

# Knowledge, Attitude, and Practice about Dental Waste Management among Dentists in Pune - A Questionnaire Study

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## Abstract

**Introduction:** Dental profession has expanded considerably, leading to a significant contribution to the production of biomedical waste (BMW). Hence, dentists ought to possess adequate knowledge about BMW management.

**Aim:** This study aims to assess the knowledge, attitude, and practices about BMW management among private dental practitioners of Pune city.

**Materials and Methods:** A cross-sectional questionnaire-based survey was conducted among 200 dentists of Pune. A closed-ended, validated, pretested questionnaire comprising four sections with questions on demographics, knowledge, attitude, and practice of BMW management was distributed among 200 private practitioners. The results were expressed as numbers and percentage for each question.

**Results:** Of 200 dentists, 112 completely filled questionnaires were obtained. It was found that 94.6% of dentists were aware of the BMW management legislation; however, only 81.2% had registered with local BMW management service agency. 100% of dentists considered improper management of dental waste to be hazardous to health. However, segregation and color coding of waste before disposal was followed by only 73.3% and 79.5% of dentists, respectively.

**Conclusion:** It can be concluded from the present study that in spite of sufficient awareness about BMW management legislation; furthermore, training, awareness, educational, and motivational programs are required to attain better implementation of the laws by the dentists.

**Key words:** Attitude, Dental waste management, Dentists in Pune, Knowledge, Practice

## INTRODUCTION

Biomedical waste (BMW) is defined as the waste generated during the diagnosis, treatment, or immunization of human beings or in research activities pertaining thereto or in the production or testing of biological, and including categories mentioned in Schedule I of the BMW (management and

handling) (second amendment) Rules 2000, by Ministry of Environment and Forests notification.<sup>[1-3]</sup>

BMW management is the scientific disposal of BMW through segregation, collection, and treatment which enables decreased spread of infection.<sup>[4]</sup> BMW has been given extreme importance by Member States of the World Health Organization (WHO) Regional Office for Europe. It has been in the agenda of Sixth Ministerial Conference on Environment and Health.<sup>[5,6]</sup> Waste production in India hiked from 415,429 kg in 2011 to 484,271 kg per day in 2013. Maharashtra is the second maximum biowaste producer after Karnataka followed by Kerala being the third highest biowaste producer of India. BMW management

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rules were put forth by the Ministry of Environment and Forest of Government of India on July 20, 1998, under the Environment Protection Act, 1986.<sup>[1,3,7]</sup> Since then, the rules have undergone amendment in 2011 and 2016. The BMW rules, 1998 draft signified 10 categories of BMW which were subsequently reduced to 8 and 4 categories in 2011 and 2016 drafts, respectively. The revised 2016 draft provides better explanation over the classification of BMW as per color-coded containers enabling a clear vision for better segregation and disposal of BMW.<sup>[3,4,7-9]</sup> The BMW rules, 1998 (The Gazette of India, 1998) mandatorize clinical and hospital settings to strictly abide by the rules for BMW disposal.<sup>[3,10]</sup> With an increased oral health burden and expansion in dental practice, dentistry has contributed widely to the production of hazardous BMW in the form of lead foil in X-ray films, chemicals, scrap dental amalgam, etc.<sup>[11]</sup> Hence, it becomes imperative for dentists to have adequate knowledge about the rules of BMW disposal to conserve the environment and prevent health hazards. Hence, this study was undertaken to assess the level of knowledge, awareness, attitude, and practices of dental waste management among dentists in Pune city, thereby enabling formulation of strategies for adequate BMW management and disposal by dentists in the near future.

## MATERIALS AND METHODS

A cross-sectional questionnaire-based survey was conducted in December 2017. The target population comprised 500 private dental practitioners selected by simple random sampling from the list of Indian Dental Association, Pune, who were initially contacted over the telephone. About 212 dentists consented to participate in the study. Only private dental practitioners practicing in Pune city who consented to participate were included in the study. Ethical clearance was obtained from the Institutional Ethics Committee.

An initial self-structured, close-ended 27-point questionnaire was designed in English by assembling data through literature search. It comprised four domains - demographics, knowledge, attitude, and practice, respectively. It was then subjected to validity and reliability assessment. Face and content validation was done by 15 subject matter experts (S.M.E) who were experts in the fields of dentistry, dental and general waste management policies, and regulations. Face validation was conducted by discussing the questionnaire with the team of S.M.E's. Thereafter, content validation was done for all 27 questions. The content validity ratio (C.V.R.) was calculated for each question. The C.V.R was found to be less than the required value (i.e., 0.49 for 15 S.M.E's) for four questions indicating their non-essentialness.<sup>[12]</sup> Thus,

the questionnaire after validation was structured with 23 close-ended questions.

### Reliability

Reliability of the questionnaire was assessed by test-retest method to assess the stability of the questionnaire and Cronbach's alpha value enabled to measure the internal consistency of the questionnaire. Test-retest was done by distributing the pre-validated questionnaire twice among 25 dental practitioners at an interval of 12 days. Intraclass correlation coefficient with 95% confidence interval was used to assess the reliability enabling the measurement of the level of agreement between repeated measurements. The values were found to be 0.89, 0.92, and 0.83 for knowledge, attitude, and practice sections, respectively. Cronbach's alpha values were 0.79, 0.84, and 0.87 for the three sections, respectively.

### Pretesting

The 23-point pre-validated questionnaire was pretested to assess the clarity, unambiguity, and explicability of the questionnaire. It enabled to know about adequate and easy interpretation of the questionnaire by the dentists. A convenience sample of 25 dentists was selected to distribute the questionnaire. They were explained the filling procedure. Their doubts and difficulties were resolved. The responses were assessed, thereby modifying the questionnaire. Thus, the final pre-validated, self-structured, close-ended 23-point questionnaire was prepared.

The data were compiled and tabulated in Microsoft Excel spreadsheet and were subjected to frequency distribution analysis using the Statistical Package for the Social Sciences software version 18.

## RESULTS

The questionnaire was distributed among 212 private dental practitioners among which 189 dentists responded to it and completed the entire questionnaire. The response rate was 89.1%.

Of the participating dentists, 57.1% were male and 42.9% were female with 45.5% of dentists being aged <30 years and 54.5% >30 years of age. Postgraduation was completed by 38.4% of dentists while 61.6% were graduates.

The knowledge section of the questionnaire comprised six questions. 94.6% and 85.7% of dentists were aware of BMW legislation and about the local dental waste management agency, respectively. Safe disposal of waste was considered to be a team effort by 92.8% of dentists. Correct knowledge about the cytotoxic category for expired medicines and soiled waste category for impression

materials and infected cotton was known by 23.2% and 20.5%, respectively. 72.3% of dentists correctly answered about the disposal of sharps in white translucent puncture-proof containers [Table 1].

The attitude-based section of questionnaire comprised five questions. Segregation of dental waste from general waste was considered to be essential by 86.6% of dentists. 93.8% of dentists were interested in attending voluntary programs on waste management and 30.4% of dentists answered safe management of dental waste to be an extra burden on work. All the dentists considered improper waste management to be hazardous to health while 52.7% of dentists considered autoclaving of infectious waste before disposal as essential [Table 2].

The practice-based section comprised eight questions. 73.3% and 79.5% of respondent's segregated waste before disposal and color coded the waste, respectively. >81% of dentists had registered with the BMW disposal service provider. 71.4% of dentists burnt and disposed the needle

while only 42% and 43.8% reported the correct disposal of fixer and X-ray film lead foils, respectively. Excess and leftover silver amalgam was reported to be stored in fixer by 22.3% of dentists. Extracted teeth were correctly disposed in yellow bags by 70.5% of dentists [Table 3].

## DISCUSSION

Adequate management and disposal of waste are essential to prevent health hazards. According to the WHO, the health-care sector of eleven Southeast Asian countries generates 0.3 million tons of waste per year which is approximately 1000 tons/day.<sup>[13,14]</sup>

The dental sector endows considerably toward the production of hazardous BMW. Hence, it is the responsibility of dentists to abide by the government rules of waste disposal to prevent environmental pollution. Contribution of human element toward waste management over technology was emphasized to be more important by the WHO.<sup>[11,13,15]</sup>

**Table 1: Knowledge-based questions**

Questions	Options	Response (%)
Are you aware of BMW management legislation in India?	Yes	94.6
	No	5.4
Do you know the agency responsible for dental waste management in your city?	Yes	96
	No	16
Safe management of dental waste is the duty of	Only government	7.2
	Teamwork of government, dental surgeons and auxiliaries	92.8
	Do not know	0.0
Sharps (such as broken needles, surgical blades, and burs) should be disposed in	Yellow bag	13.4
	Red bag	14.3
	White translucent puncture-proof containers	72.3
	Do not know	0.0
Expired medicines belong to which category?	Chemical waste	70.5
	Cytotoxic waste	23.3
	Biotechnological waste	0
	Do not know	6.3
Impression materials and infected cotton are included in which category?	Solid waste	0
	Soiled waste	20.5
	Infected waste	65.2
	Do not know	14.3

**Table 2: Attitude-based questions**

Questions	Options	Response (%)
Do you think it is important to segregate dental waste from general waste?	Yes	94.6
	No	5.4
Will you be interested to attend voluntary programs that enhance and upgrade your knowledge about waste management?	Yes	96
	No	16
Do you think safe management of dental waste is an extra burden on work?	Yes	30.4
	No	59.8
	No comments	9.8
Do you think infectious waste should be sterilized from infections by autoclaving before shredding and disposal?	Yes	52.7
	No	27.7
	Do not know	19.6
Do you think improper waste management can be hazardous to health?	Yes	100
	No	0

**Table 3: Practice-based questions**

Questions	Options	Response (%)
Do you segregate waste before disposal?	Yes	73.3
	No	16.9
	Sometimes	9.8
Do you follow color coding of waste?	Yes	79.5
	No	10.7
	Sometimes	9.8
Are you registered with a certified waste carrier service to dispose BMW of your clinic?	Yes	81.2
	No	18.8
How do you dispose an infected needle?	Common bin	28.6
	Burn and dispose	71.4
How do you dispose used fixer solution?	Directly in basin and sewer	33.9
	Handover for offsite disposal to a certified agency	42
	Do not use solution	24.1
How do you dispose X-ray film lead foils?	Common bin	34.8
	Handover for offsite disposal to a certified agency	43.8
	Do not use	21.4
How do you dispose excess leftover silver amalgam?	Common bin	0
	Store in fixer solution	22.3
	Store in container with water	17.9
	Do not use	59.8
How do you dispose extracted teeth?	Common bin	22.3
	Red bag	70.5
	Yellow bag	2.7
	None of the above	4.5

Adequate segregation, storage, collection, and disposal of BMW are imperative. Collection of BMW should be done as per BMW management rules, 2016. The containers/boxes should be labeled with a biohazard and cytotoxic symbol.<sup>[9]</sup> Non-chlorinated plastic bags which can be incinerated should be used to prevent release of pollutants such as dioxins and furans released by normal plastic bags.<sup>[16]</sup> Maximum time limit of 48 h has been specified by the guidelines for storage of BMW before transporting to the waste treatment facility.<sup>[3,16]</sup>

In our study, 94.6% of dentists were aware of the BMW legislation in India similar to findings obtained in studies conducted earlier by Khatri *et al.* (98.67%)<sup>[17]</sup> and Lakshmikantha *et al.* (88.4%).<sup>[13]</sup> However, lesser awareness was found among dentists in the study conducted by Khandelwal *et al.* (41%)<sup>[18]</sup> and Shah *et al.* (65%)<sup>[19]</sup> 85.7% of dentists were aware of the local dental waste management agency in our study similar to the awareness noticed among dentists by Lakshmikantha *et al.* (79.5%).<sup>[13]</sup> These results thus obtained signify sufficient awareness about BMW management among dentists of Pune. 92.8% of dentists considered safe dental waste management to be a team effort of government, dentists, and auxiliaries similar to findings obtained among dentists in a study conducted by Khandelwal *et al.* (92%)<sup>[18]</sup> in 2013. Thus, a unanimous initiative by all three classes is required to safely handle dental waste disposal. Sharps should be disposed in white translucent puncture-proof containers to prevent injuries by puncture and cuts as per

BMW management rules, 2016.<sup>[9]</sup> 72.3% of dentists were aware of this in our study similar to the findings obtained among other studies conducted at Pune by Khatri *et al.* (61%)<sup>[17]</sup> and Amritsar by Narang *et al.* (60%)<sup>[20]</sup> respectively. Expired medicines belong to cytotoxic category were known by only 23.2% of dentists similar to findings obtained in studies conducted in Southern region of India by Charania and Ingle (30%)<sup>[21]</sup> and Northern part of India by Bansal *et al.* (24%)<sup>[22]</sup> Only 20.5% of dentists had correct knowledge about impression materials and infected cotton belonging to the category of soiled waste similar to findings of studies conducted by Bansal *et al.* (16%)<sup>[22]</sup> and Singh *et al.* (39.4%)<sup>[23]</sup> This signifies that the knowledge among dentists about categorization of wastes was considerably less and measures need to be initiated toward it.

Segregation of BMW in color-coded containers or bags at the point of generation before disposal is essential as per Schedule I of BMW rules, 2016 (Gazette).<sup>[9]</sup> However, this was considered to be important by only 86.6% of dentists in our study similar to findings obtained by Rudraswamy *et al.* (82.6%)<sup>[24]</sup> and Goyal *et al.* (89.8%)<sup>[10]</sup> A large number of dentists (93.8%) perceived the willingness of attending programs to get updated about BMW rules similar to findings obtained by Lakshmikantha *et al.* (84%)<sup>[13]</sup> and Khandelwal *et al.* (92%)<sup>[18]</sup>

Only 30.4% of dentists considered safe management of dental waste to be a burden on work similar to findings

of the study conducted by Lakshmikantha *et al.* (27%),<sup>[13]</sup> in 2016. An overwhelming 100% response of dentists was obtained in our study regarding consideration of improper dental waste management to be hazardous for health similar to response obtained by Narang *et al.* (100%),<sup>[20]</sup> in 2012. Additional importance has been given to pretreatment of BMW before disposal by revised rules of BMW, 2016 as per the WHO or National AIDS Control Organization guidelines to prevent microbial contamination.<sup>[4,9]</sup> However, only 52.7% of dentists considered it to be important in our study similar to findings obtained by Lakshmikantha *et al.* (59.1%)<sup>[13]</sup> in Southern region of India in 2016.

Thus, this section of questionnaire signified a positive attitude of dentists toward following and upgrading themselves about BMW legislations.

Regarding the practices of BMW rules by the dentists of Pune, it was found that segregation of waste before disposal was carried out by 73.3% of dentists similar to results obtained by Abhishek *et al.* (70.5%).<sup>[25]</sup> However, only 35.7% of dentists practiced segregation in a study conducted by Sudhakar *et al.*,<sup>[26]</sup> in 2008. Color coding of waste was carried out by 79.5% of dentists in our study similar to findings reported by Navya *et al.* (90%)<sup>[16]</sup> and Narang *et al.* (85%).<sup>[20]</sup> However, contrasting results were obtained by Khandelwal *et al.* (36%).<sup>[18]</sup> Segregation of BMW at source is a mandatory requirement by the authorities. In a city like Pune, implementation guidelines are strictly adhered and there have been reported incidents of practicing dentists being penalized for not following the same. With almost over 25% of the study sample in our study still not following the guidelines, it is a matter of concern and more awareness campaigns should be undertaken by the government.

Registration with local BMW carrier agency is essential;<sup>[9]</sup> however, only 81.2% of dentists reported of being registered similar to findings of the study conducted earlier at Pune itself in 2014 by Khatri *et al.* (74.66%)<sup>[17]</sup> but definitely higher than findings of studies conducted by Bangannavar *et al.* (59%)<sup>[27]</sup> and Abhishek *et al.* (68%).<sup>[25]</sup> Complacency on part of the authorities along with a lack of door-to-door collection of BMW in Pune city may have resulted in 19% of study sample to be still out of the ambit of registration for BMW.

Infected needles should be handled carefully as they are blood contaminated and may predispose cross infection on accidental penetration. Hence, it is mandatory to burn them and then dispose. However, only 71.4% of dentists followed this in our study similar to findings of the study conducted by Bansal *et al.* (66%),<sup>[22]</sup> in 2013,

and higher than the findings reported by Singh *et al.* (21.9%),<sup>[23]</sup> in 2014.

The fixer solution contains silver which increases the metal content in sewer if disposed in the basin directly. Ideally, it should be handed over to certified buyers who extract silver from it. Hence, handing over for offsite disposal or to certified buyer is the prescribed manner of disposal<sup>[9]</sup> of fixer solution which was followed by only 29.5% of dentists in our study. This was practiced even lesser in the study conducted by Singh *et al.* (5.6%).<sup>[23]</sup> X-ray film foils contain the heavy metal lead which cannot be incinerated or treated as common waste as it may leach from landfills, thereby contaminating soil and groundwater, leading to impaired neurological development and functions. Hence, ideally, it should be handed over to certified buyers or for offsite disposal, whereby the lead extracted from them may be used as a raw material in other industries.<sup>[23,28]</sup> However, this ideal practice of the disposal of X-ray film lead foils was conducted by only 43.8% of dentists in our study which was higher than findings of the study conducted by Singh *et al.* (2.5%),<sup>[23]</sup> in 2014. Disposal of leftover fixer solution and X-ray film foils has to be meticulously followed by dental auxiliary staff. Thus, proper training programs involving these parodontal persons would help in proper BMW disposal.

Inhalation of mercury vapors may lead to mercury toxicity. Hence, it should be handled with extreme care. Scrap amalgam contains mercury. Mercury-containing wastes should not be incinerated or autoclaved. On incineration, mercury volatilizes while it tends to escape from autoclave doors on opening them, thereby mercury vapors entering atmosphere risking to mercury toxicity.<sup>[29,30]</sup> Hence, the American Dental Association recommends storage of amalgam in “photographic fixer” in a closed container before disposing to prevent health hazards.<sup>[7,31]</sup> However, this was practiced by only 22.3% of dentists in our study similar to the finding of the study conducted by Bharadwaj *et al.* (31%),<sup>[29]</sup> in 2017. However, this practice was found to increase from 10% in 2013 to 31% in 2017 as reported by Bansal *et al.*<sup>[22]</sup> and Bharadwaj *et al.*<sup>[29]</sup>

Extracted teeth should be disposed in yellow bags (Gazette, 2016)<sup>[9]</sup> which was followed by 70.5% of dentists in our study similar to findings obtained by Bansal *et al.* (62%),<sup>[22]</sup> in 2013.

Proper disposal of BMW is the collective responsibility of the dentist, auxiliary staff, and the authorities. Even though the onus lies with the clinic owner who generates BMW, conscious involvement of the dental auxiliaries and support staff is of utmost important.

The government authorities should also play their part by awareness of the proper guidelines and strict implementation thereafter.

Thus, it can be inferred that dentists of Pune practice BMW rules but still need to be provided guidance, information, and motivation to follow them more correctly and regularly.

Proper disposal of BMW is a social responsibility. It is also necessary for all the dentists to give adequate importance to this matter. A “team up approach” by government, dentists and auxiliaries can solve the issue. Educational and motivational training programs should be conducted. Furthermore, undergraduate curriculum should include this topic along with practical demonstration classes on waste disposal. The concept of “habits die hard” should be followed by making the dental students habituated from incipient stage by their teachers to abide by these rules in educational institutions by assigning them duties of waste segregation, color coding, etc. In our study, we had used a self-reported questionnaire which may have led to subjective bias. Thus, we recommend further studies with a larger sample size and also repeated timely surveys to be conducted to monitor the change in practices which will help furthermore to formulate strategies to promote inculcation, upgradation, and adoption of BMW management rules.

## CONCLUSION

It can be concluded that dentists of Pune practice BMW rules but still need to be provided guidance, information, and motivation to follow them more correctly and regularly. It is also necessary for all the dentists to give adequate importance to this matter. A “team up approach” by government, dentists and auxiliaries can solve the issue. Educational and motivational training programs should be conducted. Furthermore, undergraduate curriculum should include this topic along with practical demonstration classes on waste disposal. The concept of “habits die hard” should be followed by making the dental students habituated from incipient stage by their teachers to abide by these rules in educational institutions by assigning them duties of waste segregation, color coding, etc. In our study, we had used a self-reported questionnaire which may have led to subjective bias. Thus, we recommend further studies with a larger sample size and also repeated timely surveys to be conducted to monitor the change in practices which will help furthermore to formulate strategies to promote inculcation, upgradation, and adoption of BMW management rules.

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