

Environmentally sustainable dentistry: a brief introduction to sustainable concepts within the dental practice

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Key Points

Highlights how sustainability ensures the basic needs and quality of life of everyone are met, now and for future generations.

Describes why sustainability in dentistry needs to be considered for planetary health, personal health, financial health and practice reputation.

Suggests there is a lack of awareness in the dental team on how to become more sustainable.

This paper introduces clinicians to sustainability as it relates to dentistry. There are seven papers in the series. These include this introduction, followed by papers on energy, procurement, travel, waste, biodiversity and engagement and embedding sustainability into current dental practice. A sustainable world aims to ensure the basic needs and quality of life of everyone are met, now and for future generations. The current delivery of healthcare in the modern world is not sustainable due to rising financial costs, increasing demands and a high environmental burden. Dentists, like their medical counterparts, need to consider the General Dental Council (GDC) standards and the relationship between planetary health and human health within their practice. There is increasing awareness of the problems associated with global warming but a lack of knowledge on how to become more environmentally sustainable. There are also financial and reputational benefits to becoming more sustainable for practices. The carbon footprint is one proxy of sustainability and is closely related to expenditure. In 2014–2015, the carbon footprint of dentistry was calculated to be 675 kilotonnes carbon dioxide equivalents (CO₂e) with 64.5% related to travel, 15.3% from energy and 19% from procurement. The GDC should consider incorporating sustainability education into the undergraduate framework in line with student demands and similar moves by the General Medical Council.

Introduction

As the Sustainable Development Unit suggests, a sustainable health and care system works within the available financial, environmental and social resources; protecting and improving health for current and future generations.¹ The present delivery of healthcare in the modern world is not sustainable due to rising costs, increasing demands, and the high environmental burden. Medicine, in general, places a high moral importance on human life.² Within dentistry in the UK, standard 1.4 of *Standards for the dental team* reminds the team

that they must take a holistic and preventative approach to patient care. Specifically, they should take account of patients' overall health.³ There is growing evidence that sustainability, or planetary health, has a considerable effect on human health.⁴

Environmental sustainability over the last generation

In recent decades, environmental sustainability has been influenced by global agreements and associated climate change legislation. The United Nations Conference on Environment and Development in 1992 resulted in one of the first frameworks for climate change.⁵ Five years later, the Kyoto Protocol committed global government signatories to reduce greenhouse gas emissions to a level that would prevent dangerous anthropogenic interference with the climate system.⁶

In 2007, the Stern review highlighted to the UK government not only the global effects of climate change but also the economic risks.⁷ In the UK, the Climate Change Act 2008, along

with EU targets, obliged the secretary of state to ensure that the net UK carbon account in 2050 would be at least 80% lower compared to the baseline.⁸ The act included carbon budgets, adaptation planning, and the set-up of an independent advisory body to ensure the aims of the legislation were met.⁹ In 2016, the Paris Agreement required countries to implement their nationally determined contributions and to increase their ambitions over time to keep the rise in global mean temperature well below two degrees.¹⁰

Despite these agreements, countries need to do more. At the time of writing, the Intergovernmental Panel on Climate Change (IPCC) has just highlighted the effects on the planet should carbon emissions not be significantly reduced. The report states that global greenhouse gases need to drop by 45% from 2010 levels in the next 12 years to stay on a 1.5 °C path. If temperatures rise by two degrees, this would expose several hundred million people to dangerous climate-related risks by 2050 and would wipe out most coral reefs.¹¹

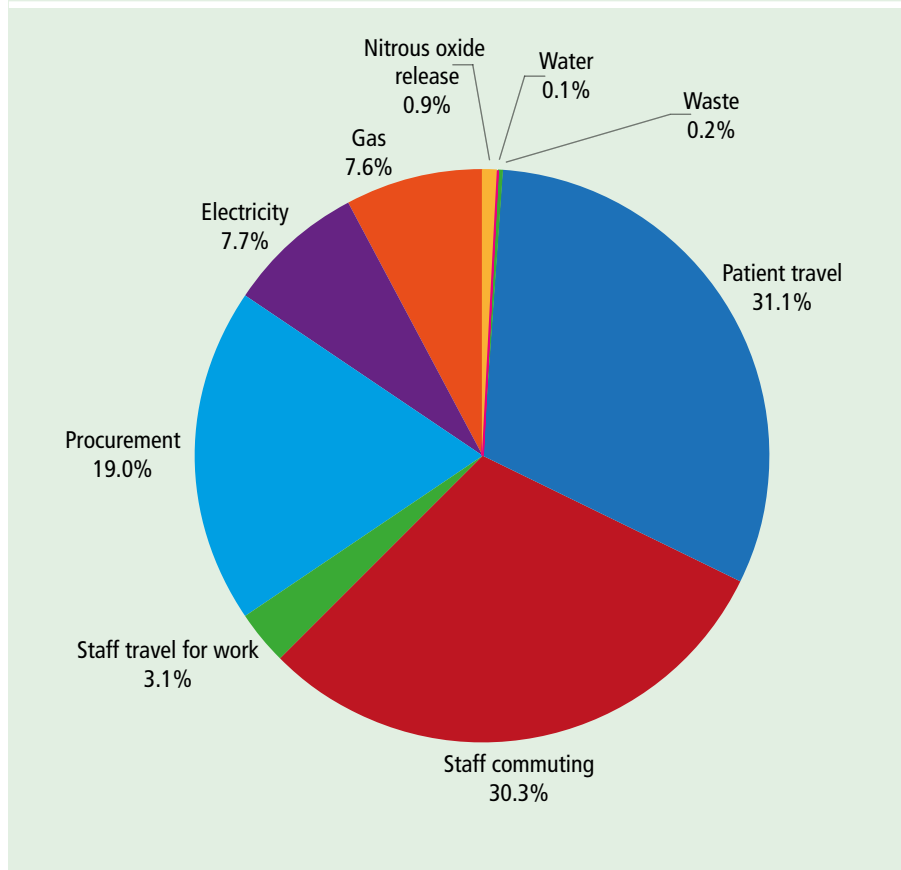
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Fig. 1 Carbon emissions NHS dentistry 2014–2015¹⁷

Healthcare systems and their impact on sustainability

Dentists, along with other healthcare professionals, have an underlying ethical obligation to *primum non nocere* (first, to do no harm). Although healthcare systems were developed to reduce disease in global populations, they are also doing harm. The NHS in England produces 22.8 million tonnes of carbon equivalent emissions (Fig. 1), 3% of the carbon footprint of the whole country (846 million tonnes),¹² with the equivalent services in the United States and Australia being 10% and 7%, respectively.¹³ Air pollution is affecting our health, and yet 10% of air pollution emissions result from health care and the use of nitrogen oxide, sulphur dioxide etc.^{14,15} Furthermore, within a Yale working group of experts in healthcare sustainability, decontamination procedures were highlighted as a significant source of pollution.¹⁶

Within dentistry, the carbon footprint has been calculated to be around 3% of the total NHS footprint, or more precisely 675 kilotonnes of carbon dioxide equivalents (CO₂e).^{17,18} Travel for NHS dentistry causes air pollution, and the associated travel impact (for

example, noise pollution, accidents) reduces overall population quality-adjusted life years by 14 minutes.¹⁹

Organisations supporting sustainable healthcare

Within the UK there are a number of organisations supporting sustainable healthcare. In 2008, the Sustainable Development Unit was established. The unit is now jointly funded by NHS England and Public Health England. The unit's areas of focus are: engaging the health and social care system, developing policy and research to identify the frameworks, networks and mechanisms that will promote a healthier environment and enable communities to adapt to weather events and climate change.²⁰ In the same year, the Centre for Sustainable Healthcare was established as a charity to help the NHS fulfil its commitment to reduce its carbon footprint. Since this time, they have worked with partners to engage healthcare professionals, patients and the wider community to understand the connections between health and environment, and to reduce healthcare's resource footprint. Both organisations have been active in encouraging change across the health and social care system.

Sustainable dentistry

Interest in sustainable dentistry has been slow to take off but it is growing. To our knowledge, the first carbon footprint for dentistry was calculated in Fife, Scotland in 2011.²¹ Public Health England (PHE) commissioned a report into the carbon modelling of dentistry in 2015, which was summarised in a 2016 British Dental Journal paper and then published as a PHE document in 2018.^{17,22} Supported by the Dublin Dental University Hospital, Health Education England (HEE) has now funded four scholars to undertake 12-month attachments in the Centre for Sustainable Healthcare to build capacity in sustainability in dentistry. The drive to improve dentistry from a sustainability perspective is growing, demonstrated by good attendance at a recent sustainability in dentistry conference, also funded by HEE.

There are also an increasing number of publications describing sustainable dentistry, including a useful review by Mullimani on waste management, and a discussion by Mills, Groce and Richardson on the barriers and facilitators to implementing sustainable dentistry.^{23,24,25}

Sustainable healthcare and NHS England commissioning

Within the NHS England standard contract, there are three clauses which currently are not applicable to primary healthcare providers such as the dental team. These include service condition 18; specifying that providers must take all reasonable steps to minimise their impact on the environment, demonstrate their progress on climate change adaptation, mitigation and sustainable development, and provide annual summaries of this to commissioners.²⁶ It is not thought unreasonable to think that such clauses could be inserted into dental contracts in the future.

Sustainability and practice reputation

Sustainability is also a marketable commodity. Practices can promote their green credentials, which is not only good from a sustainability perspective but also good for the practice reputation. A Nielsen study demonstrated the importance of sustainability, particularly within the millennial group, with almost three quarters of respondents willing to pay extra to procure sustainable products. Such products from a company that claimed to be environmentally friendly were more desirable in this generation.²⁷ In another study, 21% of

participants said they would actively choose a particular brand if the brand demonstrated clear sustainability credentials.²⁸ These commercial studies demonstrate the need not only to implement sustainability into a dental practice, but also to communicate this to both current and potential patients.

Sustainability, knowledge and behavioural change

Media coverage continues to highlight environmental concerns such as increasing carbon emissions, rising temperatures and melting ice caps.²⁹ The ‘Attenborough effect’, for example, generated a significant surge of interest in plastic and recycling.³⁰ As demonstrated in a recent study, there is interest from the dental team in how to become more environmentally sustainable, however, there is a lack of awareness on how best to accomplish this.³¹

Sustainability terms

For the reader who is inexperienced in the terminology of sustainability, the understanding of some key terms, such as global warming, carbon dioxide emissions, greenhouse gases, and carbon footprint, can be useful; so the definitions will follow.

Greenhouse gases

A greenhouse gas, or emission, is any gas that absorbs infra-red radiation. Greenhouse gases absorb solar heat, and radiated heat, and prevent heat from being lost from the planet. The increased heat is responsible for the greenhouse effect, or global warming. There are a number of different greenhouse gases. Usually, the term greenhouse gases refers to the six included in the Kyoto Protocol: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.⁶

Global warming potential

Global warming potential (GWP) indicates the amount of warming a gas causes over a given period of time, with carbon dioxide having the index value of one. The GWP is a measure of the number of times more warming other greenhouse gases are, relative to carbon dioxide. The reader is referred to Table 1, which shows the different greenhouse gases and their GWP. In dentistry, the GWP allows readers to compare gases such as nitrous oxide, which has a GWP of 298 times that of carbon dioxide.

Carbon dioxide equivalent

The reader should also be able to distinguish between the terms carbon dioxide and carbon dioxide equivalent. Carbon dioxide equivalent (CO₂e) simply converts all greenhouse gases into amounts equivalent to carbon dioxide so they can be compared.³² Greenhouse gases are collectively also known as carbon dioxide equivalent emissions.

Measuring sustainability in dentistry

Within dentistry, environmental sustainability can be measured in a number of ways. One such way is to analyse the carbon footprint, defined as the total greenhouse gas emissions produced during the delivery of a specific activity or the manufacturing of a product, expressed in equivalent tonnes of carbon dioxide (CO₂e).³³ Alternative ways of considering sustainability are: the consumption of resources, the change in air quality, and the change in waste production or biodiversity. Once sustainability is measured in some form, health care providers can look at potential, more sustainable, alternatives.

In order to understand how sustainable a specific healthcare practice is, researchers analyse their carbon footprint as a proxy measure of sustainability; as analysis of the carbon footprint allows an understanding of which elements of our current practice are not sustainable. This carbon footprint is strongly associated with expenditure: the more money an organisation spends, the higher their carbon footprint.^{34,35} Increasingly, natural resources are being measured, as well as carbon emissions, to gain a more holistic measure of overall sustainability. However, the use of carbon footprints can be problematic if viewed in isolation. For example, fluoride varnish applications have a carbon footprint but, ultimately, will improve oral health, so will reduce the long-term carbon footprint of dentistry.

Sustainability and education

Within the General Dental Council’s *Preparing for practice* document there is no requirement for sustainability to be delivered in the undergraduate setting.³⁶ However, at a recent European Dental Students’ Association meeting in April 2018, the students expressed concern that sustainability was not part of the curriculum across European dental schools. The landscape may be shifting, though, with courses now developing in Plymouth, Manchester and Dublin universities.

Within the UK, the General Medical Council (GMC) has developed learning outcomes in sustainability which include describing the interaction between the environment and human health, developing skills to improve sustainability, and the relationship between sustainability and the duty of a doctor.³⁷ These learning outcomes were published in *The Lancet*.³⁸ The sustainable healthcare education network, with dentistry included in their membership, is continuing to develop work in this area.³⁹

Conclusion

Within the dental carbon footprint of the NHS in England, 64.5% originated from staff and patient travel, 15.3% from energy and 19% from procurement. The next three papers in this series will focus on these areas.^{40,41,42} The authors are aware that to analyse environmental sustainability in a broader sense, there is a need to consider the waste, including water and nitrous oxide, produced by dentistry. This will be analysed in the fifth paper in the series. In paper six, the ability of dentistry, along with other healthcare sectors, to influence biodiversity will be discussed. The final paper in the series will discuss the engagement of the dental team, patients and members of the general public in order to embed sustainability into current dental practice.^{43,44,45}

Greenhouse gas	Global warming potential (100 years)
Carbon dioxide	1
Methane	25
Nitrous oxide	298
Hydrofluorocarbons (HFCs)	124–14,800
Perfluorocarbons (PFCs)	7,390–12,200

Finally, there is a need for a wider research agenda underpinning the development of dentistry as a sustainable health service. Within the UK and Ireland there is some early research being undertaken in waste management and behavioural change, carbon footprinting, life cycle analysis and understanding perceptions of the dental workforce.^{24,31} This work, however, needs to be developed in parallel and in collaboration with other healthcare partners.

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- Duane B, Croasdale K, Ramasubbu D *et al*. Measuring and embedding sustainable practice into the dental practice. *Br Dent J* 2019; In press.

Correction

Clinical article *Br Dent J* 2019; **226**: 16–22.

Periodontal diagnosis in the context of the 2017 classification system of periodontal diseases and conditions – implementation in clinical practice

When this article was initially published, the second footnote for Table 2 was incorrect. The correct footnote reads ‘**Measurement in mm if only bitewing radiograph available (bone loss) or no radiographs clinically justified (CAL).’

The author apologises for any confusion caused by this error.

The original article can be found here: <https://www.nature.com/articles/sj.bdj.2019.3>.