

Sustainability in dentistry part I: Sustainability and general dental practice – an overview

Learning outcomes

This article aims to assist the reader to:

- identify the contribution of a sustainable approach to mitigating the effects of climate change;
- highlight how a structured approach to sustainability within the dental sphere can provide sustainability, cost and efficiency savings in the short, medium and long term; and,
- provide exemplars of the nature and impact of sustainability interventions in the dental sphere.

Introduction

In 1987, the United Nations Brundtland Commission defined sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs”.¹ Subsequently, the ‘7 Rs’ model for sustainability was developed over time. This model refers to the concepts of Reduce, Reuse, Recycle, Rethink, Repurpose, Repair and Refuse, and provides a useful reference point for developing more sustainable clinical practice. There is a common preconception that increasing the sustainability of healthcare is more expensive. However, many interventions are cost neutral, and many that involve capital expenditure demonstrate a positive return on investment within a short period of time.² This paper aims to provide an overview of sustainability from an overall context within healthcare and specifically from a dental perspective.

Healthcare and sustainability

Healthcare is a leading emitter of environmental pollutants, responsible for 9% of common air pollutants in the US³ and 20% of UK public sector emissions.⁴ Hospitals are one of society’s most energy-intensive facilities,² and this is in addition to healthcare’s use of toxic substances such as radioactive materials and drugs. The climate footprint derived from healthcare corresponds to 4.4% of global net emissions of greenhouse gases. If the healthcare sector were considered a country, it would rank as the fifth largest emitter globally.⁵ Operating theatres have the largest individual healthcare footprint worldwide,⁵ with emissions being greater than those derived from global fishing and agriculture combined.⁶

Healthcare education

Within dentistry, sustainability is a focus for the Association for Dental Education in Europe (ADEE), which is committed to ensuring that education around sustainability is instilled in undergraduate training programmes and that such considerations are at the forefront of daily decision-making among our future colleagues. A survey of undergraduate dental students in the USA found that environmental sustainability was “quite” or “extremely” important to the respondents, but only 5% reported content on sustainability in their curricula.⁷ A survey of 735 dental professionals in Ireland found that 69% were interested in dental sustainability.⁸ Worldwide, a number of dental associations, including the American and Canadian Dental Associations, have released guidance and position papers on sustainability in dentistry. The British Dental Association and other parties form part of the Dental Sustainability Advisory Group, which has produced an excellent dental sustainability guide.⁹ This is a very practical guide, which considers a diverse range of areas in which more sustainable practice can be introduced. These range from encouraging active travel, to safely disposing of medications, to increasing biodiversity by creating a wildlife-friendly garden. All of these suggestions come with an easily visualised chart showing how easy or hard the changes are to implement, the financial return on investment, and the environmental impact of the change, among other factors. The guide also contains additional links to allow calculation of the financial and carbon savings to the practice.

Dental practice setting

A focused review of the individual practice setting with sustainability in mind is an essential step to instil and support the development of a culture of sustainability throughout the working environment. Training is particularly important so that staff are aware of the ‘easy wins’ that can be achieved; for example, recycling and double-sided photocopying. Ideally, training should be delivered from within the practice so that staff can take ownership of the process and changes can be embedded within the workplace.

Change and improvement needs to be thought of as a continuous process. There are improvements that can be made at all stages of the patient journey, from how patients and staff arrive at the practice, to how the patient progresses through their treatment.

Improvements to the practice setting can be thought of in terms of external



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Table 1: Suggested sustainability improvements in the dental practice setting.

Area	Suggestions for improvement
Access	Proximity to public transport Engage staff in sustainable, health-focused choices, i.e., steps challenge, staff walk to work Safe and secure bike storage Access to electric car charging points
Building	Optimally insulated doors, windows, floor, roof and walls Heat pump technology where appropriate Solar photovoltaic panels for renewable energy generation Other renewable forms of power where possible, such as wind or geothermal Reuse of grey water as appropriate
Internally	Only heat, air condition and provide lighting in those areas in active use, e.g., motion-activated lighting
Bathrooms	Dual-flush toilets High-efficiency toilets, using high water velocity rather than volume Recycled toilet paper Low-flow taps or low-flow aerator in tap to reduce amount of water used Energy-efficient method of drying hands Fix leaks

and internal factors. From an external point of view, improving the energy efficiency of the building has a marked impact on energy requirements, such as through insulation and double-glazed windows. With regard to the source of power, electricity suppliers who use renewable sources only and use of ground source heating or solar photovoltaic panels should be considered. Provision of secure parking for bicycles on the premises and encouragement of cycle to work schemes assist with more sustainable travel for staff and patients. This is particularly important, as travel and procurement are the largest contributors to the dentally related carbon footprint.^{10,11} Internally, introduction of low-energy LED bulbs and dual flush toilets to reduce energy and water consumption are simple infrastructural changes that could be adopted. Avoidance of heating, cooling or lighting of unoccupied spaces, maintenance of equipment with appropriate regularity, and avoidance of air and water leakages are sensible sustainable practices (**Table 1**).

Reducing waste

Proper segregation of waste is a simple and extremely effective way of reducing costs and increasing sustainability (**Table 2**). The World Health Organisation (WHO) estimates that around 85% of the waste generated by healthcare activity is general, non-hazardous waste, comparable to domestic waste.¹² Use of the incorrect method of waste disposal creates further problems, such as unnecessary incineration. The cost difference between disposal of domestic and clinically contaminated waste has been shown to differ by almost €1,000 per tonne.¹³

Table 2: Correct waste disposal.

Waste stream	Bag colour	Items	Management
Infectious waste	Yellow bag	Blood- or bodily fluid-stained items	Incineration
Infectious sharps	Yellow bin	Blood- or bodily fluid-contaminated sharp items	Incineration
Non-risk residual waste	Clear bag	Household non-risk, non-recyclable Non-contaminated gloves, aprons and masks	Landfill
Mixed recycling	Green bag	Mixed dry recycling	Recycled

Single-use equipment

The use of single-use medical devices (SUDs) is widespread. The Covid-19 pandemic has led to a considerable increase in the amount of single-use PPE, with plastic as a principal component. Increased use of PPE is problematic in terms of its production and its disposal, as the former requires sourcing through various environmentally harmful methods and the latter necessitates incineration as clinical waste, thereby contributing to air pollution and the release of potential toxins, such as mercury. Increased use of plastics and PPE is unlikely to reduce in the short term. The development of washable, reusable PPE such as sterilisable facemasks, eye protection and gowns ought to be encouraged where feasible. Other frequently used single-use items such as paper bibs, plastic wells, single-use cups, plastic 3-in-1 tips and impression trays can be replaced with reusable, sterilisable versions. It has been estimated that within a UK primary dental care setting, 14.4 tonnes of plastics are generated annually, but this increases to 27 tonnes if one includes Covid-related PPE.¹⁴

Oral hygiene

Patients' oral hygiene regimes often offer significant scope to improve overall sustainability in dental practice. The significant environmental problem associated with toothbrush disposal is well documented; nearly every toothbrush ever made since the 1930s is still in existence. Given that surveys suggest that the toothbrush beats the car and computer for inventions that North Americans cannot live without,¹⁵ sustainable toothbrushes are of considerable importance. Various innovations aimed at reducing the environmental impact of toothbrushes are becoming well established, including bamboo toothbrushes and toothbrushes with replaceable heads. A comparative analysis found that plastic toothbrushes with a replaceable head and bamboo toothbrushes have a significantly reduced environmental impact compared to traditional plastic and electric toothbrushes.¹⁶ When considering land use and the consequential reduction in biodiversity and habitat, the negative impact of the electric toothbrush was over 36 times that of the bamboo toothbrush.¹⁶

Toothpaste manufacturing companies are increasingly committed to designing containers with recycling in mind; Unilever has declared that their full toothpaste range will be fully recyclable by 2025, while Colgate has launched a recyclable toothpaste tube. At present, enough plastic waste from

toothpaste tubes is generated annually to encircle the world twice, with 300 million toothpaste tubes going to landfill on a yearly basis.¹⁷ Dental floss offers various sustainable options, ranging from those made of silk to sustainable interdental brushes.

Reduce travel

Avoiding unnecessary patient travel has a significant impact on carbon emissions. A study assessing English primary dental care demonstrated that two-thirds of carbon emissions relate to travel (patients (31%) and staff (30%)), with the remainder being related to procurement of equipment (19%) and energy usage (15.3%).¹⁰ The significance of travel-related carbon emissions in dentistry is a global phenomenon.

During the Covid-19 pandemic, travel was restricted in many locations globally, resulting in expansion of the use of online consultations and dental monitoring, such as 'Attend Anywhere', 'Dental Monitoring' and 'Dentulu'. These systems can allow virtual appointments and detect when there are problems with treatment, potentially allowing it to progress more smoothly.

Patient records

The use of electronic patient record (EPR) systems reduces the need for paper and plastic, and decreases the physical space required for their storage. An EPR system also integrates well with digital radiography, which significantly reduces the use of chemicals for film processing and single-use lead backing on films. Radiographic images can be more widely shared via electronic methods rather than printing and posting hard copies. An EPR-based approach may also be expanded to include intra-oral scanning rather than the use of impressions for generating working and study models, thus reducing material and storage requirements. In addition, this approach reduces the quantity of gypsum used for such models. Gypsum can have adverse environmental effects if disposed of incorrectly and requires special consideration.¹⁸

Reducing treatment need

A preventive approach to oral health has a positive environmental impact, as healthier mouths require less restorative intervention with a need for fewer appointments and use of restorative materials. The environmental effect of both amalgam and composite in terms of heavy metal pollution and microplastic release is well recognised. Also, a reduction in the premature loss of primary teeth due to caries may result in less impacted teeth and less crowding, with a consequent reduction in the need for orthodontic intervention and its associated environmental impact in terms of time and materials. However, awareness of the environmental impact of oral healthcare is low among professionals and the public.

By preventing disease occurrence and progression, less treatment is required, and thus less materials, travel, clinician and patient time, and re-treatment where necessary. The earlier in the disease process that preventive advice can be given and acted on, the greater its impact; for example, smoking cessation advice rather than a mandibular resection with free flap for an invasive oral cancer, or application of silver diamine fluoride to arrest caries in a deciduous tooth rather than extraction under general anaesthetic for a young child.

Patient ownership and treatment factors

Active patient involvement in and ownership of their treatment enhances the sustainability of active dental treatment, for example by leading to fewer wasted

appointments when patients fail to attend.¹⁹ This can be enhanced by the use of techniques such as electronic appointment reminders, shared decision-making, patient engagement, and addressing health behaviour change. Clinical research and systematic reviews, which demonstrate recall intervals and treatment efficiency and predictability, are beneficial. The practice of evidence-based dentistry, with more predictable outcomes, can potentially reduce the need for multiple appointments and interventions. The use of treatment protocols may further enhance these benefits, through standardisation of treatment approach and supporting the use of more sustainable procurement methods.

Conclusions

There are many actions that may be taken to improve the sustainability of dental practice. A clinician may feel overwhelmed by the magnitude of the environmental impact posed by dentistry and be unaware of their potential ability to improve sustainability. A structured approach using the ideas contained within this article and guided by the 7 Rs may help to break this down into a more manageable series of plans. While individuals may have a commitment to sustainable practice at home, this may not transfer to their workplace and professional duties. A conscious effort to translate home behaviours to work is necessary. Many changes discussed here are easy to attain and accrue a considerable impact over a working career. The overall goal is to normalise a sustainable approach, creating an environment where both clinical staff and patients are mindful of the need for sustainability in their actions. This applies to types of treatments as well as to how they are provided.

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