Journal of Atmospheric Pollution, 2014, Vol. 2, No. 1, 17-21
Available online at http://pubs.sciepub.com/jap/2/1/4

DOI:10.12691/jap-2-1-4

Are Dental Training Programs Heading towards Ecological Disaster – Results from a Survey

Khurshid Mattoo[1,*], Vishwadeepak Singh[2], Rishabh Garg[3]

[1]Prosthodontics, College of dental sciences, Jazan University, KSA
[2]Prosthodontics, Teerthankar Mahaveer dental college, Moradabad, India
[3]Prosthodontics, Subharti dental college, Meerut, India
*Corresponding author: drkamattoo@rediffmail.com

Received December 12, 2014; Revised December 17, 2014; Accepted December 23, 2014

Abstract With ever increasing number of dentists graduating in developing countries like India, biomedical waste management becomes an issue, especially when the country is listed among one of the most polluted countries in the world. **Aims:** To evaluate the relative awareness about biomedical waste management and recycling of dental materials among dental students, To determine the need for modifications in dental curriculum and to discuss various recyclable dental materials **Materials and methods**: The study was conducted in two phases, and involved dental interns from various recognized dental colleges in north India. 183 male and 317 female students, representing more than 40 approved and recognized dental institutes were randomly selected and were asked to fill the questionnaire divided into two sections each having fifteen questions. The data collected was analyzed in percent, followed by application of a 5 point unipolar scale for assessing the overall level of awareness about the two different categories. **Results:** Results show that a large percentage of the students were not aware of the process of biomedical waste management (89%) whereas about half of the subjects were moderate to slightly aware about the recycling/reusing of dental materials. **Conclusions:** Biomedical waste management is a serious issue globally and requires immediate academic assessment so that students are comprehensively taught about its management. Further studies also need to be conducted to review the current status in other professional medical courses.

Keywords: *greenhouse gases, biomedical waste, gypsum, fixer solution, mercury, eco-friendly, global warming*

Cite This Article: Khurshid Mattoo, Vishwadeepak Singh, and Rishabh Garg, "Are Dental Training Programs Heading towards Ecological Disaster – Results from a Survey." *Journal of Atmospheric Pollution*, vol. 2, no. 1 (2014): 17-21. doi: 10.12691/jap-2-1-4.

1. Introduction

Developing countries like India have in the past decade focussed largely on infrastructure development, including health sector, which in turn has given rise to innumerable industries. Industrial waste, be it in physical or chemical form is highly hazardous both to us and our environment. Likewise, health care industries that include corporate hospitals, medical and dental colleges, private clinics and many unauthorized workers produce a large quantity of waste that are either dumped in landfills or incinerated. Alarming but true, among top ten in the world, Sukinda (India's Erin Brokovich), and Vapi of India are considered second and third most polluted places in the world. Sukinda has hexavalent chromium (highly carcinogenic) present in drinking water and 85% of deaths over there are related to chromite related diseases, whereas Vapi has the highest levels of mercury in city's ground water (96% higher than WHO safety levels) [1].

The health industry in India, like any other public sector has also seen a steady rise in its infrastructural growth clearly evidenced by a drastic number of increases in the medical and dental hospitals along with other associated ancillary technical institutes that produce thousands of medical professionals every year. Waste management including that of hospitals is a serious concern throughout the world, especially as a serious contributor to global warming. It therefore becomes the primary responsibility of health care administrators to manage hospital waste in most safe and ecofriendly manner. [2,3,4] According to central pollution control board (CPBP) of India, the country generates approximately 1.48 million tonnes of healthcare waste per year. Registered healthcare facilities generate 4,057 tonnes of waste per day, out of which 2,919 tonnes of waste are treated while the rest goes untreated on a daily basis. [5] There are no studies that estimate the amount of waste produced by dental health specialists in India. According to a survey in Xanthi, Greece about 260 kilograms of dental waste was produced by 23 dental practitioners over a period of 22 days [6].

Biomedical waste practices came to limelight in the year 2002, when the World Health Organization (WHO) reported a 50% re-use in India of syringes and needles that are meant for single use. [7] Since then many researchers have been prompted to find out the level of awareness among health care professionals and has been found unsatisfactory. [8,9,10,11] Few surveys have also been conducted to find a level of awareness about biomedical

waste management among practicing dentists. [12,13,14] As there are no studies to find the relative awareness while being trained, it is hypothesized that the problem is not in the practice but it may lie in their training.

There are two aspects of conducting the present study. One aspect of this study deals with identifying the level of awareness at the basic level of professional training which actually will throw light on the level of teaching about such issues. The second aspect of this study deals with knowledge and awareness of effective waste management through the process of recycling of dental materials. Nulls hypothesis states that all dental students are taught the subject of dental materials right from their first year of training, therefore they have adequate knowledge of their effective disposal. Further objectives of this study would be to determine the need of improving basic dental education during their professional training.

2. Materials and Methods

The study was conducted after obtaining necessary clearance from the ethics committee of the University, which conducts studies in accordance with Helsinki declaration. This study was conducted in two stages. In the first stage a questionnaire was prepared and the study sample was determined, organized and planned. Formatting of the questions for the questionnaire was done so as to prevent recall bias by the subjects (Appendix 1). The second stage included distribution and collection of the questionnaire, analyzing their data and determining the response rate. Selection criteria for the subjects included the subjects who had completed their four years of training and were pursuing their internship programs, students who had never failed in any of the subjects during their graduation, subjects who had done their primary studies from English medium schools, subjects who fulfilled all the requirements laid down by their respective universities and the dental council for appearing in the final examination.

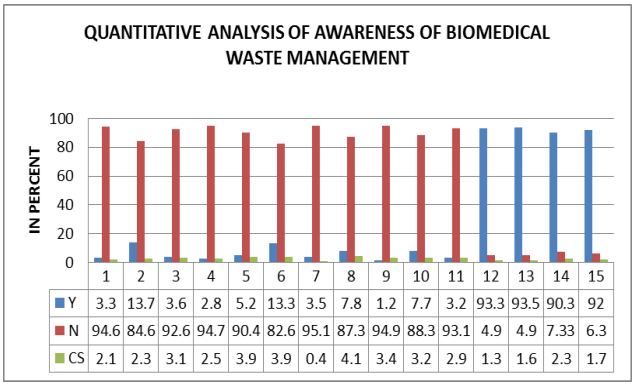
Table 1. Scoring Criteria For Overall Assessment

5 point unipolar scale for assessing awareness among subjects.		
1.	25-30	Extremely aware
2.	20-25	Very aware
3.	15-20	Moderately aware
4.	10-15	Slightly aware
5.	<10	Not at all aware

The survey was conducted by distributing the questionnaire during a conference of undergraduates. 183 male and 317 female students, representing more than 45 institutes participated in the actual study. Information sharing was based on certain principles so that the actual problem if any could be easily identified (Appendix 1 footnote). The questionnaire was divided into two sections, carrying 15 specific questions in each section. Questions in the first section were related to biomedical waste management and those in the second section were related to recycling of dental materials. The questions in the study were first refined after a pilot survey. After collecting the questionnaire the entire data was analyzed using a 5 point unipolar scale for assessing level of awareness about the two categories (Table 1). Responses for each question were then categorized into right or wrong and the sum total was then calculated for the mean. Data for all the subjects was analyzed using SPSS software system.

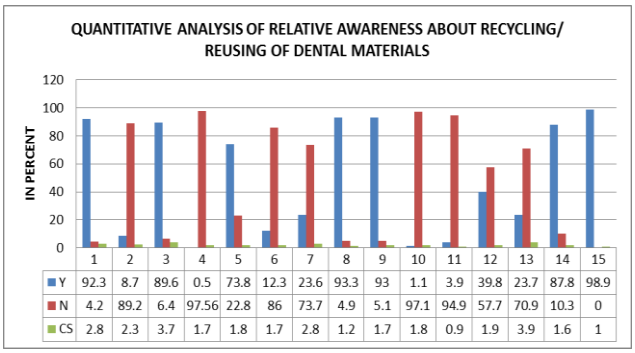
3. Results

Results show that, about 82% to 93 % of the subjects who participated in this study were not correct for question 1 to 11 about biomedical waste management, whereas between 7 to 13 % of the subjects answered correctly for question no 2, 6, 8 and 10 (Graph 1). On the other hand more than 80% of the subjects answered correctly to questions no 1, 3, 8, 9, 14 and 15 regarding recycling of materials used (Graph 2). As per the score (5 point unipolar scale) for the biomedical waste management, only 11% were slightly aware and 89% were not at all aware (Graph 3). For recycling and reusing, 23% were moderately aware and 24% were slightly aware and 53% of the students were not at all aware about recycling/reusing of dental materials according to 5 points unipolar scale.



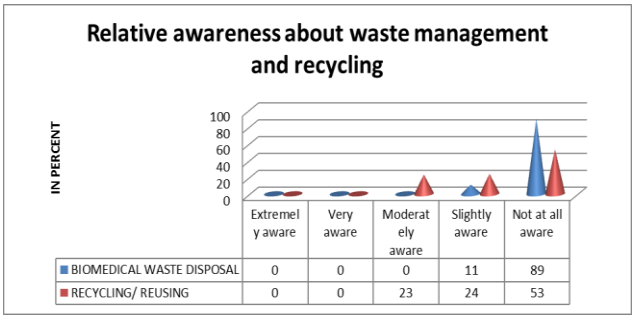
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Y	3.3	13.7	3.6	2.8	5.2	13.3	3.5	7.8	1.2	7.7	3.2	93.3	93.5	90.3	92
N	94.6	84.6	92.6	94.7	90.4	82.6	95.1	87.3	94.9	88.3	93.1	4.9	4.9	7.33	6.3
CS	2.1	2.3	3.1	2.5	3.9	3.9	0.4	4.1	3.4	3.2	2.9	1.3	1.6	2.3	1.7

Graph 1. Graphic presentation (with values) of relative awareness about biomedical waste management in study subjects



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Y	92.3	8.7	89.6	0.5	73.8	12.3	23.6	93.3	93	1.1	3.9	39.8	23.7	87.8	98.9
N	4.2	89.2	6.4	97.56	22.8	86	73.7	4.9	5.1	97.1	94.9	57.7	70.9	10.3	0
CS	2.8	2.3	3.7	1.7	1.8	1.7	2.8	1.2	1.7	1.8	0.9	1.9	3.9	1.6	1

Graph 2. Graphic presentation (with values) of relative awareness about recycling/reusing of dental materials among study subjects



Graph 3. Overall comparative awareness about biomedical waste management and recycling of dental materials among dental students

4. Discussion

Biomedical waste is defined as "any waste that is generated during diagnosis, treatment or immunization of human beings or animals, or in the research activities pertaining to or in the production or testing of biological and includes categories mentioned in schedule I of the Government of India's Biomedical Waste (Management and Handling) Rules 1998" [15,16].

Biomedical waste management in developing countries which are densely populated is a complex issue and needs to be planned in advance. The complexity of the issue is that efficient biomedical waste management has to be accomplished with less production of greenhouse gases (as they contribute to global warming). Methods used to dispose biomedical waste like incineration produce carbon dioxide and sulfur dioxide, which are greenhouse gases and cause environmental harm and global warming. [17] Lack of knowledge, poor attitude and malpractices among health care workers have been studied in Iran, [18] Palestine, [19] Dhaka, [20] Turkey, [21] South Brazil [22] and India. [23-28] These studies primarily focus on biomedical waste management without signifying its importance to recycling. Also, there are no studies that have determined the awareness among dental students undergoing training. According to this study, 89 % of the study subjects were not at all aware about biomedical waste management which is in agreement with studies done among dental practitioners, [23-28] except for a study that showed a more level of awareness (29.5%) among dental practitioners [26].

Regarding recycling of dental materials, 53% of the students were not aware except few known facts about mercury. Presently, biomedical waste management includes proper disposal of dental materials like silver, mercury, fixer solution, gypsum products and elastomers from clinics, waxes, denture base resin, orthodontic brackets, rubber products, chemicals, disinfectants etc etc. Human activities are releasing more than 30 billion tonnes of carbon dioxide gas alone each year. Methane a byproduct of waste from medical industry commonly released in landfills can absorb 23 times as much infrared radiation as carbon dioxide thereby warming the earth's surface. [29] Mercury in any of its forms in dental settings needs to be recycled carefully. To retrieve amalgam, the use of amalgam capture devices and separator, chair side traps, vacuum pump filters and/or storing in photographic fixer. [30] Installation of an approved amalgam separating apparatus in dental clinics is now mandatory in several countries like Switzer land, Germany, Sweden, Denmark. [31] Silver concentration in using fixer solutions ranges from 8-12 g/L [32] and is easily recyclable through a silver recovery unit, wherein extremely stable silver phosphate complexes is converted into silver sulfide which then settles in sludge [33,34].

Gypsum products used in dentistry should never be used as land filler material as it has the potential to produce hydrogen sulfide gases and metallic sulfide leachates. Instead, its use on sodic and irrigated soils to ameliorate the effects of poor soil properties by enhancing flocculation and aggregation of soil particles is well established. It also reduces soil crusting and sediment erosion while at the same time increase water infiltration and soil aeration. Besides agriculture it can be also used in cement manufacture (retarder), plaster board, soil amendment, athletic field marker, animal livestock bedding, flea powder, grease spill absorbent, mushroom growing, odor reduction and water treatment.

Other dental materials that can be recycled and are reused are alginate to make paper, [35] rubber [36] plastics produce electricity at waste to energy plants, unused/surplus dental alloys (containing Au, Ag or Pd), Dental gold (Extracted crowns, Bridgework & Fillings), Dental technician grindings, Dental technician crucible scrap, Dental technician vacuum bags**,** Extracted crowns, bridgework & Gold fillings and Surplus Stainless Steel Instruments. Metallic and ceramic orthodontic brackets [37,38,39] and phosphate bonded investments [40].

5. Conclusion

Hazards of poor management of biomedical waste have aroused the concern world over, especially in the light of its far-reaching effects on human, health and the environment. The problems of the waste disposal in the hospitals and other healthcare institutions have become issues of increasing concern. Although in infancy, developing countries like India possess a huge medical infrastructure with more than 280 dental colleges. With more than 20,000 graduates every year it is important that they should possess the knowledge and be absolutely aware of proper and effective biomedical waste and its environmental hazards. This study throws enough evidence on the fact that dental students are not even aware at all about biomedical waste management and/or recycling of dental materials. Further studies need to be done to find whether they are being trained or not and different methods of teaching can be compared to find out effective methods of biomedical waste management. One reason for such low awareness among medical fraternity is their poor knowledge and awareness about biomedical waste management [41].

References

[1] Walsh B. The worlds most polluted places: www.time.com.

[2] Mathur P, Patan S, Shobhawat S. Need of Biomedical Waste Management System in Hospitals - An Emerging issue - A Review. Curr. World. Environ. 2012; 7(1): 117-124.

[3] Singh VP, Biswas G, and Sharma JJ. Biomedical Waste Management - An Emerging Concern in Indian Hospitals Indian, Journal of Forensic Medicine and Toxicology, (2007-12): 1(1).

[4] Hem Chandra. Hospital Waste. An Environmental Hazard and Its Management. International society of environmental botanist. (1999); 3(5).

[5] Over 1 million tonnes Medical Waste headache for India. The pharma times. Tue, Dec 16th. Available at www.thepharmatimes.in

[6] Kizlary E, Iosifidis N, Voudrias E, Dimitrios P. Composition and production rate of dental solid waste in Xanthi, Greece; variability among dentist groups. Waste management 2005; 2(6): 582-591.

[7] Bhuyan AL. Conference reports. Journal of the Indian Society of Health Care and Waste Management. 2002; 1: 64.

[8] Pandit NB, Mehta HK, Kartha GP, Choudhary SK. Management of bio-medical waste; Awareness and practices in a district of Gujarat. Indian Journal of Public Health. 2005; 49: 245-247.

[9] Rao PH. Report: Hospital waste management-awareness and practices: A study of three states in India. Waste Management and Research. 2008; 26: 297-303.

[10] Sharma S. Awareness about bio-medical waste management among health care personnel of some important medical centres in

Agra. International Journal of Environmental Science and Development. 2010; 1: 251-255.

[11] Sreegiri S, Krishna Babu G. Bio-medical waste management in a tertiary level hospital in Visakhapatnam. Journal of Community Medicine. 2009; 5: 1-6.

[12] Kishore J, Goel P, Sagar B, Joshi TK. Awareness about biomedical waste management and infection control among dentists of a teaching hospital in New Delhi. Indian Journal of Dental Research. 2000;11: 157-161.

[13] Kishore J, Goel P, Sagar B, Joshi TK. Awareness about biomedical waste management and infection control among dentists of a teaching hospital in New Delhi. Indian Journal of Dental Research. 2000; 11: 157-161.

[14] Sudhakar V, Chandrashekhar J. Dental health care waste disposal among private dental practices in Bangalore City, India. International Dental Journal. 2008; 58: 51-54.

[15] Government of India, Ministry of Environment and Forests. Bio-Medical Waste (Management and Handling) Rules. Gazette of India. 1998 (27 Jul). Available from: http://envfor.nic.in/legis/hsm/biomed.html.

[16] Government of India, Ministry of Health and Family Welfare (MoHFW). National Guidelines on Hospital Waste Management Based upon the Bio-Medical Waste (Management and Handling) Rules, 1998. New Delhi: MoHFW; 2002.

[17] Atiyat N, Mosa M. (2002). Environmental impact assessment for domestic solid waste landfill project. Environmental Research Center: Royal Scientific Society.

[18] Askarian M, Vakili M, Kabir G. Hospital waste management status in university hospitals of the Fars province, Iran. International Journal of Environmental Health Research. 2004; 14: 295-305.

[19] Al-Khatib IA, Khatib RA. Assessment of medical waste management in a Palestinian hospital. Eastern Mediterranean Health Journal. 2006; 12: 359-371.

[20] Hassan MM, Ahmed SA, Rahman KA, Biswas TK. Pattern of medical waste management: existing scenario in Dhaka City, Bangladesh. BMC Public Health. 2008; 8: 36.

[21] Alagöz AZ, Kocasoy G. Improvement and modification of the routing system for the health-care waste collection and transportation in Istanbul. Waste Management. 2008; 28: 1461-1471.

[22] Da Silva CE, Hoppe AE, Ravanello MM, Mello N. Medical waste management in the south of Brazil. Waste Management. 2005; 25: 600-60.

[23] Sharma S. Awareness about bio-medical waste management among health care personnel of some important medical centres in Agra. International Journal of Environmental Science and Development. 2010; 1: 251-255.

[24] Narang RS, Manchanda A, Singh S, Verma N, Padda S. Awareness of biomedical waste management among dental professionals and auxiliary staff in Amritsar, India. Oral Health and Dental Management. 2012; 11: 162-168.

[25] Sreegiri S, Krishna Babu G. Bio-medical waste management in a tertiary level hospital in Visakhapatnam. Journal of Community Medicine. 2009; 5: 1-6.

[26] Sushma MK, Bhat S, Shetty SR, Babu SG. Bio-medical dental waste management and awareness of waste management policy among private dental practitioners in Mangalore City, India. Tanzania Dental Journal. 2010; 16: 39-43.

[27] Mathur V, Dwivedi S, Hassan MA, Misra RP. Knowledge, attitude and practices about Bio-medical waste management among health care personnel: a cross-sectional study. Indian Journal of Community Medicine. 2011; 36: 143-145.

[28] Sood AG, Sood A. Dental perspective on biomedical waste and mercury management: a knowledge, attitude and practice survey. Indian Journal of Dental Research. 2011; 22: 371-375.

[29] Karl TR, Trenberth KE (2003). "Modern Global Climate Change". Science 302 (5651): 1719-1723.

[30] Adams, E. Eco-friendly dentistry: Not a matter of choice. Canadian Dental Association, 2007; 73(7): 581-584.

[31] Environmentally responsible dental office: The Oregon Dentist's guide to best management practices of dental waste: April 1988.

[32] Cooley AC, Dagon TJ, Jenkins PW, Robillard KA. Silver and the environment. J. Imaging. Technol. 1988; 14(6): 183-9.

[33] Lytle PE. Fate and speciation of silver in publicly owned treatment works. Environ. Toxicol. Chem. 1984; (3): 21-30.

[34] LeBlanc GA, Mastone JD, Paradice AP, Wilson B, Lockhart HB, Robillard KA. The influence of speciation on the toxicity of silver to fat-head minnow (Pimephales promelas). Environ. Toxicol. Chem.1984; 3: 37-46.

[35] Ernest RP, Alfred A. Method of making paper from water insoluble alginate fibers. Journal of Membrane Sci 2009; 326 (2): 441-452.

[36] Morin Jeremy E. High-Pressure, High-Temperature Sintering: A Novel Approach towards Recycling of Vulcanized Rubber Powders Derived From Scrap Tires University of Massachusetts - Amherst (available at http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.investigatorInfo/investigator/7554).

[37] Coley R, Smith A, Rock WP. "Bracket Recycling - Who Does What?" British J. Orthod. 1999; 26 (2): 135-139.

[38] Bishara SE. Celebrating twenty years of contributions to the science of orthodontic materials (The most prolific scientific contributor to AJO-DO, after T. M. Graber, A. D. 2000), The Orthodontic Materials Insider, December 2007, 19(4): 1.

[39] Lew KK, Djeng SK, Recycling ceramic brackets. J. Clin. Orthod. 1990; 24: 44-47.

[40] Zutai Z, Yukimichi T, Yasuhiro H, Takashi M. Recycling of used commercial phosphate bonded investments with additional mono - ammonium phosphate. Dental material journal 2009; 24(1): 14-18

[41] Kishore J, Goel P, Sagar B, Joshi TK. Awareness about biomedical waste management and infection control among dentists of a teaching hospital in New Delhi. Indian Journal of Dental Research. 2000; 11: 157-161.

Appendix 1. Questionnaire for identifying the relative awareness of biomedical waste management and recycling

S.NO	QUESTIONS	Y(Yes)/N(No)/CS(Can't Say)
	RELATED TO BIOMEDICALWASTE MANAGEMENT	
1	Are you aware of government regulations and legislations related to biomedical waste management in our country	
2	Are you aware about the theoretical and practical knowledge required to manage and/or recycle /reuse hospital waste?	
3	Do you know how inadequate biomedical waste management contributes to environmental pollution and global warming	
4	Do you know the six effective steps of biomedical waste management	
5	Do you remember type of incinerator that was present in the institute you studied	
6	Are you aware of methods besides incineration and landfills, of effective waste disposal?	
7	Do you see that hospital waste is being managed by professionally trained staff in our country	
8	Are you aware of waste water treatment process	
9	Do you know lead aprons and lead collars should be disposed by licensed recyclers?	
10	Do you know how defective incineration emits greenhouse gases	
11	Are you aware of any environment friendly technology that converts organic waste into commercially useful by-products?	
12	Do you know the component of fixer solutions used in x-rays that is considered hazardous	

13	Do you feel that biomedical waste management should be a practical exercise in dental colleges	
14	Are you aware of the fact that improper biomedical waste management effects population	
15	Do you feel hospitals and other organizations are financially well equipped to maintain biomedical waste management	
RELATED TO RECYCLING/ REUSING		
1	Are you aware of which component of dental amalgam is environmental hazard	
2	Can silver be retrieved from dental amalgam?	
3	Can mercury be retrieved from dental amalgam	
4	Have you seen a dental unit with amalgam separator in it	
5	Excess amalgam after filling in patient's mouth should be disposed in conventional spittoon attached to dental chair.	True / false
6	Are you aware that non-recyclable materials like syringes, needles, iv sets can be recycled for other uses	
7	Can gypsum be recycled	
8	Gypsum can be used as land filler material	True / false
9	When used as land filler material it produces friendly gas	True/ false
10	Do you know that gypsum can be recycled for use in more than ten other products?	
11	Are you aware that elastomeric impression materials be recycled	
12	Can thermoplastics used in dentistry be reused	
13	Do you know what is a biodegradable plastic	
14	Apart from dental gold do you know other dental alloys that can be recycled	
15	Do you feel more studies need to be conducted regarding the subject of recycling and reusing in dentistry?	

Principles Of Sharing Information:-

1. Knowledge based on internet should not be applied
2. Information gained through resources other than the institute you have studied is not applicable
3. All information given should be based on actual experience
4. Identity of the individual or that of the institute needs not to be revealed.
5. This study is not being done to judge neither any particular individual nor any organisation.
6. This study is only meant for dental graduates who are either doing their internship or have completed graduation
7. Please answer the question in its totality and not partially.