

## Commentary

# Environmental Sustainability Through Good-Quality Oral Healthcare

In accordance with the FDI Vision 2030 document which calls for urgent action on oral health, the principal goal of oral health professionals is to promote universal oral health for diseases that are largely preventable and/or treatable in the early stages.<sup>1</sup> The provision of oral health care,<sup>2</sup> in the form of prevention, therapeutic interventions, or long-term maintenance, creates pollution and a significant carbon footprint. As oral health care providers, we have an ethical and moral responsibility to manage the impact of our activities on the environment and ensure that we do this in a sustainable manner.<sup>3,4</sup>

Oral health care contributes CO<sub>2</sub> emissions from 3 principal sources: (i) travel by patients and health personnel when commuting to and from care centres<sup>5</sup>; (ii) manufacturing, distribution, and procurement of materials and sundries along the supply chain; and (iii) waste generated and its management, including single-use plastics (SUPs) which present an environmental burden requiring urgent attention. The SUP burden is more pertinent now, with the huge volumes of SUP personal protective equipment (PPE) utilised during the ongoing COVID-19 pandemic.<sup>6</sup> The current increased use of SUPs highlights the difficulty of implementing sustainable health care practice as environmental impacts are often a secondary consideration to patient safety and optimal care. The challenges to sustainable health care practices are the perceived costs, individuals' attitudes, difficulties in the implementation of remediation measures, and the need to operate within the constraints of legislative frameworks. It is necessary therefore to structure a framework for oral health care provision that simultaneously advocates optimal patient care and promotes environmental sustainability at its core. This can be readily achieved for preventable oral diseases and through this paper, we aim to present a framework that reinforces the message that the delivery of good oral health care is key to disease reduction and, as an unintended consequence, through a reduced use of resources, it delivers environmentally sustainable outcomes (Table). In this way, a clear cause-and-effect relationship is established between the delivery of high-quality care and the achievement of practical and meaningful environmentally sustainable practice.

### Sustainability: from home to the dental practice

As individuals, we tend to separate our societal responsibilities of environmental citizenship from our professional duties in the dental surgery.<sup>7</sup> In this way, when at work, our private citizen sustainability behaviours become secondary to work drivers. To resolve this paradigm, we need to make a conscious and deliberate effort to translate our environmental "home-based" citizenship behaviours to the work

"dental practice" environment. This transition involves switching from a *behaviour approach* that is dictated by the location and circumstances in which we find ourselves to a stronger, more pervasive, and more persistent *attitudinal approach*.<sup>8</sup> This transition of our sustainability attitude from "home-based" private citizen behaviour to a "work-based" dental practice requires an understanding and appreciation amongst colleagues of our common beliefs on environmental issues. The first step is to normalise the subject of sustainability, which can be done through informal conversations and ongoing discussions amongst team members in the workplace. In this way, initial apprehension and resistance to environmentally sustainable behaviour changes in the dental practice can be addressed by increasing awareness and identifying common ground and strength of feelings amongst colleagues. The next step is to engage in real action through formal staff meetings in the dental practice. This can take place in the form of more focused discussions as part of the business agenda for the dental practice, perhaps with the appointment of a "practice sustainability champion." Simple actions that are achievable and impactful would be a perfect starting point, as suggested in this paper, to provide oral health care in an environmentally sustainable manner.

Beyond the actions of the dental team, we should be mindful of the vital role that the patient has in their contribution to sustainable oral health care as the beneficiary of the service. In this respect, the individual patient carries a significant element of responsibility for their own oral health through their attitudes and behaviours to the management of recognised risk factors, such as plaque control, diet, smoking, and alcohol intake.

### Sustainability through our actions

For oral health care provision to be sustainable, there is a requirement to meet the oral health care needs of society without compromising the ability to provide this same service in the future.

For this to be realised, active and coordinated engagement of all the stakeholders in the supply chain is a necessity. Sustainable practice requires careful consideration of, first, the manufacturing and the procurement of equipment, materials, and sundries; then the implementation of patient-centred care; and finally, the disposal of the generated biomedical waste. Thus, the actual dental team and the patient are charged with the provision of patient-centred oral health care in an environmentally sustainable manner. This paper focuses specifically on the actions of this middle 'health care team and patient' link and provides a practical

'sustainability tool.' This tool takes the form of an operational infographic framework for the management of preventable oral diseases and the sustainable delivery of optimal care in an environmentally sustainable manner<sup>4</sup>. This framework aims to reinforce the message that the delivery of good oral health care is key to disease reduction and, as an unintended consequence, it delivers environmentally sustainable outcomes (Table).

At its core, the framework consists of 4 complementary and synergistic domains that are considered by the authors to encapsulate our professional oral health care activities: *preventive care*, *operative care*, *integrated care*, and *ownership of care*<sup>4</sup> (Table). The infographic is structured so that each domain identifies the required provision actions that in turn will lead to impactful oral health and environmental outcomes. The core sustainability end points are reductions in CO<sub>2</sub> emission and waste through the promotion of good oral health.

### 1 Preventive care

The bedrock of oral health care provision is practical and patient-centred preventive regimes.<sup>9</sup> Effective prevention regimes result in a reduced need to treat preventable oral diseases, improved oral health, a requirement for less treatment, and a consequent improved quality of life for the patients.<sup>10</sup>

Reduced disease risk results in fewer appointments and interventions with consequent less patient travel, less use of materials and SUPs, less packaging, and consequently less clinical waste. In addition, there is less energy consumption, reduced manufacturing, and reduced distribution of resources, all of which result in reduced CO<sub>2</sub> emissions and less overall waste and pollution.<sup>11-14</sup>

### 2 Operative care

High-quality clinical operative care is optimised through the combination of appropriate core knowledge, task-specific skill sets, experiential learning, and teamwork combined in a synergistic manner. The provision of high-quality operative interventions results in durable treatment that will require fewer repairs and replacements. The environmental impact is similar to that of an effective preventive regime, with reduced CO<sub>2</sub> emissions through fewer patient journeys, reduced need for materials manufacturing, and reduced distribution requirements. Reduced waste and pollution result from the increased longevity of treatments and restorations that in turn results in the use of fewer materials, less packaging, and consequently less clinical waste.

### 3 Integrated care

There is an increased realisation that high-quality patient-centred care requires the active participation of all stakeholders. These include patient and appropriate support carers, the whole dental team, suppliers, manufacturers, regulatory and governance bodies, financial authorities, and educators. Integrated care is all about the effective combination of these services, such as the following: combining managed treatment appointments (smart treatment combinations and shared

family appointments); the appropriate and safe use of complementary technologies such as teledentistry and remote clinical consultations<sup>15</sup>; patients as co-creators and co-managers of their own oral health care; and the implementation of dentist-led, patient-centred structured treatment plans with joint dentist-patient responsibility for their delivery.

Fully integrated care will benefit the environment with a reduction of CO<sub>2</sub> emissions through fewer patient journeys, reduced manufacturing, and associated reduction of distribution of resources.

### 4 Ownership of care

Taking responsibility for the outcomes of the care provided by the clinician and the team is the central tenet of ownership of care. Individual and team ownership of patient-centred care is achieved by taking responsibility and pursuing active participation in core and complementary care activities and professional development. This is driven by an individual passion to excel alongside an altruistic awareness that truly holistic dental care has environmental sustainability as a stakeholder consideration. Practical recommendations are engagement with local peer group activities and research programmes with academia or industry and through collaboration and participation in societies, enterprises, and educational projects.

Personal professional participation in this way leads to continuous improvement of our knowledge, skill set, and operational management of the team, with the patient being the ultimate beneficiary, and to better clinical outcomes, improved quality of care, and more durable care. This professional engagement and development feeds directly into the previous domains that centre on the provision of high-quality patient-centred care. Consequently, the environmental outcomes are shared with reduced CO<sub>2</sub> emissions through fewer patient journeys and reduced manufacturing and distribution of materials and resources. This translates into less packaging and clinical waste that ordinarily goes to incineration or landfill.

### End point: a sustainable environment

The achievement of good oral health outcomes through the responsible engagement of high-quality patient-centred care outlined in the four domains will ultimately and inevitably result in 2 key environmental sustainability achievements:

- Fewer appointments with fewer patient journeys and reduced need for professional interventions, which results in an overall *reduction in CO<sub>2</sub> emissions*.
- Increased longevity of restorations and a reduced need for procurement, which result in an overall *reduction in waste generated*.

This concept is illustrated by considering a case study that compares two 50-year-old patients (Figure). Patient A presents with adequate oral health, no active disease and no restorative interventions. Patient B presents with a failing dentition, new and recurrent active disease, tooth loss and

**Table – Oral health measures that, when delivered carefully and systematically, will result in impactful oral health outcomes, with benefits to the patient and the team and ultimately with real environmental outcomes.**

	Oral health measures	Oral health outcomes	Environmental outcomes
<b>Preventive care</b> Assessment and management of systemic and local risk factors with a practical and patient-centred preventive regime	<p><b>Oral health education</b> Promotion of oral health care. Reduce consumption and frequency of free sugars and acidic drinks; promote toothbrushing and fluoridation; encourage dental attendance, moderation of alcohol intake, and cessation of tobacco use</p> <p><b>Oral hygiene measures</b> Toothbrushing, fluoride toothpaste</p> <p><b>Healthy diet</b> Reduced intake and frequency of sugars, acidic drinks, and alcohol and tobacco use</p>	<ul style="list-style-type: none"> <li>- Healthy mouths and healthy teeth</li> <li>- Less treatment</li> <li>- Reduced use of materials and costs</li> <li>- Professional satisfaction</li> <li>- Improved patient quality of life</li> </ul>	<p><b>Reduced CO<sub>2</sub> emissions</b> Fewer patient journeys Reduced manufacturing Reduced distribution of resources</p> <p><b>Less waste and pollution</b> Fewer materials Less packaging Less clinical waste</p>
<b>Operative care</b> Optimised through the combination of core knowledge, skill sets, experiential learning, and teamwork acting synergistically	<p><b>Best practice</b> Evidence-based and protocol-driven.</p> <p><b>High-quality and predictable care</b> Use good materials and use them well</p>	<ul style="list-style-type: none"> <li>- Reduced use of materials and costs</li> <li>- Professional satisfaction</li> <li>- Improved patient quality of life</li> <li>- Better clinical outcomes</li> <li>- Durable care</li> </ul>	<p><b>Reduced CO<sub>2</sub> emissions</b> Fewer patient journeys Reduced manufacturing Reduced distribution of resources</p> <p><b>Less waste and pollution</b> Fewer materials Less packaging Less clinical waste</p>
<b>Integrated care</b> Provided through the integration of services, structured treatments, and patient participation	<p><b>Structured treatment plans</b> Dentist-led, patient-centred, and joint “dentist–patient” responsibility for delivery</p> <p>Active patient participation Patients as co-creators and co-managers of own oral health care: decision-making, engaging with treatment, and maintenance</p> <p><b>Managed treatment appointments</b> Smart treatment combinations and shared family appointments</p>	<ul style="list-style-type: none"> <li>- Professional satisfaction</li> <li>- Improved patient quality of life</li> <li>- Better clinical outcomes</li> <li>- Durable care</li> </ul>	<p><b>Reduced CO<sub>2</sub> emissions</b> Fewer patient journeys Reduced manufacturing Reduced distribution of resources</p>
<b>Ownership of care</b> Individual and team ownership of care, thorough active participation in core and complementary activities that leads to professional development, a passion to excel, and the satisfaction of achievement	<p><b>Learn and provide best practice</b> Pursue, maintain, and practice effective and focused professional development</p> <p><b>Lead by example</b> Set high standards, engage with your profession, make a difference, inspire others</p> <p><b>Effective clinical governance</b> Continuously improve the quality of services and safeguard high standards. Check: How good am I? Audit the quality of my practice and improve</p> <p><b>Get involved</b> National and local active groups Research Collaboration and participation</p>	<ul style="list-style-type: none"> <li>- Professional satisfaction</li> <li>- Improved patient quality of life</li> <li>- Better clinical outcomes</li> <li>- Durable care</li> </ul>	<p><b>Reduced CO<sub>2</sub> emissions</b> Fewer patient journeys Reduced manufacturing Reduced distribution of resources</p> <p><b>Less waste and pollution</b> Fewer materials Less packaging Less clinical waste</p>

numerous restorative interventions. These 2 patients have been on very different oral health journeys from birth, via adolescence and into mature adulthood; that now manifest in radically different personal health and environmental outcomes. *Patient A* has benefited from effective preventive care, strong personal engagement and high-level professional support. *Patient B* will have missed out on both effective preventive care and adequate management of the various risk

factors for oral disease; resulting in a need for numerous repeat interventions and ongoing restorative management of active disease.

The environmental impact from these two oral health care journeys is also very different. *Patient A* will have a low environmental impact associated with few interventions and a reduced need for professional services. The oral health care of *Patient B* will sustain a much greater CO<sub>2</sub> footprint and will



Patient A

Patient B

**Figure – Case study of two 50-year-old patients with low and high environmental impacts.**

**Patient A:** Good oral health, no active disease, some tooth-surface loss consistent with 50 years of service; no restorative interventions and low disease risk. *The environmental impact is low* and principally associated with regular hygiene maintenance.

**Patient B:** Failing dentition with new and recurrent active disease (endodontic, periodontic, and caries), tooth loss, extensive restorative treatment (2 root treated teeth, 8 intra-coronal restorations, 5 full-coverage crowns, an endosseous implant, and evidence of recurrent caries), and persistent high disease risk factors. *The environmental impact is high* and associated with a failure to manage disease, continuous and repetitive interventional care, laboratory services, multiple care appointments (travel journeys), and high use of materials, sundries and personal protective equipment. This health and environmental impact of the high disease risk, the need for repeat interventions, and ongoing management of active disease will continue throughout the patient's life.

generate much more waste. This is a direct consequence from the need to travel for numerous appointments, increased use of professional services, and the greater use of dental materials, sundries, PPE, and laboratory services.

Thus, the impact of oral health goes beyond a personal manifestation on the individual, with environmental consequences throughout life. A preventive approach associated with high-quality oral health care management is a win-win for the individual and the environment.

## Conclusions

CO<sub>2</sub> emissions and pollution are inextricably associated with our very existence as human beings. As we learn of the urgent need to act as individuals in a private citizenship mode, we need to also understand the need to translate our behaviours to the work environment by embedding strong attitudes into our daily practice.

Sustainable oral health care is readily achievable for preventable diseases through a strong ethos of good quality of patient-centred care. Good-quality oral healthcare is a team effort that involves the whole of the dental care team, care managers, regulatory bodies, commissioners, and the patients as co-creators and co-managers of their own oral health care.

Oral healthcare providers can deliver effective and high-quality care that is environmentally sustainable. This can be achieved through the diligent observance and engagement with each of the domains that define our practice: *Preventive Care, Operative Care, Integrated care and Ownership of care*.

By promoting and consciously implementing a framework for the management of preventable diseases, we focus on the attainment of oral health. In doing so, we achieve the unintended and positive environmentally sustainable outcomes of a reduction in CO<sub>2</sub> emissions, waste and pollution. Moreover, in this manner, the profession is showing its willingness to be part of the solution and not a continuing part of the problem.

## REFERENCES

- Glick M, Williams DM, Ben Yahya I, et al. *Vision 2030: delivering optimal oral health for all*. Geneva: FDI World Dental Federation; 2021.
- Glick M, Williams DM, Kleinman DV, Vujicic M, Watt RG, Weyant RJ. A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. *Int Dent J* 2016;66(6):322–4. doi: 10.1111/idj.12294.
- Brundtland G. Report of the World Commission on Environment and Development: our common future. United Nations General Assembly Document A/42/427. 1987. Available from: [https://www.are.admin.ch/are/en/home/sustainable-development/international-cooperation/2030agenda/un\\_-\\_milestones-in-sustainable-development/1987-brundtland-report.html](https://www.are.admin.ch/are/en/home/sustainable-development/international-cooperation/2030agenda/un_-_milestones-in-sustainable-development/1987-brundtland-report.html). Accessed 8 February 2021.
- Martin N, Zenk J, Dartavalle S, Mulligan S. Sustainability in Dentistry. FDI World Dental Federation. Available from: <https://www.fdiworlddental.org/sustainability-dentistry>. Accessed 30 June 2021.
- Carbon modelling within dentistry: towards a sustainable future. Public Health England & The Centre for Sustainable Healthcare; July 2018. Available from: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/724777/Carbon\\_modelling\\_within\\_dentistry.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/724777/Carbon_modelling_within_dentistry.pdf). Accessed 29 November 2020.
- Martin N, Mulligan S, Fuzesi P, et al. *Plastics Research and Innovation Fund Conference*, University of Sheffield. UK Research and Innovation and UK Circular Plastics Network; 2020. Available from: [https://www.ukcpn.co.uk/news/plastics-research-and-innovation-fund-conference-academic-papers/?utm\\_campaign=1800008\\_UKCPN%20August%202020%20NL&utm\\_medium=email&utm\\_source=dotdigital&dm\\_i=2VFU,12K-W8,6OKE6V,43RC8,1](https://www.ukcpn.co.uk/news/plastics-research-and-innovation-fund-conference-academic-papers/?utm_campaign=1800008_UKCPN%20August%202020%20NL&utm_medium=email&utm_source=dotdigital&dm_i=2VFU,12K-W8,6OKE6V,43RC8,1). Accessed 28 August 2020.
- Dobson A. *Environmental citizenship: towards sustainable development*. *Sust Dev* 2007;15:276–85.
- Bauer N, Megyesi B, Halbac-Cotoara-Zamfir R, et al. Attitudes and environmental citizenship. In Hadjichambis AC, Reis P, Paraskeva-Hadjichambi D, Gericke N, editors, et al., *Environmental discourses in science education: Conceptualizing environmental citizenship for 21st century education*, 4. Cham, Switzerland: Springer International Publishing; 2020, p. 97–111. <https://link.springer.com/book/10.1007%2F978-3-030-20249-1>
- Delivering better oral health: an evidence-based toolkit for prevention. PHE Gateway Number: 2016224. Department of Health and Public Health England; 2017. Available from: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/605266/Delivering\\_better\\_oral\\_health.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/605266/Delivering_better_oral_health.pdf). Accessed 29 November 2020.
- Spanemberg JC, Cardoso JA, Slob EMGB, López-López J. Quality of life related to oral health and its impact in adults. *J Stomatol Oral Maxillofac Surg* 2019;120(3):234–9.
- Harford S, Duane B. *Sustainable dentistry: how-to guide for dental practices sustainable dentistry*. Centre for Sustainable Healthcare; 2018. Available from: <https://sustainablehealthcare.org.uk/dental-guide>. Accessed 8 February 2021.
- Hurley S, White S. Carbon modelling within dentistry: towards a sustainable future—Publications gateway number 2018234. 2018. Available from: <https://www.gov.uk/government/publications/carbon-modelling-within-dentistry-towards-a-sustainable-future>. Accessed 8 February 2021.
- Duane B, Steinbach I, Ramasubbu D, et al. Environmental sustainability and travel within the dental practice. *Br Dent J* 2019;226(7):525–30.
- Duane B, Stancliffe R, Miller FA, Sherman J, Pasdeki-Clewer E. Sustainability in dentistry: a multifaceted approach needed. *J Dent Res* 2020;99(9):998–1003.
- Martin N, Shahrbaif S, Towers A, Stokes C, Storey C. Remote clinical consultations in restorative dentistry: a clinical service evaluation study. *Br Dent J* 2020;228(6):441–7.

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