

Awareness, Attitude and Practices of Biomedical Waste Management among Dental Practitioners - A Cross Sectional Questionnaire Study

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Abstract

Background: Proper biomedical waste (BMW) management was one of the neglected aspects of health care for years, especially in developing countries like India. Amidst the Corona virus disease 2019 (COVID-19) pandemic, the scenario has further worsened. The health-care sector generates enormous amount of biomedical waste (BMW) and dental waste forms a subset of this hazardous waste. It is, therefore, imperative for the upcoming dental health professionals to be aware of the hazards related to improper waste management and the existing rules and regulations for the same. To gauge the gaps in knowledge of Biomedical Waste Management (BMWM) in Dental care and find ways to rectify the

same, the aim of this study was to assess the knowledge, attitude, and practice of biomedical waste management among dental clinical practitioners, academicians and students.

Material and Methods: A cross-sectional study was carried out on 500 private dental practitioner selected by simple random sampling, wherein a pre-validated, tested, and structured questionnaire with dichotomous responses and 51 multiple-choice questions divided into 4 sections was adopted and sent to the participants through online survey forms (Google Survey forms). The responses were recorded after which statistical analysis was carried out to assess the levels of knowledge, attitude, and practice among the participants.

Results: Out of 500 participants 330 (66%) were males and 170 (34%) were females. Analysis of the survey data shows that majority of Private practitioners, both BDS & MDS are aware of laws binding with such issues. Out of 500 participants, 97% agreed that waste needs to be segregated but only 60% were aware of the Guidelines regarding BMW management in India. About 66% of the dentists were not aware of the different categories (colour bags) of bio-medical waste generated in their clinic. About 56.6 % of the dentists were not aware of the bio-medical waste management law in India applicable to dentists.

Conclusion: An overall positive attitude was seen among all survey participants toward safe management of BMW. However, the Biomedical Waste Management practice and knowledge among them is not satisfactory which calls for attention on the part of educational institutions in providing continuous educational programs and monitoring the correct disposal of wastes. This was validated by the fact that increases in educational qualification showed better performance toward this subject. Therefore, education on such issues among clinical practitioners, academicians and students is critical and needs urgent intervention in this part of the globe.

Keywords: Awareness, Dental practitioners, Biomedical waste, management, practice, segregation

Introduction

Every blessing, just like a coin has two sides. Advancement and increasing demand of health care/dental care systems came as a blessing but then it upsurges the generation of Biomedical Waste (BMW) which poses a huge risk to the health of the public, patients, and professionals and contribute to environmental degradation.¹ Dental care facilities generate a high amount of BMW and improper management of these wastes poses a threat not only to the patients and the dental health professionals but also to the general population who then

become at a high risk for health hazards. Proper biomedical waste (BMW) management in accordance to the stipulated rule was one of the most neglected aspects of health care for years, especially in developing countries like India. Biomedical waste (BMW) has been defined as “any waste that is generated during the diagnosis, treatment, or immunization of human beings or animals, or in the research activities pertaining to or in the production or testing of biological or in health camps and also includes categories mentioned in the Schedule I of the Biomedical Waste (Management and Handling) rules 1998”^{1, 2}. Since the BMW Management Rules, 2016 by Government of India (GoI), Ministry of Environment, Forest, and Climate Change initiated changes by prescribing simplified categories (color coded) for segregation of different BMWs, an amendment in 2018 also came into force with the aim to improve the compliance to the rules.^{1,2} Nonetheless, proper segregation, handling, and disposal remained a serious concern for health care facilities across India with an annual growth rate of 7% with a projected estimate up to 775.5 tonnes/d by the year 2022.³

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 and lead aprons), and chemical waste (such as spent film developers, fixers, and disinfectants).⁴

Indiscriminate disposal of BMW or hospital waste and exposure to such BMW cause a serious threat to the environment and human health. BMW requires specific treatment and management before its final disposal. The severity of the threat is further compounded by the high prevalence of diseases such as human immunodeficiency

virus (human immunodeficiency virus) and hepatitis B and C.⁴

With this background, the present study was designed in an effort to evaluate the practical calibration, awareness, compliances and practices of dental care waste management among dental clinical practitioners, academicians and students in India, so that so that depending on their attitude they can be motivated to attend training and CDE programs concerning waste management so that they will be efficient to properly segregate BMW into color-coded disposing bags, disinfect and dispose hospital waste in an eco-friendly way training thus delivering safer and more effective dental care.

Aim and Objectives

Aim

To study the awareness, knowledge and practices of Biomedical waste management in Dental care among Private Practicing dentists in India.

Objectives

1. To assess the dentists awareness about Biomedical waste management in Dental care.
2. To know the various methods of bio-medical waste disposal practiced by private dental practitioners in India
3. To assess the awareness of dentist regarding color coding of biomedical wastes.

Materials and Method

This Epidemiological, Cross-sectional Observational online questionnaire-based study was planned to assess the awareness and practices of bio-medical waste disposal among 500 Private dental practitioners across the country consisting of 350 general dental practitioners (BDS) with private clinics and 150 dental specialists (MDS) who are practicing in India and registered with their respective State Dental Council. A simple random sampling is carried out to select the dental practitioners for the study.

Inclusion Criteria and Exclusion Criteria

a. Inclusion criteria: Dentists enrolled as a private dental practitioner, willing to participate and registered with their respective State Dental Council were included in the study.

b. Exclusion criteria: Dentist who were not willing to participate, House surgeons, non-practicing dentists, dentists with the administrative job only, dental students under internship were excluded from the study.

Sample size and techniques

Out of 960 dentists who visited the survey 750 chose to answer. 500 Participants were selected by a simple random sampling. A specially designed & structured questionnaire adapted from the questionnaire originally developed by Umar and Yaro⁵ and modified by Sanjeev *et al.*⁶ was used for data collection. It was validated and pre-tested by previous authors. It consisted of 51 questions (27 Open-ended & 24 close-ended questions) which was divided into four sections was used to define the precise management issues associated with hospital waste segregation, collection, transport and disposal. The first part consisted of questions for demographic profile (age, gender, and year of study, qualification and clinic location) of the participants, while the second, third, and fourth part assessed the knowledge, awareness, and practice on biomedical waste management, respectively, with 15 questions each. Data was collected during the months of October 2020–December 2020. The questionnaire was pilot tested on a small group of dentists who were requested to complete it and to indicate any questions that they found unclear. The qualification of post graduate students who are practicing was considered as BDS.

The questionnaire was put together into 4 domains

Questionnaire: It comprised of 51 questionnaires with 2–5 responses. They were further classified into five sections.

Part One- It consisted of 5 questions of demographic division and qualification data. Dentists were asked about, age, Academic Qualifications, and years of working in Dental Clinic or Hospital.

Part Two- It consisted of 7 questions based on the assessment of knowledge on Biomedical Waste Management Policies and practice.

Part Three- Response consisted of 12 questions based questions on Biomedical Waste management.

Part Four -Response consisted of 27 questions based on Practices Biomedical Waste Management (Attitude assessment).

Part Five: Response consisted of one question based on Preventive measures taken by the health-care professionals while handling BioMedical Waste.

Online survey questionnaire was created using Google Survey form and a link containing these questionnaires was shared with all the participants and required them to answer the questions. All the responses were analyzed and recorded. Completion of the survey was construed as informed consent to participate in the study. The participants were ensured about the confidentiality & secrecy of the data.

Statistical analysis

The resulting data was coded and statistical analysis was done using SPSS (Statistical Package for Social Sciences) software version 20.0 (SPSS Inc., Chicago, USA). Results were presented in form of tables and figures. Mean is calculated for demographic variables and percentages were calculated for the responses gave by the dentists.

Results

Demographic Profiles of Respondents (Table 1)

Descriptive statistic of the results showed that response rate was 100% (500), the percentage of males was 66% (n = 330) and rest 34 % (n = 170) females. The age group of participants ranged between 25 years to 60 years with the

mean age of 33 and other demographic details are given in Table 1. Majority of the participants in the present study belonged to age group 25–35 years 60% (n=300). Majority of the participants 42% (n=210) had <10 years practice experience, while 30% (n=150) were practicing from 6-10 years and 28% (n=140) for less than 5 years, and 70% (n=350) were general dental practitioners.

Biomedical Waste Management Policies (Table 2)

The majority of participating dentists i.e, 60% (n = 300) dentist had heard about guidelines lay down by the Government of India for Biomedical Waste Management, only 40% (n = 200) were aware of Biomedical Waste (Management and Handling) Rules, 1998 and its Amendments rules were made in 1998.

Response to Knowledge-Based Questions on Biomedical Waste Management (Table 3)

Out of 500 dentists who participated, 64% (n = 320) of the respondents considered all health-care wastes hazardous. About 66% of the dentists were not aware of the different categories (colored bags) of Biomedical waste generated in their clinic. 41.4% (n = 207) were reported for knowledge about sterilization from infections by autoclaving before shredding and disposal. Only 52% (n = 260) were aware of Indian Medical Association Goes Eco-friendly (IMAGE), and of them, only 25% (n = 125) knew the correct expansion of the abbreviation of IMAGE. Around 54% (n = 270) of the respondents correctly recognized the symbol of biohazard. Only 38.8% presented with Awareness of Amalgam separators

Responses to Practice-Based Questions on Biomedical Waste Management (Table 4)

All the participants agreed that hospital/clinic generate BMW. But only 78% (n = 390) had knowledge about waste management guidelines and they agreed that it has a significant influence on disposal of dental material, disposal of protective wears 40% (n = 200), and human

anatomical wastes 44.6% (n = 223). It was interesting to note that most injuries 70% (n = 350) occurred during giving an injection, which is the most important step of the procedure. These were concerned by injuries needle 90% (n = 450). With regard to prevention by Hepatitis B vaccine, 57% (n = 285) of the respondents knew about it and were inoculated. The most common problem encountered in managing the dental health-care waste was extra expenses, 63% (n = 315) of the respondents believed that safe management efforts will increase the financial burden.

Preventive Measures Taken by the Healthcare Professionals While Handling Biomedical Waste - Table 5

Use of personal protective measures while handling biomedical waste was adequate among doctors 46.8% (n = 234).





Individual Scenario			
Variables	Respondents	Frequency (n)	Response rate (%)
Total No. of respondents		500	100
Gender	Male	330	66
	Female	170	34
Age group	25–35 years	300	60
	>36 years	200	40
Years of practice after degree	>5 years	140	28
	6-10 years	150	30
	<10 years	210	42
Academic qualifications	General practitioner	350	70
	Specialist (MDS)	150	30
Type of practice (job profile)	Self-employed (private)	300	60
	Consultant visiting dental specialist	125	25
	Private practitioner (specialist) attached to Academic	75	15

Institute			

Table 1: Social -demographic variables of respondents

Individual Scenario			
Variables	Respondents	Frequency (n)	Response rate (%)
Biomedical waste (management and handling) rules were first proposed in	1997	110	22
	1998	200	40
	1999	150	30
Amendments to the biomedical waste (management and handling) rules were made in	2011	178	35
	2013	142	28.4
	2016	160	40
Biohazard symbol was developed in 1966 by Charles Baldwin	Agree	205	41
	Disagree	295	59
Guidelines lay down by government of India for Biomedical Waste Management?	Aware	300	60
	Unaware	200	40
Regulation of safe transport of Medical waste done by?	Pollution control board of India	323	64.6
	Transport corporation of India	47	9.4
	Cannot comment	130	26
Safe management of biomedical waste is the responsibility of	Only government	46	9.2
	Auxiliaries staff	204	40.8
	Dental surgeons	250	50
According to National guidelines, the maximum time limit for Biomedical waste storage	24 h	70	14
	48 h	130	26
	Cannot Comment	300	60

Table 2: Biomedical waste management policies

Individual Scenario			
Variables	Respondents	Frequency (n)	Response rate (%)
Awareness of Biohazard sign/image?	Aware	260	52
	Unaware	240	48
Biohazard sign/IMAGE stand for	Designed to warn about hazardous materials	270	54
	Particular hazard, obstacle or condition is not covered by a standard sign	230	46
Which of the following is the Universally accepted symbol for Biohazard?		70	14
		103	20.6
		316	63.2
		11	2.2
Awareness about Biomedical waste management rules applicable to Dentists?	Aware	217	43.4
	Unaware	283	56.6
Awareness about improper waste management causes various health hazards (diseases)?	Aware	320	64
	Unaware	180	36
Biomedical statement describes one type of Medical waste?	Materials that may be poisonous, toxic, or flammable and do not pose disease-related risk	67	13.4
	Waste that is saturated to the point of dripping with blood or body fluids contaminated	373	74.6

with blood	Waste that does not pose disease-related risk	60	12
	Biomedical wastes should be segregated into different categories (colored bags)?	Aware	170
Infectious waste should be sterilized from infections by autoclaving before shredding and disposal?	Unaware	330	66
	Agree	207	41.4
Labeling the container before filling it with waste is of any clinical significance?	Disagree	293	58.6
	Agree	100	20
Can any plastic bag be used for waste disposal?	Disagree	400	80
	Agree	70	14
Awareness of Amalgam separators?	Disagree	430	86
	Aware	194	38.8
One gram of mercury (source from dental amalgam) is enough to contaminate the following surface area of a lake?	Unaware	306	61.2
	30 acres	50	10
	25 acres	205	61
	20 acres	123	24.6
15 acres	22	4.4	

Table 3: Response to knowledge based questions on biomedical waste management

Individual Scenario			
Variables	Respondents	Frequency (n)	Response rate (%)
Does your hospital/clinic generate biomedical waste?	Agree	500	100
	Disagree	0	0
Amount of health care waste generated per day?	0-2 kg	440	88
	>2-<4 kg	33	6.6
	>4 kg	27	5.4
Does your clinic	Agree	306	61.2

have a tie up with waste management companies?	Disagree	194	38.8
Cleaning of dental suction unit recommended?	Daily	170	34
	Twice a week	60	12
	Once a week	247	49.4
	Once a month	23	4.6
Disposal of cotton, gauze and other items contaminated by blood?	Red plastic bag	250	50
	Yellow plastic bag	163	32.6
	Blue plastic bag	53	10.6
	Black plastic bag	33	6.6
Disposal of Pharmaceutical waste?	Red plastic bag	117	23.4
	Yellow plastic bag	200	40
	Blue plastic bag	83	16.6
	Black plastic bag	100	20
Disposal of Sharps waste?	Red plastic bag	25	16
	Yellow plastic bag	80	8
	Blue plastic bag	60	12
	Black plastic bag	27	5.4
	Puncture proof container	293	58.6
Disposal of excess Mercury & Mercury contaminated cotton?	Drain	70	14
	General garbage	300	60
	Plastic bags	40	8
	Store in glycerin	90	18
Disposal of the used developer or fixer solution?	Mix and discard into drain	80	16
	Mix and discard into General garbage/ plastic bag	37	7.4
	Discard developer into drain, Send fixer for recycling	65	13
	Discard fixer into drain Send developer	18	3.6

	for recycling		
	Cannot comment	300	60
Disposal of hazardous liquid waste?	Drain	100	20
	General garbage	50	10
	Chemical treatment and Discharge into drains	350	70
Disposal of contaminated dental materials (files/reamers/burs/ cements/suction tips used)?	General waste	50	10
	Improper manner	60	12
	Recommended manner	390	78
Disposal of used protective wears?	General waste	190	38
	Improper manner	110	22
	Recommended manner	200	40
Disposal of human anatomical waste?	General waste	67	13.4
	Improper manner	210	42
	Recommended manner	223	44.6
Disposal of all kinds of waste into general garbage?	Agree	90	18
	Disagree	410	82
Is needle-stick injury a concern?	Agree	450	90
	Disagree	50	10
Do you re-cap the used needle?	Agree	460	92
	Disagree	25	5
	Do not Bother	15	3
Do you discard the used needle immediately (needle destroyer)?	Agree	270	34
	Disagree	320	64
	Have not noticed	10	2
Sustained a needle-stick injury during the last 12 months?	Agree	273	54.6
	Disagree	80	16
	Do not remember	147	29.4

How the most recent incident did (sustained needle-stick injury) happen?	Poor disposal of needle	73	14.6
	Individual carelessness/accident	350	70
	Cannot remember	77	15.4
To whom the injury was reported?	Occupational health worker	190	38
	Nobody	310	62
Whether fully inoculated against hepatitis b?	Agree	285	57
	Disagree	215	43
Any previous training in biomedical waste management?	Agree	125	25
	Disagree	375	75
Biomedical waste management should compulsorily be made part of Dental undergraduate curriculum	Agree	450	90
	Disagree	50	10
Your knowledge regarding Biomedical Waste Management is adequate?	Agree	410	82
	Disagree	90	18
Any further training on Biomedical Waste Management?	Required	481	96.2
	Not Required	19	3.8
Maintaining BMW records mandatory in your hospital/ clinic?	Agree	107	21.4
	Disagree	320	64
	Cannot Comment	73	14.6
Problems faced in waste management?	Burden	120	24
	Financial burden	315	63
	No problem	10	2
	Non availability of service	55	11

Table 4: Response based on practices biomedical waste management

Individual scenario		
Preventive measures adopted	Frequency (n)	Response rate (%)
Gloves	150	30
Goggles	11	5.5
Gowns	108	21.6
All of the above	234	46.8

Table 5: Preventive measures taken by the health care professionals while handling Bio Medical Waste\

Discussion

This study was an effort to investigate dental practitioners' acquiescence with biomedical waste management across India. This study provided an important insight into the proper method of disposal of waste by private practitioners. 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 encountered by individuals handling the waste. A bleak picture about the knowledge and practice is provided by the survey. The study revealed several loopholes in the knowledge, attitudes, and practices among the health professionals. Health professionals have an ethical responsibility toward the environment and themselves. They must not forget that they are at risk of treating patients who may have infectious diseases due to the nature of their profession. Dentists, dental assistants, and patients may be exposed to pathogenic microorganisms localized in the oral cavity and respiratory tract, including Cytomegalovirus, HBV, HCV, Herpes simplex virus type 1 and 2, HIV, Mycobacterium tuberculosis, Staphylococci, Streptococci, and other viruses and bacteria.

These microorganisms can be transmitted by professionals by direct contact with a patient's saliva, blood, skin, or oral secretions, or by indirect contact through injuries

caused by contaminated sharp instruments, or by droplet infection from aerosols or spatter to dental healthcare.

Self-reported awareness about the biomedical waste management system among dentists in the present study (100%) was good.

Although the self-reported awareness was high, as much as 38.8% dentists were not registered at the local governing body. Those who had not registered were disposing of waste more commonly in dustbins. The advent in hospitals of disposables has brought in its wake many ills, such as improper recycling, illegal Re-use and a rise in the volume of waste.

The biomedical waste generated by hospitals and clinics can be broadly classified as general waste, infectious waste, and non-infectious but toxic waste. About 75–85% of waste generated in hospitals is a non-risk or general waste, which includes cardboard boxes, paper, plastic packaging, and kitchen waste. Infectious waste, which includes human anatomical wastes, infectious disposable plastic items, and sharps accounts for only remaining 10–15% of total quantity of waste generated in a hospital. Non-infectious but toxic waste includes chemical waste, genotoxic waste, and radioactive waste which comprises about 5–10% of total volume of generated hospital waste.

Sushma et al. study showed that a significant percentage of practitioners (47.9 percent) dispose of dental waste without segregation and prior disinfection, which exposes garbage collectors to a high risk of infection from health care waste that was consistent with the current study (64.4 percent)^{7,8}.

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

1998 and amendments. These rules were aware by the HCW of the present study.⁹

This study in concordance with the study carried out by Sood et al regarding the maximum time limit for storage of biomedical waste according to national guidelines. They were not aware of the time limit (60%) and were aware of the fact that it was 48 hr.¹⁰

IMAGE is the scheme of IMA, Kerala, for the scientific disposal of biomedical waste. IMAGE provides comprehensive service by providing training to hospital staff for segregation of biomedical waste in color-coded bags, collection of it from hospitals, transportation in specially designed covered vehicles, scientific treatment, and final disposal in the common facility. The participants were aware of the IMAGES in the present study.

In a study conducted by Kishore et al¹¹; a study in a teaching hospital in New Delhi some 12 years ago, only 35.9% of respondents were aware of this. However, the guidelines given by Government of India for biomedical waste management were concerned; it was reassuring to note that only 43.4% of the dentists were aware of the legislation applicable to hospital waste management. More than 60% of the HCW had no knowledge about the type of waste to be collected in black, red, or yellow colored bags related to the current study. These findings were in concordance to the studies done by Patil et al. (72.5%).¹²

Only 14% of the participating dental practitioners proposed that any plastic bag can be used for waste segregation. The observation is in contrast with the results of studies done by Charania et al and Sudhir et al where the corresponding values were 28% and 27%, respectively.^{13,14}

About 34% of the Dental Practitioners held Poor knowledge in reference to color coding for infectious waste management which was in consensus to earlier

study of Uddin et al. found the similar findings in a study at Faridpur hospital.¹⁵

About 38.8% of the participants were aware of amalgam separators. Amalgam separators are devices made to remove amalgam waste particles completely in dental office discharge. These separators remove the particles using several techniques such as sedimentation, filtration, centrifugation, or ion exchange.

There are no reliable data available of the quantum of waste generated per person per day either in Indoors or Outdoor patient in Indian Hospital. Even there is no uniformity in the data on the volume of biomedical waste being generated. The difference in the amount of waste production ranges not only from country to country, but also throughout the country, which depends on the type of health care service, hospital specialization, the number of recycled products used in the health center and the percentage of patients seen on a day-care basis. The average daily waste generated from anatomical waste is 5.6 kg according to study by Singh et al. In the present study, the quantum of average daily waste particularly the anatomical waste shows high quantity, i.e. 2 kg/day.

Sudhakar et al.¹⁶ conducted a study in Bangalore City, India, among private dental practitioners, where 39.1% of the interviewer did not segregate excess mercury/amalgam, but discarded it to daily garbage. This outcome is close to the current research.

The outcome of our study focused a definite need to enforce more strict laws and measures for disposal in India, so that it becomes mandatory for all private practitioners to register their clinics under bio medical waste management services.

Conclusions

Our study revealed that a large number of practitioners were aware of different categories and color coding of different types of waste yet have failed to practice the

same in their clinics. Thus, there is an urgent need for continuing dental education on dental waste management practices to these dental practitioners. Occupational safety is a prime concern. Being a recent field of interest, the level of knowledge on this concept is insufficient and needs to be increased to raise awareness to the environmental aspects. Protected and effective execution of waste management rules is not only a legal necessity but also a social liability. Lack of knowledge, motivation and cost factor are some of the hurdles faced in proper waste management. The importance of training regarding biomedical waste management cannot be overemphasized. Health-care professionals and government should work together to develop standard feasible policies for BMW management. The study revealed a lack of knowledge in different tiers of health-care providers which adversely affects their practice.

Recommendations⁹

- a. Adequate supplies and equipment should be available in all departments to take care of wastes.
- b. Collected information on various methods of disposal and updated technology should be made available to all categories of health-care personnel.
- c. Compulsory training for their health-care personnel from accredited training centers.
- d. Easy color coding for BMW disposal bags should be developed in local languages for the betterment of sanitary workers and general public awareness.
- e. Hospital superintendents, Government Health administration, and public awareness need to pay their specific attention to this important issue of health and hygiene.
- f. Intensive training or workshops program at the regular time interval for all staff working in hospitals and clinics, and a system of monitoring and surveillance about the

practice of day to day BMW management should be evolved.

g. Proper BMW disposal practices could be accentuated in health-care personnel if they are put under direct supervision and direct surveillance.

h. Reasonable amount of fund must be provided for waste management.

i. There is dire need of segregation of waste at source besides following color code system of waste management.

j. To install proper incinerators in all the cities.

k. Universal precautions should be adapted while dealing with hazardous and infectious waste.

l. Yielding posters with and leaflets should be used to for providing such education. m. Endorsing the principles of green dentistry which reduces waste and pollution, saves water, energy, and money is high-tech and supports a wellness lifestyle.

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