

# How a knee replacement impacts the planet

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A total knee replacement can greatly improve a patient's quality of life, but first the procedure itself will create nearly 30 pounds of waste, about half of which presents a biohazard and requires energy-intensive treatment for safe disposal.

A cataract surgery can give the gift of clear sight, but only after releasing

the equivalent of 181.8 kilograms of carbon dioxide, about the same as a car traveling 315 miles.

Though healthcare is one of the largest sectors in the U.S., its environmental impacts tend to fly under the radar: It accounts for 10 percent of the nation's greenhouse gas emissions, and operating rooms generate 20-33 percent of total hospital waste. Researchers are only just beginning to track and understand the sector's environmental impacts.

Among those researchers are a team at the University of Pittsburgh whose work quantifies the effects of [healthcare](#) on the environment, and in this case specifically focuses on a particularly waste-heavy and energy-intensive specialty: [orthopedic surgery](#). The researchers from the University of Pittsburgh's School of Medicine and the Swanson School of Engineering reviewed existing literature and found that while data is still sparse, efforts to reduce the carbon footprint of orthopedic surgery could make a huge impact.

"Surgical suites have a high environmental impact, partially because so many of the items they rely on are single-use, disposable products, like gowns, gloves, surgical instruments, and packaging," explained coauthor Melissa Bilec, co-director of Mascaro Center for Sustainable Innovation and William Kepler Whiteford Professor of Civil and Environmental Engineering. "We're just beginning to find out the impacts of the field, but we know the impacts are there. We also know that more research is needed to really define the best practices to reduce environmental impacts, climate change, and work toward a [circular economy](#)."

A circular economy focuses on reusing items and material to keep them in circulation rather than relegating them to a landfill at the end of their lifecycle. Bilec is leading an NSF-funded project that brings together a five-university, cross-disciplinary team to utilize convergence research to address the complex challenge of global waste and creating a circular

economy.

UPMC Orthopedic Surgery Sports Medicine Fellows and coauthors Ian Engler and Andrew Curley were inspired to join this project upon realizing the part their specialty plays in climate change—and how little the literature is addressing it.

"While thousands of articles are published in the field of orthopedic surgery each year, very few address [sustainability](#)," said Engler. "Given the immense impact of climate change, we believe that every field must consider their role in becoming more sustainable."

"We wrote this review paper to help the orthopedic field become engaged in recognizing and minimizing our impact on the planet," added Curley.

In this review paper published in the *Journal of the American Academy of Orthopaedic Surgeons*, researchers reviewed studies that evaluated the impact of surgical procedures by completing a basic waste audit, where all waste is collected, sorted and weighed, or a more complex life cycle assessment (LCA), which quantifies the overall [environmental impact](#) of the resources used.

Some current interventions in orthopedic surgery include using lower-emitting anesthesia and manufacturing techniques, redesigning custom packs, limiting single-use devices and materials, minimizing equipment in trays, properly separating waste and recycling.

These changes can make a significant difference. For example, the authors note that wide-awake hand surgery has recently been popularized as an alternative to sedative anesthesia. One study found that switching to this method, along with reducing the number of surgical supplies used for smaller procedures, led to a decrease of 2.8 tons of waste and over

\$13,000 in supplies.

Dr. Freddie Fu, a posthumous co-author on the paper, was instrumental in starting this project. Prior to his passing, Dr. Fu convened the team to share his passion for understanding the environmental impacts.

"I remember one of the last things Dr. Fu told me: "I thought I knew everything about ACL surgery, now this team is going to teach me something new," said Bilec.

Engler and Curley recalled Dr. Fu's enthusiasm for this study: "Dr. Fu was immediately supportive of our passion for sustainability. He was willing to help in any way he could. For someone known for his boundless passion, it continued to define him through his final days."

The team is honored to continue this work in his legacy.

**More information:** Ian D. Engler et al, Environmental Sustainability in Orthopaedic Surgery, *Journal of the American Academy of Orthopaedic Surgeons* (2022). [DOI: 10.5435/JAAOS-D-21-01254](https://doi.org/10.5435/JAAOS-D-21-01254)

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