KNOWLEDGE AND AWARENESS ON MANAGEMENT OF BIOMEDICAL WASTE AMONG ORTHODONTISTS AND GENERAL DENTAL PRACTITIONERS

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ABSTRACT:

Background: Dental care facilities generate a high amount of Biomedical Waste (BMW) like sharps such as surgical needles, blades, wires, brackets, extracted teeth, human tissues, discarded or expired medicines and dental materials, highly contaminated with blood and saliva. Segregation and collection should be done in separate colour coded bags or containers; according to Biomedical Waste Rules, 2016 the Ministry of Environment and Forest in India. Poor management of wastes leads to high risk to public, patients and professionals and also contributes to environmental degradation.

Aim: To assess the knowledge and awareness on management of biomedical waste management among orthodontists and practicing general dentists.

Materials and methods: A cross sectional study was conducted through Google form (electronic based survey) among general practising dentists; survey consisted of 18 closed ended questions. The data collected were tabulated in Microsoft Excel and exported to SPSS, descriptive statistics and Chi-Square test was performed ($p<0.05$ was considered statistically significant).

Results: 83.8% practising dentists follow the biomedical waste disposal policy in their hospital or clinic, among which 91% use protective barriers (e.g. gloves, masks) during handling of biomedical waste. 63.1% disposed human anatomical waste and blood contaminated waste properly where only 55.9% disposed extracted teeth and human tissue in yellow bags. Significant association was found between management of incinerated ash and qualification among orthodontists ($p=0.019$) and with experience of less than 1 year had proper knowledge; ($p=0.021$). Disposal of plaster of Paris was properly managed among general practioners ($p=0.039$). Management of sharps was done properly using needle destroyers among general dentists and orthodontists ($p=0.041$).

Conclusion: Safe and effective management of biomedical waste is a legal necessity but also a social responsibility of dentists, according to this present survey 7 – 9.2 % of the dentists are not effectively following the biomedical waste management.

Keywords: Biomedical wastes, BMW, Health Care Facility, segregation, colour coded bags.

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INTRODUCTION:

High amount of Biomedical Waste has been generated by Dental care facilities; in which 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 can be at a higher risk for health hazards [(1)]. Segregation and collection of various categories of waste should be done properly in separate containers so that each category is treated in a suitable treatment making it harmless for the surroundings [(1,2).]

Waste generated from the healthcare facility is classified as; Bio Medical Waste, General Waste and Other Wastes in which 10–25% of health-care waste is regarded as "hazardous" and may pose a variety of environmental and health risks [(3)]. According to Biomedical Waste (Management and Handling) Rules, 1998 the Ministry of Environment and Forest in India, BMW (Biomedical Waste) is defined as "Any waste which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities in the production or testing of biologicals [(4, 5)]. Bio Medical Waste Management Rules, 2016 categorises the bio-medical waste generated from the health care facility into four categories based on the segregation pathway and colour code; as Yellow Category, Red Category, White Category and Blue Category as summarized in Table-1 [(6)]. Steps involved in BMWM; five steps (Segregation, Collection, pre-treatment, Intramural Transportation and Storage) is the exclusive responsibility of the Health Care Facility; with following responsibilities.

Biomedical Waste should be segregated at the point of generation by the person who is generating the waste in a designated colour coded bin/ container.

Biomedical Waste and General Waste shall not be mixed with storage time as less as possible followed by transportation and disposal is done within 48 hours.
Phase out use of chlorinated plastic bags (excluding blood bags) and gloves by 27-03-2019.
Only Laboratory and Highly infectious waste shall be pre-treated onsite before sending for final treatment or disposal.
Provide bar-code labels on all colour coded bags or containers containing segregated bio-medical waste.

BMW generated in dental office include plastic, latex, cotton, glass, amalgam waste, mercury, X Ray processing solutions, lead foils, disinfectants, chemicals, dental casts and impressions, waste sharps like surgical needles, blades, extracted teeth, human tissues, discarded, expired medicines and dental materials, highly contaminated with blood and saliva [(2,3)]. Poor waste management practices may lead to huge risk to the health of the public, patients and professionals and contribute to environmental degradation; proper handling is important with yearly training and proper immunization [(5)]. Staff handling these materials should be trained in the Workplace Hazardous Materials Information System (WHMIS) [(2)].

All the bags/ containers/ bins used for collection and storage of bio-medical waste, must be labelled with the Symbol of Biohazard or Cytotoxic Hazard as the case may be as per the type of waste in accordance with the BMWM Rules, 2016. Interim storage of bio medical waste is discouraged in the wards / different departments of health care facilities; if needed it must be stored in the dirty utility/sections. No waste should be stored in patient care areas and procedures areas; in absence it should be stored in designated places. Proper management of the waste in the healthcare facilities and the technical requirements of waste handling are needed to be understood and practiced by each category of the staff in accordance with the BMWM Rules, 2016 [(6)]. Every healthcare facility needs to maintain the records with relation to category wise bio-medical waste generation and its treatment disposal on a daily basis. Dental biomedical waste disposal in the roadside bins can infect the municipal waste collectors if they are not properly protected, according to the Government of India; no waste to be disposed of in the open [(5)]. Present study done to assess the knowledge and awareness on management of biomedical waste among practicing orthodontists and general dentists.

Table-1: Bio Medical Waste Management Rules, 2016 categorises the bio-medical waste generated from the health care facility into four categories based on the segregation pathway and colour code.

S.no	Category	Type of waste	Type of Container
1	Yellow Category	Human Anatomical Waste Animal Anatomical Waste Soiled Waste Discarded or Expired Medicine Microbiology, Biotechnology and other clinical laboratory waste Chemical Waste Chemical Liquid Waste	Yellow coloured non-chlorinated Plastic Bags Chemical waste-yellow container
2	Red Category	Contaminated Waste (Recyclable)	Red Coloured; Non Chlorinated Plastic Bags (having thickness equal to more than 50 µ) Red Containers
3	White Category	Waste Sharps including metals	White Coloured translucent, puncture proof, leak proof, Temper Proof containers
4	Blue Category	Glassware Metallic Body Implants	Puncture proof, leak proof boxes or containers with blue coloured mark

METHODS AND MATERIALS:

Study design:

A cross sectional study was conducted through Google form (electronic based survey) among general practising dentists. The target population of the study was practising general dentists with the aim of assessing the knowledge of general dentists in Biomedical waste management. The study was approved by the Institutional review board (IRB).

Study participants:

Inclusion criteria: Dentists who are practising in dental clinics (BDS- General practioners and MDS-Orthodontists)were selected as study participants.

Exclusion criteria: Dentists who are not practising in clinics were not chosen as study participants.

A simple random sampling was done. A total of n=111 dentists participate in the survey.

Study method:

The study was constructed as an electronic based survey done through Google forms. The survey consisted of 18 closed ended questions which were related to biomedical waste management protocols followed by the clinics and questions related to colour coded waste disposals were assessed. The questionnaire was also prepared in English language and data collected, were checked regularly for clarity, consistency and accuracy. Only completely filled forms were included for analysis.

Statistical analysis:

The data collected were tabulated in Microsoft Excel and exported to SPSS (version 20) by IBM. Descriptive statistics to summarise qualitative data in percentages were used. Chi-square, non-parametric test to assess the association between the knowledge among general dentists and orthodontists, based on the years of experience ($p<0.05$ was considered statistically significant).

RESULTS:

In the present study n=111 practising dentists participated, where 67.6% females and 32.4% males participated with qualification BDS (General practitioners) were 51.4% and MDS- Orthodontics were 48.6%. 74.8% of participants were 21-30 years followed by 12.6% among the 31-40 years age group and 6.3% among 41-50 and 51-60 years. 41.4% participants had less than 1 year of experience,38.7% had 2-5 years experience and 19.8% had more than 5years experience; summarized in table-2.

Responses to questions on the knowledge and awareness on management of biomedical wastes are presented in table-3. First few questions were related to clinical protocol. 83.8% practising dentists follow the biomedical waste disposal policy in their hospital or clinic, where 73% have knowledge about the labelling system for biomedical waste disposal and transportation. 72.1% think it's mandatory to maintain their biomedical waste management records where 13.5% say no and 14.4% are not sure. 80.2% dispose of the colour coded bags as separate bags and 19.8% dispose all together as a single bag. 34.2% daily dispose wastes from your clinics, 42.3% dispose two days once and 23.4% dispose Weekly. 91% use protective barriers (e.g. gloves, masks) during handling of biomedical waste, 6.3% don't use barriers and 2.7% are not aware of the safety measures. Only 45.9% received training on biomedical waste management and still 54.1% did not receive any.

Other questions were related to knowledge about the colour coding system and their management. 63.1% disposed human anatomical waste and blood contaminated waste properly where only 55.9% disposed extracted teeth and human tissue in yellow bags; still 6.3% do not follow properly. Only 44.1% disposed of the soiled impression materials properly and 37.8% disposed of the Plaster of Paris properly in black colour. Management of sharps like orthodontic wires, blades and needles among practising dentists showed 82.9% properly disposed of in white puncture proof box and 88.3% used needle destroyers. But management of excess mercury had various opinions; 78.4% had knowledge on disposal using air tight Containers and 8.1% had no idea. Management of expired medicines were 54.1% returned to the manufacturer and 45.9% dispose of themselves; in which 26.1% disposed properly in yellow bags. Awareness on chemical treatment using 1 -2% sodium hypochlorite and disposal of incinerated ash generated from biomedical waste had 71.2% and 82% respectively had proper knowledge.

Chi-square was performed to assess the association between the knowledge of general practitioners and orthodontists based on years of experience and the results obtained are tabulated in Table 3.

Table-2: Demographic data

S.no	Parameters		Percentage (%)
1	Gender	Male	32.4
		Female	67.6
2	Age group	21-30	74.8
		31-40	12.6
		41-50	6.3
		51-60	6.3
3	Qualification	BDS (General Practitioners)	51.4
		MDS-Orthodontics	48.6
4	Experience	Less than 1 year	41.4
		2-5 Years	38.7
		More than 5 years	19.8

DISCUSSION:

Recognition and separation of waste are the best solution for successful management of biomedical waste management [(1)]. Dentists, dental assistants and other health care professionals are at risk for treating patients as well as handling waste in the clinics [(1,2)]. So hence the study was conducted to assess the awareness and practices toward dental health-care waste management among dentists.

According to Guidelines for Management of Healthcare Waste as per Biomedical Waste Management Rules, 2016;

Healthcare facilities should ensure disposal of biomedical waste within 48 hours, in present study 34.2% dispose daily and 42.3% dispose two days once. General waste should not be collected at the same time or in the same trolley in which bio-medical waste is collected [(6)]. All the bags or containers or bins used for collection and storage of bio-medical waste, must be labelled with the Symbol of Biohazard or Cytotoxic Hazard as the case may be as per the type of waste in accordance with the BMWM Rules, 2016; in present study 27% are still not aware of labelling system [(6)]. Present study, 83.8% practising dentists followed the biomedical waste management was not in concordance with study by Sood et al 2011 and Swathi et al 2019; this may be due to update of knowledge regarding biomedical waste management 2016 [(2,7)]; still in present study 16.2% dentists have improper disposal of dental waste to be improved with increased training of biomedical waste management. 54.1% of dentists who participated were not aware about the training process; it can be improved by certified training centers. As per Bio Medical Waste Management Rules, 2016, it is mandatory for all the employees of the healthcare facility to be trained on handling of biomedical waste management and handling [(6)].

In present study disposal of human anatomical waste and blood contaminated waste were correctly disposed among 63.1% in yellow colour bins or bags and still few dentists are not aware of biomedical waste management rules, 2016. 44.1% of dentists did not consider extracted teeth as an infectious waste that had variations in disposal. This may be due to considering tooth as hard tissue was not in concordance with Puri et al 2019, in which 83.9% responded as infectious waste and not few dentists are not updated with BMW, 2016 rules [(8)]. Materials contaminated with blood or other body fluids, anatomical wastes considered as hazardous waste and disposed of in yellow biomedical waste bags covered with a double bag, labelled with a biohazard symbol [(5)]. But Sharps contaminated with saliva and blood are considered infectious according to Occupational Safety and Health Administration (OSHA) and should maintained correctly in white puncture proof boxes by most of the dentists (82.9%) and most of them had knowledge of using needle destroyers significantly associated with Orthodontists, may be due more knowledge about puncture wound injuries, needle prick injuries and contagious diseases; still 17.1% had no proper knowledge on management. Hence, students need to be educated regarding the disposal of needles and other sharps in puncture proof containers [(9, 10)].

Dental materials are more commonly used among daily bases are gypsum products for orthodontic study cast, for prosthesis preparation, etc. Plaster of Paris management was not properly managed by most of the dentists where few dentists dispose in black bags and significantly associated with BDS (General Practitioners) dentists; due to lesser knowledge and still POP is more commonly used among them in dental clinics for various purposes like study cast preparation. If gypsum products are discarded in landfills it leads to hydrogen sulphide gas release which is further more toxic to the respiratory system, so this reason that the disposal of gypsum in mixed landfills was banned in 2009 [(8, 11)]. Other dental Impression materials are commonly used in clinics and hospitals where soiled impressions are considered as infectious wastes due to saliva and blood contaminants present study 44.1% managed properly not in concordance with Puri et al, 2019 in which 60.2% was considered as infectious waste [(8)]. Amalgam restoration has reduced in recent times but is still in use among dental schools; so it is important to have knowledge about proper management of amalgam as it has high toxicity [(12)]. Storage of excess amalgam in airtight Containers is the recommended method by the American Dental Association or it can be sent for recyclers who will retrieve the silver and as amalgam decomposes on heating, it should not be given for incineration. But in the present study it was similar to Swathi et al, 2019 still 21.6% were not disposing of amalgam properly [(2)].

The expired medicines should be considered as a cytotoxic waste and should be disposed in yellow container according to BMW rules amended in 2016; in the present study 45.9% dispose it by themselves in which only 26.1% disposed it properly in yellow colour bags; significantly associated with Orthodontists and most of them were not aware about proper disposal or not disposing properly similar to study by Sanjeev et al in 2014; may because of the lack of updated knowledge on the recent biomedical waste management rules [(2, 13)]. This knowledge and awareness on most of the disposal and management of biomedical waste management was not significantly associated with qualification or experience in present study.

Wearing of personal protective equipment (PPE) like head gears, eye covers (glasses), mask, apron, gloves, boots are considered important and these constitute the barrier for transmission of infections. All the health care works are considered to take immunization against Hepatitis B and Tetanus as important universal precautions [(14)]. Present study shows most of the clinics use protective barriers during disposal but still few dentists don't use PPE (9%). Generally, PPE is used among clinical and hospital environments; COVID-19 global pandemic has increased the usage PPE in domestic situations, leading to shortages in the supply and rapid accumulation of potentially infectious PPE among domestic solid waste. Proper guide on reducing, reusing, and recycling resources helps in proper PPE management during and after the current pandemic [(15, 16)]. These wastes pose a threat to human health and environment if not disposed scientifically. Healthcare facilities should implement strict rules and regulations with proper training to staff [(3)]. Due to laxity in implementation of the rules and inadequate training to healthcare personnel, there is an indiscriminate disposal of biomedical waste [(10)].

Limitations of present study are smaller sample size, restricted locations and increased concentration can be given to PPE disposal considering pandemic situations.

CONCLUSION:

Safe and effective management of biomedical waste is a legal necessity but also a social responsibility of dentists, according to this present survey 7 – 9.2 % of the dentists are not effectively following the biomedical waste management and 9% are not using proper protective barriers during disposal. Disposal of waste as per colour codes needs to be managed properly for further treatment of waste. Awareness of BMW management has to be increased by proper camps and training; as per Bio Medical Waste Management Rules, 2016, it is mandatory for all the employees of the healthcare facility to be trained on handling of biomedical waste management and handling. Few practitioners were not aware of the existing medical waste management policy 2016

being dentists. Further studies can be performed with increased sample size and various geographical locations for better results.

Table-3: Table representing questionnaire responses and Chi-Square P values

Questions		Response	Percent (n)	Chi-square test	
				Qualification (BDS-General Practitioners & MDS-Orthodontists)	Experience (<1 year, 2-5 years, >5 years)
1	Is there any biomedical waste disposal policy in your hospital or clinic?	Yes	83.8% (93)	NA	NA
		No	9% (10)		
		May be	7.2 (8)		
2	Do you follow the labelling system for biomedical waste disposal and transportation?	Yes	73% (81)	NA	NA
		No	18% (20)		
		May be	9% (10)		
3	Is maintaining Biomedical waste management records mandatory in your hospital or clinic?	Yes	72.1% (80)	NA	NA
		No	13.5% (15)		
		May be	14.4% (16)		
4	How do you dispose of colour coded bags?	All together as single bag	19.8% (22)	NA	NA
		As separate bags	80.2% (89)		
5	How frequently do you dispose of the Colour coded wastes from your clinics?	Daily	34.2% (38)	NA	NA
		Weekly	23.4% (26)		
		Two days once	42.3% 47)		
6	Do you use protective barriers (e.g. gloves, masks) during handling of Biomedical waste?	Yes	91% (101)	NA	NA
		No	6.3% (7)		
		May be	2.7% (3)		

7	Have you ever received training in any form (e.g. lecture, workshop) on Biomedical waste management?	Yes	45.9% (51)	NA	NA
		No	54.1% (60)		
8	Colour coding for disposal of human anatomical waste, blood contaminated waste?	Black	3.6% (4)	0.605	0.975
		Red	33.3% (37)		
		Yellow	63.1% (70)		
9	Extracted teeth and human tissue are disposed of in:	Yellow bags	55.9% (62)	0.388	0.511
		Red bags	27.9% (31)		
		Black bags	9.9% (11)		
		Don't know	6.3% (7)		
10	Which colour indicates disposal of sharps like orthodontic wires, blades and needles?	Plastic bags	9.9% (11)	0.758	0.133
		White puncture proof box	82.9% (92)		
		Yellow bags	7.2% (8)		
11	Management of sharps?	Needle destroyer	88.3% (98)	0.041*	0.475
		Autoclave	8.1% (9)		
		Microwave	3.6% (4)		
12	Soiled impression materials are disposed of in?	Black bags	22.5% (25)	0.546	0.656
		Blue/white bags	23.4% (26)		
		Don't know	9.9% (11)		
		Yellow bags	44.1% (49)		
13	Plaster of Paris used for orthodontic study cast preparation is disposed of in:	Yellow bags	18% (20)	0.039*	0.542
		Red bags	21.6% (24)		
		Black bags	37.8% (42)		

		Don't know	22.5% (25)		
14	Excess mercury are disposed of in:	Sink	9.9% (11)	0.703	0.180
		Air tight Containers	78.4% (87)		
		Left on the tray	3.6% (4)		
		Don’t know	8.1% (9)		
15	Can 1 -2% sodium hypochlorite be used for chemical treatment of biomedical waste?	Yes	71.2% (79)	0.812	0.376
		No	28.8% (32)		
16	Disposal of expired medicines is through?	Return it to the manufacturer	54.1% (60)	0.027*	0.203
		Dispose by Yourself	45.9% (51)		
17	If so, which colour coded bag do you dispose of expired medicines?	Red	11.7% (13)	0.917	0.268
		Yellow	26.1% (29)		
		Blue	19.8% (22)		
		Don't know	42.3% (47)		
18	Are you aware of disposal of incinerated ash generated from biomedical waste?	Secured landfills	82% (91)	0.019*	0.021*
		Dispose as general waste	18% (20)		

*Significant at P < 0.05

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