

# Strategies and tactics by which to reduce healthcare’s impact on climate change: A systematic review

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## INTRODUCTION

While healthcare systems are on the frontlines in dealing with climate induced demand for healthcare, they are also major emitters of greenhouse gases (GHG), estimated at over 4.4% of global emissions, with countries ranging from ~4 to 8.5%.<sup>(1)</sup> Healthcare’s key contribution to the world getting to net zero is to curtail its own emissions. We reviewed the international literature and assessed the ways healthcare systems are mitigating and can mitigate their carbon footprint.

## METHODS

**Search strategy:** Eight databases and authoritative reports prior to November 2023 were searched. Teams of investigators screened relevant publications against the inclusion criteria (e.g., in English, and discussed healthcare systems’ impact on climate change).

**Quality appraisal:** Four quality appraisal tools were applied.

**Analysis:** Inductive thematic analysis was used.

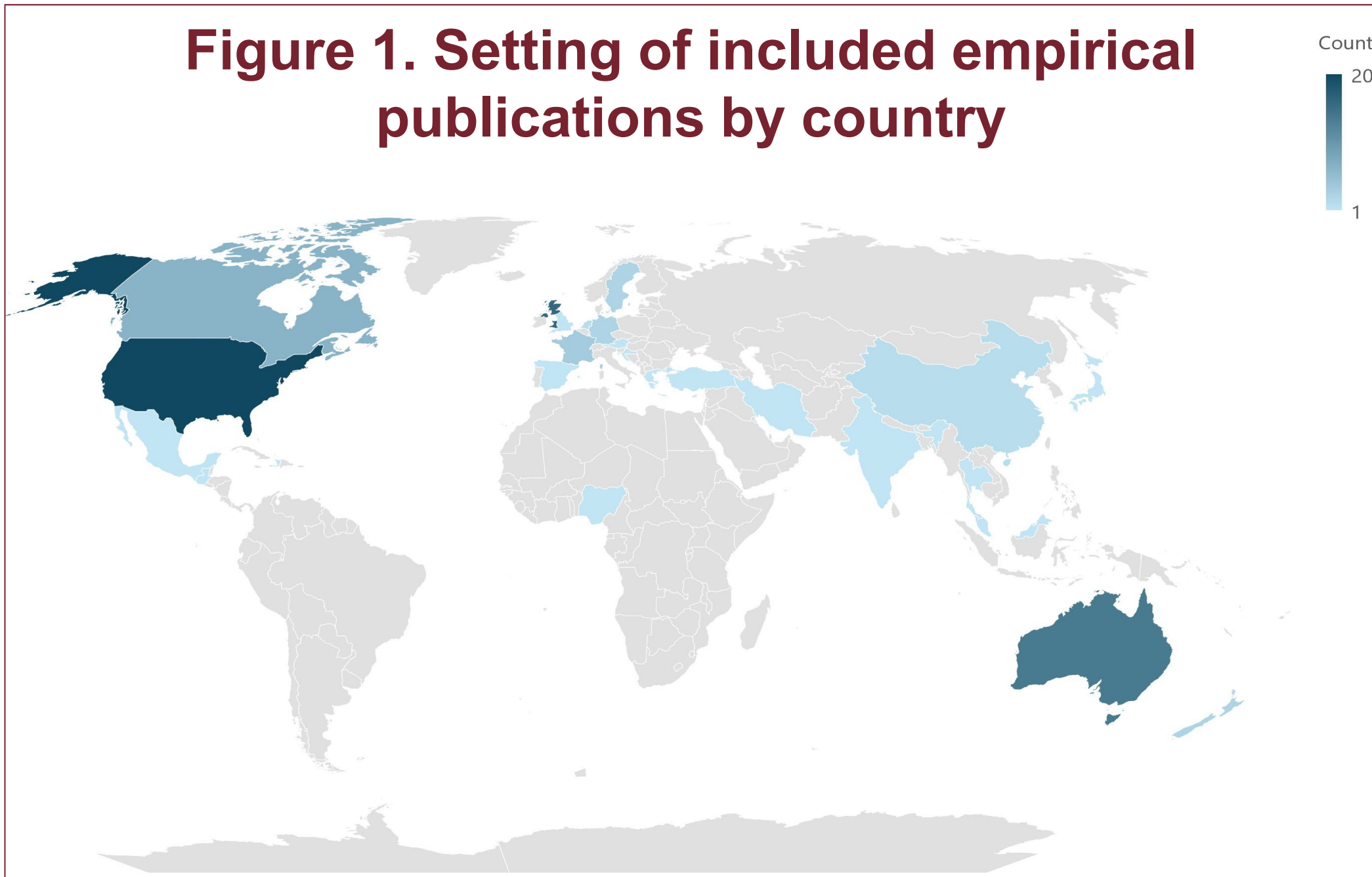
## RESULTS

**Study selection:** 33,737 papers identified; 17,944 screened; 713 assessed for eligibility; 205 papers included.

**Study characteristics:** Most papers focused on the macro healthcare system level (Table 1) and were from high-income countries (USA: n=27, 69%; UK: n=21, 10%; Australia: n=17, 8%; Canada: n=14, 7%; Figure 1).

Table 1. Level of healthcare system discussed

| Healthcare system level                           | N (%)    |
|---------------------------------------------------|----------|
| Micro (Clinical level, e.g. a clinic or hospital) | 83 (36)  |
| Meso (Regional or network, e.g. hospital network) | 31 (15)  |
| Macro (Whole healthcare system, e.g. NHS England) | 121 (52) |



### Measurement of healthcare emissions:

- Forty-eight publications developed or applied specific models or tools to measure healthcare systems’ GHG emissions (see Table 2 for examples).

Table 2. Methods for measuring healthcare GHG emissions

| Models                                                       | Level at which model can be used to evaluate GHG emissions                                        | Tools                                 | Measures GHG emissions using:                                                                               |
|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Life Cycle Assessment (LCA)                                  | Product or process (e.g., anaesthetic gases)                                                      | Carbon Calculator (online software)   | Data inputs provided by the user and then applying calculations based on established methodologies          |
| Economic Input-Output Life Cycle Assessment (EIO/LCA)        | Healthcare system (e.g., hospital or network level)                                               | Carbon Trust Recommendations          | Reports on energy consumption associated with ambulances, vehicles, on-site energy usage, and aviation fuel |
| Life Cycle Assessment - Multi-Region Input-Output (LCA-MRIO) | Product or process across entire supply chain (e.g., New South Wales, AU state healthcare system) | Pollard Model (decision support tool) | A detailed care pathway approach to simulate how theoretical changes in services impact GHG emissions       |
| Environmentally Extended Input-Output (EEIO)                 | Whole health system (e.g. National Health Services (NHS) England)                                 |                                       |                                                                                                             |

### Decarbonisation strategies and tactics identified from the literature (Figure 2):

#### ➤ Four overarching decarbonisation strategies:

- Using tools for measuring GHG emissions
- Enacting polices and governance
- Enabling change via actions of individuals and groups
- Changing organisational behaviour

#### ➤ Five tactics to decarbonise health systems:

- Strengthening healthcare infrastructure
- Minimising travel and transport
- Managing physical waste
- Decarbonising supply chains
- Changing clinical and surgical practices

Legend:

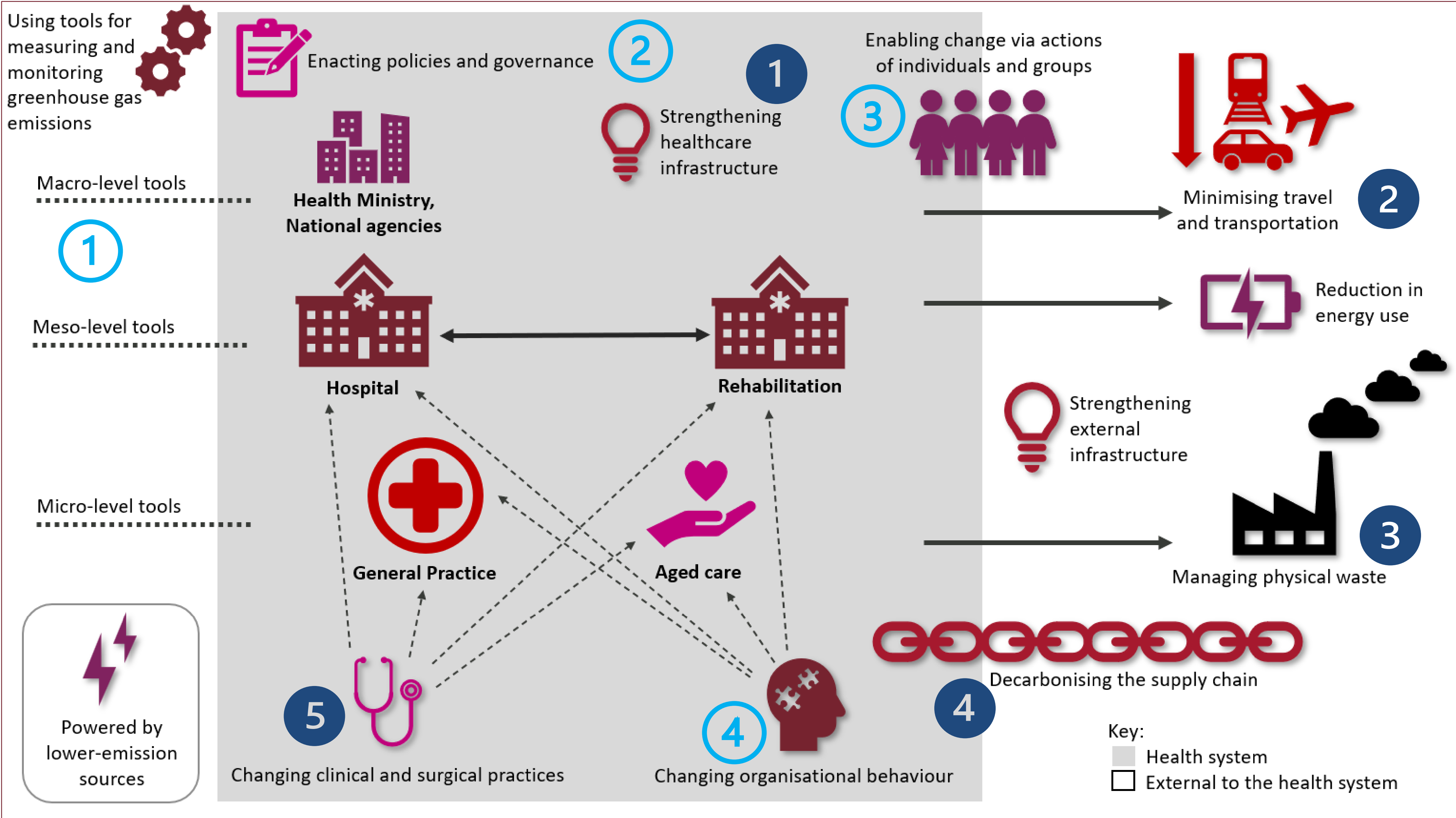
1

Overarching strategy

2

Decarbonisation tactic

Figure 2. Rich picture of decarbonisation strategies and tactics within and external to healthcare systems



## DISCUSSION AND CONCLUSION

Our review includes 18 years of studies, frameworks and tools which assess and quantify the carbon footprint of the healthcare system, and the resultant steps taken to measure and reduce these impacts across all continents except Antarctica. The results provide a comprehensive identification of overarching strategies and specific tactics, models and tools that can be implemented to decarbonise healthcare systems aiming to reach net zero emissions by 2050.

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### REFERENCES

1. Braithwaite, J., Leask, E., Smith, C.L. et al. Analysing health system capacity and preparedness for climate change. Nat. Clim. Chang. 14, 536–546 (2024). doi: 10.1038/s41558-024-01994-4

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