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A new approach to sustainable surgery: E-liability accounting for surgical health systems

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INTRODUCTION

As a sector fundamentally focused on the well-being of individuals and communities, the healthcare industry can no longer ignore its contribution to climate change. The carbon footprint of healthcare is equivalent to 5% of net global emissions with the USA the number one absolute and per capita emitter; the healthcare sector in the USA contributes 8.5% of its national emissions and 25% of global healthcare emissions.[1–3] Surgical care encompasses the spectrum of care delivery for a patient having surgery or other procedures including the procedure itself, anaesthesia care, facility use and use of supplies. This aspect of healthcare carries a particularly high carbon footprint, as operating rooms consume 3–6 times more energy than other parts of the hospital and produce up to 70% of hospital waste.[4–6] Moreover, climate change contributes to an increased burden of surgical disease, realised most notably through increased extreme weather events and subsequent trauma and injuries, disproportionately affecting low- and middle-income countries (LMICs).[7–9] Yet, despite being recognised as the greatest public health emergency of the 21st century,[10] climate change is often underplayed, neglected or even ignored in day-to-day operational decisions in the healthcare sector. With the publication of the Intergovernmental Panel on Climate Change's Sixth Assessment Report, it is evident that the healthcare sector must embrace climate accountability and engage in climate-conscious action.[11] Below, we discuss the integration of E-liability accounting for the healthcare and surgical care setting with a view to creating a more comprehensive estimation of emissions (figure 1).

There has been increasing momentum in recent years to conduct life cycle assessments (LCAs) to retrospectively analyse the carbon footprint of surgical and anaesthetic care.[12 13] These LCAs often adhere to The Greenhouse Gas (GHG) Protocol[14]—one of the most widely used tools for quantifying carbon emission, employed across sectors. The GHG Protocol divides emissions into three scopes: scope 1 constitutes direct emissions from facilities and equipment owned and operated by an organisation; scope 2, the emissions from facilities that supply the organisation's energy; and scope 3, the indirect emissions from both up and down an organisation's value chain. However, there are limitations to tracking emissions in this manner. Not only is it nearly impossible for organisations to track

SUMMARY BOX

- ⇒ The healthcare sector can no longer ignore its contributions to climate change, considered the greatest public health emergency of the 21st century.
- ⇒ Surgical care carries a large carbon footprint, with significant energy consumption, considerable waste production and reliance on complex, high-emission supply chains.
- ⇒ Tracking of up and downstream emissions, defined as scope 3 within the Greenhouse Gas Protocol, is an onerous and duplicative process.
- ⇒ E-liability accounting can holistically estimate carbon emissions and assign them to the appropriate producers and consumers, streamlining the tracking process and providing real-time feedback.
- ⇒ In surgical care, the clear accountability E-liability affords will allow hospitals to prioritise climate-conscious choices alongside patient care.
- ⇒ Thoughtful implementation of this accounting system is critical to ensure the burden of choice in climate responsibility does not fall solely onto the patient.
- ⇒ Multisectoral adoption of E-liability, while challenging to implement, would create opportunities for collaboration across fields to optimise climate-friendly practices and make meaningful progress towards a greener future.

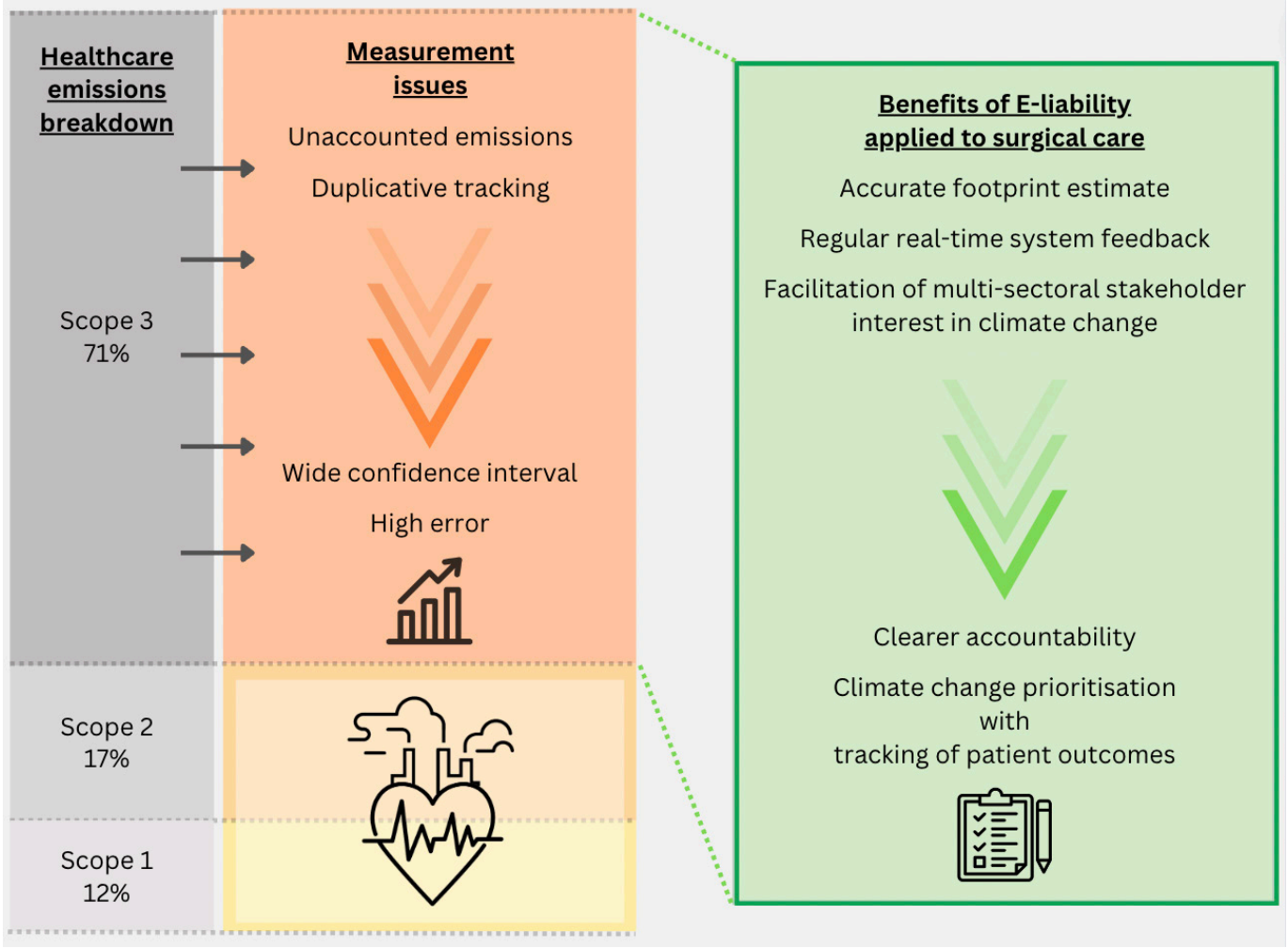

Figure 1 Surgical emissions measurement issues and the benefits of E-liability accounting.

all up and downstream emissions, accounting for emissions in such a way can lead to highly duplicative estimates of total emissions as multiple organisations feed into complex supply chain systems.

Kaplan and Ramanna recently proposed use of an E-liability accounting system in the business sector to address the flaws and weaknesses of prior approaches such as the GHG Protocol.[15] Deriving principles from activity-based cost accounting, E-liability provides a more efficient and holistic approach to estimating emissions along an entire supply chain, thus increasing accountability for climate impacts. The approach tracks emissions generated throughout the life of a good or service, and then assigns a proportion of those emissions to suppliers, manufacturers and customers at each transition point reflecting their portion of usage or utilisation throughout the life cycle of that good or service. Emissions are calculated, recorded and transmitted along the supply chain; from material extraction through to finished products sent to landfills, each step is accounted for and all emissions assigned appropriately. This shifts some accountability to sectors with high scope 3 emissions, such as healthcare, that create the demand for high emitters in the supply chain. It also facilitates a supply chain that can recognise and reward organisations with more climate conscious decision-making in terms of both its practices and its procurement.

APPLYING E-LIABILITY TO HEALTHCARE AND SURGICAL CARE

The bulk of carbon emissions from surgical care originate from both upstream and downstream processes, and more specifically, supply chain emissions. These emissions are especially difficult to account for given the lack of data on material and energy use for the production of equipment and medicines used in the provision of care.[12 13] As a result, LCAs to date have relied on assumptions and inaccurate estimates regarding supply chain emissions, which are estimated to account for more than 70% of healthcare-related emissions.[16]

The application of E-liability accounting can provide insights into the true footprint of care provision. Its utility is especially relevant in surgical care which relies heavily on multisectoral supply chains, and thus incurs predominantly scope 3 emissions. With the inclusion of upstream emissions, this approach allows for clearer accountability. Further, E-liability accounting would allow for real-time monitoring of emissions, in contrast to the retrospective

LCA approach, providing regular actionable feedback on a hospital system's decisions.

The knowledge this approach provides could be leveraged by stakeholders to facilitate climate conscious decision-making around strengthening of surgical infrastructure. With such concrete perspective on carbon emissions, hospitals can appropriately prioritise the minimisation of environmental impact alongside the optimisation of patient outcomes. Considering the interplay of healthcare with other industries, application of E-liability presents the opportunity to create consistency across sectors. Synergy in measuring carbon emissions allows for more accurate measurements, relevant comparisons, opportunities for collaboration and optimisation of climate-friendly practices.

One of the biggest challenges resulting from E-liability accounting is that the burden of accountability by extension falls on the end consumer, in this case patients accessing essential healthcare services. This is to be avoided at all costs as we continue to shed light on the myth, peddled by fossil fuel companies, of individual responsibility as a feasible means of climate change mitigation. While publicly available, accurate data around emissions may be of interest to patients seeking care within predominantly private-healthcare systems such as the USA, the responsibility must not be placed at their door. In seeking to avoid this, we must ensure governments, institutions, and multinational organisations are considered the end-customer. This holds true irrespective of whether or not E-liability accounting is used.

The above point also highlights the fact that adoption of E-liability accounting will not have uniform implications across private and public healthcare systems. The former already exposes their patient population to a greater risk of high out-of-pocket expenses and thus potential catastrophic expenditure when accessing surgical care.[17 18] The addition of an implicit responsibility for emissions reduction has the potential to further exacerbate high out-of-pocket expenditures.

Similarly, E-liability accounting needs an ecosystem of equal buy-in from all sectors. Healthcare, economics, social, and environmental stakeholders, both nationally and internationally, must be engaged to properly account for GHGs and health system liabilities. The feasibility of such buy-in and collaboration has already been questioned by Kaplan and Ramanna, when discussing E-liability accounting in relation to the business sector. We would no doubt face similar issues in attempting to collaborate within the healthcare sector. Hospitals and healthcare organisations, as entities focused on the health and well-being of all peoples, should take the first step in driving suppliers to engage in this process with the aim of fostering multilateral buy-in.

Finally, it is important to acknowledge that environmental sustainability encompasses much more than just a reduction in carbon emissions; consideration of such a narrow definition of sustainability would risk surgical care-precipitated environmental destruction and biodiversity loss through other means. Even with accurate accountability of carbon emissions, decisions around care provision, procurement, and infrastructure investment would still need to factor in other currently ill quantified environmental stressors.

CONCLUSION

It is time for the healthcare sector to come together to clearly acknowledge its collective responsibility for the significant environmental impacts resulting from healthcare, and particularly surgical care. We must develop a reliable means of accurate accountability that brings together all stakeholders and considers the entire value chain of surgical care. The need for such accountability is imperative in order to be able to keep our commitment not only to the environment but also to the health of our patients. The adoption of E-liability accounting, within the context of wider multisectoral, international buy-in, will allow for more legitimate accounting of carbon emissions allowing the surgical health sector to take responsibility for its environmental impacts. The evidence is clear; failure to do so will, without doubt, lead to environmental destruction and catastrophic health consequences for the world's population.

Correction notice This article has been corrected since it published Online to reflect the correct authors name John G Meara and Craig D McClain.

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REFERENCES

1 Pichler PP, Jaccard IS, Weisz U, *et al*. International comparison of health care carbon footprints. *Environ Res Lett* 2019;14:064004.
2 Dzau VJ, Levine R, Barrett G, *et al*. Decarbonizing the U.S. health sector-a call to action. *N Engl J Med* 2021;385:2117–9.
3 Eckelman MJ, Huang K, Lagasse R, *et al*. Health care pollution and public health damage in the United States: an update. *Health Affairs* 2020;39:2071–9.
4 MacNeill AJ, Lillywhite R, Brown CJ. The impact of surgery on global climate: A carbon Footprinting study of operating theatres in three health systems. *Lancet Planet Health* 2017;1:e381–8.
5 Lee RJ, Mears SC. Greening of orthopedic surgery. *Orthopedics* 2012;35:e940–4.

6 Van Demark RE, Smith VJS, Fiegen A. Lean and green hand surgery. *The Journal of Hand Surgery* 2018;43:179–81.
7 The intersection of climate change and surgery [The Bulletin]. 2021. Available: https://bulletin.facs.org/2021/09/the-intersection-of-climate-change-and-surgery/
8 Hashim JH, Hashim Z. Climate change, extreme weather events, and human health implications in the Asia Pacific region. *Asia Pac J Public Health* 2016;28(2 Suppl):8S–14S.
9 Deivanayagam TA, Selvarajah S, Hickel J, *et al*. Climate change, health, and discrimination: action towards racial justice. *The Lancet* 2023;401:5–7.
10 Costello A, Abbas M, Allen A, *et al*. Managing the health effects of climate change: Lancet and university college London Institute for global health Commission. *Lancet* 2009;373:1693–733.
11 Mukherji A, Thorne P, Cheung WWL, *et al*. n.d. Synthesis report of the IPCC sixth assessment report (AR6).
12 Operating in a climate crisis: a state-of-the-science review of life cycle assessment within surgical and anesthetic care-PubMed. Available: https://pubmed.ncbi.nlm.nih.gov/34251875/ [Accessed 22 Mar 2023].
13 Rizan C, Steinbach I, Nicholson R, *et al*. The carbon footprint of surgical operations: a systematic review. *Ann Surg* 2020;272:986–95.
14 Greenhouse gas protocol. Available: https://ghgprotocol.org/ [Accessed 22 Mar 2023].
15 Kaplan RS, Ramanna K. Accounting for climate change. *Harv Bus Rev* 2021. Available: https://hbr.org/2021/11/accounting-for-climate-change
16 Health care climate Footprint report. health care without harm. 2019. Available: https://noharm-global.org/documents/health-care-climate-footprint-report
17 Eze P, Lawani LO, Agu UJ, *et al*. Factors associated with catastrophic health expenditure in sub-Saharan Africa: A systematic review. *PLoS One* 2022;17:e0276266.
18 Shrime MG, Dare AJ, Alkire BC, *et al*. Catastrophic expenditure to pay for surgery worldwide: A Modelling study. *Lancet Glob Health* 2015;3 Suppl 2:S38–44.