S&S

Senses Sci 2019: 6 (4) 922-928
doi: 10.14616/sands- 2019-6-922928

Article

How dentistry is impacting the environment

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Abstract. In march 2019, the European Parliament has voted for a ban of single-use plastics to come into force by 2021 in all EU member states. Europe is setting new and ambitious standards, paving the way for the rest of the world. Dentistry aims to diminish its environmental footprint by adopting the 4R's concept (reduce, reuse, recycle, rethink) and through the switch to eco-friendly home oral hygiene products.

Keywords: Green-economy, Green-dentistry, Eco-friendly dentistry, Environmental impact, Plastics.

Introduction

Every year, Europe (EU) generate around 25.8 million tonnes of plastic waste, but less than 30% is recycled (1). Of this amount, an important portion leaves the EU to be treated in third countries, with different environmental standards (2).
In the EU, the potential for recycling plastic remains largely vacant. Recycling of end-of-life plastics is very low, especially when compared with materials as paper, glass and metals.
Globally, 5 to 13 million tonnes of plastics — 1.5 to 4% of global plastics production — end up in the oceans every year (3). It is estimated that plastic accounts for over 80 % of marine litter. Plastic debris is transported by marine currents, sometimes over very long distances. It can be washed up on land, degrade into microplastics or form dense areas of marine litter trapped in oceans (4). UNEP estimates that damage to marine environments is at least USD 8 billion per year globally.

In the EU, 150 000 to 500 000 tonnes of plastic waste enter the oceans every year (5).This represents a relatively small proportion of global marine litter, but European plastics ends up in defenseless vulnerable marine areas, such as the Mediterranean Sea and fragments of the Arctic Ocean.

This phenomenon is worsened by the increasing amount of plastic waste produced each year, and also by the growing consumption of 'single-use' plastics (small packaging, bags, disposable cups, lids, straws and cutlery) that are rarely recycled and prone to being littered.

In march 2019, the European Parliament has voted for a ban of single-use plastics to come into force by 2021 in all EU member states. Europe is setting new and ambitious standards, preparing the way for the rest of the Continents (6).

In this world scenario, World Dental Federation published in August 2017 a document entitled "Sustainability in Dentistry" (7), based on the 2030 Agenda for Sustainable Development of the United Nations. Transforming our world: the 2030 Agenda for Sustainable Development (8). Dentistry as a Profession is advocated to incorporate sustainable development objectives into daily practice and encourage a shift to a green economy. Oral health professionals take responsibility to reduce their impact on natural resources and at the same time as promoting optimal oral health for all people and maintaining patient safety (9). "The concept of sustainable development is based on three main pillars: the environment, the economy and society. The promotion of good oral health habits combined with the access of all people to health services together make a significant contribution to the welfare of populations around the world and could also contribute to achieving environmental goals as well as enhancing inclusive, productive and healthy lives" (10).

In addition to the dental office team, sustainability in dentistry includes many stakeholders who all have a role to play, i.e. national governments, scientists, universities, manufacturers, distributors, dental technicians, waste collectors and processors. The Federation Dentaire International (FDI) and the National Dental Associations (NDAs) have a key role for coordinating work and interacting with authorities to advocate activities related to sustainable development.

The aim of the present study was to evaluate the environmental impact of dentistry relying on searches of Literature and, as reported in a recent review, as data in Literature are limited on this subject, online websites and social media were considered a source of information for this article (11).

Eco-friendly dentistry

The "eco-friendly dentistry" term was used for the first time in a publication in 2007 by Dr. Ali Farahani and Mittale Suchak from University of Waterloo, Canada (12). The Authors defined it as an "approach to dentistry that implements sustainable practices by keeping resource consumption in line with nature's economy, by safeguarding the external environment by virtue of eliminating or reducing outgoing wastes and by promoting the well-being of all those in the clinical environment by conscious reduction of the chemicals in the breathable air" (12).

In our opinion, when it comes to eco-friendly dentistry, two different aspects of the same issue must be reconsidered: the dental office and the oral hygiene procedures carried on at home.

Dental office

A very recent systematic review by Sunali S. Khanna on the ecological dental practices included 19 original research studies (11). Out of these, 8 were questionnaire-based assessing the knowledge, awareness and implementation of green dentistry strategies; 5 studies aimed to evaluate the effects of amalgam exposure to dental patients and practitioners, while 6 studies were about the environmental impacts of disposable vs. reusable and recyclable materials in the dental office. Sunali showed also that, while various dental personnel and students possessed interest in eco-friendly alternatives, the concept of "green dentistry" was not well understood and criticism was addressed to the lack of clear guidance. When the theoretical concepts are not well understood, putting them into practice becomes even more difficult (11).

According to the Eco-Dentistry Association (EDA)'s Dental Office Waste and Pollution, each year, "dental offices generate 4.8 million lead foils, 28 million liters of toxic X-ray fixer, 3.7 tons of mercury waste, 1.7 billion sterilization pouches and over 680 million chair barriers, light handle covers and patient drapes. The average dental practice uses 57,000 gallons of water each year. With these facts, it is established that dentistry has a great impact on the environment and changing these principles and practices toward a greener environment is the need of the hour" (13).

The practice of green dentistry is based on the model of four R's—Reduce, Reuse, Recycle and Rethink. **Reduce** When reducing the amount of utilized resources we reduce directly the amount of generated waste. In the dental office it is possible to reduce the electricity and the water consumption, and the paper waste. **Reuse** Reuse an item extends its life and avoids the item to contribute to waste volume. Starting to use reusable and sterilizable instruments, suction tips, patient and chair drapes and water cups it is possible to largely reduce the plastic amount generated by disposable equipment use. The plastics in dental office are non-biodegradable petroleum-derived plastics and end up in landfills, thus polluting the environment for centuries (14). **Recycle** Glass, plastic, paper, aluminum and metals like steel can be easily recycled. Although a substantial percentage of the dental office waste ends into landfill, a lot of it can be recycled and reprocessed with easy segregation techniques (15). Recycling permits to: i) limit the use of resources in a new productive cycle; and ii) reduce the amount of waste ending into landfills (16). **Rethink** Rethink all the operative strategies in the dental office in the light of sustainability and environmentalism, may help in water and energy reduction.

There are several everyday activities where this concept may be applied: i) rethink energy by switching to sustainable and renewable energy sources; ii) rethink building through a green-architecture; iii) rethink office operations through a comprehensive digitalization of all the procedures where data are collected; iv) rethink waste management with a huge attention to waste segregation, v) rethink sterilization with steam sterilization being preferred over the cold and chemical one; vi) rethink radiology by switching to a digital radiology (**Figure 1**). Also an amalgam-free dentistry is a goal to be achieved in the next future (17) (18).

The cited studies proved that it is possible to reduce the dental office's environmental footprint by adopting simple alternatives and implementing environmentally inclined waste management strategies.

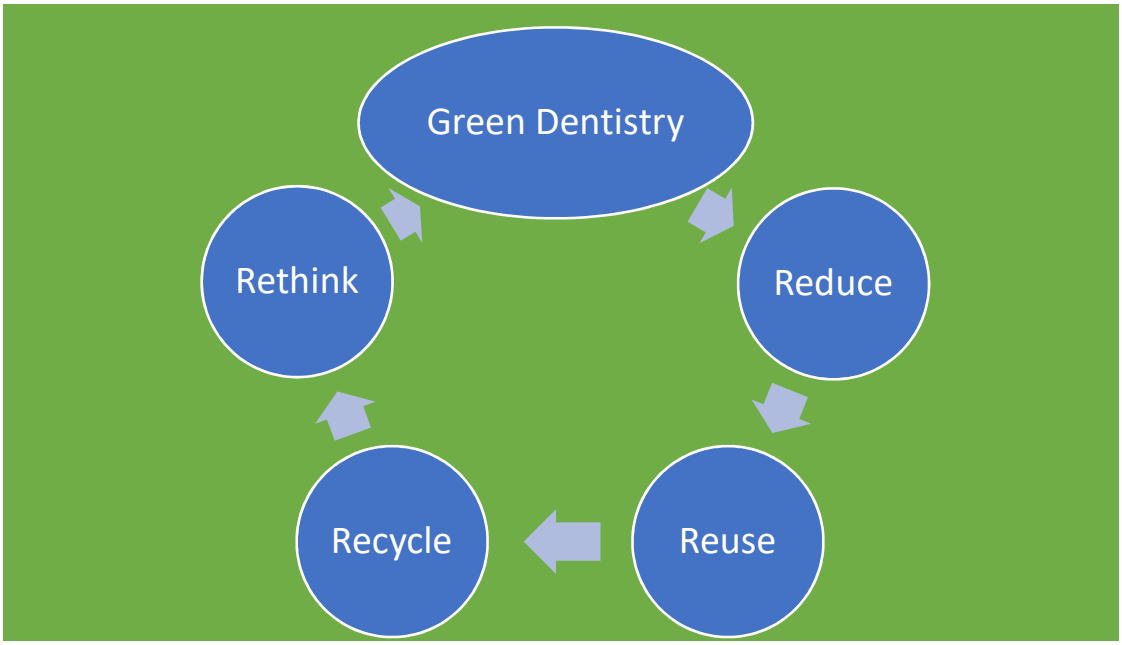

Figure 1. The 4 R's of Green Dentistry

Home oral hygiene products

Several searches were performed to find data in Literature on the impact of oral hygiene products (toothbrush and dental floss). Scanty data were available in the search engines like PubMed, Google Scholar and Scopus. Therefore, the Authors searched data using the Google platform.
Most of the available information focused on the environmental impact of toothbrush and on green alternatives. Precise data on Italian market were not available, as only estimates of consumption were found by search. Italian dentists recommend changing toothbrushes every 2 to 3 months, with 4 toothbrushes per year for approximately 50 million consumers in Italy. About 200 million pieces are expected to be sold, while only 90 million are sold per year, in Italy.

More detailed data were available about the US market, where 1 billion toothbrushes are thrown away every year and this amount is enough to run around the Earth four times. 50 million pounds of toothbrushes are added to landfills in the US annually. As manual toothbrushes are produced with larger handles, then the amount of derived plastic waste in landfills will only increase over time.

Toothbrushes are made from propylene plastic and nylon, which are sourced non-renewable fossil fuels. The bristles are made from nylon, and manufacturing it creates nitrous oxide, a greenhouse gas 310 times more potent than carbon dioxide. The handle is made of polypropylene plastic, and when discarded isn't recycled and it doesn't biodegrade (**Figure 2**). These plastics will not break down in a single generation; often they migrate from landfills and finally end up in the oceans. The quantity of plastic in oceans is expected to triple in a decade. Around 150 million tons of plastic are already floating in the oceans' water, with an additional eight million tons entering the

water each year, according to the World Economic Forum. It's estimated that by 2050 there will be more plastic than fish in the oceans. The same concept may be used when talking about dental floss, that is 100% nylon made (19) (20) (21) (22).

Figure 2. The environmental impact of plastic toothbrush

There are several green alternatives and they are widely marketed in the US, in Europe and in Australia. Eco-friendly alternatives for toothbrushes may be: i)wooden toothbrush with pig bristles, 100% biodegradable, not suitable for those with ethical concerns or vegan; ii)wooden toothbrush with nylon bristles, that have to be separated and thrown in the mixed waste; iii)silicone based toothbrushes; iv) plastic handle toothbrushes with changeable bristles. Alternatives for nylon dental floss may be: i) silk and candelilla wax floss, contained in glass and aluminum dispensers with floss-refills on sale; ii) silk and beeswax floss, in a cardboard or bio-plastic box, that are completely biodegradable (23).

Conclusions

In conclusion, consciousness about the environmental impact of oral hygiene products should increase among stakeholders and who have a role to play, including national governments, scientists, educators, manufacturers, distributors, dental equipment technicians, waste collectors and processors. Plastic toothbrushes and nylon dental floss should be considered as single use disposable plastics, with the hope that their use will be prohibited in the next future. On the other side, manufacturers, universities, those who spread the knowledge and those who educate, should concentrate efforts on the development and production of sustainable and eco-friendly alternatives

with proved clinical efficacy. There isn't an alternative planet to replace the existing one, for this reason awareness of our environmental footprint must be everyone priority.

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