



Knowledge Assessment of Biomedical Waste Management of Dental Materials in Dakshina Kannada

Vishal Tatiya S.¹  Shilpa Dandekeri¹ 

¹Department of Prosthodontics and Crown and Bridge, AB Shetty Memorial Institute of Dental Sciences, NITTE (Deemed to be University), Mangalore, India

Address for correspondence Shilpa Dandekeri, MDS, Department of Prosthodontics and Crown and Bridge, AB Shetty Memorial Institute of Dental Sciences, NITTE (Deemed to be University), Mangalore, India -575018 (e-mail: drshilpadandekeri@nitte.edu.in).

J Health Allied Sci^{NU} 2023;13:222–227.

Abstract

Aims and Objective The present survey was done to assess the knowledge, awareness, and practice of undergraduate students, postgraduate students, and practitioners about disposal of common biomedical wastes and materials used in dentistry regularly.

Materials and Methods The survey (23 questions) was conducted on 162 participants categorized as undergraduates ($n=54$), postgraduates ($n=54$), and practitioners ($n=54$) to assess their knowledge, awareness, and practice.

Results When questioned whether they were aware of disposal of waste according to color categories, 69.8% were aware of it, 2.5% were not, and 27.8% were not sure of the color-coded categories. When subjected to statistical analysis, the data were found to be statistically significant ($p=0.017$). Only 58% were aware that the number of categories of biomedical waste management is divided into four categories based on new regulations. There was statistical significance between the scores of undergraduates and practitioners ($p=0.046$).

Conclusion There is a gap between knowledge and implementation of segregation of waste at source; certified carrier service should make sure all the wastes are segregated from the dental practitioner's premise with an update on dental materials segregation for dental clinics and laboratories. Frequent updates of biomedical management of waste rules should be performed by the certified carrier.

Keywords

- ▶ biomedical and dental materials
- ▶ waste management
- ▶ dental waste

Introduction

In the field of dentistry, where the patients are led from diagnosis to treatment daily, a large amount of waste is produced that has to be disposed of. The waste produced commonly includes cotton, plastic, latex, sharps, extracted teeth, amalgam particles, waste mercury, fixers, developers, X-ray film packets, discarded and unused medicines, chem-

icals, papers, plasters, metal and acrylic prosthesis, head caps, mouth mask, soiled cotton, bibs, etc.¹ Waste management should be done by the institution or the occupier who has control over the premise or the clinic should make sure the waste produced is segregated and treated before disposal. The Ministry of Environment and Forests notified the “Biomedical Waste (management and handling) Rules, 2016.” Under these rules (Rule 4) of responsibility, the

article published online
July 12, 2022

DOI <https://doi.org/10.1055/s-0042-1750821>.
ISSN 2582-4287.

© 2022. The Author(s).

This is an open access article published by Thieme under the terms of the Creative Commons Attribution License, permitting unrestricted use, distribution, and reproduction so long as the original work is properly cited. (<https://creativecommons.org/licenses/by/4.0/>)

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

occupier of the health care facility organizing the outreach activities is totally responsible for ensuring that waste generated during such activity is properly segregated, collected, treated, and disposed of as per Biomedical Waste Management Rules, 2016.² It should be noted that these wastes should be treated within 48 hours. Students and professionals are educated on these aspects but are rarely updated, and adherence to these protocols is not strict because of their lack of detailed knowledge.

Annually, in India, waste of around 0.33 million tons is generated, which poses a threat to the general public and the environment. These wastes might actively be a part of the spread of viral and bacterial infection. As health care professionals, we know the wastes released are potentially infectious and hazardous. These materials, if not discarded properly, may pose a serious health hazard to humans and can be harmful to the environment.³

Managing this waste by health care professionals is of utmost importance, as the concentration of this waste is increasing with the increase in population and treatment demands. As dentists, we use a lot of materials that are discarded later and the best way to manage waste is to segregate at the source as it would aid in segregation in an ordered manner.

The present survey was done to assess the knowledge of undergraduate students, postgraduate students, and practitioners about disposal of common biomedical wastes and materials used in dentistry regularly.

Methodology

Ethical Clearance

Ethical clearance was obtained from institutional ethical clearance board.

Sample Selection

A cross-sectional survey was conducted among undergraduate students, postgraduate students, and practitioners in and around Dakshina Kannada from May 2020 to December 2020.

A closed-ended, self-administered questionnaire was prepared to assess the knowledge and practices of the participants regarding waste management of materials used in dentistry.

The survey was conducted on 162 participants based on sample size estimation done by G* Power software with 5% level of significance, 80% power, and 0.8 effect size.

Participants were categorized as undergraduates ($n = 54$), postgraduates ($n = 54$), and practitioners ($n = 54$). The inclusion criteria were set as undergraduates who were in their third or fourth academic year or internship, postgraduates, and practitioners in and around Dakshina Kannada. Exclusion criteria were limited to undergraduates who were in their first or second academic year.

Participants who gave written consent were included in the study. The survey was done to assess their knowledge (23 questions) in terms of the number of categories of disposal

according to new regulations, management of each category of disposal, and disposal of regularly used dental materials into the appropriate bag.

Statistical Analysis

Data obtained were entered in software, and statistical analysis was done using SPSS™ software (version 20.0) (SPSS Inc., Chicago, IL, USA). Categorical data were associated using the chi-square test. Overall scores were compared between the three groups using one-way analysis of variance (ANOVA) and the Bonferroni multiple comparison test. A p -value < 0.05 was considered significant.

Results

A total of 162 participants were included in the study, of which 54 were undergraduates, 54 were postgraduates, and 54 were practitioners.

When the participants were questioned if they were aware of the biomedical waste management categories, 87.7% of the participants were aware of the categories, 4.3% were not, and 8% were not sure of the categories.

When asked if they were aware of disposal of waste according to color categories, 69.8% were aware of it, 2.5% were not, and 27.8% were not sure of the color-coded categories. When subjected to statistical analysis, the data were found to be statistically significant ($p = 0.017$) (► **Table 1**).

The participants were asked whether they were aware of the number of categories of biomedical waste management based on new regulations; only 58% were aware that it is divided into four categories.

When the participants' data were subjected to statistical analysis through one-way ANOVA, the statistical data were found to be significant with a p -value of 0.049. When the data were subjected to post hoc tests between the groups, there was statistical significance between the scores of undergraduates and practitioners ($p = 0.046$). The scores between postgraduates and practitioners and postgraduates and undergraduates were not significant statistically. (► **Table 2**).

Assessment of the participants' inputs for the cross-sectional study based on knowledge, awareness, and practice of dental materials used during dental treatment is presented in ► **Table 3**.

Discussion

The continuous generation of waste from dental hospitals, laboratories, and clinic is never-ending and the aim of the concerned laboratories, hospitals, and clinics should be to dispose of this waste at source. Dental wastes are potentially harmful to the environment and require specific treatment and management before their final disposal.⁴ Dental clinics and laboratories generate a huge amount and range of waste—from material waste to human anatomical waste, cotton swabs, gloves, etc.

With 162 participants equally distributed among three groups of undergraduates, postgraduates, and practitioners,

Table 1 Awareness of participants if they are familiar with the disposal of waste according to color

			Are you familiar with the disposal of waste according to color?			Total	p-Value
			1	2	3		
Educational status	Postgraduate	Count	36	0	18	54	0.017
		% within educational status	66.7%	0%	33.3%	100%	
	Undergraduate	Count	41	4	9	54	
		% within educational status	75.9%	7.4%	16.7%	100%	
	Practitioner	Count	36	0	18	54	
		% within educational status	66.7%	0%	33.3%	100%	
Total		Count	113	4	45	162	
		% within educational status	69.8%	2.5%	27.8%	100%	

Table 2 Post hoc tests

Bonferroni multiple comparisons					
Dependent variable: scores					
(I) Educational status	(J) Educational status	Mean difference (I - J)	p	95% confidence interval	
				Lower bound	Upper bound
Postgraduate	Undergraduate	0.537	1.000	-0.92	2
	Practitioner	-0.944	0.360	-2.41	0.52
Undergraduate	Postgraduate	-0.537	1.000	-2.00	0.92
	Practitioner	-1.481 ^a	0.046	-2.94	-0.02
Practitioner	Postgraduate	0.944	0.360	-0.52	2.41
	Undergraduate	1.481 ^a	0.046	0.02	2.94

87.7% of the participants were aware of the biomedical waste categories and 69.8% of participants were aware of the waste disposal according to color but only 47.5% of the participants practiced disposal of waste at source effectively. This gap in knowledge and implementation of waste management risks the lives of others.

When the participants were asked "Based on new regulations of biomedical waste management waste are segregated into how many categories," overall 58% answered four categories, followed by 26.5% who answered 10 categories, which indicates that the knowledge that was instilled from books in dental school has not been updated and the remaining answers indicated they were not aware of the categories.

The gap in knowledge update could be assessed from **Fig. 1** and **Fig. 2** where around 87.7% participants agreed that they were familiar with categories of biomedical waste management but only 58% of them knew that segregation of waste is done according to four color categories and 26.5% of them chose it is according to 10 categories.

Categories in biomedical waste management are mainly focused on hospital wastes and human anatomical wastes,

and in dental clinics and hospitals, rules and amendments are clear only about human anatomical wastes, soiled cotton, gloves, etc., but unclear about materials used extensively in dental clinics and laboratories. Even certified waste carrier services have little information regarding the material disposal used in dentistry such as plaster, rubber dams, retraction cords, acrylic, elastomeric impression material, and alginate.

Pullishery et al⁵ stated that segregation of waste at hospitals is not done judiciously and also found that the knowledge of color-coded category is more among nurses and laboratory staffs compared with doctors.

Understanding the process of management of each category helps in the segregation of waste at the source. Yellow category wastes are disposed of in yellow color nonchlorinated bags. These bags undergo either incineration or pyrolysis, after which the residues are autoclaved and stored by deep burial. The liquid wastes that fall in this category are pretreated before discharging with another wastewater. Expired medicines are sent back to the company where they are incinerated at >1,200°C.⁶

Red category waste usually consists of rubber or plastic wastes that cannot be incinerated; these wastes are stored in

Table 3 Assessment of the participants' inputs for the cross-sectional study based on knowledge, awareness, and practice of dental materials used during dental treatment

Q. No.	Question	Correct answer	Correct answer %
1.	Based on new regulations of biomedical waste management, waste are segregated into how many categories?	4	58%
2.	Yellow disposal bags are managed by	Incineration/pyrolysis, autoclaving→ deep burial Chemical treatment and discharge into drains for liquids and secured landfills for solid	11.7%
3.	Red disposal bags are managed by	Autoclaving, shredding→secured land filling/deep burial	20.4%
4.	White disposal bags are managed by	Autoclave, shredding, mutilation→recycle	19.8%
5.	Blue cardboard box are managed by	Autoclave, or chemical disinfection→ recycle	50.6%
6.	Puncture-proof bags for sharps and metal objects fall under which category of regulations of biomedical waste management?	White	43.2%
7.	Mouth masks and disposable head caps to be discarded in	Yellow nonchlorinated bag/container	59.9%
8.	Cotton, gauze, and suture materials are discarded in	Yellow nonchlorinated bag/container	62.3%
9.	Sharps such as needles, suture needles, and bard parker blades are discarded in	Translucent puncture-proof bags/container: white category	63.6%
10.	Alginate impression materials are discarded in	Yellow nonchlorinated bag/container	42%
11.	Elastomeric impression materials are discarded in	Red nonchlorinated bag/container	42%
12.	Rubber dams are discarded in	Red nonchlorinated bag/container	40.7%
13.	A fixed prosthesis, which includes porcelain fused to metal crowns, and metal crowns are discarded in	Translucent puncture proof bags /container: white category	14.8%
14.	Gypsum products, which include casts, gypsum bonded investment materials are discarded in	Yellow nonchlorinated bag/container	46.9%
15.	Cast partial dentures are discarded in	Translucent puncture proof bags/container	22.8%
16.	Greenstick, impression compounds, and wax are discarded in	Yellow nonchlorinated bag/container	37.7%
17.	Local anesthetic bottles and ampules to be discarded in	Cardboard box with blue marking	29%
18.	Soft and hard splints to be discarded in	Red nonchlorinated bag/container	48.1%
19.	Retraction cords to be discarded in	Yellow nonchlorinated bag/container	49.4%
20.	Metallic implants are discarded in	Cardboard box with blue marking	48.8%
21.	Disinfection solution and developer solutions that are discarded in containers falls under which category of waste management?	Yellow	43.8%
22.	Expired or discarded medicines fall under which category?	Yellow	36.4%
23.	Discarded acrylic prosthesis is discarded in	Red	45.7%

nonchlorinated bags and are treated by autoclaving or microwaving, which is followed by shredding or mutilation, which can be a combination of sterilization and shredding. This treated waste is sent for recycling and reusing and plastics to be used in road making.⁶

White category waste is stored in translucent containers, which are puncture- and leak-proof. These wastes undergo autoclaving, dry heat sterilization followed by shredding/ mutilation, or encapsulation and stored in a concrete pit.⁶

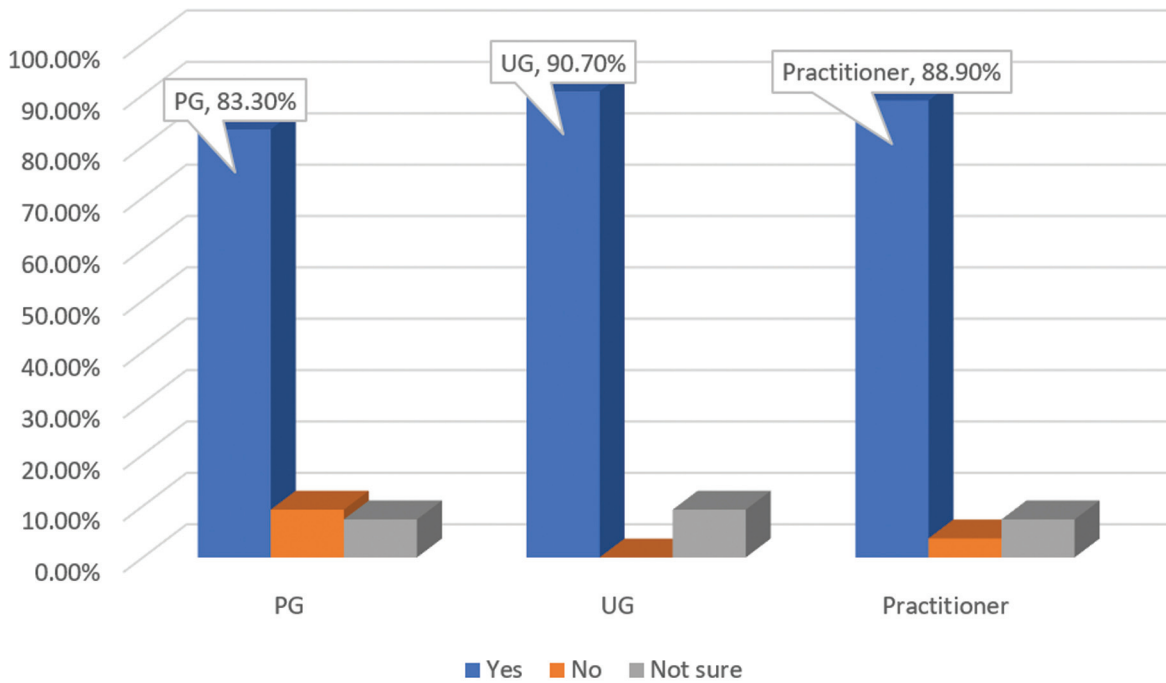


Fig. 1 Awareness among different groups on biomedical waste categories.

Blue category waste includes glassware and metallic body implants (includes dental implants) stored in blue color-marked cardboard box. They are managed by autoclaving or chemical disinfection after which they are sent back to companies for recycling.⁶

Care should be taken by the assistants at the clinics and laboratories to dispose of waste accordingly. A cross-sectional study published by Rao et al⁷ with participants that included doctors, postgraduates, staff nurses, laboratory technicians, and housekeeping staffs in a tertiary care teaching hospital in Mysuru, Karnataka, stated the presence of

facet in knowledge among the participants, and even though the knowledge about biomedical management of waste (BMW) was good among doctors, practicality was more among the nurses and laboratory technicians.

Mahajan et al⁸ stated that there is a lack of knowledge and training of the professionals in the disposal of biomedical wastes and suggested Continuing Dental Education (CDE) programs frequently to keep the concerned people updated with new rules and amendments.

Bhalla et al⁹ stated that inadequate knowledge regarding disposal of waste in the appropriate color-coded bin is

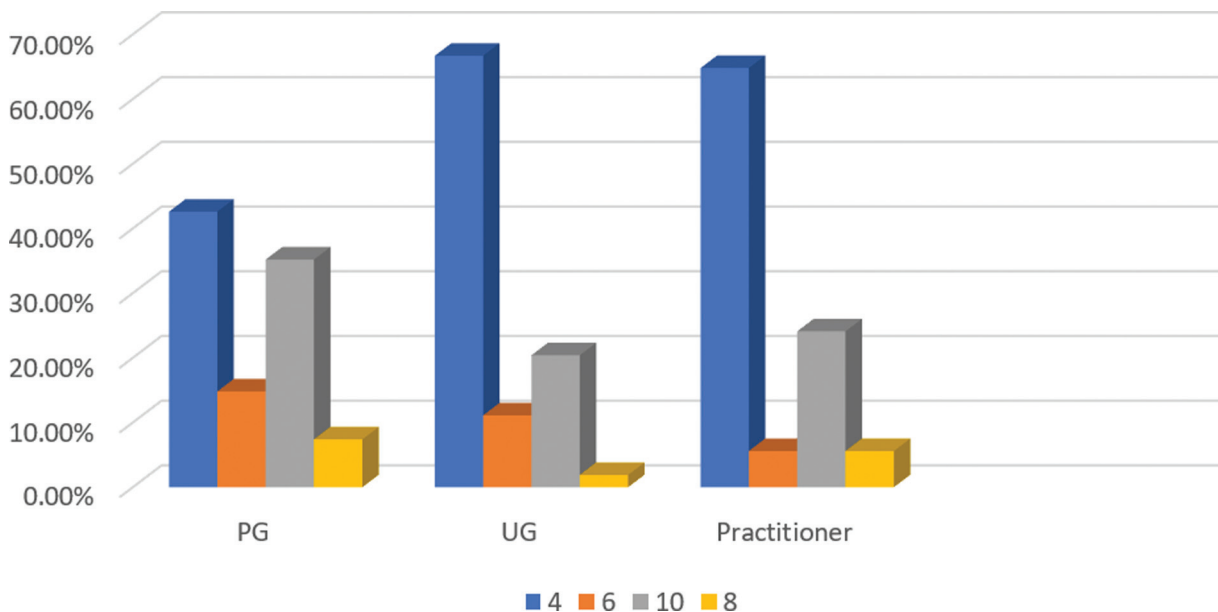


Fig. 2 Response on number of categories of biomedical waste segregation by different groups.

prevalent among supporting and paramedic staff at a much lower level and highlighted the necessity of frequent and continuous training.

Conclusion

With most of the literature focusing only on materials used daily in hospitals, very little is mentioned about dental materials used in clinics and dental laboratories. There is a gap between knowledge and implementation of segregation of waste at source; certified carrier service should make sure all the wastes are segregated from the dental practitioner's premise with an update on dental materials segregation for dental clinics and laboratories. Frequent updates of BMW rules should be performed by the certified carrier service and knowledge assessment carried out to make sure the clinics and laboratories are implementing waste disposal with updated knowledge as set by the ministry of the country.

Funding

None.

Conflict of Interest

None declared.

Acknowledgment

We thank NITTE (Deemed to be University), AB Shetty Memorial Institute of Dental Sciences (ABSMIDS).

References

- 1 Bindra S, Mehrotra N, Chaudhry K, Nagpal K. A study on management of dental health care waste: Hyderabad experience. *IOSR J Dent Med Sci* 2015;14:98–102
- 2 Central Pollution Control Board. Guidelines for Management of Healthcare Waste as per Biomedical Waste Management Rules, 2016. Available at: https://cpcb.nic.in/uploads/Projects/Bio-Medical-Waste/Guidelines_healthcare_June_2018.pdf
- 3 Palwankar PV, Singh A. Safety and measures for auxiliary staff associated with hospital waste disposal. *Indian J Dent Sci* 2012;4(01):104–106
- 4 Dash K, Das M, Satapathy NK. Assessment of knowledge, attitude, and practices about biomedical waste management among nursing professionals in a tertiary care hospital, Bhubaneswar, Odisha. *Eur J Mol Clin Med* 2021;8(03):1127–1142
- 5 Pullishery F, Panchmal GS, Siddique S, Abraham A. Awareness, knowledge and practices on bio-medical waste management among health care professionals in Mangalore-A cross sectional study. *Int Arch Integr Med* 2016;3(01):29–35
- 6 Datta P, Mohi GK, Chander J. Biomedical waste management in India: Critical appraisal. *J Lab Physicians* 2018;10(01):6–14
- 7 Rao D, Dhakshaini MR, Kurthukoti A, Doddawad VG. Biomedical waste management: A study on assessment of knowledge, attitude and practices among health care professionals in a tertiary care teaching hospital. *Biomed Pharmacol J* 2018;11(03):1737–1743
- 8 Mahajan S, Kumar S, Kadashetti V. Knowledge attitude and practices of biomedical waste management among dental practitioners in Karad City Maharashtra, India. *Indian J Public Health Res Dev* 2020;11(02):30–33
- 9 Bhalla GS, Bandyopadhyay K, Pandey C, Anand N, Gupta S. Keeping in pace with new biomedical waste management rules: Assessing the knowledge, attitude, and practices of health-care workers of a tertiary care hospital in north India. *Med J DY Patil Vidyapeeth* 2021;14(06):662–667