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A CROSS-SECTIONAL STUDY ON AWARENESS OF ECO-FRIENDLY DENTISTRY AMONG DENTAL PRACTITIONERS OF PAKISTAN

Dr. Ayesha Khan[1], Dr Sadia Hameed[2], Dr Sumera Bijarani[3], Dr. Husna Maab[4], Dr Pirya Devi[5], Dr Muhammad Farrukh[6], Muhammad Anas[*7]

[1]BDS, Ziauddin University Karachi
[2,3]BDS, Bibi Aseefa Dental College Smbbmu Larkana
[4]BDS, Army Medical College, Rawalpindi
[5]BDS, BiBi Aseefa Dental College Smbbmu Larkana.
[6]BDS, Margalla Institute of Health & Sciences
*[*7]BDS, Bacha Khan College of Dentistry Mardan*

[*1]ayshakhn18@gmail.com, [2]sadiapanhwar50@gmail.com, [3]sumera.hussain124@gmail.com, [4]dr.husnamaab17@gmail.com, [5]Priyabatra962@gmail.com, [6]drfarrukhbds@gmail.com, [*7]anas.khan.jadoon137@gmail.com

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Corresponding Author: * Muhammad Anas BDS
Bacha Khan College of Dentistry Mardan, Pakistan
Email:anas.khan.jadoon137@gmail.com
https://orcid.org/0009-0005-9914-397X

Abstract

Background:
Eco friendly or Green Dentistry can emerge as vital approach, by effectively designing Dental clinic and using more eco friendly material. This study aims to explore the awareness, attitude and practice of eco friendly dentistry among practitioners in Pakistan.

Materials and Methods:
A cross sectional study was conducted among the House officers and Trained Dentist across the Pakistan using self-structured questionnaire comprising of 16 close ended questions adopted from reviewing literature and previous research paper. Data collected online through various platforms and 115 responses calculated using WHO calculator. Statistical analysis was performed using SPSS version 27.

Results:
This study assessed the awareness and adoption of eco-friendly dentistry practices among 115 working dental practitioners. The survey revealed that 57.9% of respondents were familiar with eco-friendly dentistry, while 75.7% recommended its adoption. However, significant gaps were identified, including the use of paper-based records (55.8%), low adoption of natural disinfectants (25.2%), and inadequate recycling practices (20.7%). Furthermore, improper mercury disposal (78.1%) and limited use of reusable materials (45.2%) were noted. Encouragingly, 69.6% of practitioners used LED bulbs, and 62.3% preferred digital patient records. The majority (66.1%) believed eco-friendly practices were cost-effective. Notably, 91.3% emphasized the need for formal education on green practices to enhance sustainable dentistry.

Conclusion:
This study reveal a positive shift towards sustainable dentistry among dental practitioners in Pakistan and future efforts should focus on implementing Green Dentistry principles into Dental education and practice.

INTRODUCTION

The pressing issue of global sustainability has gained significant attention in recent years, driven by the alarming rise in pollution and the urgent need to protect the planet for future generations.(1) International forums held since 1992 have played a crucial role in defining the world's development agenda, emphasizing sustainability and cooperation.(2) In September 2000, the Millennium Development Goals were established, prompting a global movement towards sustainable development.(3) Two decades later, by November 2021, 193 nations had united in their commitment to intensify climate action.(4) Yet, to achieve transformative progress worldwide, concerted efforts are essential to implement environmentally sustainable practices at national and international levels, mitigating the devastating impacts of global emissions.(5) The dental profession, a vital healthcare sector, significantly contributes to environmental waste through its practices. According to the Eco-Dentistry Association, dental offices discard approximately, 680 million disposable dental barriers, light handle covers, and patient bibs annually and 1.7 million sterilization pouches yearly. These staggering numbers underscore the need for sustainable practices in dentistry to minimize its ecological footprint.(6) The COVID-19 pandemic has accelerated the use of single-use disposables, PPEs, single-dose medications, protective barriers, and enhanced disinfection and sterilization protocols. While these measures are crucial for infection control, it's essential to reassess practices and adopt environmentally sustainable strategies that mitigate the pandemic's carbon footprint and support long-term ecological balance.(4,6) Dental practices generate substantial amounts of non-decomposable waste, including gloves, surgical masks, suction tips, saliva ejectors, needles, and paper products. Furthermore, the industry produces significant quantities of hazardous materials, such as, 4.8 million lead foils annually, 28 million liters of used X-ray fixers from radiographic film processing and 3.7 tons of mercury-containing waste and discarded products yearly.(4,5,6)These statistics highlight the urgent need for sustainable practices and waste management strategies in dentistry. Dental practices have a significant environmental impact, with estimated carbon dioxide emissions reaching 675 kilotons annually. The profession's resource and labor intensity, combined with high energy consumption, contributes to its substantial carbon footprint.(7) A recent cross-sectional study among Lahore-based dental practitioners revealed a concerning knowledge gap regarding amalgam waste management. The study found that nearly 76% of respondents lacked awareness about proper amalgam disposal and Minamata Convention guidelines, highlighting the need for education and training.(8,9) The modern environmental movement, sparked by Rachel Carson's seminal book "Silent Spring" in the 1960s and 1970s, paved the way for eco-friendly dentistry. This approach prioritizes reducing dental practices' ecological footprint. The Eco-Dentistry Association defines Green Dentistry as a forward-thinking strategy that minimizes environmental harm through sustainable practices, pollution prevention, and health promotion for current and future generations.(10,11) This study aims to investigate the awareness and understanding of eco-friendly dentistry among dental practitioners in Pakistan. It seeks to assess their knowledge of sustainable dental practices, pollution prevention, and environmental responsibility. The study will evaluate the prevalence of eco-friendly attitudes and behaviors among Pakistani dentists, identifying gaps in awareness and practice. Findings will inform educational initiatives and policy changes to promote environmentally responsible dentistry in Pakistan.

Materials and Methods:

A cross-sectional study was conducted among dentists across Pakistan which included house officers (working in different public and private hospital setups), trained dentists (working in their own private practices) and senior dental professionals. This research adhered to the ethical guidelines outlined in the 2013 Helsinki Declaration.(12) Data collected through a web based, self-administered questionnaire

which included different questions regarding the awareness of green dentistry also known as eco-friendly dentistry. The questionnaire was made by searching literature and compiling previous research papers on green dentistry, keeping in mind the present issues and conditions of our environment. The ethical approval of the study was obtained from the ethical committee of Bacha khan medical College, Mardan Pakistan with reference number# 696 BKMC, dated 20th November 2024.

Study Design:
A cross-sectional survey conducted having a sample size was 115 which was calculated using WHO calculator in which confidence level was 95% with 7% margin of error including females and males dentists in
Pakistan.
Sample Size: 115 participants

Sampling Technique: Consecutive sampling (a type of non probability sampling).

Sampling Selection:
Inclusion Criteria: 1. dentists across Pakistan which included house officers (working in different public and private hospital setups), trained dentists (working in their own private practices) and senior dental professionals.

Exclusion Criteria: 1. Other than dental graduates of Pakistan 2.Foriegn graduates

Data Analysis Procedure:
The collected questionnaires were systematically coded and compiled, then transferred to Microsoft Excel for data organization. The data was subsequently exported to Statistical Package for Social Sciences (SPSS) version 27.0 for comprehensive analysis. Utilizing descriptive and inferential statistical methods to investigate the awareness and understanding of eco-friendly dentistry among dental practitioners in Pakistan.

Results:
A survey of 115 working dental practitioners revealed significant insights into eco-friendly dentistry practices.(Graph 1) Notably, 57.9% of respondents were already familiar with eco-friendly dentistry, while 42.1% were not. However, there is room for improvement in record-keeping, as 55.8% still use paper-based systems, whereas 44.2% have adopted computer-based systems.

Table 1: Awareness of dentists regarding eco friendly dentistry

Questions	Response	
	Yes	NO
Do you know about green dentistry?	57.9%	42.1%
Do you use computer based record system for proper waste management?	55.8%	44.2%
Should Eco friendly dentistry be universally recommended?	76.7%	23.5%

Majority of the dentists (75.7%) recommended eco-friendly dentistry, while 23.5% did not. Interestingly, only 25.2% used natural disinfectants like tea tree oil/thyme, while 74.8% did not. Furthermore, 79.3% of respondents did not recycle fixer and developer solutions from X-ray waste, and 78.1% disposed of mercury improperly.(Table 1,2).

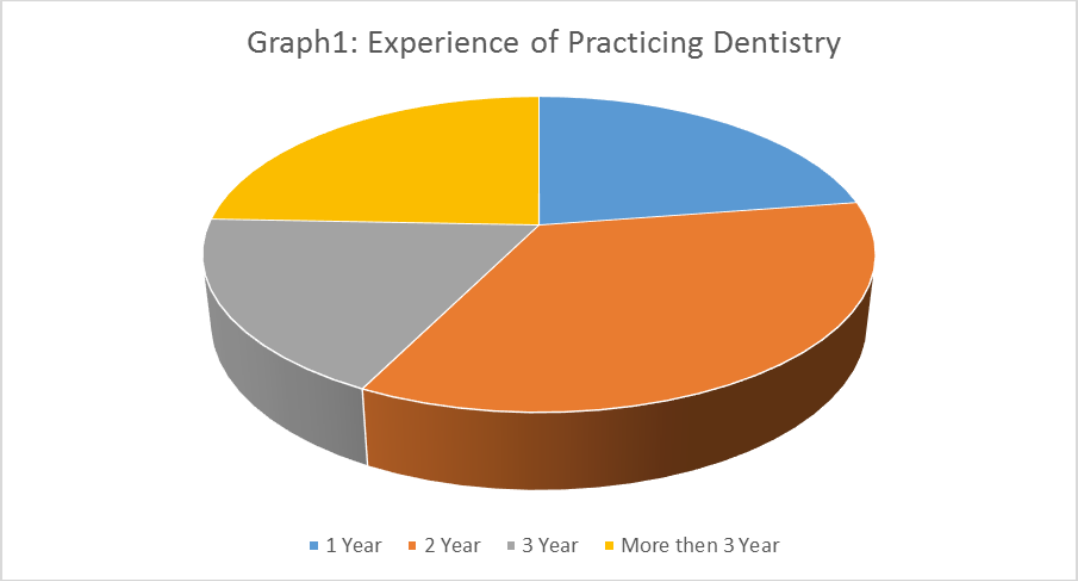
Table:2 Attitude and Practice regarding eco friendly dentistry:

Do you recycle the fixer and developer solution of X ray?	Yes=20.7%, No=79.3%
Do you use Tree oil/thyme/natural disinfecting agent?	Yes=25.2%, No=74.8%
Where you dispose mercury?	In liquid=21.9%, In Garbage=78.1%
What do you use an alternative to amalgam?	Composite=79.1% , GIC=20.9%

What do you use for energy management?	LED=69.6% , Normal light bulb=30.4%
Do you unplug all electric devices after use?	Yes=80%, Sometimes=12%, No=8%

What is your prefer methods of maintain patient records?	Digital Records=62.3% Paper Record=37.7%

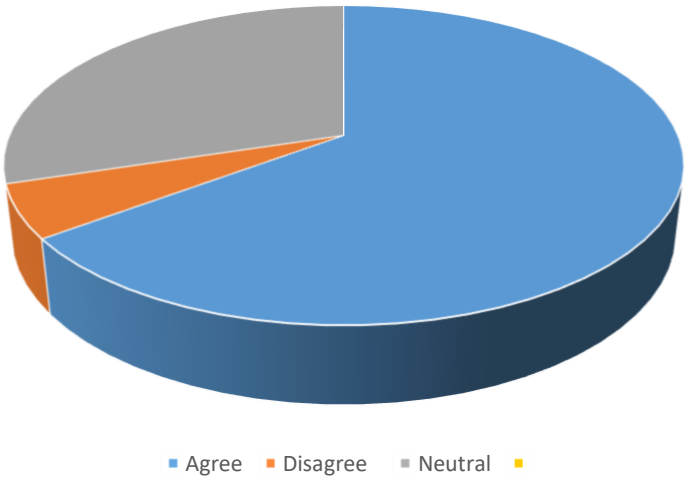
Do you reduce water wastage during hand wash?	Yes=57.4%, Sometimes=36.5%, No=6.1%
Which type of lab coats and patients drapes is being used in your practice?	Re-useable =45.2%, None Re-useable=26.1%, Both=28.7%



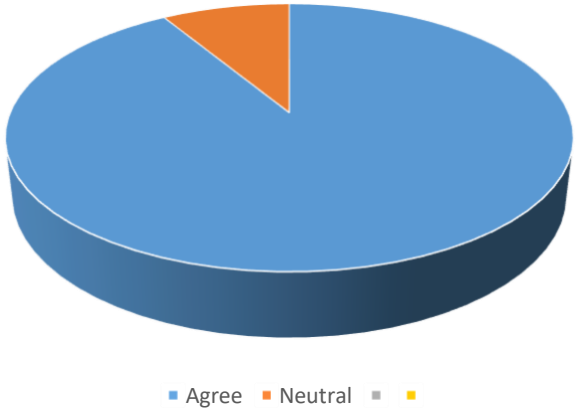
In terms of sustainable practices, 45.2% of respondents used reusable lab coats and patient drapes, while 26.1% used non-reusable, and 28.7% used both. Encouragingly, 69.6% used LED bulbs, reducing energy consumption. Additionally, 79.1% preferred composite as an amalgam alternative, while 20.9% used glass ionomer cement. Water conservation and energy efficiency were also assessed. While 57.4% reduced water waste during hand washing, 36.5% did so only sometimes. Moreover, 80% turned off electronic devices after use, but 12.2% did so only occasionally. The majority (62.3%) preferred digital patient records, while 37.7% still used paper records.

The survey highlighted the economic benefits of green practices, with 66.1% believing it was cost-effective, and 30.4% disagreeing.(Graph 2) Most importantly, 91.3% emphasized the need for formal education on green practices, underscoring the importance of awareness and training in adopting sustainable dentistry practices. (Graph 3).

Graph: 2 Response of dentists to shifting of dental practice to green practice would be more economical.



Graph 3: Response of dentists to formally educating dentist/dental students regarding green practice



Discussions:

Eco-dentistry has revolutionized the field, transforming it from pollution prevention to sustainability promotion. The enthusiastic response from participants was noteworthy, despite knowledge gaps in green practices. Most showed eagerness to transition their practices to eco-friendly dentistry, embracing a more sustainable future. (11) Our research revealed a notable disparity in eco-friendly awareness between students and consultants. A significant 57.9% of dentists demonstrated familiarity with sustainable practices, whereas 42.1% are clueless. This suggests a moderate degree of knowledge, although a large number of dentists require further education on sustainable dentistry procedures, while in previous study conducted in West India have less awareness, (51.8%) participant have no Knowledge about green dentistry .(13) The findings highlight the necessity of educational programs to increase awareness and comprehension of environmentally friendly behavior. Dentists recognize the environmental impact of amalgam and disinfectant solutions and a desire to implement them. Nevertheless, financial limitations pose a significant barrier to the widespread adoption of sustainable dentistry practices.(14) The majority of practitioners (55.8%) continue to utilize outdated paper-based record systems, whereas

44.2% have adopted computer-based systems. Transitioning to digital records not only minimizes paper waste but also increases record-keeping efficiency. (15,16) Approximately 79.3% of practitioners do not recycle fixer and developer solutions from X-rays, showing a lack of ecologically responsible disposal methods. Only 20.7% of these solutions are recycled. Another source of worry is mercury disposal, with 78.1% of practitioners throwing it out with ordinary waste, potentially causing environmental damage.(17) Only 21.9% use safer ways of disposal. These findings highlight the urgent need for tight regulation and training to enhance waste management in dental clinics which is same as previous studies.(17,18,19) The paper emphasizes that 74.8% of practitioners avoid utilizing natural disinfectants such as tree oil or thyme, while just 25.2% use these environmentally friendly choices. Approximately 45.2% of dentists utilize reusable materials, 26.1% use non-reusable products, and 28.7% combine the two. Increased usage of reusable materials might drastically minimize clinic waste. Furthermore, the usage of LED bulbs by 69.6% of practitioners is a positive step toward energy efficiency, as opposed to 30.4% who continue to utilize traditional light bulbs. The adoption of Glass Ionomer Cement as an alternative to amalgam restoration by 20.9% of practitioners is encouraging, but it highlights the need for more promotion of these materials which is same as previous studies .(20,21)
The majority (79.1%) continue to use amalgam, which poses environmental and health risks because of its mercury level. While 57.4% of dentists actively decrease water waste during hand washing, 36.5% only do so on occasion, indicating that there is space for improvement in terms of routinely adopting water-saving behaviors. Encouragingly, 80% of practitioners disconnect electronic devices after usage, indicating a strong commitment to energy saving which is same like mentioned in previous studies.(21,22,23) According to the report, 66.1% of dentists feel that moving to green practices is cost-effective since it takes fewer resources and infrastructure. However, 30.4% disagree, most likely owing to a lack of understanding or early investment worries. An astounding 91.3% of dentists stressed the need of officially teach practitioners about environmentally responsible dentistry.(24,25,26,27) Silver diamine fluoride (SDF) is a game-changer in pediatric dentistry, offering a effective, efficient, and environmentally sustainable solution for managing multiple caries in children.(28,29) The limitation of this study, sample size was informed by prior research, potentially introducing bias. The investigation focused on dentists, overlooking the crucial roles dental hygienists and assistants play in implementing eco-friendly strategies. The scarcity of literature on this topic restricts our analysis to the authors' perspective. Consequently, we recommend further global research within the dental community to address this knowledge gap. The dental profession must contribute to environmental preservation through sustainable practices. Integrating green dentistry into dental curriculum is essential for meaningful impact.

Conclusion:
This conclusion emphasizes the necessity of integrating sustainability into dentistry courses and ongoing professional development programs. The study's findings show that while dental practitioners in Pakistan are becoming more aware of eco-friendly dentistry, there are still gaps in implementation. Initiatives like formal training, the establishment of standard criteria, and raising awareness about the long-term advantages of sustainable practices are critical. Encouraging digital record systems, efficient waste disposal, and the use of sustainable materials may considerably enhance the dentistry industry's environmental performance

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Ethical approval obtained from the Bacha Khan Medical College, Mardan (Certificate No. 696/BKMC)
Participants Consent: Informed consent taken

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