

ECO-FRIENDLY, SUSTAINABLE CATARACT SURGERY



Two studies evaluated strategies for reducing the procedure's environmental footprint.

BY AHMET AKMAN, MD, FACS, AND SIREL GÜR GÜNGÖR, MD

QUANTIFYING THE REDUCTION IN ECONOMIC AND ENVIRONMENTAL WASTE FROM MULTI-USE PHACOEMULSIFICATION TUBING/ CASSETTES AND DIAMOND BLADES

Chen SP, Baveja GB, Chang DF¹

Industry support for this study: Two authors disclosed relationships with industry

ABSTRACT SUMMARY

This study quantified and compared the cost, waste, and carbon emissions associated with single-use and reusable cataract surgery equipment and instrumentation. The first part of the study used data collected over 1 year to compare the environmental and financial impact of an approved multiuse phaco tubing and cassette system versus single-use equivalents on the same machine. The second part of the study assessed the same parameters for reusable diamond knives compared to disposable metal knives for an equivalent number of cataract and other IOL-related surgeries during a 10-year period. A life-cycle equivalent analysis quantified the total carbon footprint of each component from production to disposal.

For 2,700 surgical cases performed in 1 year, reusable phaco packs reduced cost by 66.7% (\$121,500 for single-use vs \$40,500 for multiuse). For every 1,000 procedures, moreover, the reusable phaco packs were projected to save an estimated 322.8 kg of plastic waste and 938.3 kgCO₂e—equivalent to driving a car 2,283 miles or 3,674 km. Over 10 years, the use of diamond knives was

STUDY IN BRIEF

► A study quantified and compared the cost, waste, and carbon emissions associated with single-use and reusable cataract surgery equipment and instrumentation. The use of validated reusable phaco systems and diamond knives was found to reduce surgical cost, plastic waste, and carbon emissions significantly without compromising safety.

WHY IT MATTERS

The health care sector contributes to greenhouse gas emissions. Transitioning from single-use to validated reusable phaco systems and diamond knives could reduce the economic and environmental footprint of cataract surgery.

projected to save an estimated \$30,430 per 1,000 cases and reduce plastic waste and carbon emissions by greater than 99%. No cases of endophthalmitis or toxic anterior segment syndrome were reported in the study.

DISCUSSION

In the United States, the health care sector contributes up to 10% of greenhouse gas emissions, largely driven by material use and waste from ORs.^{2,3} Most cataract surgical supplies in the United States are classified as single-use because labeling a device as reusable requires US FDA validation to ensure its safety and efficacy after multiple uses—a process that is costly and time-consuming and may delay product approval. Combined with liability concerns and limited financial incentives, these barriers have discouraged manufacturers from developing multiuse phaco systems.

A single-use designation does not imply that the reuse of a device is unsafe—only that it has not been

tested. CMS regulations, however, often treat any off-label reuse of ophthalmic devices such as phaco tubing and surgical knives as unsafe despite a lack of scientific evidence.⁴

As a global movement toward sustainability in health care has highlighted, there is a clear unmet need for manufacturers to develop and offer validated multiuse phaco tubing and cassette systems. Despite their availability in more than 60 countries, such devices remain unavailable in the United States owing to regulatory and commercial barriers. Collaborative action by regulators, manufacturers, and surgeons is essential to achieving meaningful progress in this area. The substantial reductions in cost and waste shown in this study were achieved through the implementation of reusable systems in clinical practice. Adopting validated reusable technologies, such as diamond knives and multiuse phaco systems, could improve both economic efficiency and environmental sustainability in cataract surgery.

COMPARATIVE CARBON FOOTPRINTING STUDY OF REUSABLE VS. DISPOSABLE INSTRUMENTS IN CATARACT SURGERY

McCance E, Steinbach I, Morris DS⁵

Industry support for this study: None

ABSTRACT SUMMARY

This prospective study assessed the environmental impact of streamlining

STUDY IN BRIEF

- ▶ A study assessed the environmental impact of streamlining single-use cataract surgery packs and replacing disposable instruments with reusable alternatives. A process-based carbon footprint analysis compared the life-cycle greenhouse gas emissions of single-use versus reusable forceps and gallipots. Replacing disposable instruments with reusable alternatives and optimizing cataract surgery packs were found to reduce carbon emissions by more than 27-fold, saving over 1.2 tons of CO₂e annually, even in a low-volume surgical unit.

WHY IT MATTERS

Cataract surgery is the most frequently performed operation worldwide. This study builds on evidence showing that the broader adoption of reusable instruments could reduce the environmental impact not just of ophthalmic surgery but also of other surgical specialties that commonly rely on prepackaged single-use instrument sets.

single-use cataract surgery packs and replacing disposable instruments with reusable alternatives. A process-based carbon footprint analysis compared the life-cycle greenhouse gas emissions of single-use versus reusable forceps and gallipots.

Single-use items were shown to have a 27-fold higher carbon footprint than reusable equivalents (322 kgCO₂e vs 12 kgCO₂e per 1,000 cases). A net carbon benefit was achieved after only 19 reuses. In a small surgical unit performing 1,584 cases annually, streamlining disposable packs saved 935 kgCO₂e per year, and switching to reusable instruments resulted in an additional 309-kgCO₂e reduction.

DISCUSSION

ORs generate up to 30% of total hospital waste, making them one of the largest contributors to hospital waste and carbon emissions.⁶ McCance et al⁵ demonstrated that single-use items within disposable cataract surgery packs contribute substantially to the overall carbon footprint of surgical practice, particularly when considered across the large global volume of procedures performed annually. Although the analyzed surgical unit performed only 1,584 cataract surgeries per year, the estimated reductions achieved through streamlining disposable packs (935 kgCO₂e) and switching to reusable alternatives (309 kgCO₂e) indicated that the potential environmental savings would be even greater in higher-volume centers. The reusable instruments evaluated in the study

were manufactured in Sialkot, Pakistan, whereas the single-use equivalents were produced in the United Kingdom. Despite the additional transportation distance, the single-use items had a 27-fold higher carbon footprint than their reusable counterparts, suggesting that the local production of reusable instruments could enhance sustainability outcomes.

Consumables are widely recognized as a major environmental hot spot in surgery, with medical equipment accounting for nearly one-third of total emissions related to cataract surgery.^{7,8} Supply chain processes contribute approximately 59% of the National Health Service in the United Kingdom's total carbon footprint and 71% of health care's global footprint.⁶ The results of the analysis by McCance et al⁵ were consistent with previous life cycle assessments comparing single-use and reusable product categories across health care sectors,^{9,10} but the study by McCance et al⁵ also provided a focused, direct comparison of individual items used in a cataract surgical setting. Because the items they evaluated were not specific to ophthalmology, the findings are applicable to other surgical specialties that commonly rely on prepackaged single-use instrument sets.

McCance et al⁵ provided robust evidence that both streamlining preprepared single-use surgical packs and replacing disposable items with reusable alternatives are effective interventions for reducing the carbon footprint of surgical operations. Although the magnitude of the impact

may vary depending on institutional and geographic context, consumables have consistently represented a major carbon hot spot within surgical care.⁶ Reducing their environmental impact remains a critical focus for mitigating the climate burden of ORs and promoting long-term, sustainable surgical practice. ■

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SECTION EDITOR EDWARD MANCHE, MD

- Director of Cornea and Refractive Surgery, Stanford Laser Eye Center, Stanford, California
- Professor of Ophthalmology, Stanford University School of Medicine, Stanford, California
- edward.manche@stanford.edu
- Financial disclosure: None

AHMET AKMAN, MD, FACS

- Professor of Ophthalmology, private practice, Ankara, Turkey
- ahmetakman@hotmail.com
- Financial disclosure: None

SIREL GÜR GÜNGÖR, MD

- Professor of Ophthalmology, private practice, Ankara, Turkey
- sirelgur@yahoo.com
- Financial disclosure: None