What role for environmental impacts of pharmaceuticals in HTA? Overview of an evolving evidence landscape

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If the health sector were a country...

BACKGROUND

- The healthcare sector's contribution to the climate is significant, accounting to around **5%** of national carbon footprints (Pichler et al 2019).
- 14 countries have already committed to developing a carbon-neutral healthcare system by 2050 (Wilkinson, 2021), the UK´s NHS is at the forefront with its commitment to achieve a net zero healthcare system by 2045.
- HTA agencies are beginning to commit to incorporate environmental sustainability in their models (so far ignored as ´externality´) (CADTH 2022, NICE 2021).
    - for example CAR-T therapy: apherisis, biopsies, cell production, hospital stay, imaging studies, drugs, hotel, travel …
      And: one CT alone = 200 to 300 kg eCO2 (Picano 2021).

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BACKGROUND

- The incorporation of environmental sustainability in HTA processes requires **new methods/data sources** (Toolan et al 2023, McAlister et al 2022): *(i) information conduit, (ii) parallel evaluation, (iii) integrated evaluation, (iv) environment-focused evaluation* (Toolan et al 2023).
- **Key methodological challenges**: availability of indicators/data on the eCO2 intensity of health innovations from a full life-cycle approach (LCA), consideration of social cost of carbon emissions, lack of standardization and consensus.
- A rapidly evolving field of research (Marsh et al 2016,Polisena et al 2018, Guirardo-Fuentes et al 2023, Pinho-Gomes A et al 2022).

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Aim of the scoping review

This scoping review aims to

1. Summarize methodological approaches enabling the inclusion of environmental considerations into HTAs,
2. Appraise the application of these approaches in various use cases and to
3. Identify gaps in current knowledge that should be addressed by future research.

Approach – search strategy

CONT´ED

- A scoping review was conducted and reported according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping reviews.
- A systematic search was performed in February 2024 in Medline (PubMed interface) based on the search strategy used by *Guirardo-Fuentes* et al 2023 which is based on *Polisena* et al. 2018.
- Because some functions of OVID are not available in PubMed, the search strategy was adapted to function in PubMed.

Search	Actions	Details	Query	Results	Time
#12	···	›	Search: ((((((("Greenhouse Gases") OR ((Carbon) AND (emission* [Title/Abstract]))) OR (((("greenhouse gas"[Title/Abstract]) AND (emissions[Title/Abstract])) OR (accounting[Title/Abstract]))) OR ((carbon dioxide[MeSH Terms]) AND (emission*[Title/Abstract]))) OR (("Climate Change") AND (mitigation[Title/Abstract]))) AND (("carbon cost"[Title/Abstract:~3]) OR ((((((("health technology assessment"[Title/Abstract]) OR (HTA[Title/Abstract])) OR (HTAs[Title/Abstract])) OR ("health technology assessment"[Other Term])) OR (HTA[Other Term])) OR (HTAs[Other Term]))) OR (((((((("health technology assessment"[Title/Abstract]) OR (HTA[Title/Abstract])) OR (HTAs[Title/Abstract])) AND (environmental*[Title/Abstract])) OR ("health technology assessment"[Other Term])) OR (HTA[Other Term])) OR (HTAs[Other Term])) AND (environmental*[Other Term]))	504	07:56:23
#11	···	›	Search: (((((((("health technology assessment"[Title/Abstract]) OR (HTA[Title/Abstract])) OR (HTAs[Title/Abstract])) AND (environmental*[Title/Abstract])) OR ("health technology assessment"[Other Term])) OR (HTA[Other Term])) OR (HTAs[Other Term])) AND (environmental*[Other Term])	11	07:56:00
#10	···	›	Search: (((((("Greenhouse Gases") OR ((Carbon) AND (emission* [Title/Abstract]))) OR (((("greenhouse gas"[Title/Abstract]) AND (emissions[Title/Abstract])) OR (accounting[Title/Abstract]))) OR ((carbon dioxide[MeSH Terms]) AND (emission*[Title/Abstract]))) OR (("Climate Change") AND (mitigation[Title/Abstract]))) AND (("carbon cost"[Title/Abstract:~3]) OR ((((((("health technology assessment"[Title/Abstract]) OR (HTA[Title/Abstract])) OR (HTAs[Title/Abstract])) OR ("health technology assessment"[Other Term])) OR (HTA[Other Term])) OR (HTAs[Other Term]))))	497	07:52:48
#9	···	›	Search: ("carbon cost"[Title/Abstract:~3]) OR ((((((("health technology assessment"[Title/Abstract]) OR (HTA[Title/Abstract])) OR (HTAs[Title/Abstract])) OR ("health technology assessment"[Other Term])) OR (HTA[Other Term])) OR (HTAs[Other Term]))	10,195	07:52:23
#8	···	›	Search: (((((("health technology assessment"[Title/Abstract]) OR (HTA[Title/Abstract])) OR (HTAs[Title/Abstract])) OR ("health technology assessment"[Other Term])) OR (HTA[Other Term])) OR (HTAs[Other Term])	8,611	07:51:58
#7	···	›	Search: "carbon cost"[Title/Abstract:~3]	1,587	07:49:50
#6	···	›	Search: ((((("Greenhouse Gases") OR ((Carbon) AND (emission* [Title/Abstract]))) OR (((("greenhouse gas"[Title/Abstract]) AND (emissions[Title/Abstract])) OR (accounting[Title/Abstract]))) OR ((carbon dioxide[MeSH Terms]) AND (emission*[Title/Abstract]))) OR (("Climate Change") AND (mitigation[Title/Abstract]))	166,155	07:48:49
#5	···	›	Search: ("Climate Change") AND (mitigation[Title/Abstract])	4,948	07:44:32
#4	···	›	Search: (carbon dioxide[MeSH Terms]) AND (emission* [Title/Abstract])	8,558	07:43:26
#3	···	›	Search: ((("greenhouse gas"[Title/Abstract]) AND (emissions[Title/Abstract])) OR (accounting[Title/Abstract])	123,850	07:42:04
#2	···	›	Search: (Carbon) AND (emission*[Title/Abstract])	41,965	07:40:08
#1	···	›	Search: "Greenhouse Gases"	6,534	07:36:35

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CONT´ED

Approach - search strategy

Further searches were conducted in the International HTA Database and Climate Change and Human Health Literature Portal as well as in LIVIVO and Google Scholar.

- International HTA Database 14.02.2024: 3 hits; no duplicates
- Climate Change and Human Health Literature Portal 14.02.2024: 19 hits; 10 duplicates
- LIVIVO ((("greenhouse gases") OR carbon) OR "climate change") AND "health technology assessment"; (environment* OR sustainab*) AND "health technology assessment" 14.02.2024: 8 hits; 7 duplicates
- Google Scholar ("greenhouse gases" | carbon | "climate change") + ("health technology assessment" | HTA | HTAs); (environment* | sustainab*) + ("health technology assessment" | HTA | HTAs) 15.02.2024: 37 hits; 13 duplicates

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Approach - search strategy

CONT´ED

Records identified = 541

Search strategy conducted by two senior researchers (MM/OG)

Records screened = 541

Screening was performed using ASReview by senior researcher (OG)

Full text review = 40

Full text was retrieved for all papers and assessed for inclusion (OG)

Final studies included = 25

Data extraction by two senior researchers (JB, OG)

Data extraction according to:

author, year, country, perspective, type of study (review, case study, methodological, educational), objective, methods presented, type of intervention in focus, key results, proposed solution for HTA integration, key challenge identified, quality appraisal

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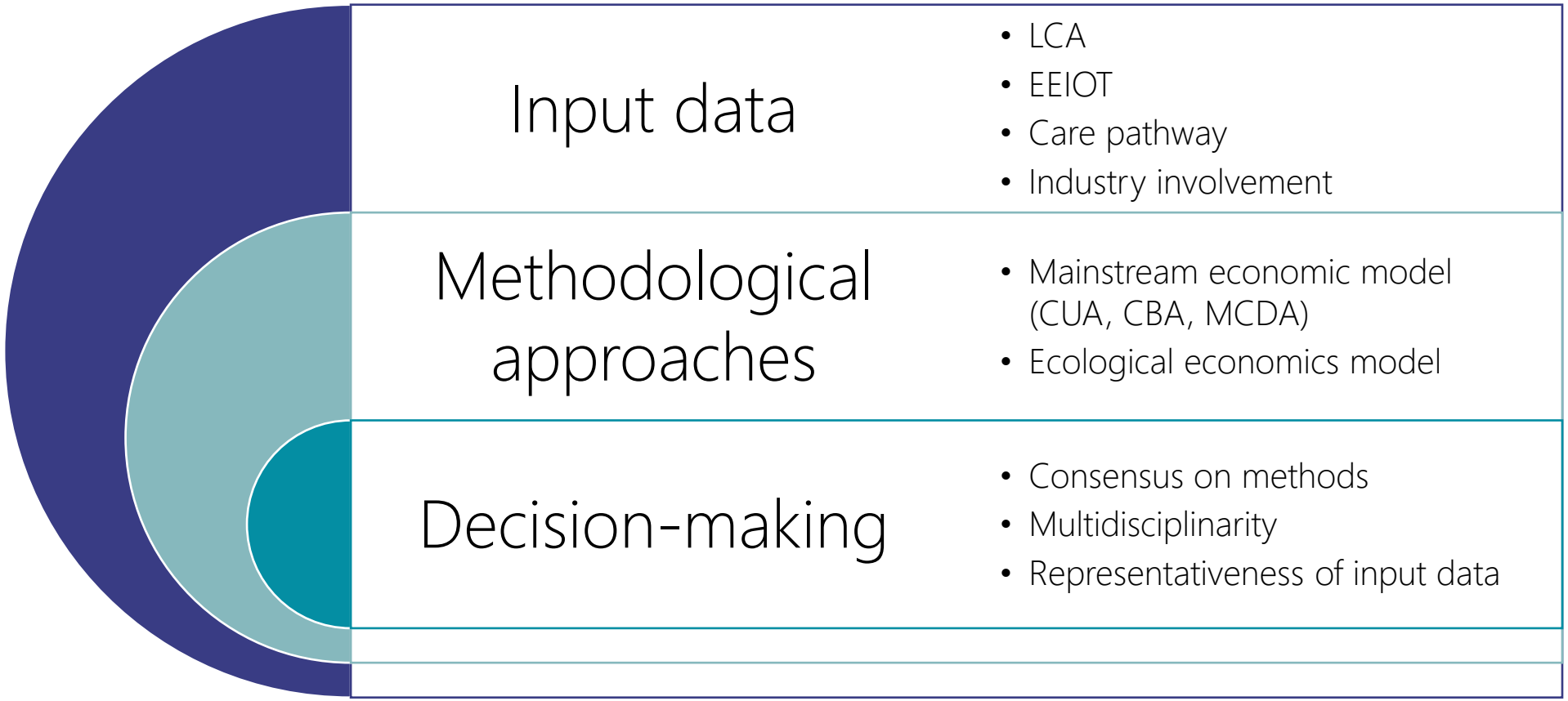
Preliminary results - challenges

CONT´ED



Based on: Guirado-Fuentes et al 2023

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Practical example (asthma inhalers)

CONT´ED

- *Long-term scenarios* (A: status quo, B: 2% switch/a, C:5% switch/a) of switching from ***metered-dose to powder-based inhalers***, incorporating assessment of Social Cost of Carbon (Kponee-Shovein et al 2022).
    - Over 50-year time horizon, scenario A results in 826 million tonnes of CO2e globally, scenario B and C lead to an emission **reduction of 38% and 58%, respectively**.
    - At the same time, under scenario B and C disability adjusted life years **improved by 33% and 51%.**
- Analysis of impact on greenhouse gas emissions of ***switching using dry powder inhalers vs metered-dose inhalers*** (containing harmful propellants), combining NHS prescription data with carbon footprint data on inhalers (Wilkinson et al 2019).
    - For every 10% of metered-dose inhalers changed to dry powder inhalers, **58kt CO2e/a can be saved**.

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Practical example (robotic surgery)

CONT´ED

- *Systematic review* on environmental impact (Papadopoulou A et al. BJS 2022), assessment of impact contributions according to Tool for Reduction and Assessment of Chemicals and Other environmental Impacts (TRACI), calculation of disability-adjusted life years following Bhobal/Norheim 2021. Key outcomes: DALYs averted per tonne of CO2/per tonne of waste
- Robotic procedures we*re linked up with 43.5% higher GHG emissions and up to 24% higher waste weight* than comparable laparoscopic alternatives (complex materials, e.g. robotic arms and disposable instruments account for 93%).
- Studies suggest that robotic surgery *has a lower DALYs averted per tonne of CO2e* – the increase in environmental impact is not sufficiently offset by clinical benefit (after incorporating environmental impact, laparoscopic performs favorably compared to robotic surgery).

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Practical example (obesity treatment)

- HTA incorporating the impacts of obesity-related treatment decisions on UK carbon emissions: use of cohort Markov model to track the emissions of the UK population after receiving one of two obesity treatments, semaglutide and bariatric surgery.
- ***Two new carbon measurement tools:***
  - *incremental carbon footprint effectiveness ratio* (ICFER) and
  - *incremental carbon footprint cost ratio* (ICFCR), possible to assess the emission impact of proposed health policies.
- *Both interventions below ICER of 20,000 GDP per QALY*
- ICFCR shows a reduction of *1.13–4.51 kgCO2e* for every pound spent on obesity treatment (Kindred et al 2024)
- But: rather crude assessment of CO2e for treatment options (173kg for b_sx, 252kg/a for semaglutide)

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Practical examples (Pinho-Gomes et al 2022)

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Study	Intervention	Incorporation of environmental dimension
Preux et al	In-center versus home hemodialysis	Adding carbon footprint to classical CEA
Ortsäter et al	RESPIMAT reusable vs RESPIMAT disposable	LCA accounting for the entire life cycle to estimate carbon emissions followed by social cost of carbon
Debaveye et al	Three modalities of treatment for schizophrenia	LCA to model the environmental impact of the supply chain, health benefits measured as DALYS and added to Markov model
Duane et al	Recycable tooothbrushes	LCA followed by CUA based on DALYs
Debaveye et al	Mass drug administration of mebendazole	Environmental impact measured using LCA and converted into DALYs
Jacob et al	Active traveling to school	CBA used to combine health and environmental effects (converting both in monetary terms)
Marsh et al	Addition of insulin to an oral antidiabetic regimen	HRQoL estimated using IMS CORE model. Costs of carbon calculated from NHS data based on budget data and CO2 emissions

Discussion

CO2e Emission data can be successfully used to estimate the environmental impact of technologies, including both direct effects (i.e., raw materials/waste/ emissions) and indirect effects, ideally through LCA.

Key challenges:

- lack of data on environmental impact other than for CO2 emissions
- CO2 emission data not being sufficiently disaggregated
- Methods need refinement and consensus

But:
field is emerging!

Thank you!