

Awareness about biomedical waste management and knowledge of effective recycling of dental materials among dental students

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Abstract

Aims and Objectives: Biomedical waste management has become a concern with increasing number of dental practitioners in India. Being health care professionals, dentists should be aware regarding safe disposal of biomedical waste and recycling of dental materials to minimize biohazards to the environment. The aim of the present study was to assess awareness regarding biomedical waste management as well as knowledge of effective recycling and reuse of dental materials among dental students. **Materials and Methods:** This cross-sectional study was conducted among dental students belonging from all dental colleges of Bhubaneswar, Odisha (India) from February 2016 to April 2016. A total of 500 students (208 males and 292 females) participated in the study, which was conducted in two phases. A questionnaire was distributed to assess the awareness of biomedical waste management and knowledge of effective recycling of dental materials, and collected data was examined on a 5-point unipolar scale in percentages to assess the relative awareness regarding these two different categories. The Statistical Package for Social Sciences was used to analyze collected data. **Results:** Forty-four percent of the dental students were not at all aware about the management of biomedical waste, 22% were moderately aware, 21% slightly aware, 7% very aware, and 5% fell in extremely aware category. Similarly, a higher percentage of participants (61%) were completely unaware regarding recycling and reusing of biomedical waste. **Conclusion:** There is lack of sufficient knowledge among dental students regarding management of biomedical waste and recycling or reusing of dental materials. Considering its impact on the environment, biomedical waste management requires immediate academic assessment to increase the awareness during training courses.

Key words: *Biomedical waste, dental materials, recycling*

INTRODUCTION

Health care industry is one of the leading industries worldwide, and in India it is growing by leaps and bounds. Increased life expectancy, greater health

awareness, and increased prevalence of lifestyle diseases have been key contributors to this growth. The Indian health care sector includes corporate hospitals, private clinics, and medical and dental colleges that generate biomedical waste. This includes

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human and animal anatomical waste and treatment apparatus such as syringes and needles, as well as various materials used in the health sector in the process of diagnosis, treatment, and research. Biomedical waste is generated in hospitals, nursing homes, blood bank, and pathological laboratories during diagnosis, treatment, or immunization of various diseases.^[1]

The generation of a comparatively large amount of potentially infectious and hazardous waste has increased in the healthcare services.^[2] According to a survey conducted by the Indian Society of Hospital Waste Management in June 2016, the quantum of waste that is generated in India is estimated to be 1–2 kg per bed per day in a hospital and 600 g per day per bed in a general practitioner's clinic. The overall waste generated throughout the country increased from 415429 kg in 2011 to 484271 kg per day in 2013. Karnataka was the highest producer of biowaste at 83614 kg per day, followed by Maharashtra, which produced 65660 kg of biowaste every day. Kerala was the third highest producer of biomedical waste in 2013 with the generation of 47223.84 kg per day.

A major issue related to current biomedical waste management in many hospitals is that the implementation of biowaste regulation is unsatisfactory. Alarming, most of the produced biomedical waste is either incinerated or dumped in landfills or let off in the nearest water body untreated. Improper waste disposal has led to numerous health hazards such as injuries from sharps, development of nosocomial infections in patients particularly human immunodeficiency virus (HIV), Hepatitis B and C, and emergence of resistant strains of microorganisms.^[3]

In year 2002, the World Health Organization (WHO) reported biomedical waste practices in India. WHO reported that 50% reuse of biomedical waste products such as needles and syringes, which are meant for single use.^[4] The Ministry of Environment and Forests of Government of India first proposed biomedical wastes rules on 20th July 1998. On 24th August 2011, the 1998 rules were amended and uniform guidelines and code of practice for management of biomedical waste were given to include all persons who generate, collect, receive, store, and transport biomedical waste. New guideline consists of 1–17 rules, I–VI schedules, and I–VI forms. New regulation clearly states that the “occupier” of an institution/hospital/clinics generating biomedical waste shall be responsible for taking required steps to ensure that such biowaste is handled without any adverse effect to human health and the environment. The 2011 draft demarcated 8

categories of biomedical waste (down from 10 categories in the 1998 notification).^[5] Sound management of biomedical waste is thus a crucial component of environmental protection. Healthcare facilities must employ effective treatment and disposal technologies.^[6]

There were two aspects of this present study. One aspect was to identify the level of awareness regarding biomedical waste management among dental students of Bhubaneswar city, at the primary level of dental professional training, which actually elucidate the level of teaching about this important aspect. The second aspect of study was related with knowledge of dental students in regards to effective recycling and reuse of dental materials.

MATERIALS AND METHODS

The study was carried out after obtaining required clearance from the Research and Ethics committee of the university. An informed consent was obtained from each participant for the study after detailed explanation of the study procedure. This study included all the students belonging to third and final year as well as the interns enrolled in the Bachelor of Dental Surgery (BDS) professional course from three dental colleges of Bhubaneswar. A universal sample of 600 students from all these three colleges made up the sample population. Out of this study population, 500 participants consented or were available during the study. A response rate of 80% was recorded for this study. The study was carried out from September 2015 to December 2015.

A pre-tested questionnaire was taken from a similar study conducted in India.^[4] The questionnaire was split into two categories, with 15 definite questions in each category. Questions in the first category were related to biomedical waste management whereas the second category questions were related to the recycling and reuse of dental materials. Reply for each question were then divided into right or wrong, and the summation was calculated for the mean. Collected data was analyzed and a 5-point unipolar scale was used to analyze for the assessment of awareness and knowledge regarding both the categories. This questionnaire was tested for content validity by 15 experts in the field. The Cronbach's alpha value was 0.78 indicating high validity. Face validity was tested by carrying out a pilot study on a sample of 30 participants for assessing the uniformity in interpretation of the questions. Data for all the participants was evaluated using the Statistical Package for the Social Sciences software system.

RESULTS

This was a cross-sectional study that included a total of 500 participants, 208 males and 292 females, belonging to all three dental colleges of Bhubaneswar city. The total duration of the study was approximately 3 months.

The study consisted of two parts. The first part comprised questions to assess the awareness of biomedical waste management, and the second part comprised questions to analyze the knowledge of effective recycling and reuse of dental materials.

When the results pertaining to relative awareness of biomedical waste management were analyzed, it was found that a majority of them gave a positive answer for question numbers 1, 2, 3, 6, 8, 9, 11, 12, 13, 14, and 15, with the highest percentage observed for question number 13 (61.6%) and lowest for question 6 (42.5%). However, for questions 4, 5, 7, and 10 there was a negative reply ranging from 47.5% for question 4 to 40.5% for question 7. A very small percentage of participants, ranging 8.1–17.9% fell into neither of the category [Table 1; Graph 1].

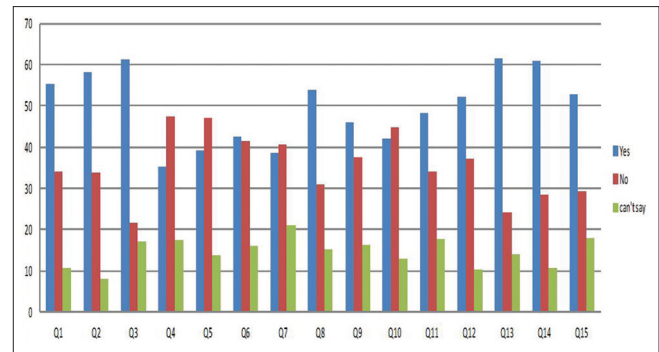
The second part of the study also contained 15 questions. Only question number 1 (75.4%) and 14 (45.5%) had a positive reply. Except for question number 7, 8, 9, and 15, all fell in the “No” category with 56.5% for question 4 to 35.9% for question 12.

Question number 8 saw a higher percentage (45.3%) of participants in the “can’t say” category when compared to other two categories [Table 2; Graph 2].

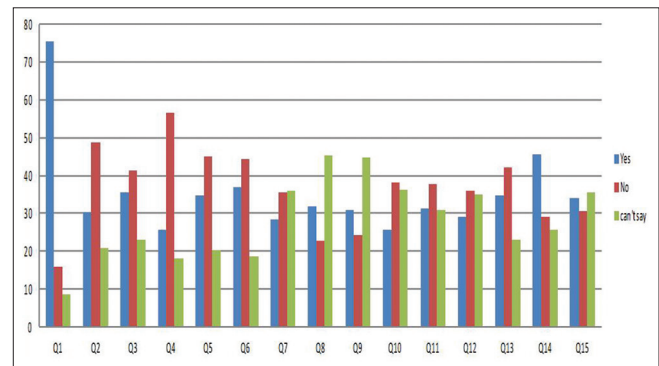
The entire collected data were evaluated using a 5-point unipolar scale for the assessment of awareness and knowledge in both the categories. Of the entire study participants, 44% were not aware about the management of biomedical waste, 22% were moderately aware, 21% slightly aware, 7% very aware, and 6% fell in the extremely aware category. Similarly, a higher percentage of participants (60%) were completely unaware regarding recycling and reusing of biomedical waste. Approximately, 27%, 6%, 4%, and 3% fell in the slightly aware, moderately aware, very aware, and extremely aware categories, respectively [Table 3; Graph 3].

DISCUSSION

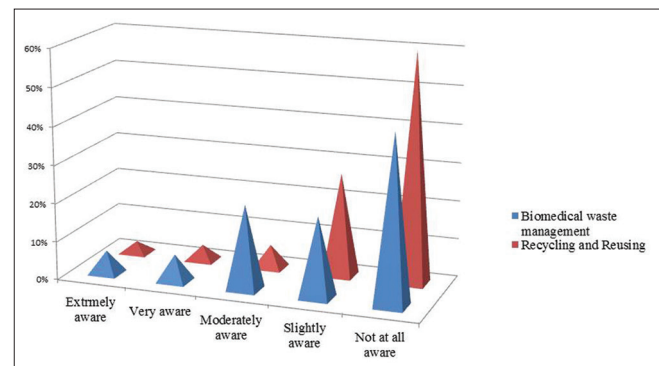
Considerable amount of biomedical waste is generated in dental practices, which can be hazardous to the environment, as well as to those who come



Graph 1: Quantitative analysis of awareness of biomedical waste management



Graph 2: Quantitative analysis of relative awareness about recycling and reusing the dental materials



Graph 3: Relative awareness about biomedical waste management and recycling

in contact with these materials, if not dealt with appropriately.^[1] According to the WHO fact sheet, approximately 20% of waste generated by various health care units is reported to be hazardous.^[7] Rapid urbanization and population growth has led to more and more number of hospitals and private clinics. With the increase in health care facilities, comes the generation of surplus amount of biomedical waste. The more serious situation in future may arise due to the toxicity and unavailability of dumping grounds for such wastes.^[8]

Table 1: Analysis of awareness about biomedical waste management

Questions	Yes (%)	No (%)	Can't say (%)	P value (Chi-square test)
Are you aware of government regulations and legislations related to biomedical waste management in our country	55.3	34.1	10.6	0.001
Are you aware about the theoretical and practical knowledge required to manage and/or recycle/reuse hospital waste	58.2	33.7	8.1	0.032
Do you know how inadequate biomedical waste management contributes to environmental pollution and global warming	61.2	21.7	17.1	0
Do you know the six effective steps of biomedical waste management	35.1	47.5	17.4	0.004
Do you remember the type of incinerator that was present in the institute you studied	39.2	47.1	13.7	0.324
Are you aware of methods, besides incineration and landfills, of effective waste disposal	42.5	41.5	16	0.007
Do you see that hospital waste is being managed by professionally trained staff in our country	38.5	40.5	21	0.029
Are you aware of waste water treatment process	53.8	31.1	15.1	0.039
Do you know lead aprons and lead collars should be disposed by licensed recyclers	46	37.6	16.4	0.36
Do you know how defective incineration emits greenhouse gases	42.1	44.9	13	0.038
Are you aware of any environment friendly technology that converts organic waste into commercially useful by-products	48.3	34	17.7	0.436
Do you know the component of fixer solutions used in X-rays that is considered hazardous	52.3	37.3	10.4	0.004
Do you feel that biomedical waste should be a practical exercise in dental colleges	61.6	24.3	14.1	0.001
Are you aware of the fact that improper biomedical waste management affects population	61	28.4	10.6	0.032
Do you feel hospitals and other organizations are financially equipped to maintain biomedical waste management	52.8	29.3	17.9	0.797

Table 2: Analysis of awareness about recycling and reusing of dental materials

Questions	Yes (%)	No (%)	Can't say (%)	P value (Chi-square test)
Are you aware of which component of dental amalgam is environmental hazard	75.4	15.8	8.8	0.044
Can silver be retrieved from dental amalgam	30.3	48.9	20.8	0.61
Can mercury be retrieved from dental amalgam	35.7	41.1	23.2	0.496
Have you seen a dental unit with amalgam separator in it	25.6	56.5	17.9	0.474
Excess amalgam after filling in patient's mouth should be disposed in conventional spittoon attached to dental chair	34.8	44.9	20.3	0.809
Are you aware that non-recyclable materials like syringes, needles, and iv sets can be recycled for other uses	36.9	44.5	18.6	0.988
Can gypsum be recycled	28.4	35.7	35.9	0.39
Gypsum can be used as a land filler material	31.8	22.9	45.3	0.58
When used as a land filler material can produce friendly gas	31	24.3	44.7	0.368
Do you know that gypsum can be recycled for use in more than ten other products	25.5	38.2	36.3	0.937
Are you aware that elastomeric impression materials can be recycled	31.3	37.9	30.8	0.571
Can thermoplastics used in dentistry be reused	29.1	35.9	35	0.588
Do you know what is biodegradable plastic	34.7	42.3	23	0.476
Apart from dental gold other dental alloys can be recycled	45.5	28.9	25.6	0.329
Do you feel more studies need to be conducted regarding the subject of recycling and reusing dentistry	33.9	30.5	35.6	0.641

Table 3: 5-point unipolar scales for assessing awareness in both categories

	Extremely aware	Very aware	Moderately aware	Slightly aware	Not at all aware
Biomedical waste management	6%	7%	22%	21%	44%
Recycling and Reusing	3%	4.00%	6%	27%	60%

In densely populated developing countries, management of biomedical waste is a complicated issue and should be planned in advance. Concern about the release of greenhouse gases during incineration of biomedical waste has also grown, which ultimately causes environmental harm and global warming.^[9] Many studies from developing countries have been documented in the literature showing inadequacy of knowledge and indigent attitude among health care workers regarding biomedical waste. These studies have been reported from India,^[10,11] Brazil,^[12] Dhaka,^[13] and Turkey.^[14] These studies were mainly focused on biomedical waste management, but did not discuss recycling of waste. There are no studies reported in India regarding the awareness of biomedical waste management among dental students undergoing training.

From this study, it was found that 44% of study populations were not aware about the management of biomedical waste. This is in accordance to studies done by Sreegiri *et al.*, Mathur *et al.*, and Sood *et al.*, where the awareness was very less about biomedical waste management.^[15-17] According to a study done by Narang *et al.*, a higher percentage of studying participants, almost 89%, were not aware about biomedical waste management.^[18] This shows the relative negligence among health care workers regarding this issue.^[17,18]

Hazards of improper management of biomedical waste have increased the concerned throughout the world, considering its deleterious effects on human health and ecosystem. Improper waste disposal by hospitals, nursing homes, and health care institutions have increased the concern about this.^[4] In the present study, it was found that most of the health care workers were unaware about the six effective steps for proper waste disposal or the type of incinerator used and the toxic gases produced from these incinerators that contributes to further global warming. Same results have been reported by Babu in his review on management of biomedical waste. Authors have emphasized the urgent need for education about the hazards of biomedical waste to the health care workers.^[19,20]

Regarding knowledge pertaining to the recycling and reuse of dental materials, 61% of the study population

was completely clueless about this issue. Most of them were unaware about the proper disposal of dental amalgam, which is considered to be a major environmental hazard,^[21] and about the recycling and reuse of gypsum products, which are abundantly used in dentistry. The results of this study are similar to studies done by Tippat *et al.*^[22]

Mercury and their products should be recycled carefully in dental setting. To decrease chances of mercury toxicity the use of chair side trap, amalgam capture devices, vacuum pump filter should be used to retrieve amalgam in dental setting.^[23] The American Dental Association recommends that excess amalgam should be stored under a small amount of “photographic fixer” in a closed container to minimize its hazard, and then it should be sent for recycling.^[24]

Gypsum and byproducts used for dental work should not in any way be considered as land filler material considering the release of hydrogen sulfide gases from it. It deteriorates soil properties by reducing soil crusting and by increasing soil aeration and water infiltration.^[4] Other dental materials that can be reused are metallic and ceramic orthodontic brackets, phosphate-bonded investments, alginate, unused dental alloys (incorporated with Ag, Au, or Pd), and dental gold.^[4] Lack of awareness about biomedical waste management and effective knowledge of recycling of dental materials among students might be associated with low emphasis given on these topics during dental graduation course. There is a need for more studies in future to determine the exact cause of low awareness regarding biomedical waste management and effective knowledge of recycling or reuse of dental materials among the dental fraternity.

CONCLUSION

Our country has a huge medical infrastructure. With increasing number of hospitals and medical and dental colleges opening, improper disposal of biomedical can lead to significant environment and health related hazards. Thus, adequate knowledge about this is essential. This study shows that there is lack of sufficient knowledge among dental students regarding biomedical waste management and/or recycling

of dental materials. For this, immediate academic assessment to increase the awareness is required during training courses. Thus, small advances need to be made in this aspect to reap great and huge benefits.

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Conflicts of interest

There are no conflicts of interest.

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