Knowledge, attitude and practice regarding green dentistry amongst the alumni of a private Dental College in Pune, Maharashtra – A questionnaire study

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ABSTRACT

Greendentistry is an upcoming practice which aims to reduce the environmental liabilities of a dental office. It is defined as a practice that reduces waste and pollution, saves energy and money, incorporates high tech innovations and is wellness based. To assess the knowledge, attitude and practice regarding green dentistry, amongst the alumni of a dental college in Pune. A questionnaire study was conducted amongst 900 graduates and post graduates of the dental college through an e-survey using google forms. A questionnaire was formulated after extensive literature search which was followed by validation, reliability testing and pilot testing among 30 participants. Statistical analysis used: Numbers and Percentages were computed for the responses and Chi square test was used for between group comparisons based on demographic variables. 310 dentists replied to the questionnaire. More than 60% participants had knowledge about waste disposal, eco-friendly sterilization, hazardous spill kits whereas less than 40% correctly answered about energy efficiency. Many participants agreed that environmental problems are something one can personally do a lot about and individuals should take lead in addressing them. 95.5% were registered with a biomedical waste disposal service. Practices like recycling reading material and using energy efficient appliances were relatively better than adequate disposal practices for fixer. The results suggest that the attitude towards environmentally responsible dental practice was relatively better than the knowledge and practice regarding the same. Increasing exposure to eco-friendly practices could help reduce the environmental burden of dentistry.

Introduction

On September 25th, 2015, the UN adopted a new sustainable development agenda to be achieved by 2030. Leading organizations of the world are taking note of the deteriorating environment and global climate change indicating the urgency to combat them. Increased industrial activities, fuel consumption and waste generation are the primary causes of the environmental damage. Dental clinics also contribute to this equation through factors like environmental cost of production, energy consumption, waste generation etc. (Mc Clea *et al.,* 2011). Dentistry is a profession of healing which also implies that dentists should monitor and take regulatory and compensatory actions for any harm created by the profession. Green dentistry is a type of clinical dental practice which alleviates the environmental burden of a dental clinic (Garla *et al.,* 2012). It advocates sustainability, prevention, precaution and mini-

mally invasive patient oriented treatment philosophy which includes responsible use of the planet's resources, judicial waste management practices, use of eco-friendly substitutes wherever possible and a rational approach of a dentist towards the environment. It has been observed in studies outside India that although green dentistry is beneficial for the patients as well as the environment, it is not practiced commonly (Shatrat *et al.*, 2013; Bush *et al.*, 2011). A greater understanding of the dentist's practices will help establish eco-friendly strategies and decrease the environmental liability of a dental office. Therefore, the present study was conceptualized.

Subjects and Methods

A cross-sectional questionnaire study was conducted amongst the alumni(BDS and MDS of a private dental college in Pune through an e-survey using Google forms between June and October 2015. A list of all the members of the alumni was obtained from the college and contacted through e-mails and instant messaging apps. Out of 1200, only 900 members were available during the study period. The inclusion criteria for the study were; analumnus/alumna who had a clinical practice and were willing to participate in the study.

Since this was an e-survey, the cover letter and informed consent were included in the Google form containing the questionnaire. A brief outline of the purpose of the study along with the inclusion criteria was stated and the participants were informed that their participation was voluntary, their personal details were strictly confidential and their anonymity would be maintained. They were asked to raise their queries, if any in the last section (comments/feedback/suggestions) of the questionnaire. This was followed by a question seeking their consent, with the option of Yes or No.

Since no previous study in similar population was found in the literature, we assumed the prevalence of knowledge to be 50% which would yield the maximum sample size.A sample size of 290 was obtained using Epi Info by the formula for prevalence in finite population.Since the response rate for an e-survey is low(7)e-mails were sent to all the 900 members.

The 20 item questionnaire was based on a conceptual frame work of three domains;'waste management', 'Items used in a dental clinic'and 'general environment". In order to have confidence in the results of the study, the content validity was established by 13 faculty members of the University. The reliability was also established by test – retest amongst 20 volunteers of similar population. The kappa value for this was 0.9 which indicated the questionnaire to be reliable. This was followed by pilot testing amongst 30 volunteers who were asked to answer the questionnaire and provide feedback on content, clarity and brevity of the questionnaire as well as the ease of using a google form. The final version was then sent to the study participants. The responses on Google form were recorded after the verification of the email address ensuring that one participant could answer only once.

The questionnaire consisted of 3 sections. The first section included demographic details. (Age, Sex, Qualification and Years in clinical practice). The second section consisted of 7 questions on knowledge, 7 questions on attitude and 6 questions on practice regarding green dentistry (15 close ended and 5 semi-closed). The third section was a comment box for queries and suggestions.

The responses were recorded on a nominal scale and summarized by converting the online recorded information into representative numbers (codes) for analysis. Once the survey was completed, the participants were mailed the answer-key to the questionnaire along with a detailed recommendation chart for making eco-friendly choices in dentistry.

Results

The data were entered and analysed using Statistical Package for Social Sciences (SPSS) Version 17 software package (SPSS inc., IBM, and Chicago, IL, USA). Numbers and percentages were calculated for each item described in Table two, three and four. Chi square statistical test was applied to compare within group responses based on the demographic variables. P value ≤ 0.05 was considered as statistically significant. The significant results from the within group analysis are mentioned below.

Demographic Details

Out of 900 dentists, 310 responded giving a response rate of 34.4%. Since 310 is greater than the calculated sample size (290), it was considered adequate. 59% females, 89% belonging to 21-35 yrs of age, 62% BDS graduates and 63% dentists who had upto 5 yrs of practicing experience responded to the survey.

S136

Eco. Env. & Cons. 28 (December Suppl. Issue) : 2022

Questions on knowledge (Table 1)

41.8% participants with a clinical experience of less than 5 years correctly answered as to what comprised of green dentistry whereas 53.5 % participants with a clinical experience of more than 5 years answered the same question correctly yielding a statistically significant difference with p value of .046.

Similarly, 23% (clinical experience less than 5 years) and 35.1% (clinical experience more than 5 years) participants knew that on an average, a computer saves 81 - 90 % energy when put to sleep or stand-by mode (p value = .029)

Questions on attitude (Table 2)

Participants showed a positive attitude towards eco

Table 1.

Questions on knowledge	Responses (%)
1) Which of these is a green dental practice?	
Use of disposable materials	33.5
Increased use of paper	01.9
Use of amalgam	01.9
Use of cloth pouches, drapes and masks	**46.1**
Don't know	16.5
2) On an average, a computer saves _____ % energy when put in sleep mode?	
50 % - 60%	21.0
61 % - 70%	13.9
71 % - 80%	11.6
81% - 90%	**27.4**
Don't know	26.1
3) Are sonic - electric tooth brushes recyclable?	
Yes	29.7
No	**47.7**
Don't know	22.6
4) Are you aware of 'hazardous spill kits' & 'mercury spill kits' in the market?	
Yes	**61.0**
No	39.0
5) Which of these item/itemsare non-incinerable wastes?	
Infectious gauze and tissue	05.2
Sharps	01.9
Amalgam, disposable cups, gloves etc.	**59.7**
None of the Above	06.1
All of the above	27.1
6) What is the most eco-friendly method of sterilization in a dental clinic?	
Autoclave	**67.7**
Hot Air Oven	03.2
Boiling	14.8
Chemical sterilization	09.0
Dont know	5.2
Other	0
1) One unit of energy saved at the clinic/home will help save _____ units of energy at the manufacturing power plant.	
1	10.6
2	06.8
3	20.3
4	02.3
Dont know	60.0

Table 2.

Questions on attitude	Responses(%)
1) Environmental Problems are something you can personally do –	
A Lot About	**77.4**
A Little About	21.3
Nothing About	01.3
2) Who should take the lead In Addressing Environmental Problems?	
Law and policy makers	17.7
Scientists and inventors	3.5
Individuals	**66.1**
Non government organisations	6.1
Business and industries	6.5
3) Health-care industry plays a role in environmental pollution -	
Agree	**85.2**
Don't know	3.2
Disagree	11.6
4) Advanced technologies like CAD-CAM & RVG reduce environmental liabilities of a dental office	
Agree	**85.8**
Don't know	9.7
Disagree	4.5
5) Eco-dentistry/green dentistry is a feasible practice	
Agree	**67.4**
Don't know	27.1
Disagree	5.5
6) The biggest barrier in practicing eco-friendly dentistry is	
High cost	19.7
Lack of alternatives	15.2
Lack of exposure	**35.2**
Tedious job	7.4
Lack of interest	15.2
Dont know	7.4
7) Incentives for implementing eco-friendly strategies will help in practicing green dentistry	
Agree	**89.1**
Don't know	4.8

friendly dentistry.84.7% females and 66.9% males believed that environmental problems were something they could personally do a lot about (p value of 0.001)

Questions on practice: (Table 3)

95.5% participants were registered with a waste management service for disposal of biomedical waste generated in their clinic. 50.3% BDS and 34.2 % MDS participants disposed fixer directly in the drain. (p value = 0.001).Also, 36.8% BDS and 53% MDS participants always used a computer-based record system in their dental (p value = 0.003)

Discussion

310 out of 900 people responded giving a response rate of 34.4%. This is greater than the average response rate for e-surveys at 24.8% reported by Mirzae A. (7)

Green dentistry is an upcoming practice which involves equal attention to sustainability, prevention and a minimally invasive treatment philosophy which will benefit the patient as well as the planet. Less than half of the participants had knowledge about what green dentistryincluded. This could be attributed to the fact that green dentistry as an entity is still in its nascent form in many parts of the world.

Biomedical waste management (BMW) is integral to every healthcare facility and anyone involved in the production, handling or disposal of health-care waste must ascertain that the waste management procedure being followed by them is in accordance with their respective authority regulations (Pruss and Rushbrook, 1999). The results of knowledge and practice regarding BMW indicated a wide gap in the

Table 3.

Questions on practice	Responses(%)
1) Are you registered with a waste management service for disposal of biomedical waste generated in your clinic?	
Yes	**95.5**
No	4.5
2) What type of light fittings do you use in your dental clinic/office?	
Compact Fluorescent Lamps (CFL)	37.4
Light emitting diodes (LED)	**41.6**
Conventional Incandescent (40W/60W tubes and bulbs)	21
Solar	0
Other	0
3) Do you check the energy star rating before purchasing an electric appliance?	
Always	**50**
Sometimes	40
Never	7.1
Dont know about the energy star rating	2.9
4) How do you dispose the fixer used in your dental clinic?	
Directly in the drain	**44.2**
Give it to a waste collector	21.9
In-house treatment followed by drainage	10.6
Send it to some other place which has a silver extraction unit	14.2
Use RVG	9
5) Do you use computer-based record system in your dental office?	
Always	**42.9**
Sometimes	39.7
Never	17.4
6) Do you recycle magazines/newspapers received in your clinic?	
Always	**41.9**
Sometimes	30.6
Never	27.4

established protocol and current practices. Exposure to high concentration of mercury vapours causes respiratory damage, CNS disorders and behavioural changes. As a part of a protocol to manage mercury, mercury spill kit should be available in a dental clinic and a person should be trained in using that (Bhardwaj *et al.*, 2014). Only 61% of participants were aware of the 'hazardous spill kits' and 'mercury spill kits' available in the market. Dental amalgam, disposable cups and gloves are Category 7 type of waste which should not be incinerated due to their toxic by products. 59.7% participants replied correctly that amalgam, disposable cups and gloves are non-incinerable wastes. These figures are better than a study conducted by Parthasarthy N and Surapaneni N where they found that 41.2% of health care professionals had some knowledge about hazards of improper disposal of biomedical waste but only 28.57% were practicing them properly (Parthasarthy and Surapaneni, 2013). 95.5% partici-

pants reported to be registered with their respective biomedical waste management service. These figures are better than a study conducted among dentists in Lucknow where only 50% dentists reported to use an authorised waste collection service (Singh *et al.*, 2004).

Radiographs are often taken in a dental clinic which generates processing waste. This is in the form of fixer, developer or lead foil. The fixer used,should be treated before disposing since it contains hazardous compounds. The most common ways of dealing with it are; give it to an authorized waste collector or use a silver extraction unit to pretreat it. 44.2% participants disposed their fixer directly in the drain. These results vary from a study conducted by Bansal *et al* in Chandigarh, Panchkula and Mohali where 12% of the participants disposed it directly in the wash basin (Bansal *et al.*, 2013). These results are an indictment of the ambiguity amongst dentists on correct radiographic waste disposal.

The healthcare profession is widely embracing technology and going digital. While it is a progressive step, the involved parties also need to understand basic energy management to prevent burdening the environment. There was poor knowledge regarding energy efficiency in computers and other appliances amongst the participants but the practice was relatively better for use of energy efficient appliances. This variation in the knowledge and practice could be attributed to the long term economic benefits of using energy efficient products which could be a motivating factor in making these choices. Light emitting diodes (LED) consume least energy followed by Compact Fluorescent Lamps (CFL) whereas conventional in can descent tubes and bulbs consume the most energy.(13) 41.6% participants used LED, 37.4% participants used CFL and 21% used conventional light fittings in their dental clinic/office. These results vary from a study conducted by Shatrat *et al.* (2013) in Jordan where 94% of the dentists reported using CFL lights in their clinics (Shatrat *et al.*, 2013). These results might also be influenced of the LED awareness generated by the government of India by launching a scheme known as the Domestic Energy Light Programme (DELP) wherein LED bulbs are provided at a subsidised rate (2016).

The ENERGY STAR program was established by EPA (Environment Protection Agency) in 1992 to help consumers understand the energy consumption patterns of the appliances they buy and thus make informed choices (15). In this study, 50% participants always checked the energy star rating before purchasing any electric appliance. These results are similar to the results from a survey conducted in the USA,where 45% participants knowingly purchased an ENERGY STAR-labelled product (EPA, 2015). The lack of energy star rating on many dental equipments like dental chairs, autoclaves, visible light activating units etc impede a dentist's ability to make an eco-friendly choicein these equipments.

Paper is extensively used in a dental office; primarily for record keeping. Using a computer based record system not only reduces the paper waste but also makes the information more accessible. 42.9% participants always used a computer-based record system in their dental office while 40.9% participants reported to use it sometimes. These results are somewhat similar to a study conducted by Shatrat et al in Jordan wherein 78.7% participants reported implementation of a computer based record system.

(5)When elimination of paper at source is not possible, the second best way to handle it is by recycling. Producing recycled paper involves 28-70% less energy consumption than virgin paper and uses less water.(17) 41.9% participants always recycled the reading material (magazines/newspapers) received in their clinic. These results vary from those reported by Shatrat et al wherein only 8% of the dentists reported recycling of the waste-paper generated in their dental office. (5)

The participants also showed a high agreement that using technologies like CAD-CAM (Computer-aided design/Computer-aided manufacturing) and RVG *(Digital Radiovisiography)* help reduce the environmental liability of a dental office. Most of the participants showed a sense of responsibility towards the environment. Most of the participants agreed that health care contributes to pollution and environmental problems are something one can personally do a lot about; wherein individuals should take lead in addressing them. These responses are contrasting to the '*The Environment: Public Attitudes and Individual Behaviour*' survey conducted in 2011 among general public in USA, where 28% individuals believed that environmental problems are something they can personally do a lot about, 46 % believed they can do little about it and 18% believed environmental problems are something personally they can do nothing about (18). The participants also showed a positive attitude towards green dentistry where most of them agreed that green dentistry is a feasible practice and incentives and policies to encourage green dentistry could increase its adoption amongst dentists. The highest perceived barrier towards green dentistry was 'lack of exposure' which reflects a need to promote green dentistry. 92.3% participants expressed interest in receiving more information on green dentistry and eco-friendly alternatives in dentistry.

An interesting observation was that, statistically significant differences were found among different group for different domains. While knowledge was higher among those with higher clinical experience, attitude was better among females and eco-friendly practice were higher among the MDS participants indicating Clinical Experience, Gender and Qualification as factors associated with Knowledge, Attitude and Practice respectively. Age on the other hand did not yield a statistically significant result for any group but could be a clinically significant factor.

The limitations of the study are;

1. Respondents may have selected answers most similar to their true response due to the limited options in a multiple choice questionnaire.
2. Ambiguity about the topic may have wrongly influenced some responses.
3. Some of the attributes covered in this questionnaire were not found in any other questionnaire in the literature, therefore direct comparison of the data among similar population group was not done.
4. Since a convenience sample was used, the results are limited to populations similar to those represented in the study.

Recommendations: Whenever possible, prefer recyclable dental equipments and products over disposable ones.Follow standard protocol for disposal of biomedical waste generated in the clinic.Use digital technology like RVG, CAD-CAM, hospital information systems etc. to save valuable resources. Ensure judicious use of water and energy in the clinic. Follow the concept of Re-think, Reduce, Re-use and Re-cycle. (19)

Conclusion

The present study revealed a lack of knowledge in certain areas and unfavourable practices of the dentists towards eco-friendly dentistry. The attitude however, was found to be good. This indicates a scope for better practices with appropriate awareness, interventions, policies and some consciousness on the dentist's part. As the burden of pollution is increasing all over the world, it is important to address this issue in various areas and at several levels. This study was an attempt towards the same. Being eco-friendly is more than a choice; it's a lifelong process beginning with evolving beliefs and priority; which is only possible by being conscious, aware and responsible towards the issue.

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