

ORIGINAL RESEARCH

Knowledge, attitude, and practices about biomedical waste management among dental healthcare personnel in dental colleges in Kothamangalam: a cross-sectional study

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Abstract

Background: Since the implementation of the biomedical Waste Management Rules 1998, every concerned health personnel is expected to have proper knowledge, practice and capacity to guide others for waste collection and management, and proper handling techniques. Dental offices generate a number of hazardous wastes that can be detrimental to the environment if not properly managed. With this background, the study was conducted to assess the knowledge, attitude and practice of biomedical waste management among dental health care personnel in Kothamangalam, Kerala.

Methods: A cross-sectional questionnaire based survey containing 24 questions to

assess the knowledge, attitude and practice on biomedical waste management. The samples were the teaching faculty members and students of 3 dental colleges in Kothamangalam, Kerala. Results were expressed as a number and percentage of respondents for each question and Chi-square test was performed for inferential statistical analysis.

Results: The mean knowledge, attitude and practice scores were 4.35 ± 1.63 , 4.69 ± 1.97 , 4.43 ± 0.78 respectively with maximum scores of 9, 5 and 10. Significant differences existed in relation to educational qualification of respondents in knowledge and practice scores.

Conclusion: The study revealed that although the attitude regarding biomedical waste

management among faculty members and students of the institution was high, knowledge and practice remained low.

Introduction

The health care sector comprise a diverse range of health care facilities which have a size assortment from large general and specialist hospitals to small municipal dispensaries and D-type centers. All these facilities are an integral part of our society with an endeavor to reduce health problems and to eliminate imminent jeopardy to people's health. In the course of curing health problems the health care sector produce huge amount of bio-medical waste which may be hazardous to all those who come in contact with this waste. Hazardous waste management is a concern for every health care organization.¹

Health-care waste refers to all the waste generated by a health care establishment. It is estimated that 10-25% of health care waste is hazardous, with the potential for creating a variety of health problems.² The waste produced in the course of healthcare activities carries a higher potential for infection than any other type of wastes.³ Bio-medical waste collection and proper disposal has become a significant concern for both the medical and the general community. Since the implementation of the biomedical Waste Management Rules 1998, every concerned health personnel is expected to have proper knowledge, practice and capacity to guide others for waste collection and management, and proper handling techniques.²

Dental offices generate a number of hazardous wastes that can be detrimental to the environment if not properly managed. This includes sharps, used disposable items, infectious wastes (blood-soaked cotton, gauze etc.), mercury containing waste (mercury, amalgam scrap), lead containing waste (lead foil packets, lead aprons) and chemical waste (such as spent film developers, fixers and disinfectants). Studies have shown that waste water from dental offices typically contains elevated concentrations of metals such as mercury, silver, copper, tin and zinc. Sources of these metals include placement and removal of amalgam fillings (mercury, silver, copper, tin and zinc) and disposal of the spent X-ray fixer solution.

The biomedical waste management and handling rules have been notified in 1998.⁵ The rules were amended twice in 2000, primarily to address administrative matters. The rule makes it mandatory for the health care establishments to segregate, disinfect and dispose their waste in an ecofriendly manner. An important pre-requisite and key to successful waste management program is segregation which is the separation of different types of waste as per treatment and disposal option. Segregation and collection of various categories of waste should be done at the source, in separate containers so that each category is treated in a suitable manner to render it harmless. For waste management to be effective, the waste should be managed at every step, from acquisition to disposal.⁴

With this background, the study was conducted to assess the knowledge, attitude and practice of biomedical waste

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management among dental health care personnel in Kothamangalam, Kerala.

Methods

The study was a cross-sectional questionnaire based survey. The target population was the dental students and the teaching faculty members of three dental colleges in Kothamangalam. A prefabricated validity tested questionnaire that was administered to the target population. The questionnaire was divided into two parts. The first part consisted of questions on personal and professional data including age, gender, qualification, experience and type of practice. The second part contained 24 questions on assessment of knowledge, attitude and practice regarding biomedical waste management. All questions in the questionnaire were close-ended.

The questionnaires were distributed by the faculty members of Department of Public Health Dentistry and dental students posted in the department. The respondents were

asked to return the questionnaire immediately.

All returned questionnaires were coded and analyzed. Results were expressed as a number and percentage of respondents for each question and were analyzed using the SPSS Version 17 software. Chi-square test was performed and the level of significance was set at $p < 0.05$.

Results

Respondent's profile

Among a total of 264 respondents, 33% (n=87) were males and the rest 67% (n=177) were females. About 44% (n=116) were undergraduate students, 16.7% (n=44) were interns, 9.5% (n=25) were post graduation students and the rest 29.9% (n=79) were teaching faculty members. Among the faculty members, 74.7% (n=59) had private practice in addition to institution based practice. The profile of respondents is given in table 1.

Table 1. Profile of respondents

VARIABLE		n	%
GENDER	MALE	87	33.0
	FEMALE	177	67.0
EDUCATIONAL QUALIFICATION	UG STUDENT	116	43.9
	PG STUDENT	25	9.5
	INTERN	44	16.7
	GRADUATE	10	3.8
TYPE OF PRACTICE	POST GRADUATE	69	26.1
	INSTITUTION	20	25.3
	INSTITUTION AND PRIVATE	59	74.7
YEAR OF STUDY	THIRD YEAR	56	48.3
	FINAL YEAR	60	51.7

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Assessment of knowledge, attitude and practice on biomedical waste management

Response to knowledge based questions on biomedical waste management is given in table 2. About 75% of the respondents (n=198) considered all health-care wastes hazardous. 27% of the respondents (n=72) were not aware of the fact that biomedical waste management and handling rules are applicable to dentists. About 14% of the respondents opined that any plastic bag can be used for waste disposal, around 16% had

received training on biomedical waste management. Only 45% were aware of IMAGE and of them, only 22.3% knew the correct expansion of the abbreviation IMAGE. Only 9.5% of the respondents knew that the maximum storage period for biomedical waste according to the national guidelines is 48 hours. Around 64% of the respondents correctly recognized the symbol of biohazard. In majority of the knowledge related questions, significant differences in responses were observed in relation to educational qualification and year of study.

Table 2. Response to knowledge based questions on biomedical waste management

QUESTION	RESPONSE	n	%	Sig.
Are all healthcare wastes hazardous?	Yes	198	75.0	
	No	66	25.0	
Are you aware that biomedical waste management rules are applicable to dentists?	Yes	192	72.7	Educational qualification (p=0.007)
	No	72	27.3	
Can any plastic bag be used for waste disposal?	Yes	37	14.0	
	No	227	86.0	
Have you had any training in Biomedical waste management?	Yes	43	16.3	Year of study (p=0.001)
	No	221	83.7	
Are you aware of IMAGE?	Yes	121	45.8	Educational qualification (p=0.001), type of practice (p=0.001), year of study(p=0.01)
	No	143	54.2	
If yes, what does IMAGE stand for	Indian medical association for greener environment	12	4.5	Educational qualification (p=0.001), type of practice (p=0.001), year of study
	Indian medical association for goes ecofriendly	59	22.3	

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	Indian medical association is green and eco friendly	24	9.1	(p=0.001)
	Don't know	26	9.8	
According to national guidelines, what is the maximum time limit for which biomedical waste can be stored?	24 hours	66	25.0	Educational qualification (p=0.007), year of study (p=0.010)
	72 hours	15	5.7	
	48 hours	25	9.5	
	Don't know	158	59.8	
Are you aware of amalgam separators?	Yes	107	40.5	
	No	157	59.5	
Which of the following is the universally accepted symbol for biohazard?		38	14.4	Educational qualification (p=0.042), year of study (p=0.010)
		169	64.0	
		52	19.7	
		5	1.9	

Table 3 contains the responses to attitude based questions on biomedical waste management. The response showed a favourable positive attitude towards the topic of discussion. No significant differences in response were observed in relation to the independent variables assessed in the study.

Table 3. Response to attitude based questions on biomedical waste management

QUESTION	RESPONSE	n	%	Sig.
Do you agree that biomedical wastes should be segregated into different categories?	Yes	255	96.6	Year of study (p=0.002)
	No	9	3.4	
How often do you recommend cleaning of dental suction unit?	Daily	192	72.7	
	Twice a week	29	11.0	
	Once a week	35	13.3	
	Once a month	3	1.1	
	Once a year	5	1.9	
Do you feel that biomedical waste management should compulsorily be made part of dental undergraduate curriculum?	Yes	249	94.3	Year of study (p=0.013)
	No	15	5.7	

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Do you think your knowledge regarding biomedical waste management is adequate?	Yes	47	17.8	
	No	217	82.2	
Do you think you require any further training on biomedical waste management?	Yes	257	97.3	Year of study (p=0.023)
	No	7	2.7	

Table 4 has responses to practice based questions on biomedical waste management. About 58% agreed that the institute they were working in had a tie-up with waste management companies. Among the private practitioners, 83% (n=51) had tie up with waste management companies. About 18% disposed all waste in general garbage. Majority of the respondents (48.5%) disposed blood soaked cotton, gauze etc. in

red bag, 34.5% disposed pharmaceutical waste in yellow bag, 56.8% disposed sharps in puncture proof container. About 54% stored the excess mercury and mercury contaminated cotton in glycerin. Vast majority of the respondents (65%) didn't know how the used developer and fixer solution had to be discarded. 67.4% treated the liquid wastes with chemicals before discharging into drains.

Table 4. Response to practice based questions on biomedical waste management

QUESTION	RESPONSE	n	%	Sig.
Does your institute have a tie up with waste management companies?	Yes	155	58.7	Educational qualification, (p=0.007) type of practice (p=0.001), year of study (p=0.003)
	No	109	41.3	
Does your clinic have a tie up with waste management companies?	Yes	51	19.3	
	No	10	3.8	
Do you dispose all kinds of waste into general garbage?	Yes	48	18.2	
	No	216	81.8	
Do you segregate the biomedical waste according to different categories?	Yes	181	68.6	Educational qualification (p=0.003)
	No	83	31.4	
Where do you dispose cotton, gauze and other items contaminated by blood?	Red plastic bag	128	48.5	Educational qualification (p=0.001)
	Yellow plastic bag	76	28.8	
	General garbage	25	9.5	
	Blue plastic bag	10	3.8	

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	Puncture proof container	17	6.4	
	Black plastic bag	8	3.0	
Where do you dispose pharmaceutical waste?	Red plastic bag	43	16.3	Educational qualification (p=0.001)
	Yellow plastic bag	91	34.5	
	General garbage	44	16.7	
	Blue plastic bag	30	11.4	
	Puncture proof container	4	1.5	
	Black plastic bag	52	19.7	
Where do you dispose waste sharps?	Red plastic bag	36	13.6	Educational qualification (p=0.001), year of study (p=0.046)
	Yellow plastic bag	19	7.2	
	General garbage	23	8.7	
	Blue plastic bag	20	7.6	
	Puncture proof container	150	56.8	
	Black plastic bag	16	6.1	
Where do you dispose excess mercury and mercury contaminated cotton?	Drain	28	10.6	Educational qualification (p=0.001), year of study (p=0.001)
	General garbage	40	15.2	
	Plastic bags	11	4.2	
	Store in glycerin	142	53.8	
	Any other	43	16.3	
How do you discard the used developer or fixer solution?	Mix and discard into drain	42	15.9	Educational qualification (p=0.001)
	Mix and discard into general garbage/plastic bag	9	3.4	
	Discard developer into drain, send fixer for recycling	36	13.6	
	Discard fixer into drain, send developer for recycling	7	2.7	
	Don't know	170	64.4	
How do you dispose the hazardous liquid waste?	Drain	66	25.0	Educational qualification (p=0.037)
	General garbage	20	7.6	
	Chemical treatment and discharge into drains	178	67.4	

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Table 5 has the mean and standard deviation (SD) scores of knowledge, attitude, and practice of biomedical waste management among the study subjects in relation to educational qualification. The mean knowledge, attitude and practice scores were 4.35±1.63, 4.69±1.97, 4.43±0.78 respectively with maximum scores of 9, 5

and 10. Significant differences existed in practice scores among faculty and students. Significant differences existed in relation to educational qualification of respondents in knowledge and practice scores. No significant difference in response was observed in relation to teaching and practice experience among the faculty members.

Table 5. Mean and standard deviation (SD) scores of knowledge, attitude, and practice of biomedical waste management among the study subjects in relation to educational qualification

EDUCATION	KNOWLEDGE (Mean ± SD) Max. score = 9	ATTITUDE (Mean ± SD) Max. score = 5	PRACTICE (Mean ± SD) Max. score = 10
UG students	3.92 ±1.68	4.52 ±0.80	4.49 ±1.72
PG students	4.89±1.61	4.40±0.69	6.50±2.24
Interns	4.23±1.54	4.41±0.72	4.76±1.10
Graduates	4.25±1.46	4.30±0.81	4.52±1.97
Post Graduates	4.87 ±1.44	4.44 ±0.76	5.19±2.06
TOTAL	4.35±1.63	4.69±1.97	4.43±0.78

Discussion

Hospitals and other health-care establishments have a “duty of care” for the environment and for public health, and have particular responsibilities in relation to the waste they produce.⁶ 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, unauthorized and illegal re-use, and an increase in the quantity of waste. Dental practice involves many

hazardous exposures and this calls for proper segregation and disposal of biomedical waste.⁷ The hazards of waste disposal from dental practices can be divided into two main areas. First, there is a wider environmental burden of a variety of hazardous products and second, the more immediate risks of potentially infectious materials that can be countered by individuals handling the waste.⁸

The Ministry of Environment and Forests, Government of India has notified the new draft Bio-medical Waste (Management and Handling) Rules, 2011 under the Environment Protection Act, 1986 to

replace the earlier Bio-medical Waste (Management and Handling) Rules, 1998 and amendments thereof. Several new provisions have been added to the new rules including the scope of application of these rules exclusively to biomedical waste alone and not other wastes like radioactive, hazardous chemicals, municipal solid wastes etc.; the necessity of every occupier/operator irrespective of the number of patients being serviced to obtain an authorization; reduction in the number of categories of waste from ten to eight etc.⁹

Knowledge, attitude and practice act as three pillars, which make up the dynamic system of life itself. Knowledge is some information that is acquired or gained. It results in congeniality and advertence about an eclectic thing or a situation. Knowledge, being the basic criterion that allows one to earmark between the right and the wrong, is a mixture of comprehension, experience, discernment and skill. Attitude accredits to thinking towards a proper situation. Practice means contemplation of rules and knowledge that lead to action. Thus, a right knowledge, a positive attitude and a good practice are imperative to guide and serve the patients.^{10,11} Thus, this study was conducted with the objective of assessing the knowledge, attitude and practice regarding biomedical waste management among dental healthcare personnel.

It is an important observation that about 75% (n=198) of the respondents considered all health care wastes to be hazardous. This awareness is better than the result conducted among dental health care personnel in three private dental colleges in Delhi, by Sood et.

al.⁴ Only 72% of the respondents (n=192) were aware of the fact that biomedical waste management and handling rules were applicable to dentists. However studies conducted in Amritsar⁷ and Delhi⁴ revealed that the awareness in this regard was 80% and 75% respectively. The observation in this study may be attributed to the fact that majority of the respondents who were not aware of this fact belonged to the student's group especially the third year BDS students.

Only 14% of the respondents including the dental students opined that any plastic bag can be used for waste segregation. The observation is in contrast with the results of studies done in Chennai⁸ and Davangere¹², where the corresponding values were 28% and 27% respectively. The observation is in contrast with the study conducted in Delhi⁴, where the corresponding value was 34%. Only 16.3% of the respondents agreed that they had received training in biomedical waste management. IMAGE is the scheme of Indian Medical Association, Kerala for scientific disposal of biomedical waste. IMAGE provides comprehensive service by providing training to hospital staff for segregation of biomedical waste in colour coded bags, collection of it from hospitals, transportation in specially designed covered Vehicles, scientific treatment and final disposal in the common facility.¹³ About 45.8% (n=121) were aware about IMAGE. A significant decrease in awareness regarding this was seen among the students in comparison to the interns and teaching faculty members. Among the students, the final year students had significantly greater awareness. However, only 22.3% (n=59)

could answer the expansion of the abbreviation IMAGE as Indian Medical Association Goes Ecofriendly.

Regarding the maximum time limit for storage of biomedical waste according to national guidelines, about 60% (n=157) admitted that they were not aware of the time limit and only 9.5% (n=25) were aware of the fact that it was 48 hours. About 40% of the respondents were aware of amalgam separators. Amalgam separators are devices designed to remove amalgam waste particles completely in dental office discharge. These separators remove the particles using different techniques such as sedimentation, filtration, centrifugation or ion exchange.⁴ About 64% of the respondents were aware of the symbol for biohazard. In majority of the knowledge questions, educational qualification played a pivotal role in determining the response. The mean knowledge score was 4.35 ± 1.63 with a maximum score of 9. The graduates and postgraduates had significantly higher knowledge scores. Among the students, final year students had better knowledge. This observation may be due to the fact that the third year students participated in this study during the beginning of their academic session and thus had a lack of awareness regarding this topic of discussion.

Regarding the attitude related questions, almost 97% of the respondents opined that the biomedical wastes should be segregated into different categories. The results are similar to the results of the study conducted by Sood et. al. in Delhi⁴. A very positive attitude towards healthcare waste management is highlighted by the

observation that over 94% of the respondents felt that the topic should compulsorily be made part of the dental undergraduate curriculum, over 82% of the respondents felt that their knowledge regarding the same was inadequate and over 97% were interested in receiving further training on the same. The mean attitude score of 4.69 ± 1.97 (maximum 5) indicated a very favourable attitude with no significant difference in relation to educational qualification.

The practice related questions rather presented a different picture. Majority of the students were unaware of their institutional tie-up with waste management companies. About 18% of the respondents disposed all kinds of waste into general garbage. This result was in contrast with a study conducted by Sudhakar et. al. in Bangalore, where the corresponding figure was 47.6%.¹⁴ The results are comparable to the observations in the Amritsar study (17.5%)⁷ and are better than the Delhi⁴ study wherein the corresponding value was 36%. Regarding the segregation of wastes into different categories, 31.4% of the respondents admitted that they did not segregate the wastes before disposal. The results in this regard are similar to the results obtained in the study conducted in Bangalore¹⁴ and strikingly in contrast with the results of studies conducted in Chennai⁸ and Davangere¹² where the corresponding figures were 82.4% and 70% respectively. It is a surprising finding that only 28% of the respondents disposed blood soaked cotton, gauze in red coloured bag. The corresponding figures in studies conducted in Amritsar⁷ and Delhi⁴ were 42% and 36%.

It is an important observation that about 15.2% of the respondents disposed mercury in general garbage. In Chennai study⁸, the corresponding value was around 32% and in Bangalore study¹⁴, it was around 15%. Poor practice scores were obtained in relation to majority of the practice related questions. The mean practice score of 4.43 ± 0.78 (maximum 10) shows an unfavorable picture. Although the graduates and postgraduates had significantly higher scores than students, the overall scores remained low. One possible explanation for this observation is that in institutions and majority of the clinics, it is the chair-side assistants and other auxiliaries who segregate the waste.

The study thus throws a light on the existing knowledge, attitude and practice of the dental health care personnel in Kothamangalam. This study indicates that there is an urgent need to train the dental personnel regarding the same. Occupational safety is a prime concern.

Conclusions

Our study revealed that although the attitude about biomedical waste management was high among the faculty members and students, the knowledge and practice was comparatively low. The faculty members had significantly higher knowledge scores than students. This study indicated that there is a need for creating awareness among dentists regarding biomedical waste management. The topic should compulsorily be made a part of the dental undergraduate curriculum. Continuing dental education programs are yet another

effective method in imparting awareness among the dental practitioners.

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