis B and C, whereas auxiliary staff had poor knowledge about it. In present study, doctors were found to have significantly better knowledge than auxiliary staff about measures to be taken following accidental exposure to infected blood, body fluids or sharps ( $p=0.007$ ) [Table 2]. The awareness on BMW hazards and method of prevention of hazards among hospital staff is crucial to protect them from different types of infection.

Response to practice based questions are shown in Table 3. Out of 125 subjects, 68% agreed that BMW should be segregated at the point of waste generation. In one of the similar study conducted in Bangalore, corresponding value was found to be 87.5%.<sup>[13]</sup> Majority (96%) respondents agreed to follow colour coding of BMW but less than 65% of them could correctly answer use of each colour coded bag. This was in consensus with results of Sanjeev R et al study.<sup>[17]</sup> It was surprising to observe that only 12.5% of our study participants were able to answer correctly that plastic items should be disposed off in red coloured bag. Narang S et al<sup>[18]</sup> in Amritsar, India also reported that only 25% dentists and 7.5% auxiliary staff correctly knew use of red bag in

their study. In our study, doctors were more aware of the use of blue puncture proof container than auxiliary staff ( $p=0.002$ ). In another study done in Indian hospitals in 2006, a higher level of awareness was observed and the questions related to waste segregation were answered correctly by all the doctors (100%) and about 60% of auxiliary staff. This variation in level of awareness was due to the training that the staff received in their hospital. <sup>[19]</sup> According to the Biomedical waste (Management & Handling) Rules; waste should not be stored beyond 48 hrs. <sup>[1]</sup> Doctors of our hospital had significantly better knowledge regarding this issue ( $p<0.001$ ). In present study, 52% of the study participants were aware of the different methods used for treatment of BMW. 60% study participants correctly answered method of disposal of incineration ash. Response among doctor was found to be significantly better than auxiliary staff ( $p<0.001$ ).

Regarding the attitude related questions [Table 4], 97.6% of the respondents agreed that safe – management of BMW is an important issue. A very positive attitude towards healthcare waste management is highlighted by the observation that 96% of the study participants felt need of separate training programme for BMW management and 90% were interested in receiving training on the same. The results are similar to the results of the study conducted by Sanjeev R et al <sup>[17]</sup> in Kothamangalam and Gupta S et al <sup>[20]</sup> in Lucknow. 88.8% respondents opined that there is a need of sterilization of infectious waste by autoclaving. Majority of them (94.4%) were agreed to report to the pollution control board of India about a

particular institution if it is not complying with the guidelines for BMW management. Overall, favorable attitude was found among health care personnel of our hospital.

## CONCLUSIONS

Our study revealed that although attitude about BMW management was high among health care personnels of our hospital, the knowledge and practice was comparatively low. There is a need to evolve continuing education programme for health care personnels to make them aware about the proper management of BMW. Sensitization of employees coupled with effective implementation of rules and regular monitoring by authorities can go a long way towards the safe disposal of hazardous hospital waste and protect the community from its various adverse effects.

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