Aligning Health Technology Assessment With Healthcare Net Zero Targets: A Parallel Evaluation of Single Use Versus Reusable Devices

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INTRODUCTION

Climate change is the greatest threat to human health in the 21st century.[1] To limit global warming to 1.5°C, greenhouse gas emissions must peak before 2025 at the latest and decline 43% by 2030.[2] The United Kingdom National Health Service (UK NHS) produces 24.9 million tonnes of carbon dioxide equivalent (CO_2^e) and aims to be net zero by 2045.[3] Health technologies contribute to 60% of the NHS carbon footprint so targets include reducing disposable medical device use and waste volumes.[3]

Healthcare is increasingly reliant on single-use plastics.[4] Changing from single-use to reusable equipment achieves average carbon footprint reductions of up to 56%.[5] This study assessed the environmental impact of local anaesthetic biopsies (re-usable and disposable equipment) of suspicious laryngeal and pharyngeal lesions in NHS Scotland. [6] This work was undertaken as part of a Scottish Health Technologies Group (SHTG) assessment and included analysis of the safety, clinical effectiveness, cost effectiveness and budget impact.

Figure 1: Process map to determine carbon footprint

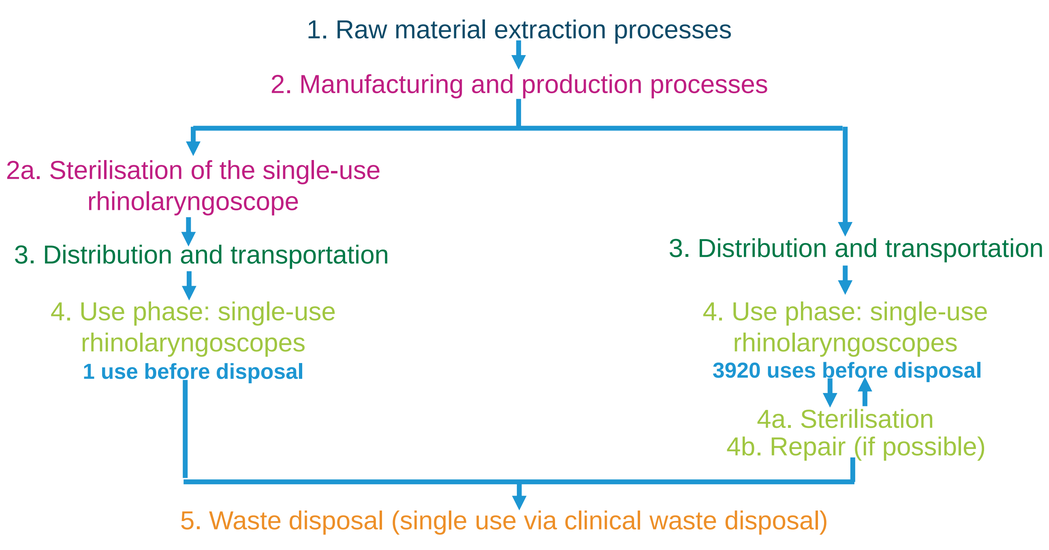

Table 1: Carbon footprint of rhinolarygoscopes

Stage (category) in life cycle assessment	Single use device (0.16kg) total $kgCO_2^e$	Reusable device (0.82kg) total $kgCO_2^e$
Raw material acquisition and manufacturing	1.37	0.002
Manufacturing sterilization	0.30	N/A
Sterile barrier systems	0.24	N/A
PPE used during pre-packaging stage of production	1.93	N/A
Downstream transportation (predominantly based on air freight)	2.14	0.0013
Use phase sterilisation	N/A	1.33
PPE using during re-sterilisation	N/A	1.93
Sterile barrier systems	N/A	N/A
Waste disposal requirement	0.05	0.000082 (negligible)
Total CO_2^e per functional unit	6.03 (very high*)	3.26 (high*)

Abbreviations: CO_2^e, carbon dioxide equivalent; PPE, personal protection equipment.
*Categorised using the Publicly Available Specification (PAS) 2050 Guidelines.[7]

METHODS

Using the annual number of biopsies (2,264) undertaken across NHS Scotland, environmental data were extrapolated to estimate annual carbon footprint and annual waste volumes generated. Guidance, protocols and HTA principles were followed.[7-10] A pragmatic literature review was undertaken to acquire environmental data on medical scopes. Single-use and reusable medical scopes, such as duodenoscopes and endoscopes, were used because of a lack of available primary data. These devices were chosen because of similar composition and materials to flexible rhinolarygoscopes.

Informal telephone interviews were conducted with NHS staff located in NHS Greater Glasgow and Clyde Board. Questionnaires were emailed to both the single-use and reusable device suppliers to collect data on processes across the life cycle of the devices and information about the device and its composition. The life cycle was mapped out for each device (Figure 1) and carbon emissions were estimated for key processes (Table 1). Uncertainty analysis was undertaken. See Table 2 for key modelling assumptions.

RESULTS

The life cycle CO_2^e emissions of the single-use device is 46% higher compared with its reusable equivalent. The estimated annual carbon impact of using single-use rhinolaryngoscopes for biopsy procedures is 13,652 kg CO_2^e, compared with 7,381 kg CO_2^e for reusable rhinolaryngoscopes. Raw material acquisition, the use of personal protective equipment (PPE) and transportation were carbon hotspots.

Disposable device use for this indication in NHS Scotland produces 12.6 tonnes of clinical waste per year compared with a negligible volume of waste for the reusable equivalent.

This report informs health technology assessment (HTA) policy development and supports the inclusion of environmental outcomes, including carbon footprinting and reporting waste volumes based on annual consumption of products.

The study used a hybrid and pragmatic approach to data acquisition. However, a high-level life cycle inventory based on good quality data was not possible, mainly due to the lack of access to primary data from industry suppliers. There was also heterogeneity and a lack of robust, reliable data across publications.

Table 1: Key modelling assumptions

Assumptions	Rationale
Secondary data was sourced for endoscopes	Environmental data of similar types of medical scopes could provide technological representation of missing data
The weight of a single-use and a reusable device was assumed to be 0.16kg and 0.82kg, respectively	It was sensible to assign these weights to both devices based on actual measurement
The life span of the reusable device was determined to be 3,920 uses per device	The same principle of technological representation was applied
Environmental impact of the sterilisation process for the reusable device was based on the use of an AER at NHS GGC Board. The sterilisation process data for the single-use device was based on secondary data published on the use of EtO.	Data was obtained from staff at NHS GGC to determine the environmental impact of using AER. The use of EtO is widespread in the sterilisation process of a single use device.
It is assumed that both will require the use of PPE	PPE is used across the life cycles of both devices, particularly during the sterilisation phase.
Supply chain routes, transportation and quantities are representative and generalised	Supplier data on national distribution centres, for example, procurement data on ordering levels and likely transport routes and various freight options

Abbreviations: AER, automated endoscopic reprocessor; NHS GGC, National Health Service Greater Glasgow and Clyde Board; EtO, Ethylene Oxide.

CONCLUSIONS

This pilot study is the first if its kind within the field of HTA. The findings are in line with other research and provides important methods for HTA sustainability globally. The study supports a multidisciplinary approach that includes the use of an environmental management framework in combination with HTA principles to enable appropriate and necessary reporting of environmental outcomes in HTA. These findings highlight the urgency for regulation to be put in place that aids the use of reusable medical equipment to support healthcare sustainable development.

REFERENCES

1. Romanello et al. The Lancet. 2023;402(10419):2346-2394. **2.** United Nations. Paris Agreement. 2015 [Online]. **3.** NHS England. Delivering a 'net zero' National Health Service. 2022 [Online]. **4.** Grand View Research. Medical plastics market size and trends [Online]. **5.** UK Health Alliance on Climate Change. The green surgery report [Online]. **6.** Healthcare Improvement Scotland. An assessment of local anaesthetic biopsies of suspicious laryngeal and pharyngeal lesions. 2024 [Online]. **7.** bsi.knowledge. PAS 2050:2011. 2011 [Online]. **8.** World Resources Institute. The Greenhouse Gas Protocol. 2011 [Online]. **9.** ISO. ISO 14040:2006. 2006 [Online]. **10.** Drummond et al.. Int J Technol Assess Health Care. 2008;24(3):244-258.

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