

The Carbon Footprint of Surgical Operations

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1. Definitions

- Carbon footprint: the greenhouse gas emissions associated with a product, activity, or system expressed as carbon dioxide equivalents (CO₂e)
- Carbon hotspot: a specific activity attributable to a large proportion of the carbon footprint

2. Background

Why is the carbon footprint of surgical operations important?

- The healthcare sector accounts for 4-5% of global greenhouse gas emissions
- The NHS produces 25% of all UK public sector greenhouse gases
- Almost two thirds of NHS emissions relate to medicines, medical equipment, and supply chains
- Operating theatres are up to six times more energy-intensive than the rest of the hospital and are a major source of waste
- Reducing emissions produced by surgical operations first requires the evaluation of the carbon footprint to identify carbon hotspots

3. Objectives

- Update Rizan *et al.* (2020) 'The carbon footprint of surgical operations a systematic review'⁽¹⁾
- Identify carbon hotspots within surgery
- Identify recommendations that can reduce the greenhouse gas emissions associated with surgery

4. Methods

Selection of studies

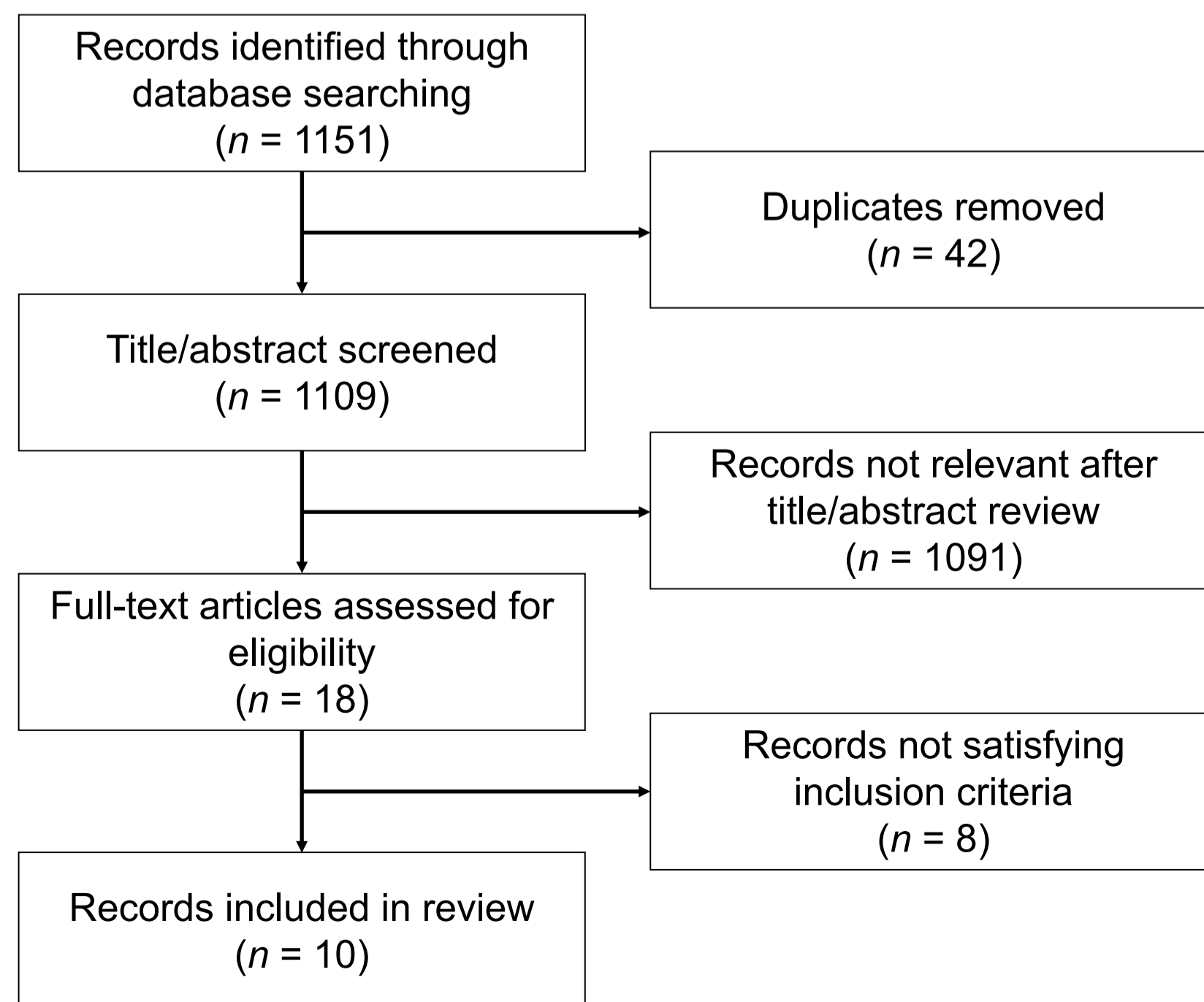


Figure 1. Carbon footprint data displayed as car journeys

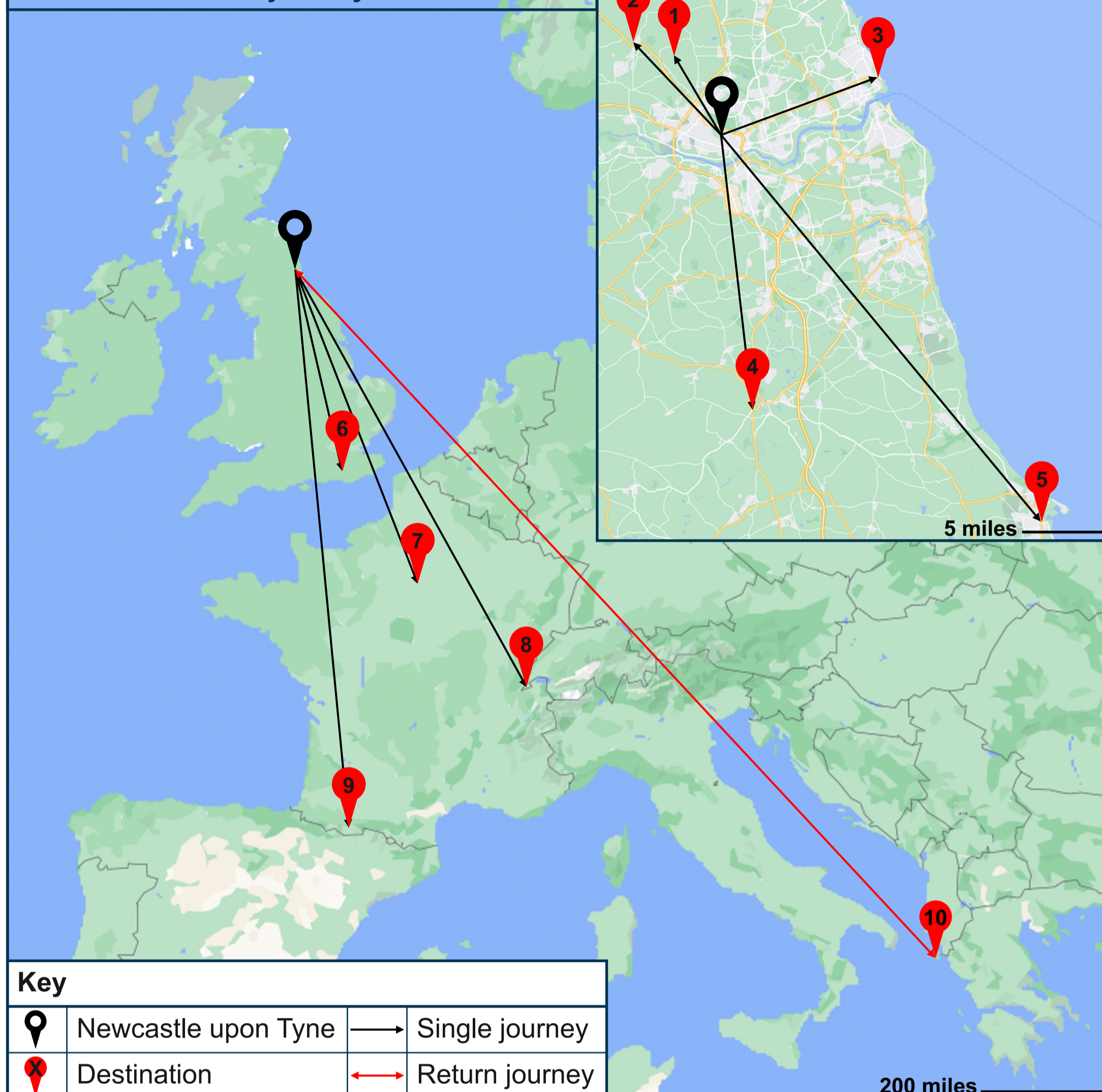


Table 1. Data from included studies

Study	Surgery Type	Carbon Footprint (carbon dioxide equivalents (KgCO ₂ e))	Equivalent Destination	Equivalent Distance by car (miles)
1 Boberg <i>et al.</i> 2022 ⁽²⁾	Laparoscopic cholecystectomy	0.79	Newcastle Airport	4.41
2 Misrai <i>et al.</i> 2021 ⁽³⁾	Prostate surgery	1.24	Ponteland	6.90
3 Jabouri <i>et al.</i> 2022 ⁽⁴⁾	Skin surgery	1.28	Tynemouth	7.10
4 Moussa <i>et al.</i> 2022 ⁽⁵⁾	Retinal detachment	2.60	Durham	14.44
5 Rizan <i>et al.</i> 2022 ⁽⁶⁾	Laparoscopic cholecystectomy	4.48	Hartlepool	24.86
6 Tan <i>et al.</i> 2021 ⁽⁷⁾	Skin cancer surgery	50.32	Gatwick Airport	279.56
7 Ferrero <i>et al.</i> 2021 ⁽⁸⁾	Cataract surgery	81.13	Paris	450.72
8 Grinberg <i>et al.</i> 2021 ⁽⁹⁾	Heart surgery	124.30	Geneva	690.56
9 Latta <i>et al.</i> 2021 ⁽¹⁰⁾	Cataract surgery	151.90	Pyrenees	843.89
10 Hubert <i>et al.</i> 2022 ⁽¹¹⁾	Coronary artery bypass surgery	505.10	Corfu (return)	2806.11

5. Results

- The carbon footprint of a single operation ranged from 0.79- 505.10 KgCO₂e [Table 1.]
- KgCO₂e values have been converted into equivalent miles driven by car [Figure 1.]
- Coronary artery bypass surgery had the largest calculated carbon footprint which is equivalent to a return trip to Corfu by car
- Major carbon hotspots identified were manufacturing and procurement of medical supplies and transport of staff and patients
- Three studies^(2,4,6) compared single-use versus reusable instruments. All found reusable items to have a lower carbon footprint. The average reduction in emissions across the studies was 65%

6. Recommendations

Reducing emissions of medical supplies

- Forming sustainable supply chains by utilising local manufactures, partnerships with suppliers, switching to reusable instruments, and reducing waste

Reducing emission from transport of staff and patients

- Partnerships with local governments to subsidise public transport
- Facilities for safer cycling and walking
- Staff car-pooling schemes

Increasing oversight

- Integrating the assessment of the carbon footprint of healthcare services into service evaluations and quality improvements
- Providing the carbon footprint of medical products at the time of regulatory approval and certification
- Standardising carbon footprint calculations so that operations can be compared between different hospitals

7. Conclusions

- There is variation in the carbon footprints of surgical operations
- Differences in the methods for calculating the carbon footprint makes direct comparison of studies challenging

Future research should focus on

- Improving the design of reusable equipment
- Comparing the carbon footprint of the sterilisation of reusable equipment versus using disposable equipment
- Comparing patient outcomes with reusable instruments versus single-use instruments

8. References

- Rizan *et al.* *Ann Surg.* 2020;272:986-995
- Boberg *et al.* *PLoS One.* 2022;17:e0271601
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- Jabouri *et al.* *Br J Dermatol.* 2022;186:735-736
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- Rizan *et al.* *Surg Endosc.* 2022;36:4067-4078
- Tan *et al.* *Australas J Dermatol.* 2021;62:e170-e177
- Ferrero *et al.* *J Fr Ophthalmol.* 2022;45:57-64
- Grinberg *et al.* *Eur J Cardiothorac Surg.* 2021;60:1325-1331
- Latta *et al.* *N Z Med J.* 2021;134:13-21
- Hubert *et al.* *J Clin Anesth.* 2022;80:110850