# Plastics: time for a rethink? Part II: plastic goods in a dental practice

Plastics contribute to climate change, and there may be serious health implications from ingesting them. Practitioners should rethink their use of plastics, and reduce, reuse and recycle – disposal should be considered only where necessary.

### Learning outcomes

This article aims to assist the reader to:

- rethink, reduce and reuse plastic consumables and disposables in dental practice; and,
- better manage all types of dental waste, including recycling.

## Introduction

There's no denying it: plastics use and waste are ubiquitous. In part I of this short series (published online only at https://jida.scholasticahq.com/article/125286-plastics-time-for-a-rethink-part-1), we considered the proliferation of plastics in the environment, along with their environmental damage and the health effects, actual and potential, for wildlife and humans. The proliferation of plastics, macro- and micro-, is compounded by their longevity in the environment.[1] The evidence is building that plastic is a worrying pollutant.

## The four Rs

The EU waste hierarchy (Article 4, Directive 2008/98/EC) establishes actions based on sustainability, which prompt us to have 'Rethink' at the top of that hierarchy.[2] Many of us think of the Rs in waste management, at home and at work. The list may be short or long, but for the purpose of this paper we suggest 'Rethink, Reduce/Reuse and then Recycle' (**Figure 1**). Waste prevention is the key. We can reduce or prevent waste generation by considering whether we need the plastic product at all, exploring alternatives in either product or material and, most importantly, avoiding single-use or disposable products. We need to reduce what we buy and reuse what we can.

## Reduce the amount of single-use instruments

Single-use plastics are produced by an energy-intensive process and have a considerable carbon footprint as well as being pollutants.[3] Reusable instruments are more environmentally friendly and pose fewer risks to human health compared to their single-use counterparts. Dentists aiming to adopt eco-conscious practices are encouraged to opt for reusable instruments where possible.[4] Reducing the use of single-use and other plastics will reduce the amount of waste and also save money.

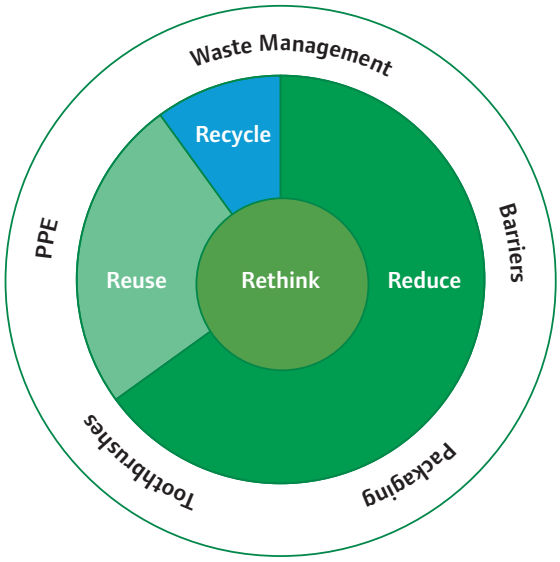


*FIGURE 1: Waste management options.*

## Reduce the amount of plastic barriers

Plastic barriers are used to cover hard to clean equipment such as air/water syringes, dental light handles, curing lights, and other difficult to clean areas. Manufacturers should be encouraged to produce equipment with easily cleaned handles, controls, and other areas that are regularly handled. This is already happening and improved design of equipment should reduce the use of barriers. A risk assessment should be carried out to examine the need for the use of any barriers, and they should only be used if there is no alternative. Infection control guidelines should consider the infection control advantages of the use of barriers, but this should not be done without a detailed understanding of the environmental impact of these barriers. Reduction in the use of barriers would also save money.[5,6]

## Reduce single-use gowns

The ecological impacts of disposable personal protective equipment (PPE) arise from multiple stages, including its manufacture, transport to dental clinics, and disposal. The production of polypropylene, polyester, and other synthetic fibres

**Dr Ahmed Kahatab**
Specialty trainee in special care dentistry
Education lead
Past President of Irish Society of Disability and Oral Health
Member of the IDA Quality and Patient Safety Committee

**Dr Nick Armstrong**
Retired Principal Dental Surgeon HSE
Member of the IDA Quality and Patient Safety Committee

**Dr Michaela Dalton**
General dental practitioner HSE
Member of the IDA Quality and Patient Safety Committee

**Dr Eamon Croke**
General dental practitioner
Part-time lecturer, Dublin Dental University Hospital
Member of the IDA Quality and Patient Safety Committee

**Dr Brett Duane**
Associate Professor in Public Dental Health, Dental Science
Trinity College Dublin

**Corresponding author:** Dr Ahmed Kahatab E: kahataba@tcd.ie

from oil is a significant contributor to global carbon emissions associated with textile production for PPE. The environmental impacts of reusable gowns are considerably lower than those of disposable gowns. Reusable gowns reduce greenhouse gas (GHG) emissions by 66%, energy consumption by 64%, and solid waste generation by 84%.[7]

Polyester and polypropylene gowns have been available for over 30 years. Although their use peaked during the Covid-19 pandemic, their production, transport, and disposal result in a significant carbon footprint. Modern reusable (washable) cotton, cotton-polyester, or polyester gowns are practical alternatives to disposable gowns due to reduced plastic usage and lower GHG emissions. While cotton is natural, breathable, and biodegradable, it may wear out faster and take longer to dry than polyester. On the other hand, synthetic fabrics release microfibres into the environment every time they are washed. Laundry worldwide results in the release of around 500,000 tonnes of plastic microfibres into the oceans per year.[8]

The appropriate choice of material should be based on durability, sustainability, and breathability requirements.

## Rethink other PPE

The predominant polymer used in surgical masks is polypropylene, with other components typically including polyester and polyetherimide. Their production, transport, and disposal contribute significantly to the carbon footprint. Potential alternatives include:[9]

- reprocessing surgical masks using moist heat, dry heat, and vaporised hydrogen peroxide;
- using bioplastic-based materials such as sugarcane; and,
- using purpose-designed reusable face masks.

Eye protection is typically fabricated from polycarbonate. Visors with disposable face shields have a higher environmental footprint than reusable visors. Therefore, reusable visors are preferred where appropriate, with consideration for less environmentally damaging domestic cleaning solutions.

Regarding gloves, little literature exists on safe and sustainable alternatives to commonly used nitrile and latex gloves. As with other aspects of PPE, the priority should be to reduce their consumption to minimise environmental impact.

## Buy from manufacturers that promote reduced packaging

All packaging should ideally be reusable or biodegradable, or just avoided. There are companies, for example Planmeca in Denmark, who supply dental practices with products in reusable bags. Ideally, companies should follow this example: deliver regular orders in reusable boxes and these should be collected by the supply company for further use. Dental practitioners could influence the amount of plastic waste that is generated by manufacturers and suppliers by requesting less packaging waste and the use of reusable packaging where possible. Bigger organisations such as dental hospitals could help influence this across the UK and Ireland.

## Use biobased plastic

Bioplastics, made from biobased polymers, offer potential for creating more sustainable plastic life cycles as part of a circular economy.

There is often confusion among consumers about certain descriptions of plastics. The term 'bioplastics' is often used to describe very different materials, and the terms 'biobased', 'biodegradable' and 'compostable' can be misleading.[10] Biobased plastics are not always 100% biological but can also be from fossil fuels. They are not necessarily biodegradable or compostable. It is important to examine the full life cycle of biobased plastics, to ensure that they are beneficial to the environment beyond the reduction in use of fossil resources.

Compared to plastics derived from fossil fuels, biobased plastics can reduce carbon emissions, possess beneficial material properties and, in some cases, align with current recycling systems. Certain types may even biodegrade under specific and controlled conditions. However, these benefits may involve trade-offs, including potential disruptions to agriculture, conflicts with food production, ambiguous end-of-life processes, and higher production costs.[11] There needs to be clear regulation, and investment will be needed to increase production of these bioplastics to a much greater scale in a truly sustainable manner.[10,11]

**Table 1: Electric or manual toothbrushes? Aids to decision-making.[12]**

| | |
|---|---|
| **Electric brushes**<br>**Consider an electric brush where:**<br>■ the modest improvement in plaque control associated with these would have a significant impact on the patient's periodontal disease risk; or,<br>■ the patient already uses an electric toothbrush. | **Reduce the environmental Impact by considering:**<br>■ sharing toothbrush handles within a family, using separate heads;<br>■ sourcing replaceable heads made from alternative material (e.g., recycled plastic or bamboo); or,<br>■ encouraging responsible disposal at the end of the life of the brush (e.g., plug-in rechargeable electric brushes can be disposed of with other electronic waste through the WEEE system). |
| **Manual brushes**<br>**Recommend a manual toothbrush where:**<br>■ the modest improvement in plaque control associated with an electric brush would NOT have a significant impact on the patient's periodontal disease risk; and,<br>■ the patient DOES NOT already own an electric toothbrush. | **Reduce the environmental impact by considering:**<br>■ alternative materials such as recycled plastic or bamboo;<br>■ sourcing brushes with replaceable heads; and,<br>■ encouraging responsible disposal at the end of the life of the brush. |

## Use the right toothbrushes

One of the biggest oral health interventions the dental profession makes is encouraging optimal oral hygiene in our patients for the prevention of periodontal disease and caries. This will often include discussions around choice of toothbrush. When the health of a human population is considered in terms of years lost to illness, disability and early death (disability-adjusted life years/DALYS), studies suggest that, at present, using a plastic toothbrush that is then recycled achieves the optimum balance between the sustainability of the toothbrush itself and the associated DALYS.[12,13]

Toothbrush choice would ideally take into account the more effective plaque removal provided by an electric toothbrush, but electric toothbrushes have a significantly higher environmental impact than all other types of toothbrush.[12,13] It is important to ensure that using an electric toothbrush is necessary to reduce periodontal disease/gingivitis. **Table 1** may assist in informing that decision.[12]

At present there are limited options for recycling toothbrushes and those options are costly (e.g., TerraCycle oral care waste and packaging recycling),

but it is hoped that this will improve in the future. Reduce the amount of fossil fuel toothbrushes by promoting replaceable heads as this cuts down on the amount of plastic. Snapping the heads off traditional toothbrushes may mean that the brush can be recycled (depending on the waste management company's acceptance) and this can result in a reduction in their carbon footprint of almost 90%.[12]

## Manage our waste better

Plastics are used in dentistry as packaging, barriers, screens, protective glasses, PPE such as aprons and gloves, waste bags, and in other areas. Clinical waste and general waste can be reduced by reducing single-use instruments, careful categorisation and segregation, and making sure that anything that can be recycled is, and that anything not clinically contaminated is dealt with using non-healthcare waste techniques. This will reduce the use of yellow/black bags.

## Recycling plastic

According to a 2022 OECD report, plastic waste has more than doubled and only 9% of plastic waste is recycled, 19% is incinerated, and about 50% goes into landfill.[14] The Environmental Protection Agency's (EPA) latest figures on packaging waste show that recycling rates remain low at around 30%, with most plastic packaging waste treated by incineration.[15]

EU Directive 2019/904, on the reduction of the impact of certain plastic products on the environment, was published on June 5, 2019.[16] This Directive is primarily aimed at single-use items such as cotton buds, cups, plastic bags, wet wipes, packets and wrappers. We are awaiting an update on progress.

Recycling plastic is controversial and is complicated by different types of plastics needing different processes. We should also not recycle plastics that contain toxic chemicals.

The term plastic relates to any product with organic polymers of high molecular mass. Plastics are usually synthetic and are most commonly derived from fossil fuels.[17] According to a Greenpeace report, recycled fossil fuel plastics often contain higher levels of some harmful chemicals, including toxic flame retardants, benzene, brominated and chlorinated dioxins, and endocrine disruptors.[18] In addition, plastic may degrade each time it is reused, so in order to recycle, a small amount of virgin plastic is needed to maintain product quality. Recent research has also highlighted the problem with recycling, with a Scottish study showing that 6-13% of recycled plastic becomes microplastics in the waste management system waste water.[19]

There are multiple solutions to fossil fuel plastics, but without effective recycling (and elimination of microplastics release) the safest solution is to use reusable systems such as metallic products or 100% biobased plastics.[19]

A group of 175 countries is trying to negotiate a binding treaty on plastic pollution at the Fifth Session of the UN Intergovernmental Negotiating Committee on Plastic Pollution and slow progress is being made. Recycling is a core part of the discussions and it is hoped that there may be agreement that used plastics are reused and remade rather than dumped.

## Healthcare waste

Recycling healthcare waste is also seldom carried out primarily due to multiple fears of cross-contamination. However, it is possible. Regulatory experts need to ensure that all recycled products meet stringent standards, such as article 25 of the EU Medical Devices Regulation and the International Standard for Organisation code 11737-2, which require traceability and often necessitate virgin plastics for medical devices.[20,21] A system of recycling medical waste would require effective sorting of different plastics, tracing origins of plastics, and a system that shreds, autoclaves and then completes the recycling process. While fully closed-loop recycling for medical devices may be unattainable, there is potential to increase recycled materials in non-critical components, such as packaging.[19]

Our daily waste policy priority should be to rethink and reduce our goods consumption, with reuse and recycle as secondary options, and disposal as the last and worst option.

## Take home messages

- Plastics are produced from fossil fuels and contribute to climate change;
- there are potentially serious health implications from ingested plastics;
- 100% biobased plastics may be biodegradable and not fossil fuel based;
- single-use plastics should be avoided;
- practitioners should rethink the use of all disposable and plastic products: rethink, reduce, reuse, or recycle; and,
- disposal is the last choice in waste management.

## References


1. European Environment Agency. Plastics. November 27, 2024. https://www.eea.europa.eu/en/topics/in-depth/plastics?activeAccordion=4268d9b2-6e3b-409b-8b2a-b624c120090d. Accessed December 20, 2024.
2. European Parliament, Council of the European Union. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. *J Eur Union*. https://eur-lex.europa.eu/eli/dir/2008/98/oj.
3. Duane B. *Sustainable Dentistry: Making a Difference*. Springer; 2023.
4. Byrne D, Saget S, Davidson A, *et al*. Comparing the environmental impact of reusable and disposable dental examination kits: a life cycle assessment approach. *Br Dent J*. 2022;233(4):317-325.
5. Hashemizadeh A, Lyne A, Liddicott M. Reducing single-use plastics in dental practice: a quality improvement project. *Br Dent J*. 2024;237(6):483-486.
6. European Commission. Single-use plastics. December 2, 2017. https://environment.ec.europa.eu/topics/plastics/single-use-plastics_en. Accessed December 23, 2024.
7. Vozzola E, Overcash M, Griffing E. An environmental analysis of reusable and disposable surgical gowns. *AORN J*. 2020;111(3):315-325.
8. Savelli H. Fashion's tiny hidden secret. United Nations Environmental Programme. March 13, 2019. https://www.unep.org/news-and-stories/story/fashions-tiny-hidden-secret#:~:text=Laundry%20alone%20causes%20around%20half,almost%20three%20billion%20polyester%20shirts. Accessed January 3, 2025.
9. Walsh LJ. Reusable personal protective equipment viewed through the lens of sustainability. *Int Dent J*. 2024;74(Suppl 2.):S446-S454.
10. European Commission. Biobased, biodegradable and compostable plastics. February 12, 2018. https://environment.ec.europa.eu/topics/plastics/biobased-biodegradable-and-compostable-plastics_en. Accessed December 20, 2024.
11. Rosenboom JG, Langer R, Traverso G. Bioplastics for a circular economy. *Nat Rev Mater*. 2022;7(2):117-137.
12. Lyne A, Ashley P, Saget S, Porto Costa M, Underwood B, Duane B. Combining evidence-based healthcare with environmental sustainability: using the toothbrush as a model. *Br Dent J*. 2020;229(5):303-309.

13. Yaacob M, Worthington HV, Deacon SA, et al. Powered versus manual toothbrushing for oral health. *Cochrane Database Syst Rev*. 2014;2014(6):CD002281.
14. OECD. Global Plastics Outlook: Policy Scenarios to 2060. 2022. https://www.oecd.org/en/publications/2022/06/global-plastics-outlook_f065ef59.html. Accessed January 5, 2025.
15. Environmental Protection Agency. Waste packaging statistics for Ireland. November 25, 2024. https://www.epa.ie/our-services/monitoring—assessment/waste/national-waste-statistics/packaging/. Accessed December 15, 2024.
16. European Union. Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment. 2019. https://eur-lex.europa.eu/eli/dir/2019/904/oj. Accessed August 25, 2024.
17. Nayanathara Thathsarani Pilapitiya PGC, Ratnayake AS. The world of plastic waste: a review. *Clean Mater*. 2024;11:100220.
18. Greenpeace. International Annual Report. Published online 2023. https://www.greenpeace.org/static/planet4-international-stateless/2024/06/10b1dd12-greenpeace-international-annual-report-2023.pdf. Accessed August 25, 2024.
19. Brown E, MacDonald A, Allen S, Allen D. The potential for a plastic recycling facility to release microplastic pollution and possible filtration remediation effectiveness. *J Hazard Mater Adv*. 2023;10:100309.
20. European Parliament. Medical Devices Regulation (EU) 2017/745. Publications Office of the EU. April 5, 2017. https://op.europa.eu/en/publication-detail/-/publication/83bdc18f-315d-11e7-9412-01aa75ed71a1/language-en. Accessed January 5, 2025.
21. ISO 11737-2. Sterilization of Health Care Products — Microbiological Methods. 2019. https://www.iso.org/standard/70801.html.