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Biomedical Waste Disposal: Knowledge, Attitude, and Practice among Dental Practitioners in Tanta City, Egypt

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ABSTRACT: Background: Dental health-care facilities should adopt strict rules and strategies for dental waste management to minimize the risk of transmission of the disease from the dental clinic to the community. Indiscriminate disposal of biomedical waste constitutes a massive risk to the general public health, health care workers, and patients.**Aim:** This study aims to assess knowledge, attitude, and practice among dental practitioners of different dental health sectors in Tanta city, Egypt. Methodology: A cross‑sectional study was conducted in 200 practicing dentists in Tanta city.A self‑structured close-ended questionnaire was used to obtain the required data.**Results:** The level of dental practitioners' awareness of BMW management policies ranged from 82.5% to 96%. Regarding BMW management practices, 90% of dental practitioners were aware of the disposal of various items into different color-coded bags. Dental practitioners of the private dental sector had the lowest correct responses (20%) regarding the disposal of used plastic items. Finally, 81.5% of dental practitioners settled that there should be regular educational programs on biomedical waste management. Also, 80% of them accepted to receive training in any form on BMW **Conclusion**: Based on The results of this study, it can be concluded that despite high awareness level of dental practitioners in Egypt about BMW management policies, proper disposal of contaminated plastic items, impression material, and soiled dressings was not yet accurately implemented by dental practitioners. Also, dental practitioners lacked knowledge regarding the correct practice of safe disposal of excess mercury and treating infectious waste before disposal.

KEYWORDS: Attitude, Practice, Biomedical, Waste, Knowledge, Dentist

I. INTRODUCTION

Recently, the remarkable improvement of dental technology and increased accessibility of dental healthcare facilities have not only enhanced quality of life of the community but also pose a high risk to population health and sharing of environmental degradation due to the creation of a great amount of biomedical waste [1-3].

Biomedical waste (BMW) referred to any waste generated during treatment or immunization of human beings or animals [4]. So, dental waste is a risky division of BMW as dental practices produce large amounts of wastes contaminated with blood and body fluids such as cotton, latex, sharps, extracted teeth, and other materials. Moreover, dental office wastewater contains a high concentration of metal such as mercury, silver, tin, and copper produced from amalgam restoration and X-ray fixer solution [5-7].

According to Nakajima et al., 1996 dental health care facilities generated many types of wastes, the most dangerous types of dental wastes are hazardous and biohazardous waste [8]. Firstly, Biohazardous wastes which contaminated with pathogenic organisms causing transmission ofdiseases such as Hepatitis B, C, and HIV to the individuals handling waste especially in the presence of open wounds [9,10]. Secondly, Hazardous waste which contains metals such as silver, lead, mercury, X‑rays films, and cleaning solutions are toxic and never degrades once they reach the environment [11].

Consequently, every dental health-care facility should adopt strict rules and strategies

for dental waste management to minimize the risk of disease transmission from the dental clinic to the community [12,13]. These rules should be strictly followed at every single level of generation, collection, transportation, storage, treatment, and disposal. Indiscriminate disposal of biomedical waste constitutes a massive risk to the general public health, health care workers, and patients [14,15].

According to the World Health Organization (WHO), developed countries produce up to 0.5 kg of hazardous waste per hospital bed per day. Even though the amount for developing countries is only 0.2 kg per hospital bed per day, healthcare waste is often not divided into hazardous or non-hazardous wastes, so the actual amount of hazardous waste much higher [16]. Resembling many low-income countries, Egypt fights to improve its hospital waste management practices. Although the Environmental Law No. 4 of 1994 was delivered to arrange integrated hospital waste management implementation, authorities are failing to set up efficient systems regarding segregation, collection, transfer or treatment, because of weak legislative enforcement [17].

In Egypt, the elevated awareness about dental treatment among the public increased the number of dental healthcare facilities and the amount of biomedical waste generated together with increasing global awareness about biomedical waste management and associated hazards. Therefore, the present study was conducted to access and compare knowledge, attitude, and practice of biomedical waste disposal among dental practitioners of different dental sectors in Tanta city, Egypt.

II. MATERIAL AND METHODS

Study design

This research was carried out as a descriptive cross-sectional study.

Sample selection

The sample of this study was randomly selected from the dental practitioners in Tanta city who were distributed into four sectors; educational, ministry of health, insurance, and private sector. The sample excluded non-practicing dentists and dentists with an administrative job only [18].

Sample size calculation

The sample size was calculated using the Epi-Info program, version 6, with expected frequency of satisfactory knowledge, attitude and practice score 74% [18] at alpha error = 0.05 and power of the test = 80%. This yielded a sample size of 200 dentists.

According to the proportion of dental practitioners inside each dental health sector, a proportionally weighted sample was taken as follows 80 dentists from the ministry of health, 40 dentists from the faculty of dentistry, 20 dentists from the insurance sector, and 60 dentists from private sectors.

Approval from the Research Ethics Committee, Faculty of Dentistry, Tanta University was secured before the start of the study.Oral consent was gained from participants after clarifying the study objectives and assuring data concealment. To preserve confidentiality, the questionnaire was anonymous and data were kept confidential in a file that could be accessed only by the authors.

Survey tool

Data collection was done with the help of a structured, self-administered, close-ended questionnaire. It was handed to the participants during evening clinic hours. The questionnaire originally developed by Narang RS et al; 2012[19] with some modifications. A pilot study was conducted among a sample of 10 dentists to pre-test the questionnaire to insure reliability and comprehensibility. Cronbachs alpha test showed the reliability coefficient of 0.89 and was found satisfactory for conducting the study.

The pretested questionnaires were included in the final study. The first part of the questionnaire contained questions about the demographic profile of the participants, while the second part evaluated knowledge, Attitude, and Practice (KAP) toward biomedical waste management with sixteen questions. Of the sixteen questions, the first three questions

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assessed dental practitioners' knowledge and attitude regarding BMW management policies. The next eight questions assessed the knowledge of BMW management practices and the last five questions evaluated the participants' awareness and education regarding BMW management.

The questionnaire was administered to the participants by the author with proper instructions. Master chart and coding list were prepared before entering the data and then the collected data was entered into the computer through Microsoft Excel Sheet.

Datawas transferred to SPSS for statistical analysis. A Chi-square test was applied to compare between correct responses obtained from dental practitioners in different dental sectors. P-value ≤ 0.05 was considered statistically significant.

III. RESULTS

The demographic profile of study participants obtained from different dental health sectors of Tanta city showed that (60%) were males and (40%) were female. The majority of dental practitioners (66%) were general practitioners and (34%) were specialists. Among the respondents (56.5%) were practicing forthe past 5 years, (27.5%) were practicing for 6–10 years and (16%) had experienced more than 10 years. (Table 1)

Table1: Demographic profile of the participating dental practitioners

Characteristics		No	Total
Gender	Male	120 (60%)	200
	Female	80 (40%)	
Level of education	BDS	132 (66%)	200
	MDS	59 (29.5%)	
	PHD	9 (4.5%)	
Practicing Since	0-5ys	113 (56.5%)	200
	6-10ys	55 (27.5%)	
	>10ys	32 (16%)	

Table 2 revealed a statistically significant difference in knowledge regarding government guidelines on waste management and waste management policy ($p < 0.05$). The highest correct responses (95% and 96.25% respectively) were found in dental practitioners of the ministry of health. Meanwhile, no difference was found in knowledge concerning the responsibility for the safemanagement of biomedical waste among dental practitioners of different dental health sectors with 96% total correct responses. In general, the level of dental practitioners' awareness of BMW management policies ranged from 82.5% to 96%.

Table2: knowledge and attitude regarding BMW management policies among dental practitioners of different dental health sectors

Survey question		Different Dental Health Sectors						
		Educational (n= 40)	Ministry of health (n= 80)	Insurance (n= 20)	Private (n= 60)	Total (n=200)	$\chi 2$	P-value
guidelines laid down by Government for BMW management	Correct	35 (87.5%)	76 (95%)	14 (70%)	45 (75%)	170 (85%)	20.380	<0.05*
	Incorrect	5 (12.5%)	4 (5%)	6 (30%)	15 (25%)	30 (15%)		
Waste management policy in hospital/clinic	Correct	38 (95%)	77 (96.25%)	18 (90%)	32 (53.33%)	165 (82.5%)	36.52	<0.05*
	Incorrect	2 (5%)	3 (3.75%)	2 (10%)	28 (46.67%)	35 (17.5%)		
Responsibility for the safe management of BMW	Correct	39 (97.5%)	78 (97.5%)	17 (85%)	58 (96.67%)	192 (96%)	2.63	>0.05
	Incorrect	1 (2.5%)	2 (2.5%)	3 (15%)	2 (3.33%)	8 (4%)		

Regarding BMW management practices, 90% of dental practitioners were aware of the disposal of various items into different color-coded bags. However, the difference was not significant

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among different dental sectors (p>0.05). The highest incorrect responses among dental practitioners were found in the disposal of used plastic items, impression material, and soiled dressings (68.5%& 65.5%) respectively.

Table 3: knowledge and attitude on BMW practices among dental practitioners ofdifferent dental health sectors.

Survey question		Different Dental Health Sectors						
		Educational (n= 40)	Ministry of health (n= 80)	Insurance (n= 20)	Private (n= 60)	Total (n=200)	$\chi 2$	P-value
Are different colored bags used?	Correct	36 (90%)	75 (93.75%)	18 (90%)	51 (85%)	180 (90%)	3.54	>0.05
	Incorrect	4 (10%)	5 (6.25%)	2 (10%)	9 (15%)	20 (10%)		
Disposal of plastic item	Correct	15 (37.5%)	27 (33.75%)	9 (45%)	12 (20%)	63 (31.5%)	18.45	<0.05
	Incorrect	25 (62.5%)	53 (66.25%)	11 (55%)	48 (80%)	137 (68.5%)		
Disposal of impression material, soiled dressings	Correct	16 (40%)	24 (30%)	8 (40%)	21 (35%)	69 (34.5%)	4.75	>0.05
	Incorrect	24 (60%)	56 (70%)	12 (60%)	39 (65%)	131 (65.5%)		
Disposal of sharps, needles	Correct	37 (92.5%)	75 (93.75%)	17 (85%)	49 (81.67%)	178 (89%)	7.98	>0.05
	Incorrect	3 (7.5%)	5 (6.25%)	3 (15%)	11 (18.33%)	22 (11%)		
Disposal of extracted teeth, human tissue	Correct	39 (97.5%)	76 (95%)	18 (90%)	52 (86.67%)	185 (92.5%)	6.87	>0.05
	Incorrect	1 (2.5%)	4 (5%)	2 (10%)	8 (13.33%)	15 (7.5%)		
Disposal of excess mercury	Correct	11 (27.5%)	24 (30%)	6 (30%)	11 (18.33%)	52 (26%)	16.42	<0.05
	Incorrect	29 (72.5%)	56 (70%)	14 (70%)	49 (81.67%)	148 (74%)		
Wearing protective barriers during handling of BMW	Correct	37 (92.5%)	76 (95%)	18 (90%)	55 (91.67%)	187 (93.5%)	2.32	>0.05
	Incorrect	3 (7.5%)	4 (5%)	2 (10%)	5 (8.33%)	13 (6.5%)		
treating infectious waste before disposing of them	Correct	15 (37.5%)	34 (38.75%)	13 (65%)	12 (20%)	74 (37%)	20.85	<0.05
	Incorrect	25 (62.5%)	46 (61.25%)	7 (35%)	48 (80%)	126 (63%)		

Of all dental sectors, the dental practitioners of the private dental sector had the lowest correct responses (20%) regarding the disposal of used plastic items and the difference was statistically significant (p<0.05). On the other side, the majority of dental practitioners (93.5%) agreed to wear gloves and mask while handling BMW. (Table3) Furthermore, the correct practice responses of dental practitioners regarding the disposal of contaminated needles and extracted teeth were (89%&92.5%) respectively and the difference was not statistically significant. On the other hand, the correct responses

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concerning the disposal of excess mercury and treating infectious waste before disposal were (26%&37%) respectively and there was a statistically significant difference ($p<0.05$) among the different dental sectors. The dental practitioners of the private sector exhibited the highest incorrect responses (81.76%&80%) among all study participants. (Table3)

Table 4: knowledge and attitude on BMW awareness among dental practitioners of different dental health sectors.

Survey question		Different Dental Health Sectors						
		Educational (n= 40)	Ministry of health (n= 80)	Insurance (n= 20)	Private (n= 60)	Total (n=200)	$\chi 2$	P-value
health hazards with improper waste management	Correct	38 (95%)	78 (97.5%)	19 (95%)	57 (95%)	192 (96%)	5.86	>0.05
	Incorrect	2 (5%)	2 (2.5%)	1 (5%)	3 (5%)	8 (4%)		
Maintained BMW records in your hospital/clinic	Correct	35 (87.5%)	74 (92.5%)	17 (85%)	33 (55%)	159 (79.5%)	32.54	<0.05
	Incorrect	5 (12.5%)	6 (7.5%)	3 (15%)	27 (45%)	41 (20.5%)		
Generation of biomedical waste in hospital/clinic	Correct	34 (85%)	58 (72.5%)	15 (75%)	48 (80%)	155 (77.5%)	2.54	>0.05
	Incorrect	6 (15%)	22 (27.5%)	5 (25%)	12 (20 %)	45 (22.5%)		
regular educational programs on biomedical management needed	Correct	38 (95%)	77 (96.25%)	16 (80%)	32 (53.33%)	163 (81.5%)	30.85	<0.05
	Incorrect	2 (5%)	3 (3.75%)	4 (20%)	28 (46.67%)	37 (19.5%)		
received training on BMW management	Correct	37 (92.5%)	73 (91.25%)	15 (75%)	36 (60%)	161 (80.5%)	36.74	<0.05
	Incorrect	3 (7.5%)	7 (8.75%)	5 (15%)	24 (40%)	39 (19.5%)		

Concerning the education and awareness of BMW, nearly all dental practitioners (96%) agreedthat biomedical waste causes health hazards and 77.5% of them believed that dental clinics generate biomedical waste. However, there was no statistical difference was found between different dental sectors ($p>0.05$).

Moreover, 79.5 of dental practitioners approved that maintaining BMW records in their clinics wasmandatory. Finally, 81.5% of dental practitioners settled that there should be regular educational programs on biomedical waste management. Also, 80% of them accepted to receive training in any form on BMW, which was statistically significant with p-value < 0.05 (Table 4)

IV. DISCUSSION

Nowadays, one of the serious threats to the environment and human health is the haphazard disposal of biomedical waste. so, proper management of biomedical wastes includes active participation and harmonization between governmental and non-governmental organizations, the dental institutions, and the healthcare personnel [20,21].

Egypt as a developing country had a shortage of strong rules and regulations for the segregation and appropriate management of

BMW [15]. Hence this research aimed to assess the knowledge, attitude, and practice of biomedical waste management among a group of dental practitioners in Tanta city to identify the gaps between the current KAP among the health-care workers involved in waste management and the future desired state that should be reached.

This cross-sectional study was conducted on a predesigned and pretested self-administered questionnaire which analyzes the knowledge and attitude regarding BMW management policies, practices, and awareness among dental practitioners. Almost all the questions were of a closed‑end type to avoid any recall bias, easy to analyze, and attain a quicker response from participants.

In this study (60%) of dental practitioners were males and (40%) were female which in the same line with studies done byFarmer GM et al.,1997[9] andRadha Ket al.,2009[3].Also, (66%) were general practitioners and (34%) were specialists in contrast to the study done by Sood AG &Sood A,2011[22]where 47% were graduates and 53% were postgraduates.

Among the respondents of this study (56.5%) were practicing dentistryforthe past 5 years, (27.5%) were practicing for 6–10 years, and (16%) had experienced more than 10 years. This is nearly similar to the study done by Bansal et al.; 2013[23] where 60% of the subjects had the experience of <5 years; 28% had experience <5–10 years and 12% had experience for more than 10 years.

In the present study, the level of dental practitioners awareness about BMW management policies ranged from 82.5%to 96%which is in agreement with the study done by Singh T et al.;2018[21]who assessed the awareness of biomedical waste management in dental students of numerous dental colleges of Nepal and they found that the bulk of the dental students had a positive attitude towards management policies of biomedical waste.

Also, in the same line of our results,the study was done by Sushma MK et al.;2010[24]who evaluated the awareness level of policy related to waste management in private dental clinics in India and They found that a high percentage of dental practitioners were aware of the legislative policy.

In contrast to the present results, Kishore J et al.;2000[25]assessed the awareness level about BMW management between dentists of a teaching hospital, and they revealed that the mainstream of the participant was not aware of the correct clinical waste management regulations. This disparity of results maybe attributed to the different survey sampling methodology and size.

Concerning BMW management practices, the current results showed that 90% of dental practitioners were aware of the disposal of various items into different color-coded bags which agreed with the study done by Narang RS et al; 2012[19]. While only 27.4% of dental practitioners in a study investigated the disposal of dental waste in Bangkok were aware of this practice [26].

In respect to the disposal of used plastic items, impression material, and soiled dressings 65.5%- 68.5% of the participants were unable to respond correctly that the disposal of used plastic items should be in a red-colored bag which agreed with the study done by Bangennavar BF et al., 2015[27]. However, in a study conducted by in Indian hospitals revealed 100% correct responses by all participants. It was returned to the training that the team received in their hospital [28].

Furthermore, the correct practice responses of dental practitioners regarding the disposal of contaminated needles and extracted teeth were (89%&92.5%) respectively which is similar to the result obtained by Arora et al., 2014[29] and unlike the results of the study done by Singh et al., 2012[30]&Asgad A et al.,2014[18]who found that a small percentage of dental practitioners (25.5%) use safety boxes for sharps and needles.

Only 26% of dental practitioners in this study dispose ofthe excess mercury; simply by storing it in a closed container with a photographic fixer to reduce its hazard and facilitate its recycling.This was consistent with the results of done by Osamong et al., 2005[31]and Arora et al., 2014[29].

On contrary, a study by Singh T et al.,2018[21] revealed a maximum awareness

of dental students regarding disposal of mercury (79.8%-97.9%) which may be owed to the detailed explanation of dental amalgam in the subject of dental materials, which is educated during the first year of a dental program.

The present results which is corresponding to the results of Singh T et al.,2018[21]discovered that (93.5%) of dental practitioners were aware of using protective barriers while handling BMW. This illustrated that dentists were aware of dental waste generated in day-to-day dental practices which need special consideration, as they are health hazard items. However, only 37% of dentists be familiar with treating BMW before disposing of them.

Concerning the education and awareness of biomedical waste management, nearly all dental practitioners (96%) agreed that biomedical waste causes health hazards and 77.5% of them believed that dental clinics generate biomedical waste. However, there was no statistical difference was found between different dental sectors ($p>0.05$). Moreover, 79.5% of dental practitioners approved that maintaining BMW records in their clinics was mandatory. In the same line, 81.5% of dental practitioners settled that there should be regular educational programs on biomedical waste management and 80% of them accepted to receive training in any form on BMW, which was statistically significant with p-value < 0.05. Lastly, for the education and awareness of biomedical waste management, it was found that the majority of dental practitioners in different dental sectors of Tanta city had a positive attitude. These results were close to studies done by Radha R et al., 2012[32]; Chaudhari et al., 2015[33] and Malini et al., 2015[34].

V. CONCLUSIONS

Based on the results of this study, it can be concluded that despite the high awareness level of dental practitioners in Egypt about BMW management policies, proper disposal of contaminated plastic items, impression material, and soiled dressings was not yet accurately implemented by dental practitioners. Also, dental practitioners lacked knowledge regarding the correct practice of safe disposal of excess mercury and treating infectious waste before disposal.

It is recommended that dental practitioners should receive intensive educational programs and training in biomedical waste management to improve their practices. The authoritative bodies in Egypt should effectively implement the rules and guidelines with regular audits to improve dental waste management practice.

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