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Product stewardship in health care: The importance of minimising the environmental and health impacts of plastic products

Abstract

Increased waste in health care is a widespread problem. Currently, modern clinical practices favour single-use products and pre-packaged supply kits. Many of these consist of various types of plastics. By weight, up to 25 per cent of total hospital waste is plastics. Common plastics used are polyethylene terephthalate, polypropylene, polyethylene, polyvinylchloride and polyurethane. Polyethylene terephthalate represents the highest volume, and accounts for 40 per cent of the plastics used in operating rooms.

Health care has an enormous ecological footprint. Around the world, health care waste management strategies and clinician activities are starting to address how health care affects our planet and public health. Recovery of valuable waste, or product stewardship, is one of these strategies.

In many countries, product stewardship in health care is still non-existent or unregulated. Clinicians and health service organisations must make product stewardship in health care an integral part of sustainable procurement and health care business activities. In addition, sustainable solutions require the engagement of suppliers of plastic packaging who can contribute to reducing waste in health care and minimising the impact of plastics on the environment and public health.

Keywords: product stewardship, extended producer responsibility, sustainability, health care, plastics, public health

Introduction

The United Nations have developed 17 inter-related 'sustainable development goals'. Sustainable Development Goal 3 (SDG3) is 'good health and well-being', and SDG13 is 'climate action'¹. Medical organisations such as the Australian Medical Association and Doctors for the Environment Australia have highlighted the detrimental effects of climate change to human health² and the recent Health Care Without Harm green paper Health Care's Climate Footprint reports that health care contributes to greenhouse gas (GHG) emissions and global warming³. One of the key findings of the report is that 4.4 per cent of net

global emissions are from health care³. Australia has the tenth highest GHG emissions from health care and is among the top emitters per capita (1.29 tons of CO₂ per capita)³. In addition, seven per cent of Australia's total GHG emissions can be attributed to health care⁴.

There is a need for health practitioners to address climate change and work towards reducing health care GHG emissions⁵. Health care providers are encouraged to be vigilant and active in reducing the carbon footprint and pollution generated by health care itself. Clinicians need to be in the forefront of highlighting the environmental crisis that has both direct and

indirect adverse effects on the public's health⁶.

Manufacture, distribution and disposal of products used in health care all result in GHG emissions. This has created a need for health care facilities to review their waste management strategies. A review of waste management strategies in hospitals by Fletcher et al.⁷ reported that most strategies caused environmental harm and more innovative solutions are needed. World-wide, eight per cent of GHG emissions related to health care can be attributed to the use of rubber and plastic products². Although plastics have transformed the health care industry, it is very important to reduce the negative environmental impacts of plastic products – such as plastic packaging – by improving recovery and recycling of these materials.

Table 1 shows common plastics used in health care and their properties. Due to their favourable properties, common plastics used in health care are polypropylene, polyethylene, polyethylene terephthalate, polyethylene terephthalate glycol, polyvinyl chloride and polyurethane^{8,9}.

McGain et al.¹⁰ estimated that, by weight, between 20 and 25 per cent of total hospital waste is plastic. This is comparable to the proportion of plastic waste generated in operating rooms (ORs) where plastic packaging, in particular, has increased since the introduction of laparoscopic and interventional procedures. Around 40 per cent of OR plastic waste is polyethylene terephthalate (PET)^{11,12}.

PET is one of the most often used plastics in health care due to its high strength barrier and versatility¹³. It is thermoformed to fit the shape of different medical instruments and used in sterile barrier medical device packaging (see Figure 1).

Table 1: Types of plastics used in health care

Type of plastic	Use in health care	Properties	Sterilisable	Recyclable
polypropylene (PP)	<ul style="list-style-type: none"> • orthotics • prosthetics • non-absorbable sutures • prescription bottles • disposable syringes • disposable warming blankets 	<ul style="list-style-type: none"> • resistant to impact and corrosion • highly durable • stable with acids and other chemicals 	yes	yes
polyethylene (PE)	<ul style="list-style-type: none"> • medical implants • personal protective equipment 	<ul style="list-style-type: none"> • biocompatible • durable • resistant to impact and chemicals • low moisture absorption 	yes	yes
polyethylene terephthalate (PET)	<ul style="list-style-type: none"> • packaging • instrument wraps • vascular prostheses 	<ul style="list-style-type: none"> • transparent • durable 	yes	yes
polyethylene terephthalate glycol (PETG)	<ul style="list-style-type: none"> • food preparation trays • sterilisation trays 	<ul style="list-style-type: none"> • transparent • durable • safe to use in contact with food 	yes	yes
polyvinyl chloride (PVC)	<ul style="list-style-type: none"> • infusion bags • catheters • tubing • face masks • surgical gloves 	<ul style="list-style-type: none"> • resistant to corrosion • flame retarding 	no	yes, as single plastic only
polyurethane (PUR)	<ul style="list-style-type: none"> • medical implants • surgical drains • tubing 	<ul style="list-style-type: none"> • high compressive strength • impact resistant 	yes	yes

Current situation of plastics recovery in Australia

In metropolitan and regional areas of Australia, recyclable materials such as hard plastics, paper and cardboard, glass and metal are collected in comingled waste bins by waste contractors. The bins are transported to material recovery facilities (MRFs) where their contents are separated into different streams of recyclable material. MRFs typically separate plastics into PET, high-density polyethylene (HDPE) and mixed plastics.

Collecting recyclable waste in comingled bins is a valuable solution for households and industries but faces some challenges. These include confusion about which

items are allowed, contamination of recyclables by non-recyclables, degradation of recyclable materials and inclusion of small uncollectable items.

In Australia, the overall recycling rate of plastics in 2018–2019 was 11.5 per cent. Of all the types of plastic, PET had the highest recovery rate at 21.0 per cent followed by high-density polyethylene (HDPE) at 19.7 per cent¹⁴. In Australia, 363 200 tonnes of PET were consumed in 2018–2019 but only 76 400 tonnes were recovered. The Australian government estimates the economic loss from insufficient recovery of PET and HDPE at A\$419 million per year¹⁵. However, in the health care setting, no guidance about which clinically used PET and HDPE products are recyclable is available. Health care

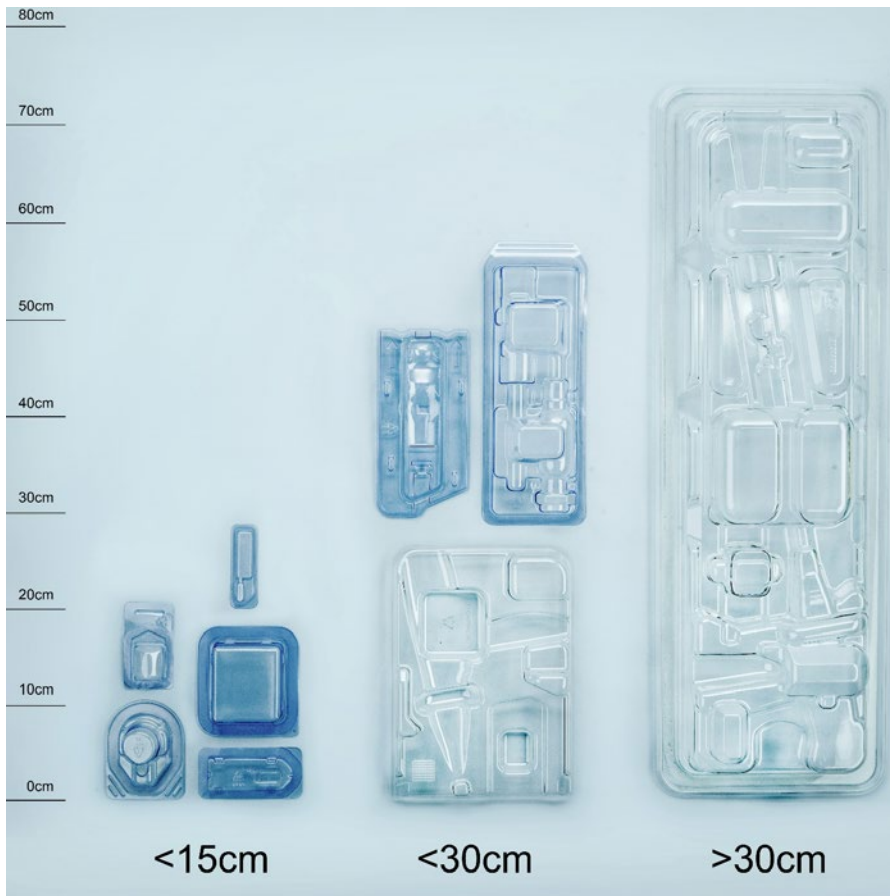


Figure 1: Typical shapes and sizes of PET packaging for medical instruments
(Source: Royal Brisbane and Women’s Hospital)

plastic waste differs vastly in size and shape from household plastic waste. Additionally, plastics used in health care may contain toxins such as phthalates which can have a detrimental effect on health⁶.

Product stewardship and extended producer responsibility

Product stewardship and extended producer responsibility offer a practical and widely proven model for cost-effective measures that minimise the impact of products and packaging on the environment and human health. The health care industry as producer of recyclable products is required to engage with their customers to provide sustainable solutions.

Product stewardship

Product stewardship is a widely utilised and applicable framework for managing products, packaging and other resource streams¹⁶. It underpins the global movement towards a circular economy for materials and resources. Product stewardship acknowledges the shared responsibility of participants throughout the product lifecycle – from raw material production to product manufacture, sale, use and recovery or disposal.

Product stewardship is based on several key principles:

- End users recycle their products and packaging through easily accessible pathways.

- Manufacturers are encouraged to develop products and packaging that can easily be recycled according to local remanufacturing capacity.
- Manufacturers can create end-markets for recovered materials by using recycled content in their products and packaging.

In 2011, the Australian government introduced the *Product Stewardship Act 2011* to manage the environmental and health and safety impacts of products. Australia has a range of voluntary, co-regulated and mandatory product stewardship schemes¹⁶ that may be aimed at recovering problematic materials not covered by conventional resource recovery systems.

Voluntary schemes are typically funded through membership or subscription fees that are used to support the creation of a circular model for the targeted materials. Mobile Muster and Drum Muster are voluntary schemes.

Co-regulated schemes, such as the Australian Packaging Covenant¹⁷, are delivered in collaboration by industry and government. They are typically voluntary and often funded by levies agree to and managed by industry. Participants pay the levy voluntarily to participate in the scheme, enabling accreditation and providing a financial base for recovery and recycling of targeted materials along the value chain. For example, container deposit schemes (CDSs), funded by the beverage industry, have been implemented across Australian states and territories and aim to minimise littering and recover resources used in the production of beverage containers.

Mandatory schemes are generally underpinned by regulatory frameworks that oblige all product

manufacturers that place the targeted materials into the market to contribute to the recovery and recycling of these materials at the product end-of-use.

Product stewardship of plastics in health care

In 2023, the Minister for the Environment listed plastics in health care products in hospitals on the product stewardship priority list. With up to 25 per cent of all hospital waste being plastics¹⁰, product stewardship programs are innovative options for all plastics generated in health care.

A product stewardship program, led by health care manufacturers, has established PVC separating at the point of generation and collects PVC products from hospitals across Australia and New Zealand. The program, PVC Recycling in Hospitals, is supported by the Vinyl Council of Australia. To our knowledge, there are currently two product stewardship programs related to health care in Australian hospitals – PVC Recycling in Hospitals and Wrapback™, that collects polypropylene blue wrap from hospitals in Australia.

Extended producer responsibility

Extended producer responsibility (EPR) is perhaps the most complex of the product stewardship models currently operating around the world. It requires collaborative efforts of producers, government and consumers, with financial responsibility formally placed on producers through legislative and regulatory instruments. EPR programs such as CDS, have been shown to work successfully when governments regulate and monitor industries and producer strategies for waste product disposal,

mandate or provide incentive for environmental targets to be met and assist with funding research and development.

Used packaging materials in Australia are regulated under the *National Environment Protection (Used Packaging Materials) Measure 2011* (NEPM). The NEPM establishes compliance obligations for brand owners responsible for placing packaging on the Australian market, and engages with participants along the circular packaging value chain. Obligated businesses must provide annual public reporting and planning for the delivery of improved sustainability outcomes for their packaging. These obligations can be met by becoming a signatory to the Australian Packaging Covenant, a co-regulatory product stewardship agreement based on shared responsibility principles. Among other measurable outcomes, signatories to the covenant commit to delivery of the 2025 National Packaging Targets. The aim is that by 31 December 2025:

1. all packaging will be recyclable, reusable or compostable
2. most (70%) of plastic packaging will be recycled or composted
3. packaging will be made from, on average, half recycled material
4. problematic and unnecessary single-use plastic packaging will be phased out.

The NEPM also compels state and territory governments to establish a corresponding statutory basis for non-signatories to the covenant, to ensure compliance obligations are met by all organisations placing packaging on the Australian market.

Until recently, a lack of enforcement for non-signatories to the covenant has resulted in challenges with free-riders and poor compliance.

However, a rapidly growing global awareness of the environmental and health impacts of plastic packaging is seeing increased focus on improving sustainability outcomes. In the Australian context, this shift is visible through the Australian government's National Waste Policy Action Plan 2019 and the National Plastics Plan 2021 as well as significant investment through the Recycling Modernisation Fund and National Product Stewardship Investment Fund, among others^{14,18,19}. State and territory governments are providing similar support to build onshore capacity for resource recovery and remanufacture. Manufacturers are moving to deliver on increasingly ambitious commitments to packaging sustainability, reflective of the increased pressure from consumers to take responsibility for packaging waste.

Ten years ago, Hopewell et al.²⁰ reported that around four per cent of the world's oil and gas, both non-renewable resources, are used as raw materials for plastics and a further 34 per cent is expended to provide energy for plastics manufacture. They propose that with the combined efforts of the public, industry and government it may be possible to divert most plastics from landfill to recycling over the next decade²⁰.

It is widely accepted that approximately 80 per cent of all environmental impacts are determined during the design phase of a product²¹. In Japan, the Container and Packaging Recycling Law introduced in 1995 was the first law reflecting the EPR idea. Under this law, responsibility was partially shifted from municipal councils to producers. As a result of EPR laws, Japan's automobile manufacturers began to use one type of recyclable

thermoplastic instead of composite materials for ease of recovery for recycling²².

This strategy has great potential when applied to single-use packaging of operating theatre instruments. The task of recycling packaging would be greatly simplified for the busy health care worker if all theatre instrument packaging was guaranteed by producers to be PET. This could help to overcome cultural barriers to recycling that are present in health care work environments^{23,24}. Currently, only clear or translucent PET is considered circular (i.e. recyclable back to the same application again, for example, bottle-to-bottle) or of competitive market value once recycled^{25,26}. If EPR laws provided incentive to producers to ensure all packaging of theatre instruments was clear PET, this could make recycling of plastic packaging waste coming from hospitals less resource intensive for recycling companies. It could also result in recycled products of higher quality without the need for extra investment to improve recycling facilities.

Conclusion

In a carbon footprinting study in three health systems, MacNeill et al.²⁷ described the impact of surgery and surgical products on climate change and public health. The study also highlighted the importance of health care practitioners in all areas of health care being proactive about promoting sustainability.

We call on industry to engage with the health care sector to establish sustainable product stewardship programs. We also call on governments to support such sustainable activities in hospitals to support clinical and waste management staff.

Establishing product stewardship schemes in health care settings for a variety of plastic products, such as PET packaging, would provide resources to segregate and collect plastics at source and prevent contamination. It could contribute to making subsequent segregation in MRFs obsolete and enable the recovery of plastics that cannot be recovered in MRFs due to their material type or size.

Recovery of high value plastic products and packaging resources will contribute to a reduction in the size of health care's ecological footprint, both GHG emissions and the environmental impact of waste. Bespoke product stewardship schemes and commitment to producer responsibility for plastic products used in health care would contribute to an increase in the recycling rate and reductions in waste going to landfill and GHG emissions.

Such approaches may also result in budgetary benefits through capturing the value of resources that currently contribute to the waste management costs of health care.

The health care sector is a dynamic and steadily increasing industry that is challenged to lower their detrimental impact on the environment and prevent harm. Addressing climate change and offering solutions is a professional responsibility for clinicians.

Key takeaways for clinical practice

Why did we do this project?

- Around one quarter of the waste generated in operating rooms is plastics; most of these end up in landfill due to limited recovery or recycling strategies.

What did we find?

- We found that around 40 per cent of all operating room plastic waste is made of polyethylene terephthalate (PET).
- Specifically, single-use surgical instruments are packaged in high grade PET.
- In contrast to community-based PET bottle recycling schemes, there is currently no recovery process for PET generated in health care.

How can health care professionals use these results?

- Policy makers: Governments and health care institutions should establish product stewardship schemes for plastics in health care to provide resources and strategies that support health care workers and hospital waste management staff.
- Health care Industry: The health care Industry should continue to increase their commitment to product stewardship and embrace producer responsibility for their products.
- Clinicians: Clinicians have a professional responsibility to address climate change and to contribute to a reduction in greenhouse gas emissions from health care.

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