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Issues and Challenges of Biomedical Waste Management Practices in Dental Healthcare: An Institutional Study

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Abstract

Background: *Biomedical waste management (BWM) in dental institutions is a crucial public health concern due to the risks associated with improper waste disposal. However, infrastructural limitations, inadequate training, lack of expertise, and financial constraints often hinder effective management. This study aimed to identify and evaluate the challenges associated with BWM in dental healthcare institutions and propose practical recommendations for improvement.*

Methods: *A mixed-methods approach was adopted. The qualitative component included a thorough review of existing literature and in-depth interviews with healthcare professionals and support staff to understand current practices and perceived challenges. The quantitative component involved a nationwide survey targeting dental institutions in India, focusing on departmental waste management practices and difficulties encountered. Statistical analyses, including analysis of variance (ANOVA) and Welch tests, were performed to assess variations in types of biomedical waste across different departments.*

Results: *The study classified the various types of biomedical waste generated in different departments. For instance, the Department of Oral Surgery primarily generates extracted teeth and post-operative tissues, while the Department of Oral Medicine & Radiology produces lead aprons and radiographic films. Significant inter-departmental variation in waste types was observed (P-value<0.05). Key challenges included limited infrastructure, ambiguous regulatory guidelines, lack of training, and cultural or administrative barriers. Interviews revealed limited awareness among staff regarding waste segregation and transport, indicating the need for more effective training initiatives.*

Conclusions: *A comprehensive and practical approach is essential for enhancing BWM in dental institutions. Improvements in infrastructure, increased financial support, and structured training programs are critical to ensuring effective and sustainable waste-handling practices.*

Keywords: Biomedical waste management, Challenges, Practices, Dental institution.
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Introduction

Biomedical waste management (BWM) in dental healthcare institutions plays a fundamental role in ensuring the safety of healthcare personnel, patients, the general public, and the environment.[1] The nature of dental practice involves the routine generation of biomedical waste, including sharps, human and animal tissues, infectious materials, pharmaceuticals, chemicals, and pathological waste.[2] Effective management of such waste requires a systematic approach involving appropriate segregation, handling, storage, transportation, treatment, and disposal processes.[3]

Compliance with legal and regulatory frameworks is a mandatory requirement for all dental institutions. Regulatory bodies such as the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) have established guidelines aimed at minimizing the risks associated with biomedical waste.[4] In addition to these federal guidelines, institutions must also adhere to state-specific regulations that may outline specific standards for waste segregation, labelling, storage, and documentation.

Proper training of healthcare personnel in waste management procedures is essential. All staff must be capable of correctly identifying and managing different categories of biomedical waste.[5–7] Moreover, institutions are encouraged to incorporate waste minimization strategies, including the reuse and recycling of materials where appropriate, thereby contributing to responsible and sustainable waste management practices.[7] Maintaining detailed records of waste generation, treatment, and disposal is also necessary to ensure regulatory compliance. These records serve as an important audit trail and assist in verifying that appropriate procedures are being followed [8–10]

Despite existing guidelines, many dental healthcare institutions continue to face challenges in implementing effective BWM. Among the most prominent issues are insufficient training and awareness among staff, leading to unsafe disposal practices.[7] Additionally, the lack of adequate infrastructure, such as storage and treatment facilities, further hampers the implementation of proper waste management systems. Regulatory compliance may also prove difficult in regions with limited resources or overly stringent legal requirements.[9,10]

This study seeks to assess the current BWM practices within dental healthcare institutions, with particular attention to identifying the barriers that hinder their effective implementation. A mixed-methods approach has been adopted, comprising a review of existing literature and qualitative interviews with dental professionals and auxiliary staff. The goal is to provide a comprehensive understanding of the challenges faced and to propose practical solutions for improving waste management systems in dental settings.

Numerous authors have explored BWM in dental healthcare settings, including the types of waste produced by various dental departments. A summary of selected studies is presented in Table 1.

Table 1. Literature review on BWM in dental healthcare

Title	Methodology	Findings	Suggestions	Reference
Bangladesh's Sustainable Development via Eco-Friendly Bio-Medical Recycling	This study is empirical research based on surveys. The primary objective of the research is to understand the current state of environmentally friendly biomedical waste management technological practices for Bangladesh's sustainable growth.	The findings showed that incineration is sometimes performed and that dumping is Bangladesh's most prevalent method of handling biomedical waste. Research from past and current work on sustainable development goals (SDGs) shows that this system has a significant role in transmitting illnesses and environmental harm. Additionally, those managing biomedical waste (nurses, sweepers, and cleaners) must gain appropriate expertise in environmentally acceptable waste management.	If the government and healthcare institutions started various educational programmes like workshops, training, etc., for the staff, educating and enhancing their learning and expertise would be simple.	(6)
Practising dental practitioners should handle biological and dental waste safely in light of the COVID-19 pandemic.	The questionnaire was delivered to participants in both paper and digital versions. Descriptive analysis was done for the category and numerical variables. The relationship between dental professionals' knowledge and waste disposal practices was examined using the Spearman correlation test.	Before aerosol treatments, 71.63% of participants practised PCR tests. The COVID-19 outbreak, according to 88.65% of individuals surveyed, has increased the expense of safe practices and dental disposal.	It is suggested that the governing authorities amend and firmly enforce the rules and regulations while keeping COVID-19 in mind.	(7)
Dental practice's significant environmental effect and the handling of biomedical waste: A viewpoint	A technique for measuring continuous improvement is the Plan–Do–Check–Act (PDCA) cycle, which has four stages: plan, do, check, and act. Consequently, the auditors may assess the organisation's understanding of environmental laws and the formulation of the environmental objectives and practices necessary to achieve the intended outcomes.	Alternative waste management practices and cutting-edge technologies, such as artificial intelligence and robotics applications, when carrying out BWM methods in developing countries, considerations used in numerous developed nations must be considered.	The need to ensure appropriate medical waste audits in all healthcare organisations cannot be overstated.	(8)
Evaluation of Clinics' Staff Members' Medical Waste Management Understanding, Attitude, and Practice	Data were gathered using face-to-face interviews in cross-sectional research developed using a sample of 344 respondents drawn from 172 clinics using stratified random sampling.	The vast majority of those polled (87.2% female) had attended at least a single educational course on handling medical waste, and 36.9% were between the ages of 20 and 29. They had over five years of work experience, 52.0%, and 51.2% of the respondents were female. *The total results (89.5%, 91.9%, and 92.2%, respectively) for knowledge, attitude, and practice were relatively high.	It is recommended that further exploration be undertaken to increase the engagement of male respondents in the survey, as well as those in the age group of 30 and above with less than five years of work experience and no training courses on managing medical waste.	(9)

Current procedures and potential future developments for biological waste management in Ayurvedic hospitals	Three Ayurveda colleges, ten Government hospitals, twenty large private hospitals, and 35 Ayurveda clinics provided data that was utilised to determine the types of wastes produced, the quantity produced, and the disposal methods employed.	Ayurveda biological waste is now disposed of through landfills, incinerators, and sewage/drains. However, there are advantages and disadvantages to these approaches. Our examination has uncovered several intriguing topics for further study, including the sensible use of bioremediation methods in managing biomedical waste and using efficient microorganisms and solar energy for trash disposal.	The execution was terrible, even if the SOPs and norms were standardised. The hospital staff, including the medical and paramedical staff, violated the rules of separating waste at the source.	[10]
A cross-sectional quantification study evaluated healthcare workers' medical waste management expertise, attitudes, and practices at a tertiary institution in Botswana.	This self-administered survey was utilised in cross-sectional quantitative research with 703 participants. SAS software was used to analyse the data. Every step of the data-collecting process included the use of descriptive statistics. Nonparametric tests were used to examine the respondents' attitude responses.	Most respondents (4.43 out of 5) agreed that healthcare waste should be segregated at the point of generation. A colour-coding system was implemented by the healthcare facility, according to a majority of those polled (mean score=4.59), who also identified healthcare workers' (HCWs) lack of understanding of the hazards of poor waste disposal as the biggest impediment to medical waste management (MWM).	To improve compliance, HCWs should receive ongoing training on MWM, focusing on regulatory obligations and their participation in creating MWM policy.	[5]
Policies for handling and disposal of healthcare waste in the Kumbo East and Kumbo Western health districts	A qualitative cross-sectional study was done in 30 of the 52 health care facilities (HCFs) in the research region. Participating HCFs were chosen randomly, whereas staff members were chosen through convenience sampling. P-values under 0.05 were considered significant for collecting data via questionnaires, interviews, and direct field observations; SPSS V 17.0 was used for the analysis. Administrators made up the majority of participants (66.7%) who were aware of a national policy manual for waste management.	Regarding the category of persons, there was no statistically significant knowledge difference. Of an NPG (P-value=0.134). Community health facility employees comprised the majority of individuals who knew of an NPG (66.7%), followed by staff from confessional health institutions (45.1%), and the least number of people came from public health facilities.	Because of the distances between certain healthcare institutions, including a representative sample of waste handlers in the research, it was impossible, since some departed the facilities as soon as their morning cleaning duties were through.	[11]
Review of Private Hospitals' Medical Waste Management	A questionnaire-based survey was conducted among nine hospitals that were visited.	These variations can be attributed to the state and capacity of the hospital, the type and calibre of medical services provided, the equipment's quality, the hospital's location, the variety of hospital departments—such as surgery, general, and so forth—the number of patients, the use of disposable materials in the laboratory, and hospital waste management—particularly the sorting, recycling, reusing, and cleansing of infectious wastes.	The hospital's handling of waste was graded negatively regarding division, gathering, transport, short-term storage, and training, but good treatment.	[12]

Evaluation of medical staff members' knowledge of and behaviour regarding managing medical waste at Nairobi's Kenyatta National Hospital.	Two hundred forty-four medical professionals from the casualty, orthopaedic, and general surgery departments, including physicians, nurses, and support workers, were chosen using simple random selection. For quantitative data, they were given structured questionnaires.	The incinerator of Kenya's largest hospital, KNH, burns trash. Two hundred twenty-five tonnes of polythene bags and plastics, including PVC, are produced daily in Nairobi. They are recycling 1%. Kenyans burn garbage. Most research participants thought incineration was harmless. Near Dandora, Nairobi incinerators discharge dioxin-rich bottom ash. 28% of municipal solid garbage cadmium and 32% of hazardous lead come from plastics. Seventy local recyclers recycle 150 industry plastics.	Therefore, additional training is required to manage medical waste appropriately. Additionally, since doctors oversee most hospital departments, they should take the lead in demonstrating awareness of these crucial elements of medical waste leadership.	(13)
Management of medical waste in Kuwaiti private hospitals	A questionnaire-based survey was done among two major private hospitals	Based on the results, local healthcare waste management (HWM) may be improved. Consider the following to create a sensible waste management system for Kuwaiti medical facilities.	Meetings between administrative and maintenance staff involved in waste management should be held regularly to address technical or practical problems and provide infirmary- and region-specific solutions.	(14)
Comparison of Staff Perceptions and Hospital Waste Management Practices in the UK and Libya about Recycling	The final surveys were developed by taking their opinions into account. These were dispersed randomly in 3 similar HCFs in Libya and two previously chosen hospitals in the UK. Four hundred fifty-three questionnaires in all were returned.	According to the report, underfunded hospitals should recycle and construct infrastructure. In underdeveloped nations, the handling of medical waste should be taught. Hospital trash disposal practices in developed and emerging nations may be altered due to new waste management technology, including domestic waste recycling.	The findings indicated that it is challenging to forecast hospital staff members' attitudes towards recycling. However, employees who had received waste management training were more in favour of recycling than those who had not.	(15)
Iranian dentists' adherence to oral radiology safety requirements	700 of 1000 Iranian Dental Association 48th Annual Congress attendees submitted questionnaires. Participants were questioned about demographics, primary radiation protection knowledge, selection criteria, radiographic waste management, patient and staff safety, and equipment and technique. Data was described.	According to this investigation, 1% and 3% of the processing solution and lead foil were adequately disposed of, respectively. Regarding this matter, the dental profession significantly contributes to environmental pollution through dental imaging procedures. Selling old fixers and lead foils to nearby vendors and metal scrap dealers helps induce dentists to reuse silver and lead.	The findings indicate dentists' understanding of and attitudes towards oral radiology safety regulations could be better. The faculty members are in charge of creating new, more effective teaching strategies for undergraduate and graduate levels of education, considering these requirements.	(16)
Lahore's public and private hospitals' policies for managing hospital waste	A uniform checklist was utilised to evaluate the practices of the nursing and sanitary personnel.	To observe and contrast the practices used in public sector hospitals and private hospitals for managing hospital waste	Better government structure, practices and financing likely explain public hospital practices. Waste handlers should get particular health education. The Health Care Waste Committee should mandate proper training.	(17)
Control of hospital waste in Egypt's El-Beheira Governorate	An evaluation of the hospital's waste handling system's discrimination, collection, transportation, therapy, and disposal. According to WHO (1999) & the Egyptian Prime Minister's Executive Order Nos. Disposal was done using a questionnaire at 338/1995 & 1741/2005 of the Environment Law No. 4.	The survey found that hospital workers require training, from administrators and senior management to physicians and nurses to trash handlers and maintenance and incinerator operators.	Effective medical waste management plans need cooperation across several sectors and execution levels, including hospital staff, private businesses, and local and national governments.	(18)

Patna City's Integrated Bio-Medical Solid Waste Management Plan	A questionnaire-based survey was conducted to collect primary and secondary data, and various sources and departments were contacted.	This paper provides a comprehensive review of biomedical wastes, some suggestions for managing them effectively, and a discussion of the crucial strategic steps needed to prepare a successful strategy.	Based on an assessment of the most recent trends and industry best practices, the research has produced comprehensive policy recommendations for effectively managing biomedical waste.	[19]
Medical waste management practices are currently in Bangladesh's Dhaka City.	A systematic questionnaire was used to collect information on the volume and source of various healthcare wastes produced by various HCEs.	This article aims to chronicle waste management practises (such as trash collection, keeping, transferring, and disposal) and the types and amounts of waste generated by healthcare enterprises (HCEs). Out of the 68 HCEs that were already present in the research regions, a total of 60 gave us pertinent data.	The analysis shows that, besides a few private HCEs that separate their infectious wastes, there is no appropriate, systematic handling of medical waste. It was discovered that certain cleaners could recover used test tubes, saline bags, blood bags, and sharps for resale or reuse.	[20]
An overview of the handling of biomedical waste in certain Egyptian governorates	This study aimed to assess how biological waste was handled and treated in different hospitals in Egypt. The five hospitals and ten central medical institutions were surveyed using a modified waste disposal survey questionnaire.	Due to a lack of clearly defined standards and practices, researchers discovered that biological material is being inappropriately managed in hospitals and hospitals that provide primary care.	Implementing waste management policies, strategies, and procedures is highly advised, as is establishing training programmes for all healthcare professionals.	[21]
Hospital waste management in Sylhet city	The study examines how a few healthcare centres (HCCs) waste disposal procedures in SCC are functioning and evaluates ways to improve hospital sanitation standards.	A week-long study at several hospitals, clinics, diagnostic centres, and outdoor clinics in the SCC region was conducted to determine the rate at which various waste types are generated.	A week-long investigation at some hospitals, clinics, diagnostic facilities, and outdoor clinics in the SCC area was carried out to ascertain the pace at which different kinds are produced.	[22]
Mercury in Health Care, Geneva, Switzerland.	World Chemical Safety Certificates 0056, 0978, 0979, 0980, 0981, 0982, and 0984 were issued by IPCS in 2000. Geneva, Global Programme on Chemical Safety, World Health Organisation.	Up to 5% of all mercury discharged in wastewater may come from healthcare institutions. Since dental amalgam might include up to 50% elemental mercury, it may be a significant source of exposure.	Encourage nations to create and implement mercury laws and regulations, and encourage practical strategies for reducing mercury emissions from cremations.	[23]
Review of Microbiological Hazards in Healthcare Wastes and Health Effects, WHO, Geneva.	The report was compiled from a few controlled studies and qualitative observations of the impact of occupational and public health.	There are several areas of concern for potential transmission of human pathogens to the public and waste workers.	Specific actions must be taken immediately and quickly to lessen the burden of illness in developing nations.	[24]
Health care waste management that is safe: a practical approach	250 private dental professionals participated in a cross-sectional survey.	Only 14% of dentists knew of the various types of biomedical waste produced in their offices. About 28% of people are unaware of the BMW load in the nation and the colour-coded trash cans.	The requirement for ongoing dental training on dental treatment and waste disposal for dental professionals is critical.	[25]
Pollution Prevention Strategies Used by Oregon Hospitals	Questionnaire Surveys were sent to 57 hospitals in Oregon, and 24 facilities responded (42.1 %)	Results show that buying decreased hazardous materials (92%), recyclable packaging (75%), and recycled content items (83%). Some hospitals use cadmium-free red bags (25%), reusable shipment containers (34%), and minimum packaging (46%). No hospital buys chlorine-free office paper.	These efforts have fostered relationships between hospitals and are helping move Oregon hospitals collectively towards pollution prevention in healthcare.	[26]

Indian HWM	The current situation is analysed, including waste amounts, composition, processing, treatment, and disposal in various HCFs.	Waste reduction efforts must be made, and a suitable strategy must be developed based on the situation. Finally, sufficient financial arrangements must be established.	A healthcare waste-management strategy involves institutional frameworks, suitable technology, operational strategies, financial management, and staff training programmes.	[27]
Dentists at a teaching clinic in New Delhi, India, know about biological disposal and infection prevention.	A questionnaire-based survey among 64 dentists.	Half of dentists followed infection control procedures, but none knew the hazards they faced. Most people are ignorant about waste management practices.	Dentists should be instructed and trained in handling and managing biological waste.	[28]

Materials and Methods

The study's primary goal is to investigate the problems and difficulties associated with dental HCFs' biological waste management procedures. This research intends to look at the current methods used to manage biological waste in oral HCFs and pinpoint the most significant difficulties these facilities encounter. The research methodology may be qualitative, quantitative, or, in rare circumstances, a combination of the two. We used both a qualitative and a quantitative strategy for this study.

Quantitative Method: This mixed-methods, descriptive and exploratory institutional study evaluates BWM practices and challenges in dental healthcare settings.

Sample size and Sampling Technique: This exploratory mixed-methods study involved a purposive sample of 34 participants, including nurses, lab technicians, and doctors from various hospital departments, to identify challenges in BWM. Although the sample size was small, it was considered suitable due to time, accessibility, and staffing constraints. The study aimed to gather in-depth departmental insights and ensure diverse perspectives across units such as oral medicine, surgery, pathology, and orthodontics. A self-designed structured questionnaire was used, and complete responses were saved for future research. A total of 35 participants were selected, with data collected using a random sampling approach.

Interview Methodology and Qualitative Analysis: The description of the interview process and qualitative analysis requires greater detail. In this study, data were collected using digital tools, specifically the **Interview Schedule application**, which facilitated structured, field-based data collection. Pre-drafted questions were administered through a structured interview format to ensure consistency across all participants.

Data Collection:

- The researcher used the **Interview Schedule application** to collect primary data during field visits.
- A structured interview method was employed, using a standardized set of questions designed in advance.

Inclusion Criteria: Nurses, lab technicians, and doctors from various departments across different hospitals who were willing to participate in the study.

Exclusion Criteria: Individuals who were unwilling to participate or were unavailable during the data collection period.

Data Analysis: Descriptive statistics were used to summarize demographic and awareness data. To determine significant differences in awareness levels among three independent groups, a one-way analysis of variance (ANOVA) was conducted. ANOVA was appropriate due to the categorical nature of the groups and the continuous awareness score, allowing comparison of group means. ANOVA was chosen because it allows for comparing the means of more than two independent groups to determine whether there are significant differences among them in terms of the response variable—awareness level. It tests the null hypothesis that all group means are equal against the alternative that at least one group mean differs. This method is appropriate given the categorical nature of the independent variable (group type) and the continuous scale of the dependent variable (awareness score).

Qualitative Method: For the qualitative part of the study, five respondents participated in one-on-one, in-depth interviews. All respondents were asked the same set of predetermined open-ended questions focused on their understanding and perceptions regarding recyclable waste and its transportation to recycling centres. The qualitative data were analyzed using thematic analysis. This involved organizing responses into themes and sub-themes that emerged from the narratives. The analysis was grounded in the sense-making theory, aiming to understand how individuals interpret and make sense of their role in waste management and recycling. Responses were coded, and the frequency of each code was noted. The coding system was anonymized using identifiers (e.g., Respondent 1=R1). This triangulated approach—quantitative validation through ANOVA and in-depth understanding through qualitative themes—ensured a robust and comprehensive analysis of the research question.

Results

Descriptive Statistics: Before conducting ANOVA, descriptive statistics were calculated for the dependent variable—the quantity and types of waste produced by different dental departments. Table 2 presents the types of waste generated by each department.

Table 2. Types of waste produced by different dental departments

Department	Types of waste generated
Oral Medicine & Radiology	Lead apron, X-ray films (developed and undeveloped), expired and discarded medicines.
Oral & Maxillofacial Surgery	Extracted teeth, post-operative tissues, and infected suture materials
Oral Pathology & Oral Microbiology	Glass slides, coverslips, wax blocks
Orthodontics	Used orthodontic wires, metallic brackets
Periodontology	Broken scaler points, post-surgical waste
Prosthodontics	Impression materials, dental waxes, green stick compound, and implant prosthesis
Conservative & Pedodontics	Deciduous and permanent teeth, orthodontic appliances

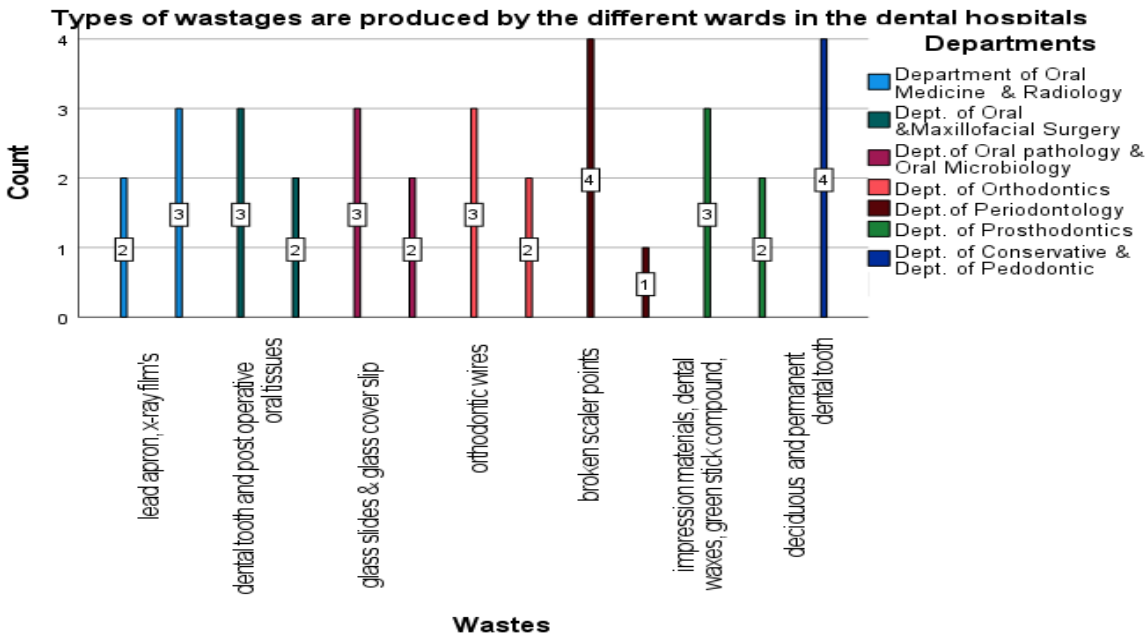

Figure 1. Problems encountered by the HWM team in implementing the HWM system

Inferential Statistics: To evaluate whether the mean quantity of waste generated significantly differed across departments, a one-way ANOVA was conducted (Table 3, Figure 1). The dependent variable was the mean quantity of waste, and the independent variable was the department type (categorical with 7 groups).

Table 3. Descriptive statistics for the quantity of waste by department

Department	Mean quantity of waste (kg/week)	Standard deviation
Oral Medicine & Radiology	15.2	1.8
Oral & Maxillofacial Surgery	18.7	2.1
Oral Pathology & Microbiology	9.6	1.2
Orthodontics	12.4	1.5
Periodontology	11.7	1.6
Prosthodontics	14.8	1.9
Conservative & Pedodontics	16.1	2.0

Table 4. ANOVA results for the quantity of dental waste by department

Source	Sum of squares	Df	Mean square	F	Sig. (P-value)
Between Groups	532.571	6	88.762	327.018	0.000
Within Groups	7.600	28	0.271		

Total	540.171	34

The ANOVA test result indicated a statistically significant difference in the mean quantity of waste generated between departments (F=327.018, P-value<0.001) (Table 4). This implies that at least one department produces a significantly different amount of waste compared to others. Since the assumption of homogeneity of variances may not always hold, a Welch's ANOVA was also conducted. The Welch test also confirmed a statistically significant difference (P-value<0.001), reinforcing the ANOVA findings (Table 5).

Table 5. Welch's test of equality of means

Statistic	Df1	Df2	Sig. (P-value)
270.167	6	12.431	0.000

Table 6. Thematic analysis: awareness of recyclable waste management

Statement	Number of respondents
Recyclable wastes should be separated from non-recyclables to prevent processing issues and value reduction	1
Plastic packaging should be free from food residue to maintain quality and facilitate recycling	2
The glass should be transported carefully to prevent breakage and contamination	1
Paper products should be kept dry and uncontaminated to ensure recyclability	1

A semi-structured interview was conducted with five participants to explore awareness about recyclable waste being transported to recycling centres. The responses were coded and classified into broader themes. Participants emphasized the importance of proper segregation, cleanliness, and handling of recyclables such as plastic, glass, and paper (Table 6). For example:

- **Resp1**: "Recyclable wastes should be separated from non-recyclables since mixed waste is hard to process."
- **Resp2 & Resp3**: "Plastic packaging must be free from food residues to maintain its recycling value."
- **Resp4**: "Glass should not be broken or mixed with other materials."
- **Resp5**: "Paper must be dry and uncontaminated to remain recyclable."

Discussion

The waste producers should bear the cost of managing, controlling, and properly disposing of biomedical waste. This includes hospitals, clinics, nursing homes, research laboratories, veterinary establishments, manufacturers of medical devices and diagnostic kits, and vaccine producers. These HCFs are responsible for generating biomedical waste and must bear the cost of its management, control and disposal. The cost of these activities may include the purchase or hire of equipment, personnel training, transportation, treatment of waste, the cost of its final disposal, and the cost of monitoring the operations. The waste producer should also bear the cost of any damage caused to the environment due to improper handling and disposal of biomedical waste.[27]

Hospitals are responsible for safely managing and disposing of biomedical waste generated from the clinical activities conducted on their premises. They must ensure that the biomedical waste is segregated, treated, and disposed of as per the country's relevant laws. They must also ensure the waste is handled, transported, and disposed of safely and environmentally friendly. Hospitals must also ensure that the staff is adequately trained to safely handle biomedical waste.[28]

Selecting an exact target group is essential in managing, controlling, and properly disposing of biomedical waste. This target group should be identified based on the type of waste and the location of the waste.[29] HCFs waste management companies, and relevant government departments should be identified and involved in the process. Public health and safety organizations should also be consulted to ensure that the waste is handled and disposed of in accordance with regulations. Furthermore, local community members should be involved in creating awareness and ensuring that their health and safety are not compromised.

The most appropriate terms and conditions for managing, controlling, and adequately disposing of biomedical waste should include measures to protect the environment and patients. This should include segregating the waste, keeping clear records of the waste generated, providing adequate training to staff, disposing of biomedical waste in approved locations and methods, and regularly monitoring and updating policies and procedures. It should also include provisions for the safe and hygienic transportation and storage of biomedical waste. Finally, it should include measures to ensure the safety of staff and patients by providing appropriate protective clothing and equipment.

These factors directly affect the proper management, control, and disposal of biomedical waste. The overall management, control and proper disposal of the biomedical waste scheme during the period under study was largely successful. It was a positive step in the right direction.[30] Factors that directly affect the successful management of biomedical waste include the availability of proper infrastructure,

appropriate technology and resources. Additionally, the active participation of relevant stakeholders, such as healthcare providers, regulatory bodies, and waste management companies, is essential in ensuring the safe and effective disposal of biomedical waste.

From the above analysis, it can be concluded that there is a significant difference between the wastes from different hospital departments and that awareness among people about recyclable wastes is increasing. For the segregation of different kinds of waste, proper training should be given to the HWM team, and awareness campaigns should be conducted. The cost of management, control and proper disposal of biomedical waste should be shared between the hospitals and the government. The hospitals should also be involved in managing, controlling and adequately disposing of biomedical waste by providing the facilities and resources required. The target group for the management, control and proper disposal of biomedical waste should be identified, and the terms and conditions should be made according to the protection of the environment and patients [31, 32] The overall management, control and proper disposal of biomedical waste schemes should be evaluated occasionally to ensure that they are moving in the right direction.

The study's findings indicate that there's a considerable disparity in the waste generated by various wards in dental facilities. The awareness among people regarding recyclable waste is increasing, and the HWM Management team needs some help in implementing the HCWM system. Proper training and awareness should be provided to segregate different kinds of waste easily. The cost of management, control and proper disposal of biomedical waste should be shared between the hospitals and the government. The target group should be identified, and the terms and conditions should be established according to the protection of the environment and patients. The overall management, control and proper disposal of biomedical waste schemes should be evaluated occasionally to ensure that they are moving in the right direction.

Limitations: This study has a few notable limitations. First, the qualitative data were based on interviews with only five participants, which may not fully represent the perspectives of a wider population. Second, since the research was limited to a single dental institution, the findings may not be generalizable to other settings or regions. Third, some of the data were self-reported, which can introduce response bias or inaccuracies due to social desirability. Additionally, the study did not involve direct measurement of the dental waste generated, relying instead on reported information, which may affect the precision of the results. Lastly, as a cross-sectional study, it reflects practices and awareness at a single point in time and does not account for potential changes or improvements over time.

Conclusion: Proper management, control and disposal of biomedical waste is essential to protect the environment and the patients. HWM teams require proper training and awareness to segregate different kinds of waste easily. The cost of management, control and proper disposal of biomedical waste should be shared between the hospitals and the government. The target group should be identified, and the terms and conditions should be established according to the protection of the environment and patients. The overall management, control and proper disposal of biomedical waste schemes should be evaluated occasionally to ensure that they are moving in the right direction.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of the Institute of Medical Sciences, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, India (Ref. No: DMR/IMS.SH/SOA/2021/197)

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Conflict of Interest

The authors declare that they do not have any conflicts of interest.

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