

# REDUCING THE CARBON FOOTPRINT OF CATARACT SURGERY IN THE UNITED STATES

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# PURPOSE

- To quantify the disposable waste generated by a routine cataract operation in the United States and the associated carbon footprint
- To compare these results to reported data and identify areas to reduce waste during routine phacoemulsification procedures in the United States

# BACKGROUND

- The United States healthcare industry contributes significantly to greenhouse gas emissions (10% of national GHG emissions in 2013) and solid waste generation (3.4 billion pounds annually).<sup>1,2</sup>
- Cataract removal is a common procedure with over 3 million cases performed annually in the US.<sup>3</sup> This number will continue to increase as surgical techniques improve and the population ages.<sup>4</sup>

1 Eckelman MJ, et al. Estimated Global Disease Burden From US Health Care Sector Greenhouse Gas Emissions. *Am J Public Health* 2018;108(S2):S120-S122.

2 Thiel CL, et al. Environmental impacts of surgical procedures: life cycle assessment of hysterectomy in the United States. *Environ Sci Technol*. 2015 ;49(3):1779-86.

3 Merali FI, et al. Preoperative Evaluations for Cataract Surgery Are Routine but Anachronistic. *JAMA Ophthalmol*. 2018;136(3):239.

4 Lee CS, et al. Disparities in delivery of ophthalmic care; an exploration of public Medicare data. *PLoS One* 2017 Aug. 12(8), e0182598.

# BACKGROUND

- The carbon footprint of cataract surgery was investigated in a prior UK study which reported 181.8 kg carbon dioxide-equivalents (CO<sub>2</sub>eq) in GHG emissions after a single routine cataract operation.<sup>5</sup>
- The Aravind Eye Care System in India, which has taken steps to reduce its carbon footprint, reported 6 kg CO<sub>2</sub>eq in GHG emissions and 250 g of waste per routine phacoemulsification with lower complication rates than the UK.<sup>6</sup>
- There is a relative lack of data examining the carbon footprint and waste generation of cataract surgery in the United States.

<sup>5</sup> Morris DS, et al. The carbon footprint of cataract surgery. *Eye* 2013;27(4):495-501.

<sup>6</sup> Thiel CL, et al. Cataract surgery and environmental sustainability: Waste and lifecycle assessment of phacoemulsification at a private healthcare facility. *J Cataract Refract Surg.* 2017;43(11):1391-1398.

# METHODS

- Observational analysis of one uncomplicated cataract extraction at a tertiary care center near Boston, Massachusetts
- Waste was separated by material and the weight was measured directly
- A lifecycle assessment calculator was used to estimate the carbon footprint associated with waste materials<sup>7</sup>
- Surgical demographics, such as the number of routine phacoemulsification procedures performed annually, was obtained from the surgical department

# RESULTS

- At a tertiary care center in the US, one routine cataract surgery generated 3.35 kg of disposable waste (approximately 13 times higher than the waste generated per case at Aravind Eye Care System).<sup>6</sup>
- The carbon footprint per case was estimated at 10.5 kg of carbon dioxide-equivalents (CO<sub>2</sub>eq), comparable to GHG emissions from 26 miles driven by an average passenger vehicle.<sup>8</sup>
- Extrapolating to the 2,210 routine cataract operations performed annually at this center, we can estimate an annual production of 7,403 kg of disposable waste with a carbon footprint of 23,205 kg CO<sub>2</sub>eq.

# RESULTS

- There are over 3 million cataract operations performed in the United States each year.<sup>4</sup> Assuming similar findings at different centers nationally, this would amount to over 10 million kg of disposable waste and 31.5 million kg of CO<sub>2</sub>eq from phacoemulsification procedures in the US alone.
- This environmental footprint is equivalent to
  - **34,436,617** pounds of coal burned
  - **3,544,503** gallons of gasoline consumed
  - **6,688** passenger vehicles driven for 1 year<sup>8</sup>

<sup>4</sup> Lee CS, et al. Disparities in delivery of ophthalmic care; an exploration of public Medicare data. *PloS One* 2017 Aug. 12(8), e0182598.

<sup>8</sup> Greenhouse Gas Equivalencies Calculator | US EPA. US EPA. <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>. Published 2019. Accessed February 19, 2019.

# DISCUSSION

- The carbon footprint and waste generation per phacoemulsification in the United States is much higher than that reported at the Aravind Eye Care System in India.<sup>6</sup>
- Application of Aravind model strategies, such as incorporation of reusable surgical instruments and efficient surgical turnaround, would reduce the carbon footprint of phacoemulsification in the US.<sup>6</sup>

# DISCUSSION

- Barriers to change in the US include regulatory policies, defensive medicine practices, and inertia of large hospital systems.
- Given the high number of cataract operations performed annually in the US it is critical that we attempt to decrease waste production and GHG emissions per case.

# CONCLUSION

- There is a lack of data examining the waste production and carbon footprint of cataract surgery in the US. This study attempts to quantify these factors to identify areas for improvement.
- Results support earlier findings that the Aravind model offers a sustainable approach to cataract removal compared to other centers.
- Additional studies are needed to measure the carbon footprint reduction when the Aravind model is applied to cataract surgery in the US.