Discussing the environmental impact of dental-associated travel – how do we build from the current COVID-19 crisis towards a more sustainable future within dentistry?

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Key points

Sustainability is a marketable commodity which can improve a practice's reputation, a statement supported by commercial studies.

There are numerous suggestions for change to reduce the environmental impact of dental services, including the implementation of information technology where appropriate.

Preventative dentistry is the most sustainable way to ensure optimal, accessible and affordable oral health for patients, with minimal impact on the environment.

Abstract

Dentistry is a highly energy- and resource-intensive field and consequently has a significant environmental impact. In 2013–2014, total greenhouse gas emissions of NHS dental services in England measured 675 kilotonnes of carbon dioxide equivalents, with 64.5% related to travel, 19% from procurement and 15.3% from energy use. There is currently an absence of comprehensive standards or guidelines for sustainable dentistry. Instead, sustainable initiatives have been at a small scale and are adopted voluntarily by groups or professionals as an ethical duty or practical requirement. However, a recent study showed that there seems to be increasing interest from dental teams in how to become more sustainable. This opinion article focuses on how the dental profession can ensure a sustainable recovery as England emerges from the COVID-19 crisis, with an emphasis on improving environmental sustainability related to travel within the dental healthcare system. Reducing dental-associated travel can include changing mode of transport, combining family appointments, appropriate scheduling of dental examinations, preventive dentistry and the use of information technology.

The background of NHS dentistry in England

'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.'[1] In England, NHS dentistry is delivered by NHS high street dentists, Community Dental Services and through secondary care, in hospitals. Dentistry is a highly energy- and resource-intensive field, so has a significant environmental impact. In 2013–2014, 28.7 million courses of dental treatment were undertaken, involving 61.3 million dental procedures. Total greenhouse gas emissions of NHS dental services in England measured 675 kilotonnes of carbon dioxide equivalents (CO2e), of which 64.5% related to travel, 19% from procurement and 15.3% from energy use.[2,3] Currently, there is an absence of comprehensive standards or guidelines for sustainable dentistry: sustainable initiatives have been at a small scale and are adopted voluntarily by groups or professionals as an ethical duty or practical requirement.[4] However, a recent study showed that there seems to be increasing interest from dental teams in how to become more sustainable and there was good attendance at recent dental sustainability conferences in England.[5]

The COVID-19 pandemic has had a large impact on the provision of NHS dentistry.[6] As England emerges from this crisis, how can the dental profession ensure a sustainable recovery?

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The environmental impact of dental-associated travel

Total greenhouse gas emissions related to staff and patient travel within NHS dentistry measured approximately 435 kilotonnes tCO2e annually, nearly two-thirds of the total greenhouse gas emissions by NHS dentistry.[7] This article will primarily focus on environmental sustainability related to travel within the dental healthcare system, as it's a major contributing factor to greenhouse gas emissions. A glossary of terms is included in Appendix 1. Indeed, to mitigate the effects of the carbon dioxide equivalents emitted due to dental travel-related activities annually, 28,048,800 trees would need to be planted, requiring 16,835 hectares of land (Figure 1).

In addition to the CO2e emissions, dental-related transport in England is also responsible for releasing a significant amount of nitrogen

Fig. 1 Highlights the number of trees and land required to mitigate the effects of CO2e emitted due to dental travel-related activities annually. Offset calculations are based on 1,600 trees per hectare, which sequester an estimated 20 tonnes of carbon dioxide per year for 30 years. In practice, land and tree planting costs vary from project to project, but average $5 per tonne based

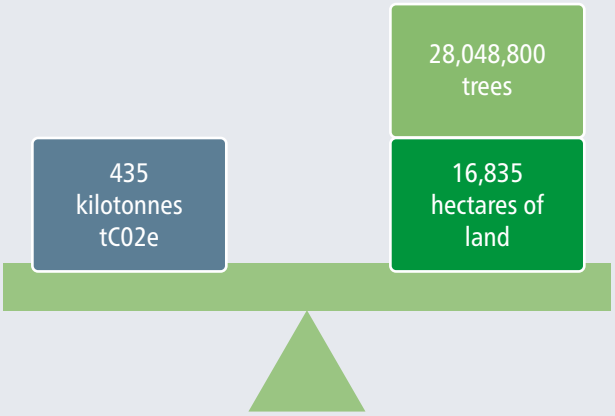

Table 1 Nitrogen oxides and particulate matter released annually due to dental-related transport in England[7]

Air pollutant	Tonnes per year
Nitrogen oxides (NO_x)	372
Particulate matter (PM2.5)	19

oxides (NO_x) and particulate matter (PM2.5) annually (Table 1). This air pollution is estimated to reduce over 325 quality-adjusted life years (QALYs) per year, at an estimated economic loss of £17.5 million to health and society.[7] As this is an estimate using the health outcomes of travel tool, which can only quantify acute health impacts, the impact on QALY is likely to be higher when taking into consideration additional emission-related morbidity.

Suggestions for change

Considering a change in mode of travel

Previous recommendations for sustainable travel included carpooling and using mass transit systems to travel to dental practices.[4] However, as England emerges from the COVID-19 crisis, the government has advised individuals to avoid the use of public transport where possible.[8] As a journey by private car is estimated to generate around 151 g CO2e emissions for every kilometre, emphasis should therefore be shifted towards encouraging staff and patients to increase active travel, by cycling/walking or switching over to vehicles which reduce fossil fuel usage or run on alternate energy sources.

Active travel is a sustainable form of travel that generates negligible carbon emissions while providing significant cardiovascular, general health and economic benefits.[9] Dental practices can consider implementing the following suggestions to support active travel for both their staff and patients. Dental practices can share resources, such as maps of local safe cycle routes, on practice websites and in staff induction packs. Practices can also sign up to the government's Cycle to Work scheme and/or by ensuring there is secure cycle parking on site.[10] However, private care usage is sometimes unavoidable; therefore, to reduce emissions, practice staff could be offered driving efficiency courses – these schemes have also been shown to be of economic benefit to the partaker.[7] To explore how patients and staff are travelling to dental practices following the COVID-19 crisis, an online survey tool can be used to assess travel patterns and to investigate what could help them incorporate more active travel.

Additionally, the UK government is encouraging individuals and organisations to switch to electric vehicles. Operationally, electric vehicles have lower carbon, NO_x and PM2.5 emissions, resulting in a much lower air pollution impact. Dental practices can encourage electric and hybrid vehicle usage by providing maps of locally available charging points on the practice website for patients. Furthermore, dental practices could consider installing an electric vehicle charging point. These can have a set-up cost of £300 if purchased through the Office for Zero Emission Vehicles, a government-run scheme.[9]

Combining appointments and appropriately scheduling dental recall appointments

To decrease dental-associated travel and the frequency of individuals leaving their homes as England emerges from the COVID-19 crisis, there are three key factors that can be considered by healthcare professionals regarding patient appointments:

- Firstly, family dental appointments should be combined where feasible to facilitate only one return journey being necessary for several appointments
- Secondly, to reduce the number of appointments needed to complete a course of treatment, dental treatment should be planned to minimise travel by combining multiple procedures into one visit
- Lastly, dental professionals should consider reducing the frequency of dental examinations scheduled by implementing the evidence-based risk assessment approach.[7] While patients at high risk of developing dental disease should be seen at 3-monthly intervals, adult patients at low risk of dental disease can have the longer interval of 24 months for recall examinations implemented.[11]

Reducing the number and frequency of dental appointments will reduce dental-associated travel and its environmental impact and will likely have a positive impact on reducing the spread of COVID-19, all while enabling dental care professionals to continue practising socially responsible dentistry.

Preventative dentistry

Sustainable dentistry goes hand in hand with preventative dentistry. A reduction in the occurrence of dental disease will lead to a reduction in the overall resource use in later years. In England, preventative dentistry should be provided in line with *Delivering better oral health* guidelines.[12] Due to the global pandemic, there will have been a reduction in the number of patients having attended a dental appointment over the last few years. It is therefore imperative that messages to encourage prevention of dental disease are reinforced by dental practices using social media and online tools.[7] Appropriate educational resources promoting dental health can also be sent directly to patients through email or text, if in line with general data protection regulations.[13,14] The

prevention of oral diseases and the promotion of health should be recognised as the most sustainable way to ensure optimal, accessible and affordable oral health with minimal impact on the environment.

Information technology

Teledentistry, the use of information technology and telecommunications, should be employed for communication to reduce travel-related emissions. It enables professional interactions between healthcare practitioners, peers and patients, while eliminating the need to travel and meet in person to discuss the same. During the COVID-19 crisis in England, analgesic advice, antibiotic prescriptions and referrals to urgent dental care centres have been performed electronically by dental care professionals. A potential positive aspect of teledentistry may be an increased patient understanding of what constitutes a dental emergency (for example, swelling) and what does not (for example, de-capped crown). As England emerges from this crisis, encouraging all dental practices to adopt an electronic referral system with Global Positioning System (GPS) technology should reduce travel-associated carbon and greenhouse gas emissions, as well as paper usage. Indeed, the South East of England already uses an electronic referral system which enables patients to choose the most appropriate specialist and their closest practice.[7] In instances where paper referrals continue to be the preferred option, we must ensure that recycled or sustainably produced paper is used.[13]

Teleconference technology should similarly be used to reduce large group meetings and travel emissions associated with attending conferences. Dental conferences that live stream their events enable participants to attend virtually. This can lead to improved accessibility due to the potential lower costs associated with conference attendance and the opportunity to rewatch recorded talks.[15] The recent British Orthodontic Conference held its first ever hybrid event, highlighting the feasibility of this suggestion.

Procurement- and laboratory-related travel

To reduce emissions associated with postage, digital intraoral scanners, 3D models and digital radiographs can all be transmitted electronically to the lab and other professionals instead of posting physical copies.[4] Furthermore, digital x-rays have the added benefit of using approximately 70% less radiation and producing less waste when compared to film x-rays. Choosing manufacturers and disposal services closer to the end user is another method to reduce carbon emissions resulting from transportation of goods and long supply chains.[7] Dental products should be reused where appropriate in line with health and safety legislation *Health technical memorandum 01–05* issued by the Department of Health in England.[16] Reusing dental products will reduce the number of products required to complete a course of treatment, which has both financial and environmental benefits.

Regulatory change and business leadership

The Public Services (Social Value) Act came into force on 31 January 2013. The Act requires people who commission public services to think about how they can also secure wider social, economic and environmental benefits. Public authorities are required to 'have regard to economic, social and environmental wellbeing in connection with public services contracts'.[13] NHS England commissions NHS dentistry and uses a purchaser-provider split, which means that NHS England commissioners can have a substantial impact over the provision and location of new dental services. When commissioning dental services, NHS England commissioners use health impact assessments to ensure that economic and social factors are being considered. However, there has been little work undertaken to understand the environmental factors of commissioning dental services.[13] To address this gap, all NHS commissioners should be trained to understand the environmental impact of dentistry and how to take into consideration environmental factors when commissioning dental services. To support the delivery of accessible dental care, needs assessment should employ GPS technology to optimise the amount of travel between a patient's home and care. When commissioning dental services, NHS England could also insert environmental clauses into dental contracts. Currently, there are three clauses within NHS England's standard contract; however, they are not applicable to primary healthcare providers, such as dental practices. 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'.[17] Introducing environmental clauses into dental contracts and ensuring there is a contractual requirement for dental teams to report on sustainability, particularly on environmental metrics, would enable the dental profession to contribute to a more sustainable recovery as England emerges from the COVID-19 crisis.

Raising awareness and understanding of environmental issues could be addressed at different stages of a healthcare professional's career. Firstly, at an undergraduate level. While the General Medical Council has published learning outcomes relating to sustainability for medical doctors, there are currently no learning outcomes for sustainability within the General Dental Council's (GDC) *Preparing for practice* document.[17] In order to increase understanding of sustainability in dentistry among undergraduate students, the GDC should consider encompassing learning outcomes on sustainability as a requirement within the dental curriculum. If appropriate, a nationwide, online 'sustainability within dentistry' course could be developed by consultants with expertise in sustainability. Academic institutions could deliver this, plus any additional sustainability teaching through online platforms to reduce the need for large group gatherings. Secondly, when commencing a job as part of staff induction. By providing resources on sustainability as part of staff induction, new staff will be more likely to consider sustainability as an integral part of their role.[10] Finally, at any stage of work life through continuing professional development (CPD). To continue increasing staff knowledge on the topic of sustainability within dentistry, a practice policy on sustainability should be introduced and verifiable CPD hours on environmental sustainability specifically should be accessible for all dental team members.[10] This should enable dental professionals to have a baseline understanding of environmental issues, with a focus on the environmental impact of their services.

A survey of the general public found that 89% of respondents think that it is important for healthcare systems to become more sustainable.[4] In fact, sustainability is a marketable commodity which can improve a practice's reputation. Products from companies that claim to be environmentally

friendly are more desirable to those in the millennial group, with three-quarters of respondents in this generation being willing to pay more to procure sustainable products. Another study found that 21% of participants would actively choose a brand if it demonstrated clear sustainability credentials. These commercial studies highlight the importance of sustainability to current and potential dental patients.[17] Applying for awards, such as an NHS sustainability award and publicly celebrating achievements can communicate a positive practice image and sustainability-conscious values to the public.

Conclusion

Dentistry must be practised ethically, with high levels of quality and safety in the pursuit of optimal oral health. As we emerge from the current COVID-19 crisis, there are several suggestions for change within the NHS healthcare sector which could help ensure a more sustainable recovery, which balances economic, social and environmental wellbeing. While this essay has primarily focused on NHS dentistry, many of the suggestions are applicable to the growing private sector, which provides dental care in addition to NHS dental services. Suggestions to reduce dental-associated travel include changing mode of transport, combining family appointments, appropriately scheduling dental recall appointments and implementing preventive dentistry and information technology. For further information on environmentally conscious dentistry, a series of papers on sustainability within the dental practice have been published in the *British Dental Journal*, with two papers specifically focusing on how to reduce emissions related to procurement and energy use within dentistry.[13,18] Due to the large impact that COVID-19 has had on dental healthcare, there is uncertainty among the public and dental care professionals regarding how NHS dentistry will operate in the future. Among all this uncertainty, it is vital that environmental sustainability within dentistry does not become overlooked. There is a clear need for a wider research agenda underpinning the development of dentistry as a sustainable health service, which should be developed in parallel and in collaboration with other healthcare partners.

Ethics declaration

The author declares no conflicts of interest.

Appendix 1 Glossary of terms

- Active travel: travel that uses non-motorised methods, such as cycling and walking. Active travel generates negligible carbon emissions
- Carbon footprint: the sum of greenhouse gas emissions (carbon emissions) released in relation to an organisation, product or service, expressed as 'carbon dioxide equivalents'
- Green economy: green economy is one that results in improved human wellbeing, while significantly reducing environmental risks and ecological scarcities[19]
- Nitrous oxides: air pollutants released from combustion of fuels in vehicles[7]
- Particulate matter: particulate matter is generated from wear and tear of brakes, tyres and road surfaces. It is classified as PM2.5 or PM10, depending on the size of the particles (less than 2.5 or 10 micrometres, respectively). The smaller the particle, the further the particle matter can penetrate into the lungs[7]
- Purchaser-provider split: the purchaser-provider split refers to the creation of an internal market within the NHS in the 1990s, when the NHS was divided into those organisations that provided services (such as NHS dental practices) and those that purchased services from them. NHS service providers have to generate their own income and compete among themselves for business[20]
- Sustainability: the property of being environmentally sustainable; the degree to which a process or enterprise can be maintained or continued while avoiding the long-term depletion of natural resources[21]
- Sustainable development: development which meets the needs of current generations without compromising the ability of future generations to meet their own needs[1]
- Quality-adjusted life years: a measure of the state of health of a person in which the benefits, in terms of length of life, are adjusted to reflect the quality of life. One quality-adjusted life year is equal to one year of life in perfect health.

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