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Evaluation of Green Dental Practice Implementation among Dental Practitioners Worldwide - A Systematic Review

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Abstract

Objective: Green dentistry has been adopted and developed in various cities and countries around the globe. This presentation is, therefore, aimed at using systematic review to evaluate green dental practice and its effect in dental offices, people, and the surrounding environment.

Methods: The presentation uses PubMed, Google Scholar, and Scopus as the main databases to obtain information. Extracted data from the five narrowed down sources is then analyzed and discussed.

Results: The total numbers of studies screened in this systematic review were restructured using the PRISMA flow chart. Only the most relevant studies for this evaluation practice were used to extract data out of all the screened and removed data sources.

Conclusion: Green dental practice ensures that there are management and reduction of waste around working areas and thus providing a clean and healthy environment for the patient and medical practitioners to interact with. Green dentistry was developed to ensure that there will be less destruction of the environment and that the healthcare sector contributes to the abolishment and reduction of pollution levels around the world.

Keywords: PRISMA Flow Diagram; Cochrane Bias Assessment Tool; Green Dentistry; Green Dental Practice; Systematic Review

Introduction

One of the significant issues facing the planet in today's world is pollution, which significantly increases with each passing. Concerning that, it causes severe and irreparable harm to the environment and the earth in general. Waste produced in dental practice and dental institutions has significant effects on its surroundings. Dentists contribute about three to seventy percent of the overall mercury load entering wastewater treatment plants. In recent years, approximately 680 million plastic and paper chair barriers have been dumped into open grounds. Additionally, 1.7 billion devices and sterilization pockets are also dumped annually into landfills and open area grounds [1]. The green dental practice is a project that is aimed at transforming dentistry for sustainable development. The color "green" indicates growth, revival, and hope for a better future. Green dentistry is a metamorphosis to innovate a better way of dental practice entirely; it is not only environment-friendly but also cost-friendly and saves on time. Additionally, the green dentistry movement aids in decreasing pollution by using new procedures and management protocols. Green dentistry ensures protection to the environment and humanity from the fears of urbanization and industrialization, particularly in the developing nations [2].

In 2008, the Eco-Dentistry Association was established in the United States to educate and provide a member's association for green dental professionals. The theme of the association was to make dentistry a safer and eco-friendly venture [3]. 'Eco-friendly dentistry' and 'environmentally friendly dentistry' are words aimed at achieving 'green dentistry.' With rising awareness, many businesses started seeking to alter their operations by taking environmental responsibility. These actions were either willingly or due to regulatory pressures. Similarly, the profession of dentistry, which routinely has been producing large quantities of waste, has, in due time, adopted the 'Going Green' idea to make it environmentally friendly. Materials that have a minimal impact or zero damage to the environment are described as environmentally friendly [4-6]. Industrialization forms another factor affecting the environment. Industrialization is a term that is used to refer to growth an establishment of industries. Modernization gained popularity over the last few decades, and its advancement has led to the emergence of new industries. The development of new sectors increases pollution levels. Pollution has continuously been linked with degradation and destruction of the environment [7-12].

Green dental practice, was developed by Doctor Malden Kralj owner of Oral Dental Studio. Mazur, *et al.* [13] claim that the purpose of introducing the practice in dental offices was to manage water and energy usage and keep indoor environment quality up to the surrounding environment standards. In other words, the green dental practice ensures that activities done inside the working area have zero or minimal impact on the environment. In 2009, the Eco-friendly Dentistry Association was launched globally. An article by Sodhi & Sodhi [14] states that the association aimed to encourage the conservation of money, water, and energy while managing and reducing waste and conserving the environment in dentistry institutions worldwide.

Pollution, therefore, becomes a significant issue of concern when it comes to environmental conservation and protection. Mearns, *et al.* [15] claim that the activity also possesses a substantial threat to marine life. A lot of efforts have been reinforced into curbing the dangerous menace and enhancing the growth of a productive environment. Concerning that, the term eco-friendly practices have been popularized globally. Eco-friendly environmental practices require individuals to adopt activities that have positive impacts on the environment. These practices are aimed at reducing pollution rates and providing a conducive environment for the establishment of ecosystems [16]. About saving the environment by adopting eco-friendly features, industries, organizations, and institutional bodies have developed new ways to handle their businesses without causing harm to the environment. Some of those new eco-friendly developments according to Duane, *et al.* [17] include the adoption of renewable sources of energy as well as nuclear energy to replace fuel combustion as the significant source of energy, treatment of industrial waste effluent before releasing it into water bodies, adoption of energy-saving appliances and machinery, use of biodegradable apparatus especially in hospital setups and other various methods. These practices have contributed to resurrecting the already dead ecosystems making them flourish again.

Implementation of Green Dentistry

The healthcare sector has not been left behind in the movement. Over recent years, the establishment of 'green' hospitals has gained momentum. 'Green' hospital is a term used to refer to a system whereby hospitals adopt environmentally friendly products [18]. Green is a color that is used to represented trees and the environment in general. Green hospitals, therefore, work towards ensuring they protect the environment by saving energy, conducting waste management services, waste reduction procedures, and preventing pollution. The 'green' hospital movement has been endorsed on a global scale, and it is aimed at ensuring sustainable environmental conservation and protection at a global level [19]. Eco-friendly dentistry ensures that dental offices uphold proper waste disposal procedures and ensure that the

health of the patient, surrounding communities, and the environment are well taken care of [20]. The use of the color 'green' in the name of the movement not only symbolizes the environment but also represents the color of money since the practices also help in saving the latter. Studies by Kinakh [21] have shown that a long term financial analysis and evaluation have to be conducted to give meaning to the effectiveness of these eco-friendly dental practices. Ultimately, when the system is correctly implemented, sustainable environmental conservation will be achieved.

Previous Studies about Green Dentistry

A study was recently conducted to gauge how many dentists are aware of the principles of green dentistry and apply them during practice. The study, which was held in India, revealed that 64 % of the dentist in the survey was aware of the term 'green dentistry,' out of which 53% were males and 47 % females. A majority, 84.4% of them also showed a positive attitude towards adopting these sustainable principles. However, 49.4 % considered it very difficult to switch from current practice [22]. Among the principal factors in green dentistry of relative advantage, compatibility, simplicity, trialability, and observability, an overwhelming majority (80.9%) of the dentist found trialability to be the most influential factor in adopting green dentistry. In another study which was carried out to analyze the implementation of the green dental office, the approach showed that most dentists followed green dentistry, which comprised alternatives to amalgam filling at 98% [23]. Use of light-emitting diode bulbs was 91%, unplugging electronic devices when not in use 96%, using steam sterilization with cloth instrument wraps 93%, and reusable lab coats 89, and using digital radiography 78.6%. From the data presented, these dentist office practices managed to save energy, reduce pollution, and contribute to a healthy environment by 91% cumulatively.

Research Question and Hypothesis

Green dentistry is an initiative that is going to not only conserve the environment for future generations but also create a clean and safe atmosphere for patients to enjoy [5]. According to the reviewed literature, the movement has already been initiated in some countries. Still, little information is included on whether the initiative has been successful in the rest of the world. In addition to that, little information is provided on the challenges that come with the adoption of the movement and whether it has been able to reduce the pollution levels.

Aim and objectives

The purpose of this research design is to assess the range of implementation of green dentistry concept in clinical dental practice worldwide. The research question that this study is going to focus on is the effectiveness of fallowing adoption of the movement and how this has been achieved worldwide. Secondary sources such as articles, reports, and journals will be reviewed with the view of answering the mentioned question.

Methods

The present study of Systematic Review (SR) was done according to Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) rule. The combination will aim at reporting data retrieved during the procedure of investigation. Systematic reviewing involves secondary data sources as the primary source of information. It, however, requires proper analysis and evaluation skills.

Reviews' Bias Risk

The bias risk in any SR suggests a circumstance whereby impediments or imperfections in the system and examination or undertaking of the survey contort the results. Different tools for evaluating the risk of bias in an SR exist. A portion of the kinds of tools that can be utilized to estimate the bias risk in an SR incorporates those that are domain-based, checklist, and scale-based. One of the most widely recognized instruments used by different researchers is the Cochrane method. Cochrane method is a hazard assessment instrument for investigations like SRs, which might have biases in their conclusions, results, methodology, and so forth. The technique utilizes judgments of unclear risks, high risk, and low risk on different. For this study, the Cochrane methodology was utilized to evaluate the bias risk in the various reports that were integrated into the SR

Information Sources

As mentioned, data was to be retrieved from highly reputable sites such as PubMed, Scopus, and Google Scholar. The materials collected in this case were reports and research studies as well as articles relating to green dentistry and its development in hospital setups. The sources for information were between the years 2011 and 2020. Since the aim was to evaluate the implementation of green dentistry worldwide, sources from different parts of the world were highly considered. Authors of the chosen articles were also conducted to ascertain the information provided in these sources. Also, they offered any additional information that was to be of help in this review.

Data Screening and Selection

During the search for information materials to use in the review, I was keen on following the inclusion criteria presented earlier. Due to the large pool of data concerning pollution

and eco-friendly movements, only information related to dental offices and dentistry, in general, was considered. Google Scholar contains a lot of articles and reports as opposed to Pubmed. Pubmed is a database that only provides information related to medical practice. It was, therefore, more comfortable to obtain data from the source as compared to Google scholar.

Data Collection

The point of the exercise was to allow diversification of data from the sources. Each opinion contributed mainly to the amount of final data collected. There were articles, reports, and journals in the list of references selected. They were all analyzed, and only information concerning green dental practice implementation obtained. Also, all types of tables and numerical figures in reports were carefully interpreted, and any confirmation from the authors done. It was ensured that all information concerning green dentistry and its implementation from these sources was sufficiently captured.

Cochrane Risk of Bias Assessment

The Cochrane Library is known for its contribution to the empowerment of systematic reviews. They conduct systematic reviews on various health issues and store them for future reference. With time, they developed a bias assessment tool that detected biasness in randomized selected files and reports. The study utilized the criteria to identify biasness in the selected information sources.

Additional Analysis

Articles and reports containing quantitative and qualitative analyses in different parts of the word were given the second priority after journals. Minimal research studies have focused on the implementation of green dentistry and hence the decision. Only journals and PubMed articles delivered sufficient information about the application and adoption of green dental practice in dental practitioners around the world.

Results

The total numbers of studies screened in this systematic review were restructured using the PRISMA flow chart, as illustrated below. Only the most relevant studies for this evaluation practice were used to extract data out of all the screened and removed data sources (Chart 1).

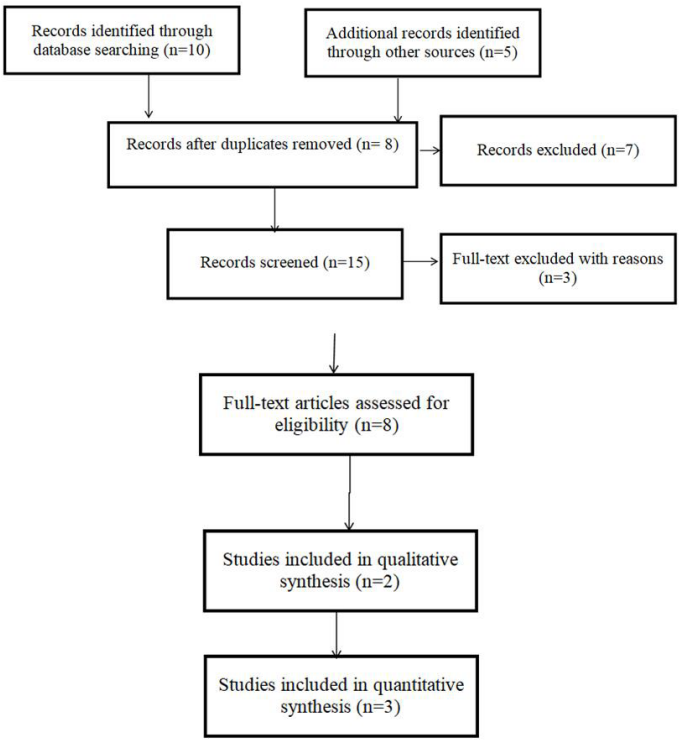

Chart 1: A PRISMA flow chart

The total number of information sources obtained from the databases was fifteen. These were the records that managed to meet the inclusion criteria highlighted in the first segment of the methodology. There were several sources excluded from the list after the screening, following some inadequacy and inconsistency of data. Additionally, records that were not presented in English were also excluded. Following the latter, there was an immediate challenge arising since a significant number of records were presented in various languages. Since the evaluation of the practice was on a global level, processed records were from different parts of the world to increase the reliability and accuracy of the analysis.

Duplicated sources were also excluded from the list. It was discovered that most of the information in some records was replicated several and thus being termed as unnecessary information. Out of the eight full texts assessed for eligibility, only five managed to be approved for evaluation and analysis. The three were ruled out as bias following the Cochrane bias assessment tool approach. The five selected articles had both quantitative and qualitative synthesis research methodologies. Out of the five, two adopted the qualitative method while the rest took the quantitative approach. They used the survey method of data collection, and they correctly presented their results and discussion appropriately (Table 1).

Table 1: Summary of the studies included in this Systematic Review

Reference	Conclusion
19. Duane B (2014) Green Dentistry: Motivating change. Br Dent J 217(8): 388	Green dentistry is an initiative that is aimed at saving resources such as money, energy, and the environment in dental offices and healthcare institutions.
17. Duane B, Harford S, Ramasubbu D, Stancliffe R, Pasdeki-Clewer E, et al. (2019) Environmentally sustainable dentistry: a brief introduction to sustainable concepts within the dental practice. Br Dent J 226(4): 292-5.	Apart from ensuring sustainable environmental conservation and preservation goals are achieved, green dentistry also focuses on ensuring that dental waste is appropriately reduced and managed in the areas of work.
18. Eram P, Shabina S, Rizwana M, Rana N (2017) eco dentistry: A new wave of the future dental practice. Ann Dent Specialty 5(1): 14-7	Green dentistry will save not only the environment but also the biodiversity and natural habitats of wild animals.
9. Gu A, Teng F, Feng X (2018) Effects of pollution control measures on carbon emission reduction in China: evidence from the 11th and 12th Five-Year Plans. Climate Policy 18(2): 198-209.	Pollution controlled the establishment of cleaner sources of energy in China, bringing an end to carbon emissions from burning fuels.
8. He G (2013) Essays on the health effects of pollution in China (Doctoral dissertation, UC Berkeley).	Pollution caused by industrial fumes led to the development of respiratory diseases among residents. The need for change was highly advisable.
1. Jhamb S Green (2019) The Future. Res Rev: J Dent 6(3): 28-30.	Conservation and preservation of the environment give rise to a better and more productive future.
5. Aggarwal VP, Kakkar A, Singh S (2017) Go green: A new prospective in dentistry. MOJ Curr Res Rev 1(1): 7-10.	Green dentistry has played a significant role in the reduction of pollution levels from a worldwide point of view.
21. Kinakh V (2016) Supporting change for sustainability in Dentistry. Visions for Sustainability 1(4): 5-12.	When green dentistry is adopted at a global level, sustainable environmental goals will be realized.
13. Mazur M, Ndokaj A, Jedlinski M, Stamegna C, Corridore D, et al. (2019) How dentistry is impacting the environment. Senses Sci 6(4): 922-8.	Green dentistry is developing waste management and reduction measures hence helping reduce and manage waste in the environment.
15. Mearns AJ, Reish DJ, Oshida PS, Morrison AM, Rempel-Hester MA, et al. (2016) Effects of pollution on marine organisms. Water Environ Res 88(10): 1693-807.	Due to the contamination of marine surfaces resulting from the accumulation of waste substances, marine life is usually put in danger. Proper waste management practices needed to be adopted to maintain a safe environment.
12. Owa FD (2013) Water pollution: sources, effects, control and management. Mediterr J Soc Sci 4(8): 65.	Water pollution was caused by improper disposal of waste products. These poisonous substances contaminated water bodies.
20. Rahman H, Chandra R, Tripathi S, Singh S (2014) Green dentistry-clean dentistry. IJRD 3(3): 56-61.	Green dentistry meant the adoption of clean medical appliances in that no harmful waste will affect the environment.
14. Sodhi AS, Sodhi HS (2019) Ecofriendly Dentistry and Green Hospitals. J Adv Med Dent Sci Res 7(5): 52-8.	Adoption of eco-friendly dentistry in healthcare facilities and dental offices led to the conservation and preservation of the environment.
11. Xu M, Wang Z, Duan X, Pan B (2014) Effects of pollution on macroinvertebrates and water quality bio-assessment. Hydrobiologia 729(1): 247-59.	Water pollution due to deposition of untreated sewage water leads to water poisoning and death of aquatic life such as fish and other small microorganisms
10. Zhang J, Yang JC, Wang RQ, Hou H, Du XM, et al. (2013) Effects of pollution sources and soil properties on distribution of polycyclic aromatic hydrocarbons and risk assessment. Sci Total Environ 463: 1-10.	Pollution leads to destruction of soil layers and caused unproductivity. It was also inferred that it leads to soil toxicity.

Discussion

This systematic review was focused towards the use of Green Dentistry among the practitioners worldwide. The reason as to why older reports are automatically excluded from the screening process is because they are out of date information. Older studies may not contain relevant updated data that is required in this systematic review. Meta-regression was not applied in this systematic review. The reason as to why is data sources obtained were filtered out using sensitivity and subgroup analysis. The five articles that were drafted as the final informative sources were evaluated and a final summary of the main findings provided. To start with, it was discovered that pollution played a significant role in environmental degradation [24]. Following the formation of the Eco dentistry association in 2009, most dental practitioners around the world started adopting eco-friendly measures to ensure a clean environment to work and live in [25]. According to one of the records, a qualitative study conducted in Thailand stated that green dental practice had gained momentum in the country [26]. Waste management and reduction had been achieved. Pollution levels around the dental offices had therefore reduced significantly [27].

It was evident from the selected studies that the use of green dentistry was encouraged by many dentists and it was found to have a positive impact on the environment. Adoption of eco-friendly dentistry in healthcare facilities and dental offices led to the conservation and preservation of the environment. Green dentistry is developing waste management and reduction measures hence helping reduce and manage waste in the environment. It was also discovered that the implementation of green dentistry had led to the sustainable management of resources such as water [28]. Adoption of eco-friendly gadgets such as biodegradable syringes and plastic also leads to a decrease of plastic waste in the surrounding environment by 30% in Chandigarh, Panchkula, and Mohali (India) [29,30]. With the reduction of

plastic waste, there was a significant decrease in soil toxicity leading to the productivity of the surrounding land and flourishment of trees and plants in the area. Implementation of green dentistry in Chennai, India, was also a success despite some dental practitioners having doubts and negative attitudes towards the venture [31]. In the end, they were able to save money and energy towards its establishment.

Limitations

There were several limitations associated with the reviewing process. The bias assessment involvement for starters was challenging to incorporate in the study. To come into a decisive conclusion about the type of system to be adopted, a lot of brainstorming activities were conducted by each member of the team. Another limitation is that some studies provided a coherent methodology but poor implementation and discussion of the results after that. The latter made the evaluation and internalization of the content difficult and time-consuming.

Conclusion

We can conclude from our systematic review that although there are challenges in the successful implementation of green dentistry practice, but the dental practitioners have shown positive intent. Further promotion of this healthy practice is required and eventually the way ahead in improving the chances of combating against pollution.

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