Embedding environmental sustainability within the modern dental curriculum – Part 1: Exploring current practice and developing a shared understanding

Short running title:

Embedding sustainability in dental curricula

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Embedding environmental sustainability within the modern dental curriculum – Exploring current practice and developing a shared understanding

Consensus paper

Short running title:

Embedding sustainability in dental curricula

Keywords

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Abstract:

Introduction:

Evidence concerning the interactions between human health and planetary health has grown extensively in recent years. In turn, the perceived importance of environmental sustainability within higher education is growing at a rapid rate. This paper provides a summary of key elements as they apply to dentistry, and provides an introduction to the reader of an early consensus of how sustainability could be included as part of the dental curriculum.

Methods:

The consensus opinion within this paper largely centres around discussion at the ADEE sustainability workshop at the annual conference in Berlin (August 2019). In order to help inform discussions at the workshop, a brief scoping questionnaire was circulated to potential participants regarding their understanding and current teaching practices in sustainability. An infographic was designed to help delegates remember the important elements of sustainable dentistry. Delegates discussed the concept of sustainability alongside the infographic, and how they could link these with the Graduating European Dentist (GED) curriculum.

Results:

The discussions within the workshop largely centred around 4 main themes: Disease prevention and health promotion, Patient education and empowerment, Lean service delivery and Preferential use of strategies with lower environmental impact.

Discussion:

It is apparent that there is a widespread need for teaching materials relating to environmental sustainability; this includes specific learning outcomes relating to the 4 educational domains of the Graduating European Dentist curriculum, and methods for teaching and assessing these outcomes.

Conclusion:

This paper reports consensus on the first phase of a pan-European working group on Sustainability in dental education

Introduction

Evidence concerning the interactions between human health and planetary health has grown extensively in recent years.[1] The COVID 19 pandemic has demonstrated the fragility of our place on this planet, and the relationship between how we live our daily lives and wider human health. Some argue pandemics such as Covid 19 are increasingly likely as humanity destroys ecological balances. For example, pandemics are much more easily transmitted due to high density living; and living in sub-standard and unsafe houses increases the vulnerability to diseases such as Covid 19.[2]

In turn, the perceived importance of sustainability (and in particular, environmental sustainability) within higher education medical programmes is growing at a rapid rate. As a consequence, it is becoming apparent that dental practice, as it is currently delivered, is not environmentally sustainable.[3] This consensus paper discusses the importance of embedding sustainability within European undergraduate dental curricula, before reporting the shared vision of a number of international educators following an ADEE (Association for Dental Education in Europe) workshop in Berlin, in 2019.

The importance of environmental sustainability and planetary health

In 1987 Bruntland advised that a sustainable world must meet our own generation's needs - but also that of subsequent generations[4]. In 2015 the United Nations published a series of 17 Sustainable Development Goals (SDGs) which were adopted by all United Nations Member States.[5] The aim was to provide a "shared blueprint for peace and prosperity for people and the planet, now and into the future". The goals are necessary crucial to *systematically* reduce our impact on the environment, as evidence underpinning the relationship between human health and the health of the planet (planetary health) continues to grow.[6] This relationship affects population health and wellbeing, through its impact on infectious and non-communicable disease, nutritional outcomes, displacement, conflict, and mental health outcomes.[7] Examples of this pattern include deteriorating air quality which is linked to a worsening global burden of disease. [8,9,10]

The environmental costs of oral health care

Changing how dentistry is delivered has the potential to significantly contribute to the reduction of the environmental footprint of the entire health care sector.[11] However, the concept is not straightforward. Currently there are aspects of the provision of dental care that contribute disproportionately to the environmental footprint - for example, the environmental footprint of travel within dentistry is considerably higher than elsewhere in the medical sector, presumably because dental appointments have the potential to be shorter and more frequent.[12] Further, research has identified a number of "hotspot" products or working practices, that have a higher than expected environmental impact. In the dental school in Malmo, for example, cotton dental gowns produced in order to reduce waste from single use items, have a relatively high environmental footprint[13]. In another example, surface disinfectant (in this respect isopropyl alcohol) has been shown to contribute 13% of the carbon emissions of a routine dental examination. Not surprisingly, procedures that take more time and use more resources (equipment, energy, chair time) have a much greater environmental impact.[14] From an oral health prevention perspective the toothbrush has recently been highlighted as a significant contributor to the global environmental footprint, with electric toothbrushes being significantly more harmful than manual.[15] Although there has been very little research carried out into dental specific *single use items,* it is expected that they also contribute significantly to the environmental footprint of dentistry.[16]

Policy to support sustainability

At a policy level, there are several international agreements established to improve planetary sustainability, including the Paris agreement[17], and the Sustainable Development Goals (mentioned previously).[18] However, policies to support sustainability within health care are not new - within Europe and beyond, countries have been legislating in an attempt to reduce their environmental impact since the mid 1990s. The International Organization for Standardization (ISO) standards (ISO 14000 series, 1996) were written to promote effective environmental management systems within organisations and small to medium enterprises (SMEs).[19] Early examples of its

implementation in health care include work with the UK's National Health Service (NHS) Purchasing and Supply Agency (now NHS Supply Chain), and work with regional procurement networks.[20] More recent examples of wider national and international policy include the UK's Climate Act of 2008, and New Zealand's Zero Carbon act of 2019 [21],[22]. Within the EU, The European Green Deal provides actions to boost resource use, restore biodiversity and cut pollution.[23]

Since publication of the United Nation's SDGs, higher academic institutions have begun to look closely at sustainability – both in terms of their civic duty, but also in order to provide a more sustainable workplace for staff and students. Institutions that implement a 'programme level approach' are undoubtedly able to introduce complex concepts like sustainability in a more global and holistic manner – and in a similar way, sustainability needs to be longitudinally integrated throughout dental curricula in order for students and staff to embrace its importance.[24]

A vision for academic change within dental education

In 2011 the first carbon footprint of a dental service was calculated [25]. Since then there has been a growing interest in environmental sustainability in dental education, as evidenced by conference proceedings (ADEE[26]), and presentations to interested parties such as the European Dental Students Association (EDSA), the Council of European Dentists, and National Local Dental Committees. The overarching feelings from these groups were bewilderment (that change is slow to come), disempowerment (the feeling that it's difficult to change), but also excitement that it is possible to make a sustainable change in dentistry. As well as in-depth conversations about changes needed within society, across policy, and within dental systems, there was the clear consensus that the future generation of dentists need to be taught basic sustainability principles (including the ethics of practicing sustainable dentistry) and practices within their undergraduate and postgraduate courses – and an awareness that they have an active role in achieving the 2030 SDGs.

Several dental academic institutions are already giving attention and emphasis to sustainability. Some are teaching the Sustainable Development Guidelines[27], and in doing so, are attempting to prepare dental graduates to have an active role fulfilling these goals e.g. The University of Sheffield[28]. However, the concept of sustainability is new for many - and requires dental leadership to ensure its principles are taught consistently and appropriately throughout dental education[29].

The Graduating European Dentist curriculum encourages relevant academic stakeholders to develop their own discipline-specific curricula.[30] Whilst this becomes a relatively focused task for well-defined disciplines and topics, the task is less straightforward for more nebulous concepts, themes, or philosophies - such as professionalism, team working, and indeed, sustainability. Whilst medical curricula already contain elements of sustainable healthcare it is important within dentistry to ensure that learning outcomes are introduced rationally into the existing curriculum.[31] Failure to do so will result in an over-burdened curriculum with little uptake, as educators struggle to know how best to implement, teach and assess the concepts of sustainability.

This paper forms part of a larger ADEE project that aims to embed environmental sustainability within modern dental curricula. ADEE has represented dental schools throughout Europe since 1975, and some would regard it as one of the major international voices of dental education. In this regard, ADEE and its membership were used as a vehicle for coordinating a number of important activities.

Aims

The main aims of this paper are therefore to:

- inform educators about the main principles of sustainable clinical practice
- report initial discussion on the importance of embedding sustainability within the domains and major competences of the Graduating European Dentist curriculum

Methods

The consensus opinion within this paper largely centres around discussion at the ADEE sustainability workshop at the annual conference in Berlin (August 2019). In order to help inform discussions at the workshop, a brief scoping questionnaire was circulated to potential participants regarding their understanding and current teaching practices in sustainability. The questionnaire data highlighted that the majority of academics were unclear about the concept of sustainability. As such, an infographic was designed (JF) to help delegates remember the important elements of sustainable dentistry (Figure 1). Delegates discussed the concept of sustainability alongside the infographic, and how they could link these with the Graduating European Dentist (GED) curriculum. Delegates worked in 4 groups, representing the 4 domains of the GED curriculum.[32]

Results and discussion

Insert Figure 1 here

The discussions within the workshop largely centred around 4 main themes:

1. Disease prevention and health promotion
2. Patient education and empowerment
3. Lean service delivery
4. Preferential use of strategies with lower environmental impact

These are discussed, in turn, below:

Disease prevention and health promotion

There was consensus that dentists need to continue to advocate and practice preventive dentistry. The dental team needs to understand both the direct benefit of home-based and professionally-delivered preventive initiatives - but also their

environmental impact. This environmental impact can be lowered by following the principles of Minimal Intervention Dentistry individualising treatment plans (personalised, precise preventive dentistry), thereby increasing efficiency of services and lowering waste.[33] Generally, while prevention has been shown to lower long-term treatment needs and costs over an individual's lifecycle, from an environmental perspective, the way in which preventive measures are delivered does also make a difference: Targeted individualised prevention based on a risk assessment approach is likely to be more environmentally-friendly than a "one-size-fits-all" approach to prevention.

Patient education and empowerment

It was felt that the main priority for oral health interventions should be to address the major determinants of oral health including common risk factors such as sugars, tobacco usage, and socio-economic disparities. National oral health programmes such as the Scottish programme 'Childsmile' are probably an efficient way of delivering fluoride prevention however no evidence exists on environmental footprint of this type.[34] Many patients could be empowered to take on a greater role in the management of their oral health. Ensuring patients have an appropriate targeted prevention and treatment plan can significantly improve the sustainability of maintaining their dentition throughout the life course. Further, empowering patients to practise daily prevention, without using dental services resources, will likely increase sustainability. There are increasing numbers of examples using social media and digital dissemination within dentistry, in order to inform and empower patients to provide self-care at home – and this has become particularly pertinent during the COVID-19 pandemic.

Lean service delivery

Improving clinical decision-making in the selection and targeting of interventions will reduce lower-value activities, and their associated environmental impacts. The group felt that within dentistry, there are many ways where service can be delivered using lean business models, e.g. by optimising recall times in line with current recall guidelines[35], by optimising patient appointment times to reduce overall patient travel, or by managing

stock to reduce waste. Using evidence-based guidelines e.g. SDCEP[36] that ensure optimal care for patients will also be effective in improving sustainability.

Preferential use of strategies with lower environmental impact

Dentistry is rapidly evolving and incorporating technology - some of which has the potential to improve sustainability, e.g. the use of digital dentistry can reduce patient and laboratory-associated travel. The introduction of teledentistry will enable the dental team to provide some consultations with patients with reduced travel, albeit with some carbon emissions relating to the energy used streaming data.[37 ,38] Digital dentistry (Digital radiographs, CadCam) is already reducing the use of polluting materials such as radiographic developer fluids, or the unnecessary use of impression materials and trays, disinfection solutions, transport to laboratories, and the subsequent technical procedures. An increased focus on learning and data information through open platforms will allow prevention and early intervention. Each technological intervention needs to be examined from a sustainability perspective to ensure environmental impact is not worsened. e.g. use of more server energy or manufacture of environmentally harmful products. There is clearly a need for a continuous interdisciplinary research process to understand which products and processes used within dentistry create hotspots. This kind of work is developing in an increasing number of countries.[39,40]

In relation to the use of restorative materials, amalgam is less of an environmental problem in the European Union with the phase down in the use of the material for environmental reasons. [41] However, in countries such as Chile and Colombia (of which some of the authors work) there is continued use of amalgam as a restoration of preference.[42] That said, no restorative product is ideal from an environmental perspective.[43]

The remainder of this paper reports discussions regarding sustainability in relation to relevant GED domains, and their respective major competences.

Domain I: Professionalism

Ethics

There are several reasons for a sustainable shift in the way we deliver healthcare. Health practitioners have a duty to provide optimal care and to first, do no harm (*primum non nocere*). As Brennan (2002) suggests, core principles of dental ethics are the primacy of patient welfare, respect for patient autonomy and commitment to social justice.[44] Without mitigation, climate change will cause a deterioration in planetary and therefore public health. Practitioners have an ethical obligation to ensure they practice dentistry with the minimum of environmental harm. It is therefore important that any curricular elements relating to ethics, stress the individual role of the dentists and their team in contributing to planetary health.

Regulation

Across Europe there are no specific regulations requiring dental services to be sustainable, although this is most likely to change in the near future. Within specific countries, there are examples of legal frameworks that require consideration of environmental well-being when procuring and purchasing goods or services.[45] The graduating European dentist is expected to "have a comprehensive knowledge of, and the skills to comply with the regulatory system of the country in which they are trained".[46] As such, it is increasingly important that graduates are aware of the relevant legislation relating to sustainability.

Historically, infection prevention and control guidance and regulation has focussed on clinical outcomes - but not sustainability.[47] Examples of this include the required use in some countries of single use soap dispensers, and single use instruments – however there is no environmental analysis of preferred practice.[48] The argument to determine the balance between environmental harm and personal harm from each process is still being developed, with more evidence needed. It is important that our graduates are aware of these potential conflicts

and changing philosophies so that they can engage with meaningful and informed debate in relation to policy change.

Professional behaviour

There is increasing evidence of leadership by Universities, and regulatory bodies, in relation to advancing the sustainability agenda.[49] Sustainability is also being encouraged or mandated by professional oral health organisations, e.g. the FDI, the BDA, the ADA and others internationally.[50,51,52,53] In this way, endorsement of the academic agenda by professional organisations adds face validity (and greater public confidence) in our undergraduate curricula. However, sustainable dentistry also requires leadership specifically from local dental educators.[54] It is imperative that students can observe and model their behaviour on that of their senior colleagues and faculty – and so whilst clear learning outcomes are important within a curriculum, it is also important to ensure that faculty are well-educated on the fundamental aspects of sustainable dentistry. It is also critically important to identify methods of teaching and assessment for specific learning outcomes that relate to sustainable dentistry – and this is where the outcomes from this working group will be developed further in order to reach a European consensus for curriculum change.

Domain II: Safe and effective clinical practice

For nearly 20 years it has been recommended that health care professionals should be taught to be safe, effective (evidence based), patient centred, timely, efficient (e.g. avoiding over use of resources) and equitable.[55] The aspect of efficiency (and therefore arguably, sustainability) is perhaps the most pertinent, as whilst being part of the recommendations for such a long time, has received little attention in terms of curricular elements, teaching or assessment.

Evidence-based practice, Audit and Risk Management

The evidence base for sustainability is becoming more robust. Whilst evidence based practice and critical appraisal are already recommended as part of the GED curriculum, dental students must also be capable of critically evaluating the environmental impact of procedures, processes and products. This will inevitably require the development of new skills sets for students and, as a consequence, their educators. Audit skills are also an existing part of the GED framework.[56] and compliance audits with sustainability principles should form a necessary part of this process. A useful example of an audit looking at compliance with waste management is provided by Richardson's team[57]. Risk management skills are usually taught in relation to safety within the clinical environment – although it is also important that curricula ensure future clinicians are adept at balancing their own, and patient safety, with wider environmental health.

Management and Leadership

As they progress through their career, dentists often become team leaders and will be responsible for implementing sustainability within their dental settings. Changing sustainability requires leadership skills and these skills are already embedded as part of their core recommended curriculum.[58, 59] Moving forwards it will be important for educators to develop relevant teaching materials in order to further develop these skills in relation to environmental sustainability.

Team-working and Communication

The concept of sustainability extends much more widely than the locale of a dental practice or surgery. Typically dental team members will communicate with a distant laboratory – although arguably this happens much less often and less comprehensively than it should. Dental practices also communicate with their patient base, and largely now this occurs via mobile or email communication. These practices may already be as environmentally sustainable as they can be – however there will undoubtedly be a move to more teleconsultation practices – and as this practice is developed further, students should be taught how this

process works, and how tele conferencing for consultations and history taking is quite different to other forms of tele communication, or indeed in-person communication. Further, in order to embed sustainability into practice, it is essential to communicate a sustainable vision both internally and externally. This communication could include marketing sustainability, e.g. putting information on practice websites, social media or within waiting room; or more directly involving patients in sustainability dialogue. The latter can be included in conversations relating to current concepts of oral health, prevention, risk assessment and treatment of oral disease.

Professional Education and Training

Successful healthcare teams must share common goals and a commitment to providing the best possible care for patients.[60] When aspiring to work more sustainably, interprofessional working becomes increasingly more critical. Removing the boundaries between teacher and student could help to challenge existing practice, and encouraging students to help co-create resources for teaching and assessing these relatively new concepts should be encouraged. As well as the content of education, consideration needs to be given as to its delivery. From a sustainability perspective, distance learning may be preferable to reduce travel. It is debatable if E-books require more or less planetary resource than paper equivalents.[61] Indeed the forced delivery of emergency remote teaching (ERT) during the COVID-19 pandemic (WHO 2020) has resulted in a significant increase in sustainable delivery of education – although whilst this might be considered to be more *environmentally* sustainable, it is debatable as to whether the nature of this shift to online delivery is educationally sustainable.[62]

Domain IV: Dentistry in society

Health Promotion and Disease prevention

Prevention should be regarded as a core tenant of sustainability and all clinicians should be involved in prevention. Prevention needs to be included in a broad curriculum where the broader social, economic and environmental determinants

Conclusion

Increasingly, population health is being influenced by deteriorating planetary health. There is a need to educate the dental team of the future about the main principles of sustainable clinical practice. This paper forms the first part of a wider pan-European working group, and reports the consensus views regarding the importance of sustainability in dental education. The paper demonstrates a need for teaching materials and guidance, and the importance of environmental sustainability is discussed in relation to existing educational curriculum domains.

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Eight Pillars Which Promote Best Practice for Dental Teaching

SUSTAINABILITY

Energy use

Low energy lighting
Carbon-free heating
Insulation

Pedagogy

Teach the dental team
Assess the dental team
Longitudinally embedded within the curriculum

Waste

Categorise
Segregate
Label
Embrace the circular economy
Influence industry

Prevention

Minimal intervention
Evidence based practice
Fluoride

Biodiversity

Habitat and species richness
Food waste
Biological impact

Procurement

Purchasing, supply chains, air miles
Reduce plastic
Influence industry

Decontamination

Reduce chemicals and plastics
Reduce single use items

Travel

Low carbon travel
Active travel

of health are taught including the common risk approach. Where possible, the curriculum should capture environmental co-benefits that a more sustainable dental system could bring such as the improvements in air quality and carbon emissions from a shift to active travel. [63]

Population Demography, Health and Disease

The world is ageing with both the world population ageing rate and net population increasing. [64] Oral health is an essential component of general health and quality of life. In particular, oral health – general health relationships manifest at old-age. With increasing numbers of people maintaining their teeth for life this will further increase dental activity. The WHO has documented that the oral health of older people is widely neglected by policy makers, health authorities, dental professionals and researchers, and other health professionals. Despite much effort in health promotion and disease prevention, dental caries and periodontal diseases are a major public health problem globally.[65] The need to provide oral health promotion strategies including disease prevention in care homes will also need to be considered from a sustainability perspective. Further, climate change will increasingly affect the health of the population, especially the most vulnerable in society.[66] Students need to be aware of the direct and indirect links between the practice of healthcare, environmental harm and personal harm.

Healthcare systems

Dental systems consist of networks of dental offices, suppliers, referral patterns and larger health care systems which are connected together in complex and changing ways.[67] Students need to learn that to make sustainable changes political, social, geographical and historical contexts needs to be considered. Several system changes could be incorporated to encourage sustainable dentistry. Service delivery is one example. Community programmes such as Childsmile, where dental professionals travel into a community setting to deliver preventive care is a useful model for students to consider.[68]