Greening Lean: Overcoming Barriers to Integrating Environmental Practices in Surgical Lean Management Projects

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Background

Surgical practices generate a large portion of hospital waste and significantly contribute to NHS carbon emissions, underscoring the urgent need for sustainable interventions. Lean management, which optimises efficiency and reduces waste, offers a pathway to address these environmental concerns. (1) However, the application of Lean principles in surgical sustainability remains fragmented and under-researched. This project aims to identify key barriers and propose solutions for embedding sustainability into Lean processes within surgery.

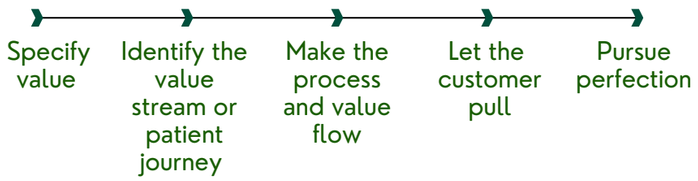


Figure 1: Lean Management Principles

Methodology

A review of 5,011 sources across MEDLINE, EMBASE, SCOPUS, EBSCO, Cochrane, and grey literature yielded 24 academic and 13 grey literature articles. CASP and AACODS tools were used for quality assessment, and thematic analysis identified systemic barriers.
Additionally, 29 semi-structured interviews with healthcare professionals and executives explored practical challenges.

Conclusion

As healthcare systems progress toward Net Zero targets, Lean management offers potential for simultaneous environmental and operational improvements. The Greening Lean Framework provides a practical pathway for integrating sustainability into Lean practices, highlighting the importance of targeted educational initiatives, enhanced interdepartmental collaboration, and strategic support.

References

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Results

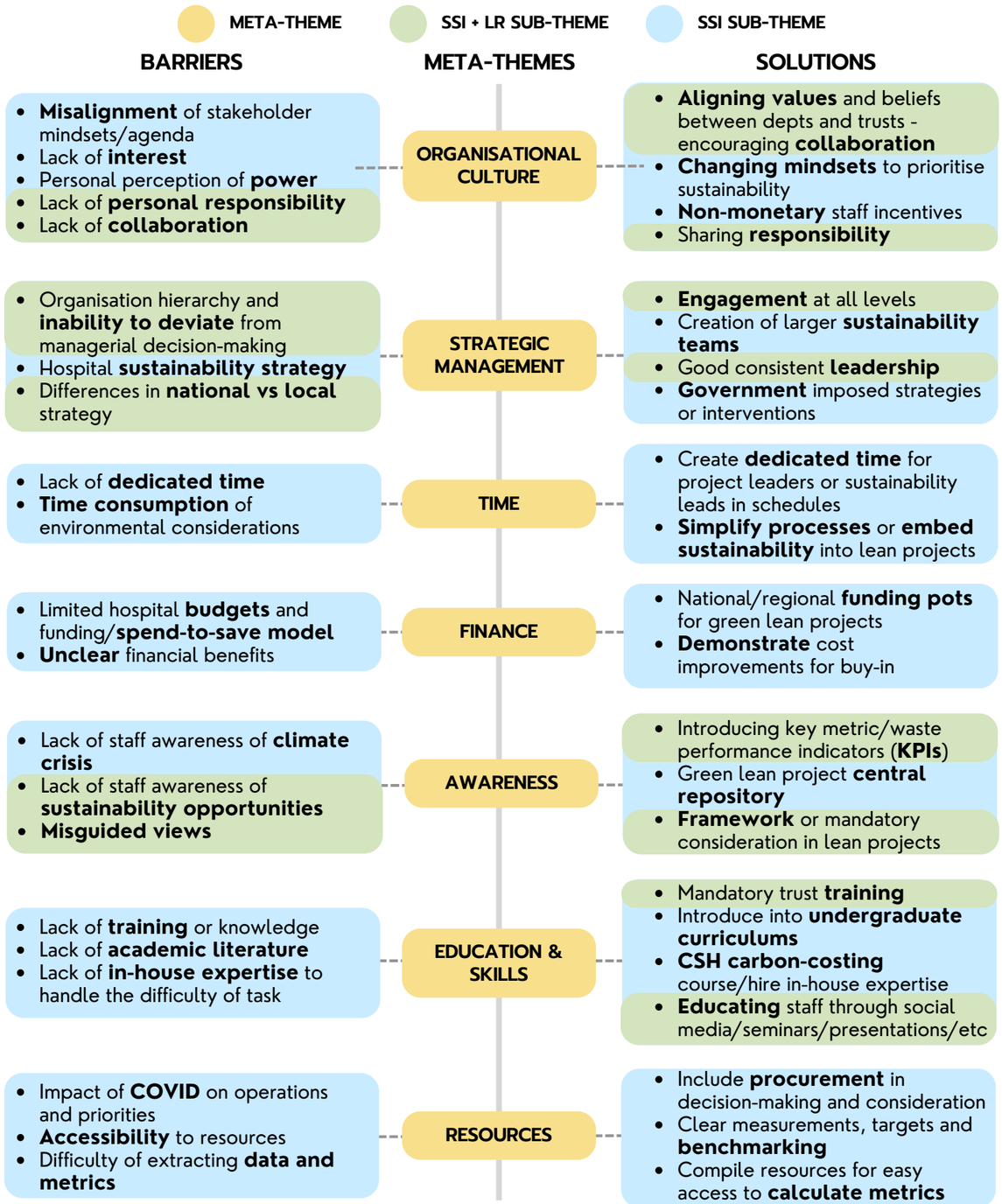


Figure 2: Thematic Analysis of Identified Barriers and Facilitators

Discussion

Findings revealed that while Lean techniques are well-established in surgery, their environmental potential remains underutilised.

The LR identified 4 key themes: **responsibility, hierarchy, collaboration, and education/awareness**, emphasising individual accountability and the need for multidisciplinary cooperation. In contrast, SSI revealed 7 broader themes, including **organisational culture, strategic management, time, finance, and resources**. While both sources stressed collaboration and education, the SSI exposed deeper logistical challenges, bridging the gap between theory and real-world implementation in Lean surgical projects.

The intersection of Lean, sustainability, and surgery remains under-explored, with no existing frameworks addressing implementation barriers. The Greening Lean Framework was developed to guide behaviour change at both individual and organisational levels, encouraging environmental considerations in Lean surgical projects. The COM-B model (3) informs the Greening Lean Framework, emphasising behaviour change.



Figure 3: Greening Lean Framework

However, the study also reveals a policy-practice disconnect, where sustainability initiatives are often deprioritised due to competing demands and resource limitations (3). Future research should focus on refining implementation strategies, evaluating long-term impact, and advocating for policy-level changes to institutionalise sustainable Lean practices in healthcare.