



## Green Dentistry: The urgent need for sustainable dental practice

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### ABSTRACT:

Health care practice is currently environmentally, socially and financially unsustainable due to excessive amounts of CO<sub>2</sub>e (carbon dioxide equivalent) and waste production. It is strange that healthcare, whose primary purpose is to promote and protect health and life, contributes to climate change resulting in increasing mortality and decreasing quality of life, by engaging in unsustainable activities. Oral health care has until recently focused only on providing optimal patient care, without considering the impact on the environment. On the other hand, since it results in the production of a substantial quantity of waste, it has a significant influence on the environment.

However, there is a growing need for sustainability education and raising awareness at the individual, collective and industrial level. Climate change and environmental pollution are important global issues, leading humans to become ecologically conscious and to focus on Sustainable Development and preservation of natural resources for future generations. Accordingly, there is an urgent need for Dentistry as a profession, to integrate sustainable development goals into Eco-friendly practice. Eco-friendly dentistry needs urgently to adopt a sustainable strategy to encourage dentists to apply innovative tactics in an effort to minimize energy consumption and toxic waste amount. Reduce, Reuse, Recycle, and Rethink (the 4 R's) are the four pillars of dentistry's effort to reduce its environmental impact. There are a number of applicable and straightforward ways to lessen a dental office's environmental impact.

Our aim is not to address only the urgent imperative need for sustainability in Dentistry but also to provide a variety of practical suggestions for an eco-friendly dental practice.

**KEYWORDS:** Eco-friendly dentistry, Green Dentistry, sustainability, '4R' concept, climate change, potentially hazardous waste.

### INTRODUCTION

There is solid evidence that human activity causes global warming<sup>1, 2</sup>. Because of human activities and greenhouse gas emissions, global average temperatures have risen substantially above pre-industrial levels<sup>3</sup>. Climate change is one of the greatest threats to human health in the 21st century<sup>4</sup>. The environment has a substantial impact on health. Globally, climate change is expected to cause about 150,000 deaths per year, and between 2030 and 2050, this number will climb to 250,000 deaths per year<sup>5, 6</sup>.

Health care professionals are not serving their profession sustainably from an environmental, social, or economical perspective because of high CO<sub>2</sub>e (carbon dioxide equivalent) emissions and waste production<sup>7</sup>. Remarkably, according to Pichler et al., health care is responsible for 5% of the national total CO<sub>2</sub>e emissions are attributable to the health care<sup>8</sup>. Generally, oral healthcare has prioritized patient care above environmental effects. On a daily basis, various electronic dental equipment, excessive quantities of water, and a plethora of disposable items for preclinical, clinical, and post-clinical use are overconsumed<sup>9</sup> resulting in pollution, especially caused by single-use plastic products<sup>10</sup>.

According to the Eco-Dentistry Association (EDA)'s Dental Office Waste and Pollution<sup>11</sup>, dental practices in US generate, each year, 3.7 tons of mercury waste, 48 million lead foils<sup>12</sup> and 28 million liters of toxic X-ray fixer liquids. Moreover, they dispose of approximately 680 million light handle covers, chair barriers and patient bibs, as well as, 1.7 billion sterilization pouches and consume 57,000 gallons (259,000 liters) of water a year<sup>13</sup>. Because of the huge amount of energy and materials it consumes, dentistry has a substantial negative influence on the environment<sup>9</sup>. Hence, oral health practitioners must assess if they have a professional duty and social



responsibility to convert dentistry from an ecologically hazardous paradigm to a sustainable one<sup>9</sup>.

### BACKGROUND INFORMATION/ HISTORICAL PERSPECTIVES

The concept of sustainability began to permeate and transform our daily lives after the publication of the United Nation's report "Our Common Future" in 1983<sup>14</sup>. This Agenda includes a set of goals for people, the environment, and economic growth<sup>14</sup>.

The term of "green dentistry" was coined at the 32<sup>nd</sup> European Dental Students' Association meeting in Santiago de Compostela, Spain in September 2003<sup>15</sup>. There, was launched the approach of the environmental effect of the dentistry profession. It addresses<sup>16</sup> the merging of improved environmental knowledge and awareness in conjunction with the promotion of procedures, rules, and policies that are compatible with the EU's long-term development aim. The aim was to establish the collaboration and exchange of information on environmentally responsible dental practices in Europe and internationally.

On April 3, 2007, Dr. Ali Farahani and MittalaSuchak published the first worldwide project on eco-friendly dentistry<sup>17</sup>. According to this paper, Eco - friendly dentistry is an ecological approach of dentistry that uses resources sustainably, protects the environment by reducing or eliminating waste, and ensures the health and well-being of everyone in the clinical environment by avoiding inhalation of harmful chemicals<sup>17</sup>.

Dr. Steven Koos, Dr. Goran Kralj and MladenKralj, trademarked and officially defined "eco-friendly dentistry" on December 22, 2009<sup>18</sup>. They explained that green dentistry, through green design and operation, protects the health of patients and staff, protects community health and natural resources worldwide. Finally, World Dental Federation (FDI) published a document in August 2017 entitled "Sustainability in Dentistry", according to the 2030 Agenda for Sustainable Development of the United Nations<sup>19</sup>. Dentists are encouraged to include sustainable development goals into their practice and promote a change to a green economy. Natural resources and patient safety are priorities for oral health experts, who are also responsible for making sure that everyone has access to an optimum level of oral health<sup>20</sup>.

### BASIC ASPECTS

Sustainable development satisfies the needs of the current generation without compromising the capacity of future generations to

meet their needs<sup>21</sup>. Furthermore, the green economy significantly reduces environmental risks and ecological scarcities, while simultaneously enhancing human welfare. Also, sustainability is an environmentally friendly method for maintaining or continuing a process or enterprise while preventing the long-term depletion of natural resources<sup>19</sup>. Sustainability is based on three primary ideas<sup>22</sup>:

- environmental protection,
- economic growth, and
- societal equity.

Sustainability in Dentistry promotes "excellent oral health practices and ensures that all people have access to health services contributes significantly to the well-being of people all over the globe, and may also help to achieve environmental goals while also improving inclusive, productive, and healthy lifestyles"<sup>23</sup>.

Green dentistry has been defined by the Eco-Dentistry Association (EDA) as "a high-tech approach that reduces the environmental impact of dental practices and encompasses a service model for dentistry that supports and maintains wellness"<sup>11</sup>. "Green dentistry," as the Eco-Dentistry Association introduces, emphasizes environmental friendliness by focusing on reducing waste and pollution while, also, saving resources such as electricity and water. Hence, this term refers to the practice of dentistry utilizing technologies, procedures, and materials that do not harm the environment<sup>24</sup>.

### THE "4R" PRINCIPLE

Dentistry can diminish its environmental impact by following the "4R" principle (Figure 1), which stands for:<sup>25</sup>

- Reduce,
- Reuse,
- Recycle, and
- Rethink



Figure 1: The "4R" principle of Green Dentistry



Dentistry and dental hygienists becoming more environmentally friendly by adopting and putting into practice these four simple actions.

#### *Reduce*

Green dentistry involves waste reduction and pollution prevention. The amount of waste generated is directly proportional to the number of resources used. So, there is need to reduce the use of disposable items, reduce the waste of useful products and raw materials, as well as the air and water pollution caused by landfills and incinerators, respectively. Also, reduce electricity, water consumption, and paper waste in the dental office, will be helpful. Examples of dental office reduction opportunities: [35]

- Purchase frequently used products in bulk, such as resin composites, masks, and hand gloves.
- Request that supply companies consolidate orders to reduce shipping boxes.
- Using digital X ray instead of conventional system.
- Use of computers and digital technology for the creation, utilization, and storage of office records to reduce paper usage.
- Use energy-efficient lighting sources like LED lights and switching off the lights and computers when not in use saves us up to 10% of energy costs[18,33].
- Replace chemical sterilization with steam sterilization.
- Installing an in- office water distiller

#### *Reuse*

Promoting the use of reusable and biodegradable materials will conserve the resources and energy required to manufacture new items. This can be accomplished by encouraging the extended use of a product [15]. All dental clinic disposables can be substituted with the following:[9,26]

- Textile patient and chair drapes
- Hospital-grade cloth operator and sterilization technique
- Reusable metal suction tips and saliva ejectors
- Reusable and sterilizable instruments

#### *Recycle*

Recycling is an efficient method for minimizing environmental pollution<sup>26</sup>. Even though a big quantity of dental office waste ends up in landfills, a substantial portion of it can be recycled and reprocessed using simple segregation methods<sup>9</sup>. Recycling limits the use of resources in a new cycle of production and reduces the amount of waste that ends up in landfills<sup>27</sup>. Examples of dental office recyclables include:

- Aluminum, glass, plastic, paper and metal recycling.
- Recycling old and damaged hand instruments to other metal items.
- Sharps can be recycled into new building materials by using a sharps disposal service.
- Wear gowns and other personal protective equipment can be recycled<sup>28</sup>.
- Install recycling bins.
- Ensuring that amalgam waste is properly recycled by installing an amalgam separator<sup>29</sup>.
- Lead sheets, fixer, and developer solution waste from conventional X-ray system can be recycled<sup>30</sup>.

#### *Rethink*

The ideas of environmentalism and sustainability may be seen as mindsets<sup>13</sup>. Reconsidering every decision and action in the dental practice can help to develop a new mentality and strategy for altering the current procedures. Simple energy and water conservation measures help to environmental preservation and sustainable development<sup>31</sup>. Rethinking strategies can be used in a variety of dental clinic activities on a daily basis:

- Rethink sterilization by using environmentally-friendly disinfectants<sup>32</sup> and avoiding hazardous and toxic chemicals<sup>33</sup>.
- Rethink radiography by switching to digital radiology<sup>34</sup>.
- Rethink waste management by separating the waste into biohazardous or recycling<sup>27</sup>.
- Rethink office operations by the digitization of patient records<sup>35</sup>.
- Rethink energy by switching to sustainable and renewable energy sources<sup>34,36</sup>.
- Rethink building by using concrete instead of bricks, double-paned glass in windows and non-toxic, eco-friendly paints.<sup>16,30,37</sup>

#### **GREEN INNOVATIONS IN DENTISTRY**

Digital technologies offer early diagnosis and preventive therapies. Patients are subject to reliable, simpler, more convenient and cost-effective procedures. The following technological innovations are part of the sustainable future of dentistry<sup>11</sup>:

- Digital X-ray system.
- Steam sterilization.
- Computer-aided design/computer - aided manufacturing systems (CAD/CAM).
- Using laser hygiene technology for oral decontamination.
- Diagnosis of periodontitis using salivary samples.
- Digital oral cancer screening.



- Using of LED-operatory lights.
- Automatic lighting system.
- Digital impressions.

### ECONOMIC ASPECTS

According to the Eco Dentistry Association, the economic benefit of going green seems to be taken

into account<sup>11</sup>. The impact on the bottom line of implementing eco-friendly innovations is nearly \$50,000 for a dental practice every year in savings and return. Specifically:

Table 1: Annual return from environmental friendly processes<sup>11</sup>

Environmental friendly process	Annual return
Reusable cups	\$178
Cloth operatory and sterilization methods	\$2,337
Reusable metal suction tips	\$170
Resin composite restorations	\$37,000
Digital billing, charting, and x-rays	\$8,769
Energy-efficient light bulbs	\$601

### I. CONCLUSION

Concerns about dentistry's potential environmental impact have led many dentists to take voluntary steps to reduce their production and release of potentially hazardous waste for the environment. Thus, it is an ethical obligation for all dentists to take the lead in creating environmentally-friendly solutions. Green dentistry requests a multidisciplinary approach that promotes the highest possible resource efficiency in dental offices. It adheres to the principles of "4R": Reduce, Reuse, Recycle, and Rethink.

Today, with the aid of models developed by a variety of organizations, any dental office may implement several easy modifications in the clinical practice that will contribute to the development of a sustainable environment while simultaneously providing the community with great dental treatment.

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