International Journal of Environmental Trends (IJENT)
http://dergipark.gov.tr/ijent
International Journal of Environmental Trends (IJENT)
2023; 7 (2),88-100
ISSN: 2602-4160
Turkish JournalPark ACADEMIC

Review Article

Green Dentistry: Sustainability In Dentistry

C. Soğancı*[1]

[1] Meram Oral and Dental Health Center, Konya, Turkey (*ORCID Number:0000-0002-8701-7299)*

Received
29 October 2023

Accepted
20 December 2023

Keywords
Green dentistry
Eco-friendly dentistry
Sustainable dentistry
Sustainability

Abstract

An approach in the relatively new field of "green dentistry" is to reduce the harm that dentistry causes the environment. The majority of dental office waste is caused by four processes: Amalgam, traditional vacuum suction systems, enfection control techniques, disposable supplies and standard X-ray equipment. Numerous dental materials damages nature and leave carbon footprints. Choosing recyclable or reusable materials is so significant. This review attempts to take attention to the issues that dentistry affects the environment and outlines actions that dental professionals can decrease the amount of general and potentially hazardous waste that is produced.

YEŞİL DİŞ HEKİMLİĞİ: DİŞ HEKİMLİĞİNDE SÜRDÜRÜLEBİLİRLİK

Anahtar Kelimeler
Yeşil diş hekimliği
Çevre dostu diş hekimliği
Sürdürülebilir diş hekimliği
Sürdürülebilirlik

Özet

Henüz yeni bir alan olan "yeşil diş hekimliği"ndeki yaklaşım, diş hekimliğinin çevreye verdiği zararın azaltılmasıdır. Diş hekimi muayenehanesi atıklarının çoğunluğu şu dört uygulamadan kaynaklanmaktadır: Amalgam, geleneksel vakumlu sakşın sistemleri, enfeksiyon kontrol teknikleri, tek kullanımlık malzemeler ve standart X-ışını ekipmanları. Diş hekimliğinde kullanılan çok sayıda malzeme doğaya zarar vermekte ve karbon ayak izi bırakmaktadır. Geri dönüştürülebilir veya yeniden kullanılabilir malzemelerin seçilmesi çok önemlidir. Bu çalışma, diş hekimliğinin çevreyi etkilediği konulara dikkat çekmeye çalışmakta ve diş hekimlerinin potansiyel olarak tehlikeli atık miktarını azaltabilecekleri eylemleri özetlemektedir.

[1] Corresponding Author Email: cemilesoganci@gmail.com

INTRODUCTION

The color green is said to be the most calming and peaceful color and has therapeutic properties. Stability, endurance, and vision can all be improved by green. This color is associated with hope, renewal, and development. It also symbolizes safety in the marketing of medications and healthcare items.

The aim of the dental profession is to maintain and improve oral health and wellbeing. Dentists employ a range of equipment and supplies to achieve these goals . Unfortunately, a few of the products that are already in use, such as heavy metals like mercury, might cause environmental risks.

Green dentistry is a method of dentistry that incorporates environmental preservation with dental procedures. The main ideas of a green dentistry practice are to conserve energy and water, use non-toxic materials, reduce the amount of waste, get rid of hazardous pollutants that harm patients and the environment, and support "green" products.

Eco-friendly dentistry is a rapidly developing area of dentistry that includes an approach to sustainability, preventive care, prudence, and a minimum invasive patient- and world-centered treatment doctrines.

RESULT AND DISCUSSION

Describe Green—Eco-Friendly Dentistry

Dr. Ali Farhani [3] defines "green dentistry," also known as "eco-friendly dentistry," 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 consciously reducing the chemicals in the breathable air."

A green group of dentists, Drs. Goran Kralj, Steven Koos, and Mladen Kralj, patented and trademarked the term "eco-friendly dentistry"[4]. By using green design and practices, "eco-friendly dentistry protects the immediate health of patients and dental staff, the health of the surrounding community, the health of the global community, and natural resources," according to their description.(4).These concepts are based on the principle of sustainable development [5]. Green dentistry is described 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" by the Eco-Friendly Dental Association.

Eco-friendly dentistry aims to reduce the harmful effects of chemicals on the environment and increase patient understanding of sustainability and the environment. It's a dental strategy that minimizes waste and resource consumption in order to promote sustainable practices. Additionally, eco-friendly dentistry tries to increase dental life expectancy.

Why is eco-friendly dentistry important?

By fostering an eco- friendly environment, this method helps in sustaining harmony between the patient and the dentist. The Eco Dentistry Association (also known as "green dentistry") suggests that minimizing waste and pollution, conserving energy, water, and finances, incorporating cutting-edge technology, emphasizing wellness, and utilizing integrative techniques are all essential.

Four A’s Of Green Dentistry

It is suggested that a management tool be created to guarantee the greater promotion of environmentally friendly dentistry.

Four A's management protocol: Ask, Assess, Advice and Assist the dentists. Its sustainability in dentistry may be ensured in this way. The four A's, which were taken from tobacco cessation programs [7], can be used to eco-friendly dentistry in the theoretical ways that follow:

a. Ask – Ask the dentist for all the information on his regular dental procedures.
b. Assess – Assess what procedures may be changed to support environmentally friendly dentistry;
c. Advice – A clear set of principles that are achievable and
d. Assist – When creating a framework, consideration should be given to the local environmental factors at the dental clinic or hospital.

Dentists are essential in fostering and developing an eco-friendly environment. Dentists need to understand that in order to be community-friendly, they must work to create eco-friendly conditions in their clinics. Every dentist should evaluate their current infrastructural arrangements, materials chosen, and treatment style. In the event of a major dental institution, the administration should also evaluate these aspects. Following an evaluation of the references [6–9], they ought to adjust the current state of affairs in accordance with the principles recommended by the eco-friendly association. The dentists themselves could try the 4 A's management tool.

Four R's of Eco-friendly Dentistry

Green dentistry is an integrated approach to dental care that reduces the harm that dentistry does to the environment while still providing patients with a comfortable and caring environment. The four R's model—Rethink, Reduce, Re-use, and Recycle—is the foundation of this approach[8].

a.Rethink — It's advised to buy fewer items (only what is required), choose ecologically friendly products, or purchase from companies that take environmental awareness seriously by offering ethical working conditions, a sustainable supply chain, and an open list of raw material and chemical suppliers.

b.Reduce — Minimize the use of dispossible materials. Paper waste can be reduce by double-sided printing and using digital communication. Also using digital X-ray machines and suitable filling materials to amalgam reduce the amount of chemicals and heavy metals [10]. Reducing energy and water use would protect the environment and also would bring financial gain for the practicers[11].

c.Re-use — Using sterilizable dental materials will reduce the amount of waste by allowing repeated use.

d.Recycle — According to guidelines from the British Dental Association, dentists must classify waste products as hazardous (including clinical waste), non-hazardous, or objectionable and record how each is handled in the office[12]. Thus making recycling easier.

In recent times, 'energy recovery' and 'molecular redesigning' have also been added to make up the five R's[13].

Processes Responsible For Waste And Pollution In Dentistry

Even while individual dentists only produce little amounts of waste that harm the environment, the combined waste produced by the dental profession may have significant effects on the environment.

The four processes responsible for most of the dental practice waste and pollution are [14] ; Placement and removal of mercury — and other heavy metals — containing dental material, Conventional X-ray systems, Infection control methods including disposable

barriers, sterilization items and toxic disinfectants and Conventional vacuum saliva ejector systems.

1. Placement and removal of mercury — and other heavy metals — containing dental material.

Mercury: For almost 150 years, mercury included dental amalgam restorative material used in dentistry. [15]. Dental amalgam waste produced by dentists has contaminated water systems with heavy metals, which has been a major problem in recent years. Dental amalgam includes 50% mercury along with silver, tin, lead, and other elements that can damage the environment [20–23], while being a strong, cost-effective, and long-lasting restorative material [16–20]. As it is recognized to be hazardous to people, animals, and plants, mercury is known to bioaccumulate [20, 24-27]. Dental amalgam is connected with elemental and inorganic forms of mercury [28, 29], which are less toxic than organic forms of mercury, which may be the reason why the scientific literature is unable to establish a causal association between dental amalgam and harmful health consequences.

Dental Amalgam Waste Products And Best Management Practices

Various waste products are produced during the placement and removal of dental amalgam restorations [34, 35]; elemental mercury vapour, dental amalgam scrap, amalgam waste and amalgam sludge.

Since the behavior of dental amalgam components in the environment is not fully understood, source removal and reduction [34, 36–39] are our strongest lines of defense against environmental mercury contamination [24, 34, 37, 40].

Precapsulated dental amalgam is suggested for usage by practitioners to lower the danger of a liquid mercury spill or environmental pollution from clinics. In certain cases, other restorative materials such as composite resin, ceramic, or other metal alloys may be used [34, 35, 38, 41,42].

Practitioners are legally responsible for the collection, storage and disposal of amalgam particles [21, 36, 43, 44].

After it is collected, mercury and dental amalgam trash should be disposed of in the same way as other hazardous waste; personnel handling amalgam waste should be properly educated and use gloves, masks, gowns, and protective eyewear [34, 35, 38]. As dentists it is our duty to make sure the trash haulers we use are authorized to handle the garbage we generate and are registered. Waste storage containers should be collected for reclamation by a registered agency [21, 22, 24, 31, 34, 35, 37, 38, 47] and ideally, these wastes should be recycled [22, 35, 36].

Dental professionals should dispose of dental amalgam in a safe and responsible manner; they should not dispose of amalgam-containing materials in regular trash or waste that will be burned [18, 21, 22, 31, 37, 38, 47]. They should also avoid rinsing chair-side traps or vacuum filters in sinks.

Silver: Another heavy metal that can get into our water system is silver, which can happen when dental office waste is not properly disposed of. Silver is a component of dental amalgam and radiographic fixer contain silver thiosulfate, this presents environmental concern [22, 38].

Lead: The lead shields that are included in every film packet are another consequence of conventional radiography. Lead is persistent in the environment and hazardous, much like silver and mercury [22, 49]. To recycle the lead shields from film packages, all that has to be done is gather them and send them back to the manufacturer on a regular basis [22, 38, 49].

Biomedical Waste

Biomedical waste comprises substances that have the potential to spread illness or are suspected of containing harmful organisms [52]. It does not include extracted teeth, but it

does include gauze drenched in blood, tissues, and syringes [52, 53]. Biomedical waste items that are not sharp should be kept in a yellow bag labeled appropriately with a biohazard symbol. Syringes and suture needles, which are considered sharps, should not be placed in bags with other general or biomedical waste materials. Instead, they should be kept in a container that is leak-proof, puncture-resistant, and appropriately labeled until they are collected and disposed [38].

2. Conventional X-ray systems.

Conventional film X-rays were employed in all traditional dentistry practices. Lead and silver are two major environmental dangers associated with this technique.

The following are some strategies to stop the pollution caused by X-ray waste: collect waste lead, utilize filter used fixer, dilute developer (if needed), use developer cleansers without chromium in the system, recover and recycle X-ray film as scrap metal, and switch to digital imaging.

Dental radiographs are increasingly being obtained using digital imaging thanks to recent advancements in radiography technology. Its benefits include lower radiation exposure and no chemical picture processing [22]. Consequently, the quantity of silver waste produced in the dental office may be significantly decreased by implementing digital imaging.

3. Infection control methods including disposable barriers, sterilization items and toxic disinfectants.

Dental professionals use a variety of disposable items, including as latex gloves, disposable bibs for patients, head rest coverings, syringes, plastic pouches, and plastic suction tips.

To avoid pollution, dispose of these disposable products [22] and replace them with cloth operatory, reusable cups, head rest coverings, reusable metal suction tips, cloth patient bibs, and cloth sterilizing techniques.

In order to make the dental office greener, dental personnel can also use a number of different strategies. Reusable plastic containers, such as those used for cleaning and disinfection treatments, can be used to store items with less packaging and reduce the amount of general trash produced [38]. Paper towels, cotton or wool rolls, and other products that are partially or completely recycled can also be utilized [22, 38, 56]. Office energy usage may be reduced using energy-efficient lighting and climate control. [22].

4. Conventional vacuum saliva ejector systems.

Dental vacuum systems, sometimes referred to as saliva ejector systems, are an essential piece of equipment in every dental practice. Regrettably, the excessive water consumption of these dental vacuum systems results in waste and contamination of the water supply[57]. Therefore, using a dry vacuum system is imperative today.

Eco Friendly Green Dentistry: The Future Of Dentistry?

The arena of holistic dentistry, often referred to as natural dentistry, unorthodox dentistry, progressive dentistry, or biocompatible dentistry, is a forward-thinking area of both medicine and dentistry that focuses on harmonization. Holistic dentistry placed a strong emphasis on preventive dental treatment and stated that it should take into account the significance of dental and oral health within the context of the patient's ideal somatic as well as demonstrative or transcendent health. Despite the diversity of practices and methods within the holistic dental community, some commonalities include a strong opposition to the use of

conventional materials like amalgam in dental fillings, nonsurgical methods for treating gum disease, and the belief that the patient's systemic health may be at risk due to the possibility of entombed microorganisms spreading from the root canals into the body. Many dentists who employ these phrases also have negative opinions about the use of fluoride in preventive [58].

A holistic consultant may treat a patient with any type of medical treatment, including traditional drugs and alternative therapies. In addition to using medication to address symptoms, the treatment strategy may or may not include introducing lifestyle changes to assist stop the problems from getting worse.

In instead of just treating the patient's "teeth," holistic dentistry recognizes and treats the patient's mind, body, and spirit. Its foundational principles include avoiding and eliminating toxins from dental materials, providing the right nutrition to prevent and reverse decaying dental disease, treating gum disease at its biological source, and treating malocclusion.

Like medicine, dentistry is based on extensive scientific study. The unsupported use of some services and treatments—many of which have either been studied and determined to be useless or have not been sufficiently studied to be deemed safe and effective for practice—is a major point of criticism leveled by holistic dentistry. For instance, herbal toothpaste and mouthwash are frequently suggested as a preventative measure or a treatment for certain dental issues. Because they are "natural," these items are said to be safer. There isn't much scientific evidence to back up these therapies, though, and herbal remedies have actually been shown to affect the safety of longer or more invasive dental operations. They can also cause extra problems if they combine with a patient's existing prescriptions.

Green dentistry is a whole-earth strategy for dental treatment that reduces the harm that dentistry does to the environment and fosters patient care [57].

Above all, dentistry is a healing profession. Today's world makes it imperative that we understand the importance of being environmentally conscious in all facets of our lives, including dentistry, which has a significant impact on the environment due to the significant amount of metallic waste generated by various dental procedures as well as the excessive use of water and electricity. This emphasizes the movement toward "green dentistry.". With the application of modern strategies and procedures, green dentistry is an innovative approach to dental care that is both environmentally friendly and cost- and time-effective. It reduces waste, energy, and pollution. Consequently, holistic or "green" dentistry guards against the negative effects of urbanization while also preserving human health.

Where Is Sustainability Relevant To Dental Practice?

It is mostly unknown how and what dental teams may do to have an influence in their day-to-day professional life, despite the fact that many dental professionals are interested and do play a role. There are probably a lot of reasons for this, chief among them being a lack of knowledge brought about by a dearth of research funds and, therefore, a lack of data to share with patients and the dental community.

It is important to motivate clinicians to investigate and bring about changes to their therapeutic practices that will make them more ecologically conscious.

The carbon footprint may be used to assess how human activity affects the environment and to demonstrate sustainable and prudent resource management. It has a stronger effect on climate change the higher the carbon footprint [60], it is the total of the emissions that every supply chain participant produces [61, 62]. Measuring and reducing the environmental impact of medical technology is a necessary step [63].

The World Health Organization (WHO) recommendations declare that it is the ethical duty of every state to safeguard public health via ecologically responsible actions [64]. Dentistry as a profession should promote the shift to a green economy and integrate

sustainability goals into daily practice, according to the World Federation of Dentists (FDI) [10]. Performing medical tasks in a sustainable way ought to be a moral requirement for oral health care practitioners [65].

Prevention

Preventing oral and dental diseases is the single most essential way to increase sustainability in dentistry. By doing so, waste creation, travel, and the manufacturing and usage of dental materials would all be decreased.

Travel

Patients, dentists, and their teams must travel in order to receive dental treatments; moving established facilities would be costly and unfeasible; workers must also travel in some capacity in order to receive dental care. There are situations where using technology can eliminate the need for travel, as was the case during the COVID-19 epidemic. Online meetings, conferences, and educational courses are just a few examples of work-related and professional activities that have been proven to operate rather well, enhancing participation and facilitating access.

Dental materials

Numerous restorative materials have an effect on the environment. By human excretion into the surrounding environment, the placement and removal of resin-based composite restorations produce microparticle pollutants that have the potential to pollute the waste system [66]. Mercury waste is harmful to the environment, yet amalgam is still used extensively in dentistry because of its flexibility as a restorative material. Since composite and amalgam materials constitute the foundation of restorative and aesthetic dentistry, disease prevention is essential to the sector's transition to a more eco- friendly one [67,68].

Dental products and procurement

An essential component of the profession's capacity to have a beneficial environmental influence is the notion of sustainable procurement. Sustainable practices should be included into the manufacturing and distribution processes of manufacturers and suppliers as part of their common environmental responsibility. Transparent disclosure of information on the materials and manufacturing processes used in the production of their products is one suggested strategy for fulfilling this obligation. It should be simple to obtain this information so that physicians and practice owners may outfit their offices and inventories with greater knowledge.

Waste management

Additionally, "waste minimization," or reducing trash at the source, is promoted by green waste management through the following methods: Material replacement, alteration, or removal. Material replacement, alteration, or removal, changes in technology or procedures include the use of non-mercury substitutes, the replacement of chemical-based cleaners with ultrasonic or steam cleaning, etc., optimal operational procedures, Preferential purchasing practices, such as choosing suppliers with minimal packaging [69].

A good, sustainable alternative for dentists is offered by waste management firms that are recognized and produce heat or power from trash, occasionally even recycling the waste streams [70].

Green energy

Practices might invest in property insulation, monitor energy consumption, and move to green energy providers. Using renewable energy sources to generate electricity, including solar panels and ground source heat pumps, would cut down on emissions caused by burning fossil fuels. The writers admit that putting some of these recommendations into practice would have clear practical and financial impacts and that government funding would be essential to the success of any such initiatives.

SUSTAINABLE DENTISTRY

Dentistry is a constantly evolving branch of Medicine. The Dentistry profile of the next decade is shaped on the basis of technological innovations, market expectations and policy guidelines in the European/World context.

The first goal is to transform Dentistry into a green transition. In fact, the World Dental Federation published a document called 'Sustainability in Dentistry' in August 2017, based on the United Nations 2030 Agenda for Sustainable Development. Transforming Our World: The 2030 Agenda for Sustainable Development (1). The document recommends that Dentistry takes sustainable development goals into account in its daily practice and support the transition to a green economy. Oral health professionals should reduce their impact on natural resources while promoting optimal oral health for all people and protecting patient safety [71].

Using innovative technology can help minimize the effect of the dentistry profession, for instance, the use of intraoral scanners reduces environmental effect because they are no longer in use and need no disposal of chemical imprint materials such silicones and pastes [72]. Also, the development of dental diagnoses based on radiological exams and photographic pictures is aided by the application of artificial intelligence techniques [73].

Regarding pharmaceutical regimens that assist dental care, sustainability is a crucial concern as well. One such instance of a recognized danger to global health, development, and sustainable development is the overuse of antibiotics and resulting sharp rise in antibiotic resistance [74].

In this situation, research on the oral microbiome also contributes significantly to our understanding of the dynamics of the oral environment in both health and sickness, opening our eyes to fresh insights into the microbial causes of oral diseases [75, 76]. The quest for novel ingredients that may be included in toothpaste and mouthwash formulations, including Camellia sinensis extract or naturally occurring olive oils that have been ozonated, is based on the recognition of the qualitative and quantitative diversity of the oral microbiota as a predictor of health. Probiotics have also been demonstrated to be useful in supporting dental health [77, 78]. Promising outcomes have been observed in a variety of settings, including dental traumatology, oral pathology, and oral surgery, when holistic approaches like photobiomodulation and kinesiology are employed [79, 80].

Thus, it is certain that the patient, the dentist, and the environmental sustainability will all profit from dental advancements throughout the next decade.

CONCLUSION

By integrating dental innovations, green dentistry reduces supply costs and increases productivity through efficient use time, reducing waste and preventing pollution. As a result, patients benefit from quality treatment with reduced treatment costs. Dentists have become increasingly concerned about the potential impact of dentistry on the environment and often take voluntary measures to reduce the production and release of environmentally unfriendly waste from their practices. As health practitioners, we must be concerned with promoting not only human health and well-being, but also the environment. A proactive approach will

ensure the success of our profession in a period when public environmental concerns are increasing and legislation protecting the environment is increasing. Providing dental services that are in the public interest with minimal harm to the environment is not only our legal obligation, but also our moral and ethical obligation.

REFERENCES

[1] Color meaning. Retrieved from http://www.bourncreative.com/ meaning- of –the color-green. Accessed. (October 2013).
[2]What is eco – friendly dentistry? Retrieved from http://www.orasurgery.com/ecofriendly/want-is-eco-friendly.php.
[3] Farhani A, Suchak M. Eco-friendly Dentistry: The environmentally-responsible dental practice. University of Waterloo, 2007. Available at http://c.ymcdn.com/ sites/www.ecodentistry.org/resource/resmgr/docs/ecofriendly_dentistry_jcda.pdf (accessed January 2017).
[4Koos S. Eco-friendly dentistry. Available at http://www. dentistryiq.com/articles/2010/01/eco-friendly-dentistry. html (accessed January 2017).
[5] United Nations. Report of the World Commission on Environment and Development – General Assembly Resolution 42/187. 11 December 1987. Available at http://www.un.org/documents/ga/res/42/ares42-187. htm (accessed January 2017).
[6] Eco Dentistry Association. About green dentistry. Berkeley: Eco Dentistry Association, 2013 [cited 2013 Nov 11].Available from: http://www.ecodentistry.org? about green dentistry
[7] Passi S, Bhalla S. Go green dentistry. J Educ Ethics Dent. 2012;2(1):10–12.
[8] Pockrass F, Pockrass I. The four "R's" of Eco-friendly dentistry. Am Dent Hyg Assoc. 2008;22: 18-21.
[9] Tobacco Free RNAO. Brief Intervention: the 4 A's. 2018 [cited 2018 Aug 25]. Avalaible from: http://tobaccofreernao.ca/en/4-s
[10] Harford S, Ramasubbu D, Duane B. How-to Guide for dental practices sustainable dentistry.entre for Sustainable Healthcare, Oxford, 2019.
[11] Duane B, Harford S, Ramasubbu D, Stancliffe R, PasdekiClewer E, Lomax R, et al. Environmentally sustainable dentistry: a brief introduction to sustainable concepts within the dental practice. Br Dent J. 2019;226:292-295.
[12] Nasser M, Evidence summary: can plastics used in dentistry act as an environmental pollutant? Can we avoid the use of plastics in dental practice? Br Dent J 2012; 212: 89–91.
[13] Thompson R C, Moore C J, vom Saal F S, Swan S H. Phil. Trans. Plastics, the environment and human health: current consensus and future trends. Philos Trans R Soc Lond B Biol Sci 2009; 364: 2153–2166.
[14] What exactly is green dentistry? Available from: http://www.ecodentistry.org/. Accessed (October 2013).
[15] G Chin, J Chong, A Kluczewska, A Lau, S Gorjy, M Tennant. The environmental effects of dental amalgam. Australian Dental Journal. 2008; 45(4): 246-96.
[16] Canadian Dental Association. CDA position on dental amalgam. February 2005. Available from URL: http://www.cda-adc.ca/_files/position_statements/amalgam.pdf (accessed December 2006).
[17] FDI World Dental Federation. FDI policy statement. WHO consensus statement on dental amalgam. 1997. Available from URL: http://www. fdiworldental.org/federation/assets/statements/ENGLISH/Amalgam/Dental_ Amalgam.pdf (accessed December 2006).
[18] Chin G, Chong A, Kluczewska A, Lau A, Gorjy S, Tennant M. The environmental effects of dental amalgam. Aust Dent J 2000; 45(4):246–9.

[19] Westman JF, Tuominen T. Amalgam waste management. Issues and answers. N Y State Dent J 2000; 66(8):20–4.
[20] Kao RT, Dault S, Pichay T. Understanding the mercury reduction issue: the impact of mercury on the environment and human health. J Calif Dent Assoc 2004; 32(7):574–9.
[21] Samek L. Disposing of hazardous waste. An update on waste management studies. Ont Dent. 1994; 71 (7): 19-20.
[22] Anderson K. Creating an environmentally friendly dental practice. CDS Rev. 1999; 12-18.14.
[23] Chilibeck R. Mercury pollution in dental office waste water. J Can Dent Assoc. 2000; 66(4): 174-75.
[24] Barron T. Mercury in our environment. J Calif Dent Assoc 2004; 32(7):556–63.
[25] Clarkson TW, Magos L, Myers GJ. The toxicology of mercury — current exposures and clinical manifestations. N Engl J Med 2003; 349(18):1731–7.
[26] Factor-Litvak P, Hasselgren G, Jacobs D, Begg M, Kline J, Geier J, and others. Mercury derived from dental amalgams and neuropsychologic function. Environ Health Perspect 2003; 111(5):719–23.
[27] Jones DW. Putting dental mercury pollution into perspective. Br Dent J 2004; 197(4):175–7.
[28] Jones DW. A Canadian perspective on the dental amalgam issue. Br Dent J 1998; 184(12):581–6.
[29] Jones DW. Exposure or absorption and the crucial question of limits for mercury. J Can Dent Assoc 1999; 65(1):42–6.
[30] Rogers KD. Status of scrap (recyclable) dental amalgams as environmental health hazards or toxic substances. J Am Dent Assoc 1989; 119(1):159–6620. Letzel H, de Boer FA, van't Hof MA. An estimation of the size distribution of amalgam particles in dental treatment waste. J Dent Res 1997; 76(3):780–8.
[31] Johnson WJ, Pichay TJ. Dentistry, amalgam, and pollution prevention. J Calif Dent Assoc 2001; 29(7):509–17.
[32] Trip L. Canada-wide standards: a pollution prevention program for dental amalgam waste. J Can Dent Assoc 2001; 67(5):270–3. Available from URL: http://www.cda-adc.ca/jcda/vol-67/issue-5/270.pdf (accessed December 2006).
[33] Stone ME. The effect of amalgam separators on mercury loading to wastewater treatment plants. J Calif Dent Assoc 2004; 32(7):593–600. [34] EPA Fact Sheet: National listing of fish advisories. [Website of the United States Environmental Protection Agency, Office of Water]; August 2004. EPA-823-F-04-016. Available from URL: www.epa.gov/waterscience/fish/advisories/factsheet.pdf(accessed December 2006).
[34] Condrin AK. The use of CDA best management practices and amalgam separators to improve the management of dental wastewater. J Calif Dent Assoc 2004; 32(7):583–92.
[35] Best management practices for amalgam waste. In A–Z topics. [Website of the American Dental Association]. Available from URL: www.ada.org/prof/resources/topics/amalgam_bmp.asp (accessed December 2006).
[36] Canadian Council of Ministers of the Environment. Canada-wide standard on mercury for dental amalgam waste. 2001. p. 1–6. Available from URL: www.ccme.ca/assets/pdf/cws_merc_amalgam_e.pdf (accessed December 2006).
[37] Pichay TJ. Dental amalgam: regulating its use and disposal. J Calif Dent Assoc 2004; 32(7):580–2.
[38] Best management practices for hazardous dental waste disposal. [Website of the Nova Scotia Dental Association]. Available from URL: www.nsdental.org/hazardous.htm (accessed December 2006).

[39] Canadian Dental Association. Dental amalgam waste protocol. 2005. Available from URL: http://www.cda-adc.ca/en/dental_profession/practising/amalgam_waste/index.asp (accessed December 2006).
[40] Soucy B. Response (to amalgam safety) [Letter]. J Can Dent Assoc 2000; 66(9):476–7.
[41] Canada-wide standards for mercury (mercury emissions, mercury-containing lamps, and mercury for dental amalgam waste): a report on progress. [Website of the Canadian Council of Ministers of the Environment], June 2005. Available from URL: www.ccme.ca/assets/pdf/joint_hg_progress_rpt_e.pdf (accessed December 2006).
[42] Mercury and the environment. [Website of Environment Canada]. Available from URL: www.ec.gc.ca/MERCURY/ (accessed December 2006).
[43] Halifax Regional Municipality by-law W-101: Respecting discharge into public sewers. [Website of the Halifax Regional Municipality], 2001. Available from URL: www.halifax.ca/legislation/bylaws/hrm/documents/By-LawW101_000.pdf (accessed Nov. 13, 2006)
[44] Frey JD. Wastewater management: amalgam and silver — a critical issue. J Indiana Dent Assoc 1994; 73(4):4–5.
[45] Vandeven JA, McGinnis SL. Cost-effectiveness of removing amalgam from dental wastewater. J Calif Dent Assoc 2004; 32(7):564–73.
[46] Adegbembo AO, Watson PA, Lugowski SJ. The weight of wastes generated by removal of dental amalgam restorations and the concentration of mercury in dental wastewater. J Calif Dent Assoc 2002; 68(9):553–8.
[47] Fan PL, Arenholt-Bindslev D, Schmaiz G, Halbach S, Berendsen H. Environmental issues in dentistry — mercury. FDI Commission. Int Dent J 1997; 47(2):105–9.
[48] Albert SB. Taking the lead in amalgam waste recycling. N Y State Dent J 2000; 66(8):4–5.
[49] Swanson RL, Roethel FJ, Bauer H. Reuse of lead from dental X-rays. N Y State Dent J 1999; 65(3):34–6.
[50] Needleman HL., Gatsonis CA. Low-level lead exposure and the IQ of children: a meta-analysis of modern studies. J Am Dent Assoc 1990; 263(5):673–8.
[51] Thacker SB, Hoffman DA, Smith J, Steinberg K, Zack M. Effect of lowlevel body burdens of lead on the mental development of children: limitations of meta-analysis in a review of longitudinal data. Arch Environ Health1992; 47(5):336–46.
[52] Stark AM. Disposal options for infectious medical waste generated during home-based dental care. Spec Care Dentist 1998; 18(5):207–13.
[53] Canadian Council of Ministers of the Environment (CCME). Guidelines for the management of biomedical waste in Canada. February 1992. CCME-RPC-WM-42E.
[54] Appendix 3 — Definition of biomedical waste. Environment Canada, National Pollutant Release Inventory (NPRI). Available from URL: www.ec.gc.ca/pdb/npri/2004Guidance/Guide2004/Guide2004_app3_e.cfm (accessed December 2006).
[55] Palenik CJ. Managing regulated waste in dental environments. J Contemp Dent Pract. 2003; 4: 76.
[56] Balfry G. Green dentistry [Letter]. Br Dent J 2001; 191(7):356.
[57] Hiltz M. The Environmental Impact of Dentistry. J Can Dent Assoc. 2007; 73(1):59- 62.
[58] Available from: https://www.en.wikipedia.org/wiki/Holisticdentistry. [Last modified on 2016 Oct 09].
[59] Eco-Friendly Dentistry – ORA Oral Surgery & Implant Studio. Available from: http://www.orasurgery.com/ecofriendly/want-iseco-friendly.php. [Last accessed on 2016 Oct 09].
[60] Carbon footprint in Hungary. Official Statistics, 2018 [Hungarian].

[61] Páldy A, Bobvos J, Málnási T. The Impact of Climate Change on Human Health and Health Care System in Hungary Magyar Tudomány 2018;179:1336–1348.
[62] Martin N, Sheppard M, Gorasia G, Arora P, Cooper M, Mulligan S. Awareness and barriers to sustainability in dentistry: A scoping review. J Dent. 2021;112:103735.
[63] Hegedus T, Kreuter P, Kismarczi-Antalffy AA, Demeter T, Banyai D, Vegh A, et al. User Experience and Sustainability of 3D Printing in Dentistry. Int J Environ Res Public Health. 2022;19: 1921.
[64] Toma A, Crişan O. Research on developing environmental ethics in pharmacists' activities. Environ Health. 2021;20: 52.
[65] Martin N, Mulligan S. Environmental Sustainability Through Good-Quality Oral Healthcare. Int Dent J. 2022;72: 26-30.
[66] Mulligan S, Kakonyi G, Moharamzadeh K, Thornton S F, Martin N. The environmental impact of dental amalgam and resin-based composite materials. Br Dent J 2018; 224: 542–548.
[67] Minamata Convention on Mercury. Text and annexes. 2019. Available at https://www.mercuryconvention. org/en/resources/minamata-convention-mercurytext-and-annexes (accessed July 2021).
[68] UK Government. Regulation (EU) 2017/852 of the European Parliament and of the Council. 2017. Available at https://www.legislation.gov.uk/ eur/2017/852/article/10 (accessed September 2021).
[69] Healthcare without harm. Non-Incineration Medical Waste Treatment Technologies. Available at https://noharm.org/ sites/default/files/lib/downloads/waste/Non-Incineration_Technologies.pdf (accessed January 2017).
[70] Holland C. Investigation: Greening up the bottom line. Br Dent J 2014; 217: 10–11.
[71] Mazur M, Ndokaj, Jedliński M, et al. How Dentistry is impacting the environment. Senses Sci. 2020; 6(4):922-928.
[72] Mazur M, Jedliński M, Ndokaj A, et al. Challenges in diagnosing and managing non-cavitated occlusal caries lesions. A Literature overview and a report of a case. Clin Ter. 2021; 171(1):e80-e86.
[73] Askar H, Krois J, Rohrer C, et al. Detecting white spot lesions on dental photography using deep learning: A pilot study. J Dent. 2021; 107:103615.
[74] Machowska A, Stålsby Lundborg C. Drivers of Irrational Use of Antibiotics in Europe. Int J Environ Res Public Health. 2018; 16(1):27
[75] Guerra F, Mazur M, Ndokaj A, et al. Periodontitis and the microbiome: a systematic review and meta-analysis. Minerva Stomatol. 2018; 67(6):250-25
[76] Nardi GM, Grassi R, Ndokaj A, et al. Maternal and Neonatal Oral Microbiome Developmental Patterns and Correlated Factors: A Systematic Review-Does the Apple Fall Close to the Tree? Int J Environ Res Public Health. 2021; 18(11):5569
[77] Trybek G, Jedliński M, Jaroń A, et al. Impact of lactoferrin on bone regenerative processes and its possible implementation in oral surgery - a systematic review of novelstudies with metanalysis and metaregression. BMC Oral Health. 2020; 20(1):232
[78] Mazur M, Ndokaj A, Jedlinski M, et al. Impact of Green Tea (Camellia Sinensis) on periodontitis and caries. Systematic review and meta-analysis. Jpn Dent Sci Rev. 2021; 57:1-11.
[79] Nardi GM, Cesarano F, Papa G, et al. Evaluation of Salivary Matrix Metalloproteinase (MMP-8) in Periodontal Patients Undergoing Non-Surgical Periodontal Therapy and Mouthwash Based on Ozonated Olive Oil: A Randomized Clinical Trial. Int J Environ Res Public Health. 2020; 17(18):6619

[80] Nardi GM, Guerra F, Ndokaj A, et al. Phototherapy and Tailored Brushing Method. Personalized Oral Care in Patients with Facial and Dental Trauma. A Report of a Case. Healthcare (Basel). 2021; 9(5):561