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A novel approach for environmental management of dental practice: the "Plan-Do-Check-Act" model

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Abstract

Background

There is increasing awareness of problems associated with global warming but a lack of a systematic approach on how to deliver more environmentally sustainable dental care. A sustainable world aims to ensure that basic needs and quality of life of everyone are met, now and for future generations. The carbon footprint is an indicator of environmental sustainability.

Aim

The aim is to suggest an environmental management change for the dental practice focusing on the objective of carbon footprint reduction.

Environmental management change design

The management change is based on the concept of "Plan-Do-Check-Act", as recommended by the International Organisation for Standardisation (ISO) and described through the environmental aspects of the dental practice. The approach focuses on establishing and implementing environmental objectives, followed by monitoring results and taking actions to improve continually. The environmental aspects considered for the dental practice are activities causing an impact on the carbon footprint: energy use, travel, product purchasing, waste production, emission to air, water use, and contamination of land.

Conclusions

The "Plan-Do-Check-Act" ISO 14100-2015 model can be effectively integrated into the dental practice setting for its environmental management. A reduction of the carbon footprint of the dental practice is achieved by applying the environmental management change described for each activity.

Key words: carbon-footprint, dentistry, environment, management, sustainability

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Introduction

Management change of the dental practice is necessary for progress and should be applied to create a culture of sustainability. Sustainability is the ability to meet the needs of the present without compromising the ability of future generations to meet their needs [1]. A key priority to ensure sustainable development is to adapt the dental practice to global megatrends such as environmental, social, and economic changes across the globe [2].

Dentistry needs to become more sustainable to avoid environmental issues, *i.e.*, climate and ecosystems changes, provide support to solve social issues, *i.e.*, population growth, ageing population, and minimise economic implications, *i.e.*, higher costs and less tax income [3]. Changes in the structure of the population, coupled with a longer life expectancy and tooth retention into old age, lead to an increased demand for dental treatments [4,5]. This results in higher pressure on resources, named as a high ecological footprint. The carbon footprint represents the main component of the ecological footprint [6], and for a dental practice, it is the amount of CO_2 emitted either directly or indirectly as a result of its everyday activity. The carbon footprint of dentistry is estimated to be about 675 kilotonnes carbon dioxide equivalents per year (CO_2e) [6].

A systematic approach to environmental management applicable to the dental practice is needed to achieve a balance between the environment, society, and economy. The application of the International Standard approach (ISO 14001-2015) to dentistry provides a framework to protect the environment in balance with socio-economic needs [7]. The framework is founded on the concept of Plan-Do-Check-Act (PDCA) that focuses on establishing and implementing environmental objectives, followed by monitoring results and taking actions to improve continually.

The aim of this manuscript is to suggest an environmental management change for the dental practice focusing on the objective of carbon footprint reduction. The management change is based on

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the concept of "Plan-Do-Check-Act", as recommended by the International Organisation for Standardisation (ISO) and described through the environmental aspects of the dental practice.

Environmental management change based on the "Plan-Do-Check-Act" ISO 14100-2015 model

The environmental aspects considered for the dental practice are seven activities causing an impact on the carbon footprint: energy use, travel, product purchasing, waste production, emission to air, water use, and contamination of land (Table 1).

1 Energy use

1.1 Plan

The energy consumption of a dental practice contributes to 15.3% of its carbon footprint [8] (Figure 1). The primary energy consumption is attributed to the activity of heating water and building, air conditioning, and using electrical equipment, such as lighting, dental chair, suction, sterilisation devices [8]. However, there are several ways practices can reduce both their costs and carbon emissions associated with energy by choosing sustainable energy, improving energy efficiency, preferring sustainable appliances, using space effectively and generating energy.

1.2 Do

Design, construction, and use of the building should consider energy efficiency and renewable energy sources. Energy consumption can be reduced by introducing energy-efficient technologies and physical measures, *e.g.*, natural ventilation, LED lighting, thermal wheels, optimised insulation levels, and renewable technology. Consequently, the carbon emissions of electricity are negligible when dental practice uses only renewable energy sources, such as wind and solar power [8].

Effective space utilisation can significantly reduce energy use per patient appointment [9]. As part of optimal utilisation, the dental surgery, reception, and waiting room areas should be utilised effectively. A

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well-run, sustainable dental practice would always use each dental chair to its maximum capacity, thereby requiring the least amount of energy for heating the building. It is necessary to manage staff shifts effectively so this process can take place. Waiting rooms should be large enough to accommodate patients without offering unsustainable energy costs.

In terms of the amount of electricity used by specific appliances, there are considerable differences, depending on wattage (amount of energy used) and the number of hours per day of usage [8]. Therefore, when purchasing new products, the practice should consider the most energy-efficient appliances and turn off appliances when not in use.

1.3 Check

The Energy performance indicator (EnPI- ISO 50001) is the appropriate method to measure and monitor energy performance that is the measurable result related to efficiency (ratio of output to input), energy use or quantity of energy consumption [10]. Energy performances should be recorded and compared in order to improve results.

1.4 Act

Actions for improvement include; developing energy monitoring and reporting processes, controlling that energy efficiency is taken into account in the design stage of the construction project, and connecting to other organisations to share resources. In addition, monitoring of performance should be conducted and discussed within the dental team to provide reassurance that activities are being conducted effectively and improve weaknesses.

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2 Travel

2.1 Plan

Travel for dentistry contributes to 64.5% of its carbon footprint (Figure 1) [11]. Three factors determine the travel footprint: patient travel (31.1%), staff travel to and from work (30.3%), and staff travel for work-related purposes (3.1%) [11].

Air pollution caused by travel for dentistry and its associated impacts, such as noise pollution and accidents, reduce overall population quality-adjusted life years by 14 minutes [11]. According to patients surveys, they typically travel by car many times to get a course of treatment [12]. Indeed, dental appointments that take only a short time generates disproportionately high levels of carbon emissions [6]. Thus, it is crucial to consider reducing travel for dentistry.

2.2 Do

The opportunity for the dental team to reduce patient and staff travel can be achieved by; combining appointments, *i.e.*, family appointments, multiple procedures in one visit, scheduling dental examination by risk assessment approach, employing technology for communication and professional interactions, *i.e.*, teledentistry, encouraging active travel, *i.e.*, cycling and walking, using public transport, car-sharing and electric vehicles by providing electric charging point at the dental practice [11,13].

The reduction of travel can be achieved by promoting preventive dentistry that diminishes the need for treatments and the environmental impact of the dental practice[11].

It is possible to reduce carbon emissions and air pollution associated with goods purchase by delivering multiple items together, shipping products from the same logistic centre, and ideally buying

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local. [12]. The dental team should also ensure that someone is always available to accept deliveries, thus avoiding the delivery company's repeated journey.

Concerning the dental laboratory, the closest laboratory has the lowest travel-associated carbon emissions and is regarded as having a lower impact on air pollution [11]. Furthermore, dental practices can increasingly influence laboratories sustainability reducing their travel-associated carbon footprint and air pollution by advising to deliver their manufactures in bulk and combining dental practice staff members' commute with the laboratory drop off and pick up.

2.3 Check

Dental practice management software can be used to measure and monitor the frequency of appointments and the type of treatments to focus on prevention based on patients' needs.

2.4 Act

Target a more personalised prevention and reduction of dental disease prevalence will reduce the overall carbon footprint and resource use in later years.

3 Purchasing product

3.1 Plan

Procurement contributes to 19% of its carbon footprint, and it is part of a carbon reduction strategy that generates benefits not only to the dental practice but also to society and the economy while minimising damage to the environment [6] (Figure 1). A procurement strategy that influences the use of fewer and more efficient resources, cuts waste, and prioritises products with low carbon footprints does not have to be expensive. The development of sustainable solutions can result in cost savings, environmental protection and better health [14].

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3.2 Do

The dental team should consider appropriate stock management and ensure that resources are not wasted, having no stock available for use beyond its expiry date and only ordering the supplies needed.[14] In addition, the choice of products should consider reducing single-use devices when possible, preferring sterilisable devices that can be recycled at the end of the life cycle.

When the practice considers stationery, environmentally sustainable products are available, as well as ways to reduce paper waste in dental practice. Before printing, staff members should consider black and white, double-sided, small font sizes using thinner paper, and remind others to follow the same printing rules. [15]. The practice should also preferentially purchase recycled paper or sustainably produced paper and try not to buy glossy, coloured or plastic-coated paper.

Along with paper, the practice should choose more eco-sustainable furniture and writing supplies [15]. It is crucial to ensure that wood products, such as medium-density fibreboard (MDF), furniture, or pencils, come from forestry certification programs.

Using the 'reduce, reuse and recycle' model can help reduce overall product use [15]. In addition, preferential purchasing by dental practices will optimistically help impact demand, increasing the supply of sustainable items.

3.3 Check

Systems that record how much consumable dental material per staff member is used can be an effective method to encourage optimal use of products.

Systems that record how many print copies per staff member could help to track paper waste.

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3.4 Act

Dentists should consider the ways they can influence manufacturers to be more ecologically sustainable. By considering only using products from sustainable, ethical companies, a significant amount of change could be achieved. Users of medical equipment should be enabled to recycle the items they use through user manuals and manufacturers should offer to recycle their equipment. Requesting reciclying information to manufacturers might encourage them to produce easily recyclable products, that can be upcycled or repurposed.

Practices could form buying cooperatives with other practices to increase their influence on sustainable procurement.

4 Waste production

4.1 Plan

Dental practices generate different types of wastes, including hazardous, that contribute to 0.2% of its carbon footprint [15] (Figure 1).

It is important for safety, environmental, and financial reasons to separate waste accurately (recyclable, clinical, hazardous). Firstly, ensuring that the clinical waste is disposed of as little as possible will reduce the carbon emissions associated with incineration. Additionally, recycling can help conserve natural resources by reducing the use of paper, plastic, and glass products, and also by reducing carbon emissions compared to landfills. Finally, the proper handling of food waste will contribute to reducing the carbon footprint through the return of nutrients to the soil [15].

In addition to the impact of improper disposal, pharmaceutical residue can also enter the food chain through wastewater. This pollution has an impact on the entire food chain. Consequently, concentrations of pharmaceutical residue adversely affect animals and humans [6].

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4.2 Do

The dental team should use recycling waste bins in dental surgery. Dental practices are encouraged to follow best management practices (BMP) in the handling and disposal of hazardous waste (*i.e.*, Mercury-containing wastes, spent X-ray fixer and developer, X-ray film, sharps, chemicals, disinfectants and sterilising agents) in order to limit the occupational and environmental hazards of each substance [16].

Dental practices should prefer durable, well-designed equipment, which will last for many years. Maintenance of dental equipment should be regularly performed and breakages should be reported as soon as possible so that repair can be undertaken. If a dental practice no longer needs an item, such as a computer, equipment or furniture, then reusing, upcycling or finding a new home should be considered to reduce landfill waste and its associated environmental impact. Dental practices can donate functional equipment no longer required to local charities, community groups, or advertise them online.

Dentists should advise patients on the safe, local recommended method for the disposal of pharmaceuticals and packaging [15]. In addition, the reduction of pharmacological prescription should be considered when possible. In this context, antibiotic overprescription can contribute to the growing global antibiotic resistance [17].

There are three alternative options for dental practices to consider regarding their food waste disposal rather than sending it to landfills [15]. Waste collectors could collect food waste to be converted into energy and used as a soil conditioner, or composted to reduce the costs associated with food disposal and improve soil quality, or managed by installing worm farms.

4.3 Check

Dental practices should keep a written waste record.

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Dental practices should have a system that identifies opportunities to convert useful waste into a resource, ideally documented in practice policy [15].

A maintenance register and policy can be regularly updated to report any equipment breakage.

4.4 Act

In order to improve waste management, the dental practice should reduce the generation of waste, ensure waste is categorised and segregated appropriately, and ensure that practice is evaluated by performing audit [15].

5 Emission to air

5.1 Plan

Greenhouse gas emission of dental practice contribute to 7.6% of its carbon footprint, and they are mainly caused by the significant amount of carbon emissions originating from travel, followed by procurement, energy, nitrous oxide, waste and water [12] (Figure 1).

The dental team should be aware of the potential impact on the environment of Nitrous oxide (N_2O) used in dentistry to reduce the need for other more invasive and potentially riskier forms of care such as general anaesthetic. Furthermore, N_2O is a gas with a global warming potential of 298 times CO_2 [18]. On average, 163 litres of N_2O is used per patient episode, equating to around 90 kg CO_2 [15]. Therefore, the reduction of N_2O levels should be considered by the dental team.

5.2 Do

To reduce N_2O levels, one method is to capture and neutralise the gas during its use. In addition, patients should be instructed to breath slowly through the nose and to not talk unless important [12].

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Actions to reduce greenhouse gas of dental practices related to energy, travel, procurement, waste and water are reported in paragraphs 1.1.2, 1.2.2, 1.3.2, 1.4.2, 1.6.2.

5.3 Check

For N_2O, a register should be updated to record equipment maintenance and test leaks. Dental clinicians should monitor exposure to N_2O by use of badges.

Action monitoring to reduce emissions to air related to energy, travel, procurement, waste, and water are reported in paragraphs 1.1.3, 1.2.3, 1.3.3, 1.4.3, 1.6.3.

5.4 Act

The dental practice should implement educational programs for dental staff to reduce N_2O emissions to air.

Implementation of plans to reduce emissions to air related to energy, travel, procurement, waste, and water are reported in paragraphs 1.1.4, 1.2.4, 1.3.4, 1.4.4, 1.6.4.

6 Water use

6.1 Plan

The proportion of the carbon footprint directly attributed to water use in the provision of oral health care is only 0.09% of the overall carbon footprint [15] (Figure 1). However, the indirect impact is significant, as the water used in dental practice needs to be treated before and after in water and sewage works, requiring significant energy and further contributing to CO_2 emissions.

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The water consumption of a dental practice consists of the usage of autoclaves, dental chairs, and daily use. The study of Duane et al., (2017) [12] reported that the average water consumption of a dental practice is estimated at around 33 thousand litres per surgery each year.

6.2 Do

Dental practices could undertake similar interventions as households to reduce water consumption. These interventions can include switching off water-using equipment when not in use, use a water-saving toilet, and collect rainwater in a water butt to use to water plants of the dental practice.

To manage the use of water more effectively with reduced waste is recommended to purchase water-efficient appliances, *i.e.*, dishwashers and sterilising equipment, use low flow devices, replace wet water vacuum pumps with dry pumps, maintain equipment, taps and avoid leaks, run autoclaves and practice laundry machines when fully loaded.

Dental staff should also take the opportunity to teach patients to turn off the faucet when they brush.

6.3 Check

Monitoring can be effectively performed by installing a meter for water use and checking for water leaks regularly.

6.4 Act

The implementation of water conservation could be achieved increasing staff and patient awareness by using motivational stickers or posters in practice restrooms and break areas.

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7 Dental practice ground

7.1 Plan

To the best of the authors' knowledge, there are not data in the literature on the impact of ground maintenance on the carbon footprint of the dental practice. At the same time, the practice ground should be considered an opportunity to restore ecosystems whilst promoting biodiversity [19].

7.2 Do

Dental practices can consider gravel or grass instead of tarmac; that impacts insects, essential biodiversity and lowers the risk of floods [19].

The planting of new trees is an opportunity to introduce natural species and mitigate climate breakdown. In addition, trees provide shelter and shade, which reduces a building's energy budget through reduced air conditioning usage and improved solar gain [19].

Ground maintenance should avoid the use of pesticides. Furthermore, the ground can be used for composting and implementing waste management [19].

Green roofs help mitigate the urban heat island effect (an urban area is significantly warmer than the surrounding countryside) and help with energy conservation and stormwater management.

In addition to the above, dental professionals can offset CO_2 emissions by investing in reforestation campaigns [20].

7.3 Check

The monitoring that the biodiversity plan of the dental practice is achieved by arranging a list of biological species populating the ecosystem of the practice ground area.

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7.4 Act

Engage staff to carry out species surveys and promote opportunities for the dental team to appreciate the natural ecosystem.

Conclusions

The "Plan-Do-Check-Act" ISO 14100-2015 model can be effectively integrated for the environmental management of the dental practice. The approach focuses on establishing and implementing environmental objectives, followed by monitoring results and taking actions to improve continually. A reduction of the carbon footprint of the dental practice can be achieved by applying the management change to each activity area.

References

1. Brundtland GH. World commission on environment and development. *Environmental Policy and Law*. 1987;14(1):26-29. doi:10.3233/EPL-1985-14107
2. Glick M, Monteiro Da Silva O, Seeberger GK, et al. FDI Vision 2020: Shaping the future of oral health. *International Dental Journal*. 2012;62(6):278-291. doi:10.1111/idj.12009
3. Glick M, Williams DM. FDI Vision 2030: Delivering Optimal Oral Health for All. *International Dental Journal*. 2021;71(1):3-4. doi:10.1016/j.identj.2020.12.026
4. Retief F, Bond A, Pope J, Morrison-Saunders A, King N. Global megatrends and their implications for environmental assessment practice. *Environmental Impact Assessment Review*. 2016;61:52-60. doi:10.1016/j.eiar.2016.07.002
5. Thomsonn WM, Ma S. An ageing population poses dental challenges. *Singapore Dental Journal*. 2014;35(C):3-8. doi:10.1016/j.sdj.2014.10.001
6. Duane B, Harford S, Ramasubbu D, et al. Environmentally sustainable dentistry: a brief introduction to sustainable concepts within the dental practice. *British Dental Journal*. 2019;226(4):292-295. doi:10.1038/s41415-019-0010-7
7. Beal S. ISO 14001 and its role in environmental preservation. *Federal Facilities Environmental Journal*. 2002;13(3):107-113. doi:10.1002/FFEJ.10049
8. Duane B, Harford S, Steinbach I, et al. Environmentally sustainable dentistry: energy use within the dental practice. *British Dental Journal*. 2019;226(5):367-373. doi:10.1038/s41415-019-0044-x
9. Duane B, Hyland J, Rowan JS, Archibald B. Taking a bite out of Scotland's dental carbon emissions in the transition to a low carbon future. *Public Health*. 2012;126(9):770-777. doi:10.1016/j.puhe.2012.05.032
10. Ocampo Batlle EA, Escobar Palacio JC, Silva Lora EE, Martínez Reyes AM, Melian Moreno M, Morejón MB. A methodology to estimate baseline energy use and quantify savings in electrical energy consumption in higher education institution buildings: Case study, Federal University of Itajubá (UNIFEI). *Journal of Cleaner Production*. 2020;244:118551. doi:10.1016/j.jclepro.2019.118551
11. Duane B, Steinbach I, Ramasubbu D, et al. Environmental sustainability and travel within the dental practice. *British Dental Journal*. 2019;226(7):525-530. doi:10.1038/s41415-019-0115-z
12. Duane B, Lee MB, White S, Stancliffe R, Steinbach I. An estimated carbon footprint of NHS primary dental care within England. How can dentistry be more environmentally sustainable? *British Dental Journal*. 2017;223(8):589-593. doi:10.1038/sj.bdj.2017.839
13. Duane B, Ashley P, Saget S, Richards D, Pasdeki-Clewer E, Lyne A. Incorporating sustainability into assessment of oral health interventions. *British Dental Journal*. 2020;229(5):310-314. doi:10.1038/s41415-020-1993-9
14. Duane B, Ramasubbu D, Harford S, et al. Environmental sustainability and procurement: purchasing products for the dental setting. *British Dental Journal*. 2019;226(6):453-458. doi:10.1038/s41415-019-0080-6
15. Duane B, Ramasubbu D, Harford S, et al. Environmental sustainability and waste within the dental practice. *British Dental Journal*. 2019;226(8):611-618. doi:10.1038/s41415-019-0194-x

 doi:10.20944/preprints202205.0241.v1

16. Environment Canada. *Dental Wastes Best Management Practices Guide for the Dental Community*.; 2005.

17. Bunce JT, Hellyer P. Antibiotic resistance and antibiotic prescribing by dentists in England 2007-2016. *British Dental Journal*. 2018;225(1):81-84. doi:10.1038/sj.bdj.2018.525

18. Gadani H, Vyas A. Anesthetic gases and global warming: Potentials, prevention and future of anesthesia. *Anesthesia: Essays and Researches*. 2011;5(1):5. doi:10.4103/0259-1162.84171

19. Duane B, Ramasubbu D, Harford S, Steinbach I, Stancliffe R, Ballantyne G. Environmental sustainability and biodiversity within the dental practice. *British Dental Journal*. 2019;226(9):701-705. doi:10.1038/s41415-019-0208-8

20. Kakkar A, Aggarwal VP, Singh S. Go green: a new prospective in dentistry. *MOJ Current Research & Reviews*. 2017;1(1):7-10. doi:10.15406/mojcrr.2017.01.00002

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Figure 1. Environmental management change diagram. It shows the integration of the "Plan-Do-Check-Act" ISO 14100-2015 model with the environmental aspects of the dental practice to reduce its carbon footprint.

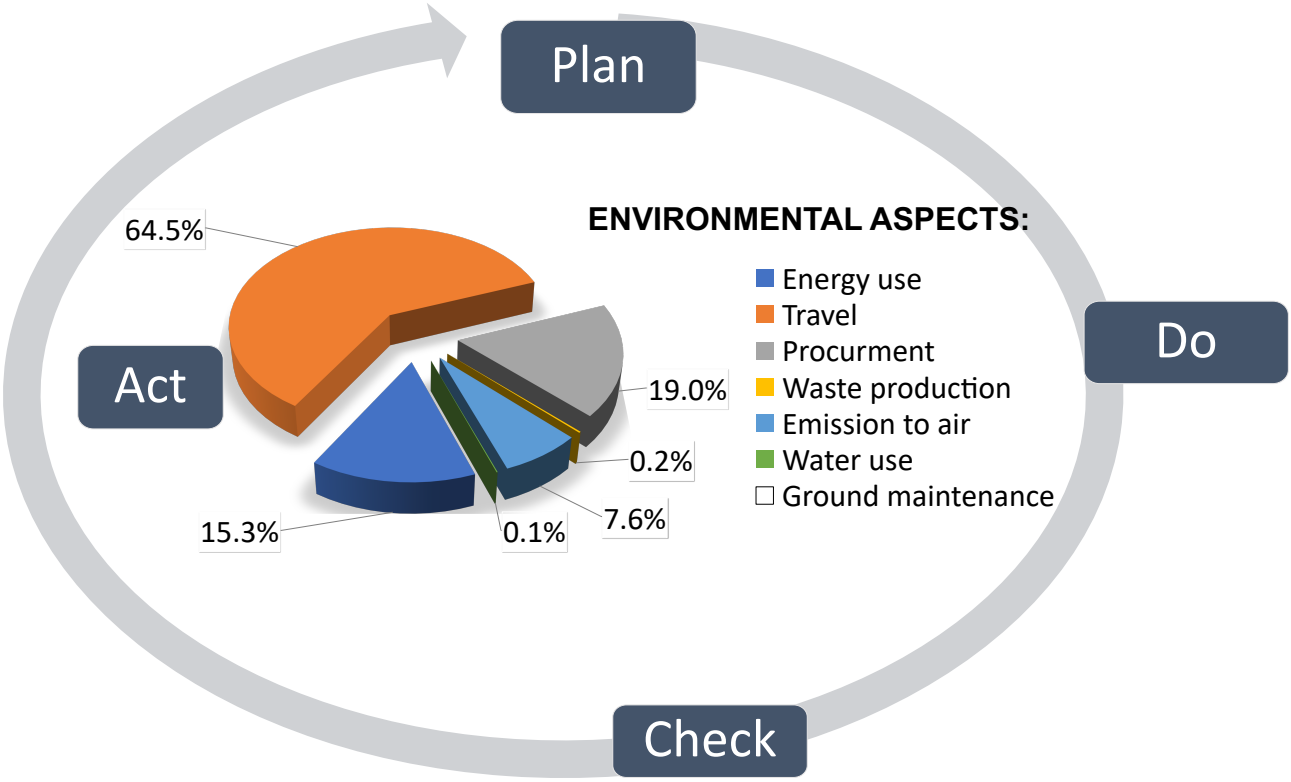

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Table 1. The "Plan-Do-Check-Act" model is described through the environmental aspects of the dental practice. The establishment and implementation of environmental objectives is followed by monitoring results and taking actions to improve continually.

	Plan	**Do**	**Check**	**Act**
Energy use	Choose sustainable energy, Improve energy efficiency, Prefer sustainable appliances, Use space effectively, Generate energy	Consider energy efficiency and renewable energy sources for construction *(e.g.*, natural ventilation, led lighting, thermal wheels, optimised insulation levels, and renewable technology), Prefer energy-efficient technologies Turn off appliances when not in use	Energy Performance Indicator (EnPI-ISO 50001)	Develop energy monitoring and reporting processes, Control energy efficiency, Connect to other organisations to share resources
Travel	Reduce patients' travel, Reduce staff travel	Combining appointments (*i.e.*, family appointments, multiple procedures in one visit), Schedule dental examination by risk assessment approach, Employ technology for communication and professional interactions (*i.e.*, teledentistry), Encourage active travel (*i.e.*, cycling and walking, using public transport, car-sharing and electric vehicles) Provide electric charging point Prefer local products with the same delivery, and transported from the same logistics centre, Prefer the closest dental laboratory	Measure frequency of appointments and type of treatment by management software	Schedule dental examination by risk assessment approach, Personalise prevention on patients' needs
Purchasing product	Prioritise products with low carbon footprints, Reduce waste	Appropriate stock management, Prefer sterilisable devices, Implement paper use reduction programmes, Reduce, reuse and recycle products	Record use of consumable for staff member	Prefer companies providing sustainable and ethical products, Influence manufacturers to be more environmentally sustainable, Form buying coperatives
Waste production	Reduce waste, Proper segregation, Recycle	Use recycling waste bins in dental surgery, Follow waste best management practice (BMP), Prefer durable equipments, Reuse and upcycle equipments, Advise patients on safe disposal of pharmaceuticals, Compost food waste	Update a equipment mantainance register, Record of waste production by categories	Reduce waste generation, Segregate waste, Perform audit

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Emission to air	Reduce travel for dentistry, Prefer sustainable procurement, Improve energy efficiency, Careful use of N_2O	Follow actions related to energy, travel,procurement, waste and water, Capture and neutralise N_2O	Follow monitoring of energy, travel, procurement, waste and water, Update register for N_2O equipment mantenance, Monitor N_2O staff exposure	Follow actions for energy, travel, procurement, waste and water, Implement educational programs to reduce N_2O emission
Water use	Reduce water consumption	Switching off water-using equipment when not in use, Use a water-saving toilet, Collect rainwater in a water butt to water practice plants, Purchase water-efficient appliances, (*i.e.*, dishwashers and sterilising equipment), Use low flow devices, Replace wet water vacuum pumps with dry pumps, Maintain equipment, taps and avoid leaks, Run autoclaves and practice laundry machines when fully loaded	Install meter for water use, Check for water leaks regularly	Increase staff and patients awarness placing stickers in the practice restroom and break area
Ground mantenance and biodiversity	Restore ecosystem, Promote biodiversity	Consider gravel or grass, Plant new trees, Avoid pesticides, Implement waste management by composting, Support reforestation campaign	Monitor biodiversity and ecosystem preservation	Engage staff with species survey

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