

The need for a sustainability dentistry guideline in Aotearoa New Zealand

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ABSTRACT

Environmental sustainability has emerged as a significant issue in dental practices. Notably, the increased usage of personal protective equipment (PPE), primarily composed of single-use plastics (SUPs), poses a significant challenge to sustainable dentistry. This discussion paper explores the environmental implications of dental practices in Aotearoa New Zealand and the necessary interventions for transitioning towards sustainable dentistry, focusing on waste reduction.

Despite the growing awareness of environmental impacts among oral health practitioners, substantial barriers persist. These include a perceived conflict between high-quality patient care, infection control, and environmental sustainability. A lack of education on managing resources and robust sustainable guidelines heightens the lack of sustainable actions. The paper explores potential plastic waste reduction strategies and sustainable practices such as digitisation, 3D printing, and the development of eco-friendly materials for personal protective equipment (PPE). It also highlights the need for preventive care, effective recycling of SUPs and PPE, and meaningful partnerships with dental product companies for innovative solutions.

The paper advocates for creating sustainability dentistry guideline that align with the objectives of the Dental Council, Ministry of Health, and Ministry of Environment. Such guidelines would promote the integration of sustainability into daily operations of dental practices, using a plan-do-check-act (PDCA) model, and contribute towards a circular economy within the dental sector. The transition towards a more sustainable future for dentistry in New Zealand requires a multifaceted approach. This includes reevaluating traditional practices, increased research and collaboration, and formulating clear guidelines and sustainable waste management strategies.

INTRODUCTION

Humanity is facing a particular global challenge of climate change. Collectively as an industry, oral health practitioners (OHPs) are working with unclear environmental sustainability guidelines. Therefore, progress is limited due to the lack of funding, resources, education, and knowledge of sustainable practices. To ensure a system-wide change, decision-making must occur at all dental industry levels. The dental industry in New Zealand should provide OHPs with a robust standards framework that includes ethical codes of conduct related to the environment. These guidelines will help initiate a more coordinated system-wise approach toward reducing waste generated by the dental industry. The New Zealand government's climate change response is to become carbon-neutral by 2050 (Semmelmayer, 2020). The emissions reduction plan sets the overall direction to achieve low carbon emissions and become a more productive, sustainable, and climate-resilient economy (Ministry for the Environment, 2022). The dental industry should look at supporting Aotearoa NZ's commitments under the Paris Agreement to promote an affordable, safe and responsive way of achieving environmental sustainable goals (Martin et al., 2021). Combined with the recent guidelines and resources provided by the FDI World Dental Federation, OHPs can commit to managing plastic waste in their clinics (FDI World Dental Federation, n.d.). This discussion paper aims to provide an understanding of the growing need to establish a sustainability dentistry guideline, in particular waste reduction from personal protective equipment (PPE), single-use plastics (SUPs) and dental homecare products.

BACKGROUND

Climate change, also called the 'hidden pandemic', threatens humans, their health, and biodiversity (McKeever, 2021). Māori are particularly vulnerable to the impacts of climate change as their cultural, spiritual and economic practices are tied with nature and livelihood (Grix & Watene, 2022; Parker, 2020). Coastal communities, food-gathering sources, sacred areas are being threatened by rising sea levels, flooding, plastic pollution and drought amongst other adverse effects. Environmental loss, loss of biological diversity and changes to ecological systems disconnects them from the life-force of the environment (mauri) (Grix & Watene, 2022; Parker, 2020). The deeply held philosophies regarding the natural environment (Kaitiakitanga), the associated cultural practices are closely linked with health and well-being (Grix & Watene, 2022; Parker, 2020). Restoring the environment also has connections to cultural well-being. New challenges arise from shifting weather patterns, rising sea levels, rising sea temperatures, extinction of species, and changing natural systems. Climate change strongly correlates with health and globally is associated with 150,000 deaths per year, primarily seen in underdeveloped countries (Martin et al., 2021; United Nations Conference on Trade and Development, 2021). The World Health Organization (WHO) estimates that by 2050, heat stress, malnutrition, and other environmentally related health conditions will be responsible for 250,000 additional deaths yearly (World Health Organization 2021).

While recent focus has been on the coronavirus disease 2019 (COVID-19) pandemic, the crisis humans face due to

climate change is far more significant due to its severity, extent, and spectrum, leading to a potential overall cost to humanity due to increased burden on the healthcare system (Ahmadifard, 2020). Literature suggests that the COVID-19 pandemic may be linked to climate change as the species migration due to habitat change may have increased the spread of the virus to other species (Bernstein, n.d.). Changes in human activities combined with environmental changes have significantly impacted migrations of certain native species and increased the chance of a viral spread (Gupta et al., 2021). Climate changes would likely bring new viruses, diseases, and vectors, and the imbalance in the ecosystem heightens the risk of having another pandemic (Gupta et al., 2021). In the recent decade, urgent calls for action have been directed at all countries to strategise ways to improve health, reduce inequity, and address climate change issues to preserve natural resources and the environment (Martin et al., 2021; United Nations, 2022). Some countries, such as the United Kingdom, have legislated to reduce carbon dioxide gas emissions, while New Zealand has chosen to become carbon neutral (Duane et al., 2020).

It is well-known that healthcare delivery, especially dentistry, is not environmentally sustainable due to high waste generation (Duane et al., 2020). Paradoxically, health care that aims to support and protect people's health contributes destructively to climate change through unsustainable practices (Martin et al., 2021). In dentistry, OHPs are required to use personal protective equipment (PPE) and single-use plastics (SUPs), which generate a large amount of general waste. In addition, a significant amount of dental homecare products such as toothbrushes, toothpaste and interdental brushes end up in landfill. It is inevitable to create non-recyclable waste as some are considered critical bio-hazard (Martin et al., 2022), yet there is room for improvement to be a more environmentally sustainable industry.

More OHPs are raising concerns about how we use our natural resources and manage waste (Grose et al., 2016). The practice of sustainability and advocating for sustainable practices are primary ways to counteract health and environmental effects and mitigate climate change consequences (Vogell and Azzam, 2020). The United Nations defined sustainability, also known as sustainable development, as "meeting the needs and aspirations of the present without compromising the ability to meet those of the future" (United Nations 1987, pg. 39). In the last decade, sustainability has gained attention and action in dentistry, known as 'green dentistry' (Duane et al., 2020). Broad strategies have been outlined by the FDI World Dental Federation which include preventative care, operative care, integrated care, and ownership of care (FDI World Dental Federation, n.d.). Furthermore, the three main project goals are suggested to help deliver ethical, high-quality, safe, and environmentally sustainable oral health care. The first goal focuses on increasing awareness of implementing sustainable actions in the community, the second describes the need to develop a guide for OHPs, and the third concentrates on strengthening guidelines with research

and literature review (FDI World Dental Federation, n.d.). Unfortunately, professional awareness of sustainability has been diminished by the recent global health crisis, the COVID-19 pandemic. Government resources, already limited and insufficient, have further been challenged by a global pandemic. The WHO estimated that 89 million masks, 76 million gloves, and 1.6 million safety glasses were required each month in the global response to the COVID-19 pandemic (Ahmadifard, 2020, Singh et al., 2020).

This raises the question of whether short-term goals of protecting public health can align with long-term environmental goals. Addressing health and environmental issues and improving policies require a collaborative and interdisciplinary approach to accelerate reducing carbon emissions to achieve proposed emission reduction plan targets (Auckland Council, 2023; Islam and Kieu, 2021). Further understanding must ensure that policies and strategies are adequate for different communities. This requires analysis of social practices, values, beliefs, and cultural perspectives to help identify barriers to sustainable practice (Islam and Kieu, 2021).

PLASTIC POLLUTION

There is overwhelming evidence of microplastics polluting oceans, entering food chains and damaging ecosystems (Lee and Kim, 2022). Global plastic production increased from 250 million metric tonnes in 2009 to 368 million tonnes in 2019 (Lee and Kim, 2022); 8 million tonnes of plastics enter the oceans per year which is a significant contributor to climate change (Jamieson, 2021). However, Aotearoa New Zealand was slow to implement a plastics ban compared to other countries which focuses mainly on consumer recycling (Jamieson, 2021). The government response to the 'rethinking plastics' report was to develop guidelines relating to sustainable use of plastics, identified as high priority. Plastic consumption in dentistry is constantly being overlooked therefore the dental industry needs to change their relationship with plastics, shifting perspective by treating it as a valuable resource rather than a disposable one.

The shift in priorities from acting sustainably to solely protecting self and the public during the COVID-19 pandemic health crisis hindered progress in reducing waste. Around the world, there is growing evidence of discarded masks and gloves ending up in the ocean, beaches, and nature trails. If disposal patterns continue, it will result in about 75% of COVID-19-related PPE waste ending in the environment (Zhang et al., 2021, Singh et al., 2020). This will be a challenge to manage sustainably if immediate actions are not taken to coordinate strategies to address the manufacturing and waste lifecycle (Singh et al., 2020).

As many countries are getting used to a new 'normal' post the COVID-19 pandemic, new strategies are required to reduce carbon emissions and waste generation to prevent further destruction of the environment. Plastic consumption needs to be reduced, which requires maximising its management whilst

reducing the burden on the waste management sector. The shift from the concept to mainstream sustainable movements has guided changes in many health sectors, yet dentistry is showing a much slower pace in developing sustainable policies, research and education to make green dentistry achievable (Duane et al., 2020). The dental field, being a high-energy and resource-intensive industry requires a collective and strategic action plan moving towards a circular plastics economy.

Most OHPs are aware of the environmental issues but cannot integrate sustainability into practice due to the conflict between providing quality care and maintaining high infection control standards (Mittal et al., 2020, Martin et al., 2021). OHPs' changing attitudes, priorities and behaviours can initiate a system-wide change to improve policies, prioritise actions and navigate a way out of a plastic-abundant environment.

IMPACT OF THE COVID-19 PANDEMIC ON PLASTIC WASTE

The COVID-19 virus has a high affinity for saliva and oral tissues and is transmitted via aerosol (Sandhu et al., 2022). As OHPs operate in an aerosol-generating environment using rotary instruments, air-water syringes, ultrasonic scalers, and other equipment. Extensive PPE measures and extra precautions were required to minimise the risk of infection during the pandemic (Lee and Kim, 2022). In 2019 and 2020, 2.3 billion PPE items were distributed in England alone to respond to the COVID-19 pandemic (Zhang et al., 2021). In New Zealand, after limiting dental procedures during the lockdown period, a new standard of infection control was introduced to enable dental services to continue while ensuring OHPs are protected (Dental Council New Zealand, 2021). This places additional PPE to protect practitioners, other dental team members, patients, and their families. It is anticipated there will be a 20% increase in mask usage globally from 2020 to 2025 due to the COVID-19 pandemic (Singh et al., 2020).

The increasing demand for PPE exacerbates issues relating to production and disposal, which can cause added risk to the environment and atmosphere (Ahmadifard, 2020). Firstly, increased PPE production increases the demand for raw plastics, which may lead to increased fracking or petrochemical manufacturing, which are toxic to the environment and add to carbon emissions (Ahmadifard, 2020). Secondly, contaminated PPE is a 'clinical waste', its disposal is heavily regulated, often requiring incineration, which releases toxins into the air. Incineration still does not guarantee the complete elimination of toxic pollutants and microparticles of plastic from the environment (Ahmadifard, 2020). Collectively, dental practices' use of SUPs and PPE can have a considerable environmental impact.

AWARENESS OF ORAL HEALTH PRACTITIONERS

OHPs are ethically obligated to make climate-conscious decisions and tailor interventions to change professional

practice (Mittal et al., 2020). However, awareness of environmental impact still remains low across the profession due to a lack of education and understanding of the current sustainable goals (Martin et al., 2021; Grose et al., 2016). OHPs often provide care without considering the treatment-related impact on the environment (Singh et al., 2020). The clinical waste audit conducted at the Capital and Coast Hospital Dental Department in New Zealand indicated three to four times as much waste per patient was being generated compared to similar studies from Greece, Iran, and India (Koyama et al., 2022). Even though different patient demographics and needs and the difference in cross-infection standards are not considered, the sizable difference cannot be ignored (Koyama et al., 2022).

There is a great need for the dental industry to understand international and national environmental sustainability goals and align practice with sustainable plans. Behaviours and attitudes that exist within the profession, such as not considering or prioritising sustainable practices, are impediments to change. To change the narrative, processes would need to change at educational, institutional, and individual levels. There is much need to increase the knowledge base of all oral health professionals to support the shift to practising sustainably and integrate sustainability goals into daily practice (Barker et al., 2022). Additionally, there is a need to support research and development into more sustainable PPE and recycling, which aligns with achieving a more circular economy (Singh et al., 2020, Zhang et al., 2021).

CURRENT WASTE MANAGEMENT STRATEGIES

Eco-friendly dentistry is still an emerging concept and part of a broader vision of providing ecologically sustainable healthcare (Duane et al., 2020). The main areas of dentistry that require improvement are waste management, energy and water consumption, transport, procurement, and single-use plastic items, including PPE (Martin et al., 2021). There are some barriers to adopting sustainable dentistry. Factors like the cost of switching to sustainable methods or products, time, lack of knowledge on best practices, limited sustainable products, professional obligations, and infection control cannot be ignored (Martin et al., 2021). Also, the molecular composition of masks comprising a combination of polymers and other materials makes separating materials for recycling or processing very complex (Rahman et al., 2022).

Even now, some methods will help resolve some environmental issues. Digital technology such as digital radiography eliminates conventional radiographs that require harmful chemicals to develop and uses toxic lead foil packaging (Mittal et al., 2020), reducing the amount of heavy metals. Digitisation also made single-visit dentistry possible by fabricating crowns and inlays through a computerised milling and grinding unit, saving time for OHP and the patient. This also reduces carbon emissions by minimising patient appointments and reducing travel. Moreover, going

paperless received attention during the pandemic with paper forms going digital. This included appointment reminders, patient forms, consent forms, invoices, and patient letters. 3D printing has a growing interest in sustainability because of its potential for mass production and its advantage over traditional manufacturing methods. 3D printing or additive manufacturing can also be explored to produce sustainable PPE using biodegradable or eco-friendly materials (Irfan Ul Haq et al., 2020), thus solving shortages and saving materials that usually go to waste if using subtractive manufacturing methods. The benefits of using 3D printing include the ability to use multi-material for printing, short product development cycle, customisation capability, time efficiency, and cost-effectiveness (Irfan Ul Haq et al., 2020).

Perhaps the most powerful way to reduce our use of plastic-based PPE would be to invest in an alternative, PPE made from renewable materials. This is a sentiment that has been reflected in the manufacturing sector. Some options explored in different studies were electronic textiles and antimicrobial textiles (Karim et al., 2020). In the hopes of providing more sustainable options for protective equipment in the setting of the pandemic, plastic-free visors comprised of sustainably sourced wood pulp and paper have been launched in the United Kingdom (UK) (Ahmadifard, 2020). Developing biodegradable materials like oxy-biodegradable suction tubes, tissues, barriers, wipes, towels, and cups that can enter the environment will not lead to long-term consequences (Plastics New Zealand, n.d.). Considering autoclavable plastic or stainless-steel suction tubes and cups to help increase the lifecycle of products. Oxy-biodegradable options are becoming more popular –plastic has an additive that degrades the plastic in the environment, and then once broken down, microorganisms further break down the plastic into nutrients for the soil (Plastics New Zealand, n.d.). We can reduce the amount of plastic by promoting high standards of oral healthcare that focus on preventable care. The consequence of good oral health can reduce the need for interventional operative care, leading to a reduction of required appointments, waste generation, and carbon emissions.

Increasing greener options for oral care products, such as bamboo toothbrushes or plant-based products, and providing digitised educational materials are also some sustainable practices seen in clinics. An innovative move to new recyclable toothpaste tubes was made to help reduce the 20 billion tubes in landfills annually. The Colgate company has exemplary strategies and goals which other companies can adopt (Colgate-Palmolive, 2023; British Dental Journal News., 2021). Collaboration between dental product companies and OHPs can encourage the public to take sustainable actions. Some companies offer free recycling programs to support communities in being environmentally friendly. Dental clinics can utilise this service to collect items, such as toothpaste tubes and caps, electric toothbrush heads, floss containers, recyclable toothbrushes, manual toothbrushes, and interdental brushes, from patients and hand them over to recycling companies. Dentistry is

highly commercialised, and from that perspective marketing sustainable practices such as recycling could improve the reputation of those companies to OHPs and consumers (Oviedo-Allison and Shockley, 2021; Wainer, 2022).

A NEED FOR A FUTURE SUSTAINABILITY GUIDELINE FOR AOTEAROA NEW ZEALAND

Even simple principles can effectively and practically reduce waste from dental clinics. De Leon emphasised that most OHPs consider two critical aspects for accepting new sustainable initiatives (De Leon 2020). Firstly, the simplicity of the recommendations and the ease of implementation. Secondly, the ability to see immediate success with the application of sustainable initiatives. Small changes, such as reducing the use of paper, digitising educational material, and electronic receipts, can lead to positive environmental impacts.

Khanna and Dhaimade suggested that most waste generated in dental clinics can be easily recycled (Khanna and Dhaimade 2019). To support New Zealand OHPs towards the clinical practice that promote environmental sustainability, the dental industry should work with New Zealand Dental Council, Ministry of Health, and Ministry of Environment to develop sustainable dentistry guidelines. Based on the current study, most of the research, data, analysis, and best practice guidelines originate from the UK, providing a general theme, plan, and identification of barriers related to sustainable practice. The UK evidence-based recommendations are still helpful for New Zealand OHPs. Yet, creating best practice guidelines for New Zealand OHPs and dental practices, followed by future research, will ensure applicability to the unique local community incorporating Tikanga Māori. Collaborative efforts of individual OHPs and the governing body will ensure New Zealand dentistry remains sustainable and viable.

RECOMMENDATIONS

It is believed that actions toward environmental sustainability are largely a government task. However, people are recognising their responsibility at a more individual, business, organisational, and corporate level. Oviedo-Allison and Shockley suggest beginning with a plan, do, check, and act (PDCA) model for integrating sustainability into daily operations and dental care models (Oviedo-Allison and Shockley 2021). Moreover, recognising the organisation's culture, purpose, philosophy, and priorities is also essential to ensure the continuity of these processes. A high level of commitment is required from leaders and organisations to establish policies, philosophy, priorities, and an action plan. The scope of management needs to be realised as this will help formalise commitment at other levels of the industry. Organisations must be transparent about their processes and reviews to generate trust in the system.

Data collection on plastic waste needs improvement therefore expanding on current evidence is imperative as well

as improving the accessibility of data on plastics to OHPs. To achieve carbon reduction, the dental industry collaboration with dental clinics could carry out emissions assessments and plastic audits. Companies such as Toitu Envirocare, Energy Emissions and Conservation Authority, climate connect Aotearoa, and plastics New Zealand are key examples of how sustainability changes businesses and industries. Enhancing the links to external stakeholders and dental supply companies and seeking more collaborative relationships will drive investment towards a more circular economy. This strategic change, supported by waste minimisation initiatives and funding for innovative solutions that aims to create a more circular and sustainable economy by offering alternatives to plastic-use through creation of new materials and mitigation of plastics (Auckland Council, 2023). This coincides with research filling knowledge gaps and encouraging innovation.

Recycling dental materials should take a much more significant role in managing clinical SUPs, including PPE, and packaging as it offers a solution to reduce waste (Oktem et al., 2023). Therefore, dental students can become great leaders to promote recycling programmes in universities and clinics (Oktem et al., 2023). The use of best practice guidelines through the adoption of technology, effective logistical management systems, and environmental regulations will be the key to a more sustainable practice with less use of plastic. A step forward would mean improving existing waste management infrastructures and developing a circular economy that allows PPE to be recycled, reused and processed, minimising environmental damage. This will be a challenge to manage sustainably if immediate actions are not taken to coordinate strategies that address manufacturing and waste cycles (Singh et al., 2020).

CONCLUSION

What is understood from historical events is that a movement towards a zero-carbon goal for Aotearoa New Zealand will require a multifaceted approach. Objectively looking at transforming traditional ways of practising dentistry and building relationships with the dental industry and government stakeholders will improve the plan of action. New Zealand needs to recognise their own framework, which requires more research, but it is critical to start making changes; waste management are one area all OHPs can focus on.

In conclusion, this discourse underscores the urgency to transform dental practices into more sustainable models. It is evident that OHPs in New Zealand, like their counterparts globally, are navigating a challenging landscape fraught with the necessity to balance quality patient care and strict infection control standards against an ever-increasing environmental footprint. Although the increasing environmental consciousness among OHPs signals a positive shift, persistent barriers need to be addressed through comprehensive, actionable, and context-specific sustainability guidelines. The exploration of potential strategies set a course toward a future where dental practices significantly contribute to

sustainable development. Moving forward, engaging dental product companies and fostering partnerships for innovative, environmentally friendly solutions will undoubtedly enhance the sector's sustainability while protecting public health. The proposal of creating robust, comprehensive waste reduction guidelines and the integration of a PDCA model in routine operations are steps in the right direction. It is critical to start making changes now before it is too late.

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