# Incorporating carbon emissions into health economic evaluation of endoscopic staplers in surgery

HTA309

Qian Xu[1,2], Zhantao Lu[1,2], Ruilin Liu[3], Bao Liu[1,2*]

All authors contributed equally.

1. Department of Health Economics, School of Public Health, Fudan University, Shanghai, China
2. Key Laboratory of Health Technology Assessment (Fudan University), National Health Commission, Shanghai, China
3. School of Management, Fudan University, Shanghai, China

## INTRODUCTION

- Climate change presents a major threat to global health nowadays [1]. Healthcare, in particular, is a contributor to carbon emissions. According to Healthcare Without Harm report in 2019, the healthcare's climate footprint was equivalent to 4.4% of global net emissions, and the contribution rate of China's healthcare system was 3.10% to the total carbon emissions [2].

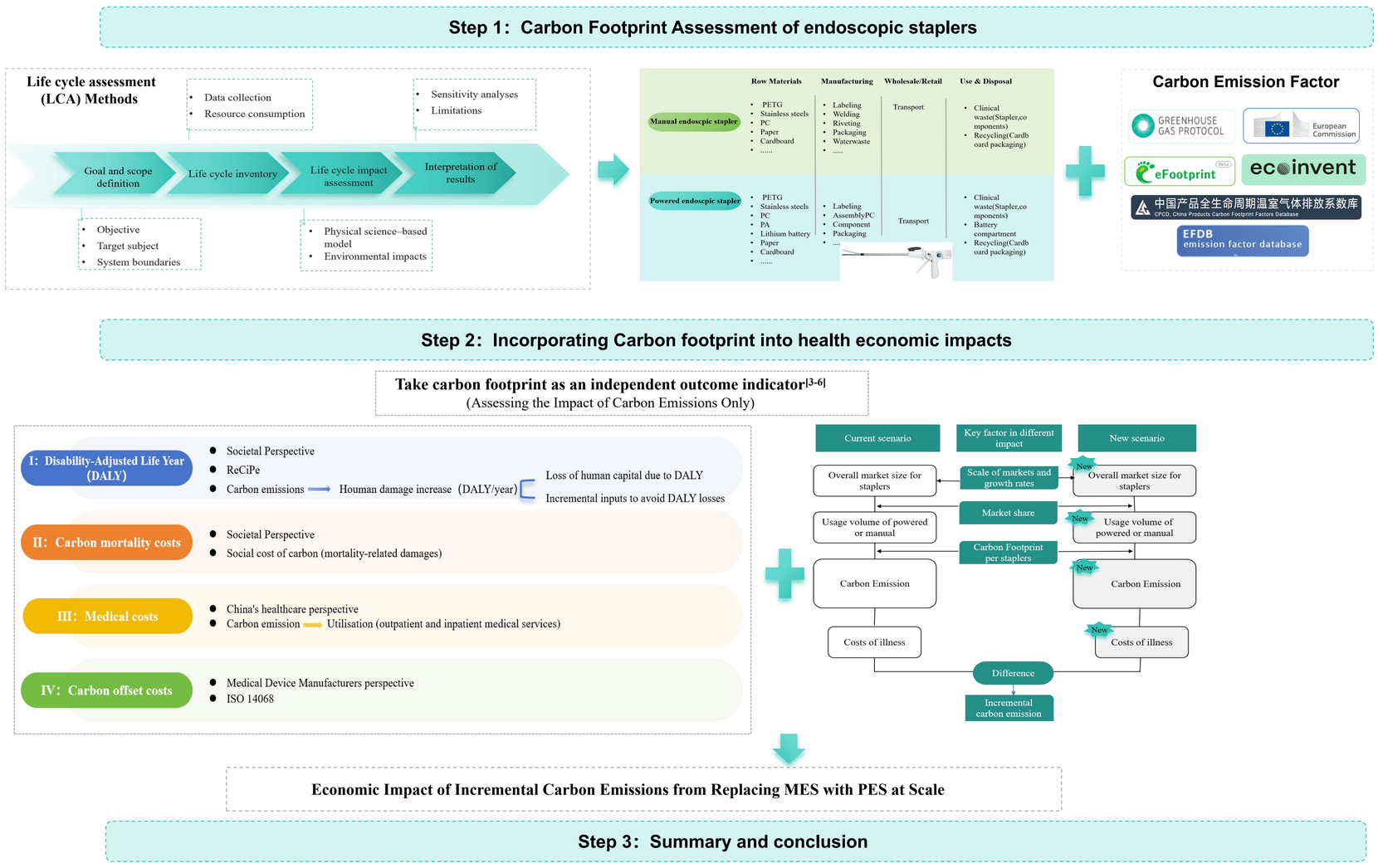
- There are lack of systematic methods on which environmental dimensions to include and how to assess environmental spillovers within economic review.

## OBJECTIVE

This study aimed to add carbon emissions to health economic evaluation of using stapler devices in China.

## METHODS

**Study framework and methods**




## RESULTS

**● The Necessity of Carbon Reduction in Healthcare**

- Climate change intensifies disease burdens, driving up healthcare utilization and expenditures.
- In regions with underdeveloped healthcare systems and limited financial capacity, the adverse effects of climate change are exacerbated.
- Due to measurement challenges, the environmental impact of external factors—such as the transportation, distribution, processing, and disposal of pharmaceuticals and medical devices—are often overlooked in assessments.

**● Take carbon footprint as an independent outcome indicator**

The carbon footprint for one manual and powered endoscopic stapler were 2.97 kg carbon dioxide equivalent ($CO_2$-eq), and 8.54 kg $CO_2$-eq, respectively.

Table 1 Carbon footprint of stapler in different phase

| Phase | PES carbon emission (kg CO2 eq) | MES carbon emission (kg CO2 eq) |
|---|---|---|
| Manufacturing | 2.65 (2.36, 2.94) | 7.89 (7.20, 8.58) |
| Transportation | 0.075 (0.067, 0.083) | 0.16 (0.146, 0.174) |
| Disposal | 0.24 (0.21, 0.27) | 0.48 (0.44, 0.52) |
| Total | 2.97 (2.64, 3.30) | 8.54(7.78, 9.29) |

Notes, PES: powered endoscopic staplers; MES: manual endoscopic staplers

**● Take carbon footprint as an independent outcome indicator**

Table 2 Economic Impact of staplers in different conversion path

| Conversion path | | Economic impact per stapler (CNY yuan) | | |
|---|---|---|---|---|
| | | MES | PES | Incremental cost |
| I: Loss of DALY | Loss of human capital due to DALY | 0.12 | 0.35 | 0.23 |
| | Incremental inputs to avoid DALY losses | 0.25 | 0.71 | 0.46 |
| II:Carbon mortality costs | | 0.91 | 2.62 | 1.71 |
| III:Medical costs | | 0.27 | 0.78 | 0.51 |
| IV:Carbon offset costs | | 0.18 | 0.51 | 0.33 |

Table 3 Carbon emission of stapers in 2025-2027

| Carbon emissions (t CO2-eq) | Current scenario | | | New scenario | | |
|---|---|---|---|---|---|---|
| | 2025 | 2026 | 2027 | 2025 | 2026 | 2027 |
| MES | 4409 | 4976 | 5616 | 3655 | 3801 | 3888 |
| PES | 6093 | 6877 | 7761 | 8261 | 10256 | 12732 |
| Total | 10502 | 11853 | 13377 | 11916 | 14057 | 16620 |
| Incremental carbon emissions | / | | | **1414** | **2204** | **3243** |

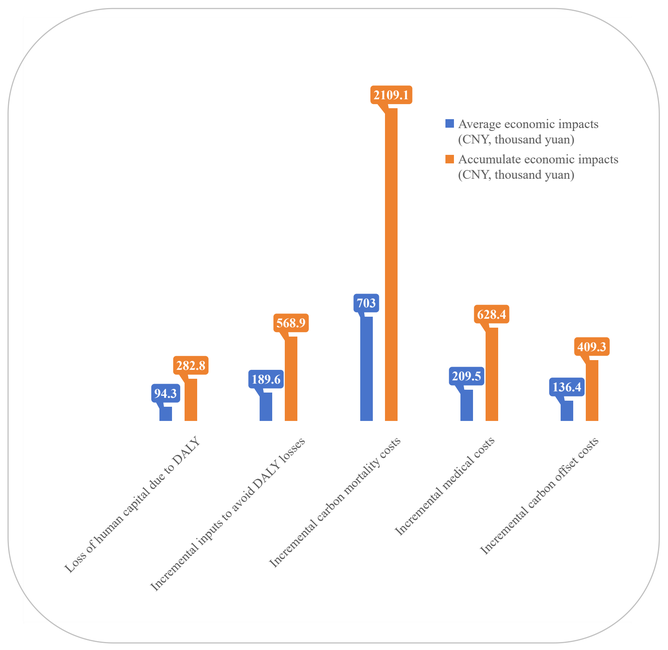



Figure 1 The average and accumulate economic impact when the PES to replace MES

## DISCUSSION

- Data for carbon emission accounting throughout the entire lifecycle of medical devices, from production to disposal, is still inadequate.
- The carbon footprint and carbon emission calculations in the pharmaceutical industry have not received sufficient attention in China. This paper aimed to raise awareness and drive progress in addressing these issues.
- Using a life cycle assessment approach to enhance the evaluation of environmental impacts of medical devices.

## DISCUSSION

- Previous studies had considered incorporating carbon footprint into health economic evaluations[7-9]. however, the development of appropriate methodologies remained underdeveloped.
- Due to the limitations of domestic carbon footprint databases, this study used carbon footprint data from similar materials as substitutes for certain stapler components. The substitutions may introduce some effects on the carbon footprint caculation.
- Our research is still ongoing, and this poster presented a partial economic evaluation that explored various approaches to translating carbon footprint into economic impacts.

## CONCLUSION

Incorporating carbon footprint into health economic evaluation revealed that powered and manual staplers exhibited different carbon emissions throughout their lifecycle. When translating these emissions into economic impacts, various approaches led to different economic outcomes. This study highlighted the importance of integrating environmental, social, and governance (ESG) considerations into health economic evaluation.

## REFERENCES

[1] World Health Organization, 2023. Climate change and health fact sheet. (accessed 12 Oct. 2023)
[2] Health Care Without Harm, 2019. Health care climate footprint report. (accessed 23 Sep. 2023).
[3] De Schryver, A. M..2009. Environmental science & technology, 43(6), 1689–1695.
[4] Tamma Carleton.2022. The Quarterly Journal of Economics, Volume 137, Issue 4, Pages 2037–2105.
[5] DONG H M, et al.2021. [J]. Science of the Total Environment,758.
[6]The World Bank. Record High Revenues From Global Carbon Pricing Near $100Billion [EB/OL].(accessed 15 Nov. 2023)
[7]AVȘAR T S, YANG X, LORGELLY P. [J]. PharmacoEconomics, 2023,41(2): 123-138.
[8]SCHUITMAKER-WARNAAR T J.et.al.[J].International Journal of Technology Assessment in Health Care, 2022, 38(S1): S30
[9]MCALISTER S, MORTON R L, BARRATT A. [J]. Lancet Planetary Health, 2022,6(12): E993-E999.

## CONTACT INFORMATION

- Bao Liu, Professor, E-mail: liub@fudan.edu.cn.
- Qian Xu, PhD student, E-mail: qianxu134@163.com