

## **Awareness of Dental Undergraduates, Post Graduates and Dental Practitioners' about Dental and Biomedical Waste Management**

Muhammad Abdullah Kamran, Uzma Zareef, Tauseef Ahmed, Raffat Rasool,  
Nabeel Khan, Mehwash Kashif

**Dr. Muhammad Abdullah Kamran**

Professor, Department of Orthodontics  
Liaquat College of Medicine and Dentistry  
Dar-ul-Sehat Hospital (LCMD, DSH)  
Karachi, Sindh-Pakistan.

**Dr. Uzma Zareef**

Professor, Department of Oral Pathology  
LCMD, DSH, Karachi, Sindh-Pakistan.

**Dr. Tauseef Ahmed,**

Assistant Professor  
Department of Oral Pathology  
LCMD, DSH, Karachi, Sindh-Pakistan.

**Dr. Raffat Rasool**

Assistant Professor  
Department of Forensic Medicine  
Karachi Medical and Dental College  
Karachi, Sindh-Pakistan.

**Dr. Nabeel Khan**

Assistant Professor  
Department of Oral Biology  
Karachi Medical and Dental College  
Karachi, Sindh-Pakistan.

**Dr. Mehwash Kashif** (*Corresponding Author*)

Professor, Department of Oral Pathology  
Karachi Medical and Dental College  
Karachi, Sindh-Pakistan.  
Email: mehwashkashif@gmail.com

**ABSTRACT**

**OBJECTIVE:** To assess undergraduate, postgraduate dental students' and dental practitioners' knowledge regarding the management of dental and biomedical waste and to focus on critical issues such as environment-friendly waste management.

**METHODOLOGY:** A total of 273 participants were recruited from January - June 2019. Through convenience sampling in this cross-sectional study, undergraduate, postgraduate dental students and general dental practitioners from private and public sector dental colleges of Karachi were included. The respondents answered different categories of waste management including biomedical waste rules, waste disposal measures, dental waste types, common dangers of inappropriate waste management, and some particular equipment problems. Data was analyzed on SPSS version 17.00.

**RESULTS:** From 273 (92.8%) completed questionnaires, 217(79.4%) were females. Undergraduate students were 61.9%, (n=169). Almost 64.4 % (n=176) of respondents didn't know about dental waste management rules. Among 75 % (n=205) of respondents, there was a consensus that hospital disposal should be treated by qualified professionals. Only 67.7% (n=185) of individuals surveyed stated that they were familiar with the categories formed by dental waste. Approximately 95.5% (n=260) of respondents recommend workshops and Continuous medical education seminars for waste management. Compared to undergraduate students, postgraduate students had a significantly higher mean score, decreasing the "know-do gap" (p=0.069).

**CONCLUSION:** Among undergraduate dental students and dental practitioners, postgraduates were found to have a greater understanding of the correct methods for disposing of healthcare waste. However, the overall knowledge level of environment-friendly waste management was less than sufficient.

**KEYWORDS:** Disposal of medical waste; Understanding of health, attitudes, practice; Dentistry

**INTRODUCTION**

The health care system is a major profession in Pakistan. It includes various health sectors like medicine, surgery, dentistry, pharmacy, physiotherapy, etc. Waste generated by these health care domains is insufficient quantity<sup>1</sup>. Healthcare waste encompasses all of the garbage that healthcare services, testing services, and research labs generate<sup>1</sup>. Moreover, waste from dispersed resources generated in process of home health care, like dialysis supplies, insulin injections etc. was too incorporated<sup>2</sup>. Approximately more than 80% of hospital waste is not harmful, among which, WHO estimates; about 10% as contagious and remaining 5% is non-infectious. Awareness regarding the proper management of medical and dental waste products, especially infectious ones, is of utmost importance for the proper care of patients, people, and the environment<sup>3</sup>.

Most dental professionals seek to function independently inside their clinics; they must be aware of proper waste management. To fulfill this requirement, it must be taught as part of the dental curriculum during undergraduate clinical training<sup>4</sup>. Improper waste treatment, like hepatitis and HIV infections, results in the aggressive spread of infection. Perhaps it serves as a breeding place for numerous other disease transmission vectors<sup>5</sup>. The spread of such infections from waste from health care presents a danger to people's health as well as to their climate. It is necessary to emphasize the proper management of biomedical waste (BWM)<sup>6</sup>. Only a few studies have been conducted in the last five years regarding waste management in dental practices in Pakistan<sup>7</sup>. Several of these researches highlighted the immediate demand for new education in BWM technologies and suggested techniques regarding proper disposal of biomaterials and radiography waste which may have less effect on the surroundings. Research has been conducted regarding biomedical management awareness and attitudes have also highlighted insufficient knowledge, substantial variance along with the call for education courses<sup>8</sup>.

As a result, this study was designed and carried out to assess undergraduate, postgraduate dental students and dental practitioners' knowledge regarding the management of dental and biomedical waste and to focus on critical issues such as environment-friendly waste management.

**METHODOLOGY**

Cross-sectional research was planned among 273 respondents from January - June 2019 through nonprobability convenience sampling; subjects were recruited for the study. The study was 6 months duration and conducted among undergraduates and postgraduate students and general dental practitioners of Karachi Medical and Dental College and Liaquat College of Medicine and Dentistry, Karachi. The sample size was calculated using Raosoft software with the accepted margin of error of 5%, 95% confidence level, the population size of 930, and response distribution of 50%. After taking informed verbal consent, participants were asked to fill out a closed-ended questionnaire about their knowledge of BWM processes by the researchers. There were five domains in the questionnaire, each of which evaluated different aspects of BWM in dentistry. A research questionnaire was comprised of 25 questions from five areas, such as "ethical aspects of biomedical waste", "stages of waste management", "categories of dental care waste", "common hazards of inappropriate waste disposal" and certain relevant equipment questions" was used to collect data. They were asked to choose the most suitable response and were told that their anonymity was kept confidential.

SPSS program 17.00 (SPSS Inc., Ill., USA) was used to conduct all the statistical analyses. The overall score of the questionnaire was calculated by giving accurate or acceptable responses a value of '1' and erroneous or improper responses a score of '0.' The overall score was compared between the sexes, designations, and qualifications of the participants using the Mann-Whitney U test which gives a comparison to the overall score among sexes, designations, and qualifications of the participants. At 0.05, the p-value was determined to be statistically important.

**RESULTS**

For data analysis, approximately 273 (92.8%) complete questionnaires were chosen. Total 217 (79.4%) were female among the participants. Most of the participants were undergraduate students (61.9%, n=169), while 17.3% (n=49) were postgraduates, and 20.14% (n=55) were general practitioners. Overall, 64.4 % (n=176) of respondents didn't know about dental waste management rules in Pakistan, (**Table I**). Approximately 53.1% (n=145) participants responded that waste can be kept up to 96 hours before disposal, while 19.4% (n=53) reported 12 hours for the waste to be disposed of. Just 9.15 % (n=25) suggested that 48 hours was the highest allowable period for the waste stores. Most respondents (67.0%, n=183) noted that a government-approved collector is responsible for the final disposal of dental wastage. (**Table I**)

**TABLE I: SHOWING AWARENESS OF BIOMEDICAL WASTE MANAGEMENT IN PAKISTAN**

<b>Query</b>	<b>Response</b>	<b>n</b>	<b>%</b>
Awareness of Pakistan's biomedical waste management laws?	Yes	31	11.3
	No	176	64.4
	Not certain	66	24.1
Duration of waste keeping	12 hr	53	19.4
	72 hr	25	9.15
	48 hr	145	53.1
	96 hr	50	0.0
Awareness of the dental waste transportation regulatory body	Yes	18	6.59
	No	72	26.3
	Don't know	183	67.0

The second area (**Table II**) consisted of knowledge about stages of waste management. Approximately (53.8 %, n= 147) perceived that they were sufficiently conscious of the skills needed to manage hospital waste. Among 75 % (n=205) of respondents, recommends that hospital disposal should be treated by qualified professionals. Results regarding awareness regarding proper order of six successful waste management steps revealed that only 42.8% (n= 117) respondents know the proper steps of waste disposal i.e. Collection- Segregation- Storage- Transportation- Disposal.

**TABLE II: KNOWLEDGE OF BIOMEDICAL WASTE MANAGEMENT**

Query	Reaction	n	%
Awareness regarding the handling of hospital waste?	Yes	69	25.2
	No	147	53.8
	Not sure	57	20.8
Biomedical waste handling by trained workers	No	10	3.6
	Yes	205	75
	Can't Say	58	21.2
Awareness regarding proper order of six successful waste management steps?	• Segregation-Collection-Transportation- Storage-Treatment- Disposal	89	30.03
	• Collection- Segregation-Storage- Transportation-Disposal	117	42.8
	• Storage- Segregation-Transportation- Collection-Treatment- Disposal	45	16.4
	• Transportation- Segregation-Collection- Storage-Treatment- Disposal	22	8.0

The information of the different types of waste generated in different dental specialty departments was assessed in the third category (**Table III**). This field was covered by approximately one-third of the questions due to its striking significance and relevance in everyday practice. About 67.7% (n= 185) of individuals surveyed stated they were not familiar with the categories formed by dental waste. The majority of respondents i.e. 48.3%(n=132) consider extracted teeth can be infected or non-infected. Pharmaceutical waste is considered to be the major component of waste management i.e. 64.1 % (n= 175). The majority of respondents (60.4, n= 129) consider a group of second-hand impression materials and cotton as highly contaminated items. Amalgam can be stocked up in common trash was responded by 53.1(n=153) respondents.

Disposal of used sharps can be done in puncture-resistant plastic bags by 53.1 % (n= 145) of respondents. Discarding of developer and fixer solution is majorly poured down the drain after being diluted as responded by 65.5(n=179) respondents. About 58.9% (161) respondents don't know about the disposal of exposed X-ray Films.

**TABLE III: QUESTIONS RELATED TO AWARENESS OF WASTE MANAGEMENT**

<b>Factors</b>	<b>Reaction</b>	<b>n</b>	<b>%</b>
Awareness of different categories of biomedical wastes	Don't know	185	67.7
	Know	88	32.2
Extracted teeth can be categorized into	Infected	100	42.1
	Non-infected	21	7.6
	Both	132	48.3
	Don't know	20	7.3
Disposal of a group of obsolete drugs	Chemical waste	56	20.5
	Pharmaceutical waste	175	64.1
	Cytotoxic waste	27	9.8
	Don't know	15	5.4
Group of second-hand impression materials and cotton	Cytotoxic	10	3.6
	dirty	98	35.8
	contaminated	129	60.2
	Don't distinguish	36	13.1
Amalgam can be stocked up	Place in a common trash can.	115	53.1
	Only airtight containers are allowed.	67	15.3
	Water in an airtight container	49	17.9
	Using the fixer	42	55.9
Disposal of used sharps	A typical bin	26	9.5
	Puncture-resistant plastic bag	145	53.1
	Break the needle and toss it away	95	34.7
	Incineration	7	2.5
Discarding of developer and fixer solution	Both of them end up in the sewer.	8	2.9
	The silver from the fixer is recovered and returned to the source in a designated facility	49	17.9
	Poured down the drain after being diluted	179	65.5
	Others	45	16.4
Disposal of exposed X-ray Films	Stored separately and disposed	96	35.1
	Buried in soil	16	5.8
	Don't know	161	58.9

## ONLINE FIRST

The final group (**Table IV**) consisted of five general information-based questions about the various hazards and the value of waste disposal, which are typically taught in the BDS curriculum. Many of the questions in this section were correctly answered, but the vast majority of respondents (95.2%, n=260) recommend waste management workshops and teaching so that realistic waste management exercises in dentistry schools would be beneficial.

**TABLE IV: THE DANGERS OF INCORRECT BIOMEDICAL WASTE DISPOSAL IN GENERAL**

Query	Answer	n	%
Regarding biomedical waste containers	Should be kept closed	119	43.5
	Should be clean in the open air	45	16.4
	Compatibility according to waste	32	11.7
	Type of container used	77	28.2
Contribution to pollution and disease dispersal	Foul odor, and growth of insects	28	10.2
	spread of Disease	127	46.5
	Both	109	39.9
Disinfection of Lead Aprons	Yes	178	65
	No	29	6.5
	Don't know	66	30.1
Hazardous component of amalgam?	Silver	15	5.4
	Tin and Copper	5	1.8
	Zinc	11	4.0
	Mercury	242	88.6
Recommendations for waste management workshops and teaching	Agree	260	95.2
	Disagree	13	4.7



## ONLINE FIRST

The questionnaire's overall score was determined by assigning a score of '1' for accurate or approved responses and a score of '0' for erroneous replies. **Table V** reveals that the mean total score values for sex, designation, and qualification were not significantly different ( $p=0.413$  and  $p=0.076$ , respectively). Compared to students, postgraduate students had a significantly higher mean score, decreasing the "know-do gap" ( $p=0.069$ ). The response given was that postgraduates spend more time in the hospital.

**TABLE V: DEMOGRAPHIC DETAILS OF STUDY PARTICIPANTS**

Factors	Category	Score			p-value
		n	Mean	$\pm$ SD	
Gender	Women	217	11.70	2.96	0.413
	Men	56	13.96	2.35	
Designation	Undergraduate	169	12.46	2.83	0.069
	Postgraduate	64	15.22	2.74	
	GDPs	40	13.8	2.89	
Qualification	BDS	55	10.58	2.81	0.076
	FCPS/MDS	49	11.17	2.80	
	Undergraduate	169	11.59	3.50	

**DISCUSSION**

According to the results, there are a few gaps in the knowledge of undergraduate dental students, postgraduate students, and general dental practitioners regarding dental healthcare waste management regulations, and awareness<sup>9,10</sup>. However, a limited number of waste management experiments have been conducted at dental schools<sup>11,12,16</sup>.

Those aspects are unfamiliar to dental students and students, and they are not taught as part of the curriculum, so students have no idea what happens to the dental materials they use or the many options for properly recycling or reusing them. Sharps are thrown away in a common container after breaking the needle, which is a big concern and an unsuitable manner to manage sharps, as indicated by around 53.1% of participants in this study's comments. This is similar to other research in which 40% and 58 percent of respondents obtained the same answers, indicating a significant "know-do gap."<sup>17,18</sup>

It is critical to establish fines/penalties for the incorrect disposal of dental healthcare waste on a regulatory level, as well as to teach dental undergraduates about this in their early years of dentistry<sup>20</sup>.

There were a few limitations in this research. Because only dentistry students were recruited, rather than the auxiliary personnel who is the driving force behind the BWM. Program limitations may have been reflected as a disparity in the participants' awareness of the BWM. Dental auxiliary should also be assessed for the knowledge and handling of dental waste. Cross-sectional design and small sample size were also the limitations of the study. It is recommended that further studies should be planned with large sample size and modify study design so that results can be generalized.

The main reason for this is a lack of education, which only addresses the disposal of biomedical waste in the clinical setting and offers little knowledge on the negative environmental consequences of improper disposal as well as modern proper disposal technologies. In comparison to the course, studies have shown that dental practitioners and students would be able to participate in continuing dental education. It resulted that everyone working in the healthcare sector has a responsibility to reduce the risks in society. This can be accomplished by educating students as early as at the undergraduate level, informing them of the most recent advancements in waste disposal, and including the practical application of efficient waste management into the dental curriculum. It is necessary to improve global awareness of proper waste disposal methods and, where possible, the introduction of modern waste recycling methods. The areas of our curriculum that need to be improved have been highlighted in this article, and the need for changes and upgrades have been expressed so that future generations of dentists will minimize the burden of improper Waste management practices in health care have to do with our environment and disease transmission.

It is advised that waste management teaching should be included in the dental curriculum. Dental personnel must also be taught and trained regarding proper and appropriate disposal of biomedical waste. Workshops and courses should be planned to educate people who will prevent harmful effects of waste management. It is also recommended to draw attention to educational syllabus flaws and curriculum which also emphasized eco-friendly management of waste.

## **CONCLUSION**

Among undergraduate dental students and dental practitioners, postgraduates were found to have a greater understanding of the correct methods for disposing of healthcare waste. However, the overall knowledge level of environment-friendly waste management was less than sufficient.

**Ethical permission:** Liaquat College of Medicine & Dentistry, Karachi, letter Dated: 24-12-2018.

**Conflict of Interest:** There is no conflict of interest among the authors.

**Financial Disclosure / Grant Approval:** There was no funding agency.

**DATA SHARING STATEMENT:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions

## **AUTHOR CONTRIBUTIONS**

Kamran MA: Concept, data collection, write-up review

Zareef U: Concept, write-up, data collection

Ahmed T: Data collection, critical review, analysis

Rasool R: Write-up, data collection, analysis

Khan N: Write-up, analysis, data collection

Kashif M: Write-up, analysis, critical review

**REFERENCES**

1. Kumar R, Khan EA, Ahmed J, Khan Z, Magan M, Nousheen N et al. Healthcare waste management (HCWM) in Pakistan: current situation and training options. *J Ayub Med Coll Abbottabad*. 2010; 22(4): 101-5.
2. Ishtiaq P, Khan SA, Haq MU. A multi-criteria decision-making approach to rank supplier selection criteria for hospital waste management: A case from Pakistan. *Waste Manag Res*. 2018; 36(4): 386-94.
3. Organization WH. Management of waste from hospitals and other health care establishments: Report on a WHO meeting. *EURO Rep Stud*. 1985; 97: 1-61.
4. Tenna A, Stenehjem EA, Margoles L, Kacha E, Blumberg HM et al. Infection control knowledge, attitudes, and practices among healthcare workers in Addis Ababa, Ethiopia. *Infect Control Hosp Epidemiol*. 2013; 34(12): 1289-96. doi: 10.1086/673979.
5. Organization WH. Preparation of National Health-Care Waste Management Plans in Sub Saharan Countries. Guidance Manual. Available from: <https://apps.who.int/iris/bitstream/handle/10665/43118/924154662X.pdf>
6. Puri S, Smriti K, Pentapati KC, Singh R, Vineetha R, Tamrakar A. Assessment of Awareness About Various Dental Waste Management Practices Among Dental Students and Practicing Clinicians. *Pesquisa Brasileira em Odontopediatria e Clínica Integrada*. 2019;19.
7. Kumar R, Somrongthong R, Ahmed J. Effect of medical waste management trainings on behavior change among doctors versus Nurses and paramedical staff in Pakistan. *J Ayub Med Coll Abbottabad*. 2016; 28(3): 493-6.
8. Kapoor D, Nirola A, Kapoor V, Gambhir RS. Knowledge and awareness regarding biomedical waste management in dental teaching institutions in India - A systematic review. *J Clin Exp Dent*. 2014; 6(4): e419-24.
9. Abhishek KN, Supreetha S, Varma Penumatsa N, Sam G, Khanapure SC, Sivarajan S. Awareness-knowledge and practices of dental waste management among private practitioners. *Kathmandu Univ Med J*. 2016; 14(53): 17-21.
10. Organization WH. United Nations Environment Programme / SBC. National Health-Care Waste Management Plan - Guidance Manual. Fundamentals of health-care waste management. Available from: [https://www.who.int/water\\_sanitation\\_health/medicalwaste/en/guidancemanual1.pdf](https://www.who.int/water_sanitation_health/medicalwaste/en/guidancemanual1.pdf).
11. Dhanya RS, Betur AP, Bulusu A, Adarsh VJ, Koshy PV, Pinto B. Management of biomedical waste in dental clinics. *Int J Oral Care Res* 2016; 4:288-90.
12. Kahar AR, Arora A, Radke U, Joshi J. Assessment of awareness regarding biomedical waste management among students and interns of dental institute. *Indian J Multidiscip Dent* 2017; 7(2): 65-70.
13. American Dental Association. Best management practices for amalgam waste. *J Okla Dent Assoc*. Summer 2004; 95(1): 28.
14. Ranjan R, Pathak R, Singh DK, Jalaluddin M, Kore SA, Kore AR. Awareness about biomedical waste management and knowledge of effective recycling of dental materials among dental students. *J Int Soc Prev Community Dent*. 2016; 6(5): 474-9.
15. Oregon Dental Association. The Environmentally Responsible Dental Office: A Guide to Best Management Practices of Dental Wastes. 2008; 1-12. Available from:

- <https://www.eugene-or.gov/DocumentCenter/View/4978/Best-Management-Practices---Dental-Offices>
16. Arora S, Mittal S, Dogra V. Eco-friendly dentistry: Need of future. An overview. *J Dent Allied Sci.* 2017; 6: 22-7.
  17. NHS UK. (HTM 07-01) Management of disposal of healthcare waste. 2013. Available from: <https://www.england.nhs.uk/publication/management-and-disposal-of-healthcare-waste-htm-07-01/>.
  18. Prouse RE, West AA, King DA, Poulson R. Method of making paper from water-insoluble alginate fibers and the paper produced. Available from: <https://patentimages.storage.googleapis.com/f6/62/5b/0fc32fd621bca1/US4104115.pdf>.
  19. Lakshmikantha R, Kanyadara J, Bullappa D, Vanishree N, Prasad KSK, Naveen N et al. To assess the knowledge, level of awareness, and attitude on biomedical waste management among practicing dentists in Bengaluru city: A cross-sectional study. *CHRISMED J Heal Res* 2016; 3(3):161-7.
  20. Ladia S, Gupta N. Effectiveness of training program related to infection control and waste management practices in a private dental college, Pune - A quasi-experimental study. *J Indian Assoc Public Heal Dent* 2017; 15(1): 4-7.