




Advancing Environmental Sustainability in Dentistry and Oral Health

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Introduction

Environmental sustainability entails the responsibility of safeguarding global ecosystems and natural resources to enhance well-being and prosperity. Within the dental profession, a commitment to supporting a transition to a green economy is vital. Integrating sustainable development goals into everyday dental practices becomes imperative, fostering healthy lifestyles and well-being for people of all ages.¹ The primary objective for oral health practitioners and dental educators is the promotion of oral health to prevent avoidable diseases. Moreover, it is both a moral and ethical obligation for oral health providers to minimize the adverse environmental impacts of their operations, aligning with sustainable development principles. This commitment extends to meeting current oral health care needs while ensuring the ability to provide the same services in the future. Dental facilities generate large amounts of waste including environmentally burdensome single-use plastics (SUPs), which requires immediate attention.² Furthermore, a comprehensive assessment is imperative for carbon dioxide (CO₂) emissions originating from various sources including travel by patients or professionals to care facilities, the manufacturing of dental materials, daily utilization of personal protective equipment (PPE), and the generation of waste. The repercussions of the COVID-19 pandemic have exacerbated the environmental challenge, intensifying the demand for SUPs and PPE, significantly impacting the environment.¹

Engaging with providers committed to sustainable oral health care poses challenges because several obstacles hinder this interaction. Notably, there exists a notable lack of understanding regarding the environmental impact of oral health care, particularly among professionals and the

broader population.³ One avenue toward sustainability is the reduction of overhead costs, achievable through prudent measures like minimizing material and equipment usage.³ This reduction not only contributes to environmental conservation but also holds the potential to enhance the overall sustainability of oral health practices. Sustainable behavior is a potent motivator with far-reaching benefits for practitioners. Beyond environmental considerations, it becomes a driving force for building, sustaining, and elevating the reputation of dental practices.³ A positive reputation, in turn, uplifts employee morale and facilitates business growth by attracting clients who prioritize sustainability. It is crucial to dispel any mindset disparities that unfairly distinguish between environmental sustainability efforts at home and those within dental offices, ensuring consistent and effective commitment to sustainability across all domains.³

Determining environmental sustainability within the dental sector involves a diverse set of approaches. One notable method is the assessment of the carbon footprint, quantifying the cumulative greenhouse gas emissions produced during specific activities or the manufacturing of products, expressed in equivalent tons of carbon dioxide.⁴ Additionally, sustainability can be gauged through various parameters, including resource consumption, changes in air quality, waste production, and impacts on biodiversity.¹ To ensure effective and patient-centered oral health care, practitioners should navigate several essential domains such as preventative treatment, operative care, integrated care, and ownership of care. These domains collectively contribute to a health care approach that is both trustworthy and tailored to the well-being of the patient.⁵

A strategic emphasis on preventative measures not only enhances oral health but also decreases the necessity for

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treating avoidable oral illnesses, thereby concurrently elevating patients' quality of life.⁵ This proactive approach further extends its positive impact by reducing CO₂ emissions. Fewer patient journeys, lower material manufacturing needs, and decreased distribution requirements collectively contribute to environmental sustainability.⁵ Moreover, high-quality operative interventions result in durable treatments, requiring fewer repairs and replacements.³ Achieving such excellence in clinical operative care involves a multidimensional approach, encompassing appropriate core knowledge, task-specific skill sets, experiential learning across diverse clinical cases, and synergistic teamwork. Central to this framework is the principle of ownership of care, wherein clinicians and their teams bear full responsibility for treatment outcomes. This entails active involvement in essential and supplementary care tasks, alongside a commitment to ongoing professional growth.

Achieving positive health outcomes through the conscientious delivery of high-quality, patient-centered care brings forth considerable environmental sustainability achievements. Specifically, it leads to a reduction in the frequency of appointments and patient journeys, and minimizes the need for additional professional interventions, thus contributing to an overall decrease in CO₂ emissions.³ Furthermore, the prolonged longevity of restorations, coupled with a diminished need for procurement, culminates in a significant reduction in overall waste generation.

A pressing requirement exists for the standardization of measurements, coupled with collaborative agreements with vendors outlining the obligations for reclaiming packaging and waste materials for redistribution. Additionally, the country's dental association holds a pivotal role in promoting sustainability within the profession. This involves active support for sustainable practices and the integration of dental sustainability as a fundamental course in the dental education curriculum.⁶

Professionals must recognize that fostering public awareness and implementing oral health practices geared toward robust disease prevention constitute the primary strategies for minimizing the carbon footprint. A dedicated focus on oral health translates into fewer treatment needs, thereby exerting a positive environmental impact. While certain interventions, such as the application of fluoride varnish for caries prevention, carry a considerable CO₂ footprint, the overall environmental balance is favorable. This occurs because the reduced demand for and utilization of oral health care services throughout an individual's life offset the initial carbon footprint. Consequently, a single intervention yields a net reduction in the carbon footprint over the long term, owing to diminished requirements for complex therapeutic, reparative, and restorative care.⁵

Enacting sustainable practices requires careful consideration, beginning with the manufacturing and procurement of equipment and materials, extending into the implementation of patient-centered care and, crucially, concluding with the responsible disposal of generated biomedical waste.⁷ Establishing sustainability metrics is important, empowering health care providers to take informed actions

and explore more environmentally responsible alternatives, thus safeguarding the health of our planet. Dentistry, owing to materials used, waste produced, and substantial electricity and water consumption, bears significant environmental concerns. It is increasingly preferable for dentists to embrace environmentally sound and socially responsible practices, necessitating a paradigm shift in the perception of "value for money" to encompass broader investments that contribute to global well-being. The key to success lies in fostering cooperation, providing comprehensive staff training, and engaging patients by increasing awareness. Leveraging e-dentistry resources, online videos, impactful notices with visuals, leaflets, and strategic social media promotion can collectively amplify the impact. Dental procedures are often associated with higher travel emissions compared to other areas of health care, despite the inherent speed of appointments.⁸ Teledentistry is actively promoted, given its perceived substantial role in time savings for patients who face challenges in taking time off from work or incurring travel-related expenses. Beyond this convenience, teledentistry brings an additional positive impact by mitigating air pollution associated with vehicle traffic.^{9,10}

The utilization of SUPs for packaging or dental supplies is acknowledged as contributing to environmental problems.¹¹ This issue underscores the importance of implementing appropriate policies and guidelines to incentivize professionals toward sustainable practices. This involves active engagement in metric-based assessments and thoughtful consideration of evidence that encompasses public health issues.

The FDI World Dental Federation is a collaborative network of dental care and research professionals. They have issued a policy statement on "*Sustainability in dentistry*," which states: "Dentistry as a profession should integrate sustainable development goals into daily practice and support a shift to a green economy in the pursuit of healthy lives and wellbeing for all through all stages of life."¹² To operationalize this commitment, the FDI has established two sets of objectives for sustainability in dentistry, highlighting the diverse opportunities to mitigate the environmental impact of health care (► **Fig. 1**).

Developing sustainable behaviors and attitudes in dentistry proves challenging across diverse global regions. Despite the inclusion in health care contracts, adherence to sustainability goals by employers remains nonmandatory by law. A noteworthy initiative has recently been undertaken in a dental practice, employing an action research approach to instill sustainability knowledge and practices among staff.³ These in-house sustainability initiatives not only enhance staff practices but also contribute to waste reduction. The environmental impact of oral health care, specifically pollution, is a significant concern. Professionals shoulder the dual responsibility of patient care and ethical stewardship to mitigate this impact on the environment. Furthermore, there is a need for comprehensive oral health research that considers both internal drivers and external forces influencing sustainability. Understanding the environmental ramifications of both home-based and professionally delivered prevention is crucial for achieving effective results.^{3,8}

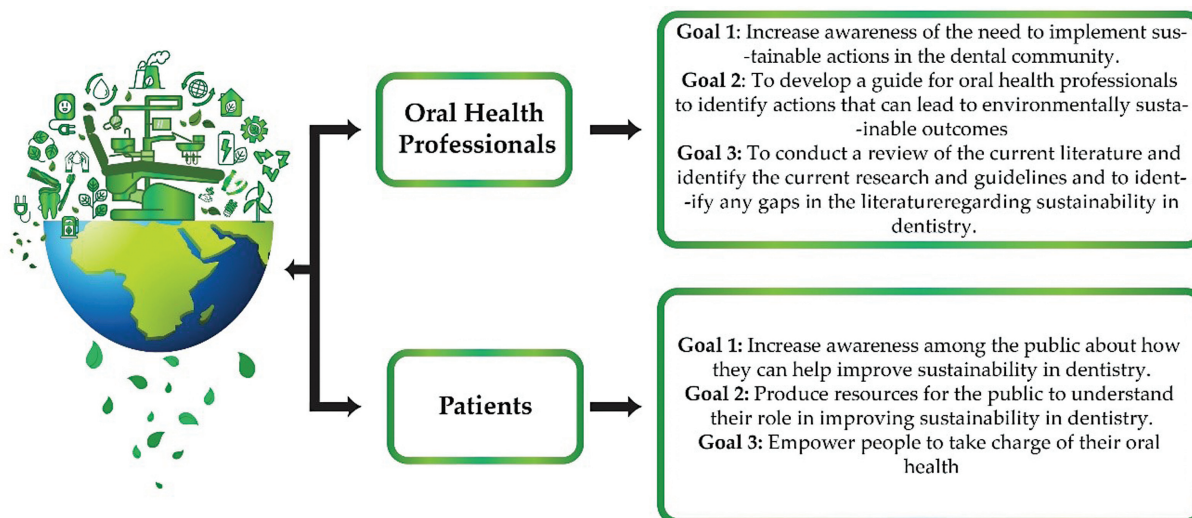


Fig. 1 Description of two sets of sustainability goals outlined by the FDI World Dental Federation for oral health professionals and patients.¹¹

Education plays a pivotal role in cultivating professional awareness, and it should be integral to undergraduate degree programs at universities, continuing seamlessly into professional growth. Including sustainability education at this foundational level holds the potential to shape a normalized attitude toward translating knowledge into practice. Therefore, it is the obligation of the academic community to expose students to this information and related research, fostering the identification of long-term solutions for maintaining a clean and safe environment. The collaborative effort of the dental care team, care managers, regulatory agencies, and patient consent is essential for delivering high-quality oral health care. Oral health care providers, through meticulous attention and engagement across preventive care, operative care, and the ownership of care domains, can deliver effective and environmentally sustainable services.¹³ A consistent promotion and implementation of a framework for managing preventable diseases contribute significantly to achieving oral health.^{3,4,7} This proactive approach not only aids in reducing CO₂ emissions, waste, and pollution but also yields unforeseen yet positive environmental sustainability effects. By adopting such a proactive approach, the dental profession demonstrates its commitment to being a part of the solution rather than perpetuating the problem. Beyond the actions of the dental team, it is essential to recognize the pivotal role that patients play in contributing to sustainable oral health care as direct beneficiaries of the service. Patients bear a significant responsibility for their oral health, influencing outcomes through their attitudes and behaviors related to recognized risk factors such as plaque control, diet, smoking, and alcohol intake.³

The dental team bears a responsibility to manage waste in the most ecologically friendly manner feasible, aligning with sustainability goals. Minimizing clinical waste not only reduces incineration-related carbon emissions but also contributes to a significant decrease in the environmental impact. Recycling is a pivotal strategy to cut down carbon

emissions compared to landfills, concurrently helping conserve natural resources utilized in manufacturing materials like paper, plastic, and glass. Dentists should consider several measures to enhance environmental sustainability. This includes reducing the packaging of sterile equipment, fostering staff discussions, involving infection control specialists for learning safe working practices, collaborating with local producers to improve packaging, and striving to use fewer tissue and gloves.⁴ Recognizing challenges in recycling plastics and instruments in oral health care settings, a key solution lies in designing simpler devices with plastics that are easily dismantled, thus enhancing recyclability and contributing to a more circular economy. While known waste management techniques of reuse, reduction, and recycling are desirable, their implementation in clinical health care settings, especially oral health care, is challenging due to the contaminated nature of waste products.¹⁴ The polymers used in therapeutic settings present additional complexities—they are expensive, prone to contamination, and challenging to clean or disinfect. However, with the rise of public environmental awareness and protective regulations, proactive attitudes within dentistry professions can not only meet these challenges but also thrive in an era increasingly valuing ecological responsibility.

With a foundation of confidence in sustainability, encompassing both environmental stewardship and personal wellbeing, dentists are empowered to make informed decisions that contribute to reducing their carbon footprint and fostering the creation of more sustainable dental offices. The imperative is clear: providing dental treatments that benefit the general population must align with moral and ethical mandates, supported not only by professional ethics but also by legal obligations. In contrast, sustainability signifies the judicious and ethical utilization of natural resources to prevent depletion and maintain ecological equilibrium. Embracing sustainable development becomes the pathway to the envisioned future—a future characterized by economic

development, social justice, environmental stewardship, and improved governance. From this comprehensive perspective, we derive actionable insights into practicing and implementing sustainable dental practices and education.

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Conflict of Interest

None declared.

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