



Topic Brief: Healthcare Industry Waste

Date: 1/30/2023

Nomination Number: 1026

Purpose: This document summarizes the information addressing a nomination submitted on October 31, 2022, through the Effective Health Care Website. This information was used to inform the Evidence-based Practice Center (EPC) Program decisions about whether to produce an evidence report on the topic, and if so, what type of evidence report would be most suitable.

Issue: The healthcare industry in the United States contributes an estimated 10 percent of the national greenhouse gas emissions and the Secretary of Health and Human Services (HHS) has set a goal for reduction of emissions from the healthcare industry by 50 percent over the next eight years as a top priority. Representatives from the Agency for Healthcare Research and Quality (AHRQ) would like to identify ways to cut healthcare industry emissions without compromising care and would like a technical brief that maps out current work on lifecycle assessments (LCAs) in the healthcare industry as a starting point for this project.

[Link to nomination](#)

Findings: The EPC Program will develop a new technical brief based on this nomination. To sign up for notification when this and other Effective Health Care (EHC) Program topics are posted for public comment, please go to <https://effectivehealthcare.ahrq.gov/email-updates>.

Background

The global healthcare carbon footprint in 2019 was estimated to account for 4.4 percent of the world's total greenhouse gas emissions, and between 7.9 to 9.8 percent greenhouse gas emissions in the United States.¹ In April 2022, HHS and the White House issued a call to action for health care stakeholders to reduce emissions across the health care sector.²

Life Cycle Assessment is a tool to assess the resources used and potential environmental impacts of a good or service, from raw material acquisition through waste management.³ It examines both the energy it uses and the pollution it creates. The processes and impact indicators are evaluated to determine how to reduce environmental burdens.⁴ A technical brief on LCA of the healthcare industry in the United States could aid AHRQ in the first stages of identifying ways to reduce the carbon footprint of healthcare.

Scope

1. Frameworks for Life Cycle Assessment (LCA)
 - What LCA models or frameworks have been developed for healthcare?
 - What measures/indicators are used to inform these models?
 - What methods have been used or proposed?

- Which components of the models are thought to have the highest impact on carbon footprint?
 - What limitations of these models have been described?
2. Studies of LCA
 - Describe the available research and use of LCA models in healthcare
 - i. What topic areas have been studied and for what settings?
 - ii. What methods were used in the analysis?
 - iii. What data sources were used?
 - iv. What outcomes have been studied, and what were the findings?
 - v. What were cited limitations of the research?
 3. Gaps in the knowledge and future research needs
 - Are there models that have been planned and not yet implemented?
 - What are possible areas of future research?

Assessment Methods

See Appendix A.

Summary of Literature Findings

We found a variety of sources of evidence relevant to mapping out the landscape of LCAs in health care.

We found seven reviews of different methodologies and of different areas in health care. Three of these were focused on surgery,⁵⁻⁷ one on hospitals generally,⁸ and a group of three that covered health technology, health care products, and pharmaceuticals, respectively.⁹⁻¹¹

We also found 23 primary studies in a sample of 200 out of 634 records retrieved from Medline. Five of these focused on personal protective equipment (PPE),¹²⁻¹⁶ four on dentistry,¹⁷⁻²⁰ and three on healthcare generally.²¹⁻²³ The remainder focused on the following areas: anesthesia and critical care,²⁴ health technology assessment,²⁵ intravitreal injection,²⁶ medical oxygen,²⁷ medical waste disposal,²⁸ orthopedics,²⁹ pathology tests,³⁰ radiology,³¹ renal healthcare,³² respirators,³³ and surgery.³⁴ From a search of all output from EBSCO Host Greenfile, we found seven studies. Three of these were focused on healthcare broadly,³⁵⁻³⁷ one on small clinics,³⁸ one on blood pressure cuffs,³⁹ one on PPE,⁴⁰ and one on telehealth.⁴¹ We found an additional 30 studies from Healthcare LCA focused on the following domains: asthma,⁴² cardiology,⁴³ antibiotics,⁴⁴ general healthcare,^{45, 46} hospitals,^{47, 48} ophthalmology,^{49, 50} gynecology,⁵¹ urology,⁵² pathology testing,⁵³ sharps,⁵⁴ pharmaceuticals,⁵⁵ PPE,⁵⁶⁻⁶² regular and intensive care,⁶³ general healthcare,⁶⁴⁻⁶⁷ vaccination,⁶⁸⁻⁷⁰ and surgery.⁷¹⁻⁷⁶

See Appendix B for detailed assessments of all EPC selection criteria.

Summary of Selection Criteria Assessment

The healthcare industry in the United States contributes an estimated 10 percent of the national greenhouse gas emissions and the Secretary of HHS has set a goal for reduction of emissions from the healthcare industry by 50 percent over the next eight years as a top priority.

Representatives from AHRQ would like to identify ways to cut healthcare industry emissions without compromising care and request a technical brief that maps out current evidence on LCAs in the healthcare industry as a starting point for this project. We found seven reviews and sixty

primary studies on LCA in a variety of healthcare domains that could contribute to the development of a technical brief.

Please see Appendix B for detailed assessments of individual EPC Program selection criteria.

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Appendix A: Methods

We assessed nomination for priority for a systematic review or other AHRQ Effective Health Care report with a hierarchical process using established selection criteria. Assessment of each criteria determined the need to evaluate the next one. See Appendix B for detailed description of the criteria.

Appropriateness and Importance

We assessed the nomination for appropriateness and importance.

Desirability of New Review/Absence of Duplication

We searched for high-quality, completed or in-process evidence reviews published in the last three years January 12, 2020 - January 12, 2023, on the questions of the nomination from these sources:

- AHRQ: Evidence reports and technology assessments
 - AHRQ Evidence Reports <https://www.ahrq.gov/research/findings/evidence-based-reports/index.html>
 - EHC Program <https://effectivehealthcare.ahrq.gov/>
 - US Preventive Services Task Force <https://www.uspreventiveservicestaskforce.org/>
 - AHRQ Technology Assessment Program <https://www.ahrq.gov/research/findings/ta/index.html>
- US Department of Veterans Affairs Products publications
 - Evidence Synthesis Program <https://www.hsrp.research.va.gov/publications/esp/>
 - VA/Department of Defense Evidence-Based Clinical Practice Guideline Program <https://www.healthquality.va.gov/>
- Cochrane Systematic Reviews <https://www.cochranelibrary.com/>
- University of York Centre for Reviews and Dissemination database <https://www.crd.york.ac.uk/CRDWeb/>
- PROSPERO Database (international prospective register of systematic reviews and protocols) <http://www.crd.york.ac.uk/prospéro/>
- PubMed <https://www.ncbi.nlm.nih.gov/pubmed/>
- Campbell Collaboration <http://www.campbellcollaboration.org/>
- McMaster Health System Evidence <https://www.healthsystemevidence.org/>
- UBC Centre for Health Services and Policy Research <http://chspr.ubc.ca/>
- Joanna Briggs Institute <http://joannabriggs.org/>
- WHO Health Evidence Network <http://www.euro.who.int/en/data-and-evidence/evidence-informed-policy-making/health-evidence-network-hen>

Impact of a New Evidence Review

The impact of a new evidence review was qualitatively assessed by analyzing the current standard of care, the existence of potential knowledge gaps, and practice variation. We considered whether it was possible for this review to influence the current state of practice through various dissemination pathways (practice recommendation, clinical guidelines, etc.).

Feasibility of New Evidence Review

We conducted a limited literature search in PubMed for the last five years January 12, 2018 - January 12, 2023. We reviewed all studies identified titles and abstracts for inclusion.

Search strategy

Ovid MEDLINE ALL 1946 to January 12, 2023

Date searched: January 13, 2023

1 (ALCA or BLCA or CLCA or DLCA or ICLA or LCAM or LCSA or NLCA or OLCA or O-LCA or PLCA or SLCA or LCA or LCIA).ti. or ("ISO 14040" or ((lifecycle or life-cycle) adj3 (assess* or analy* or inventory or manag*))).ti,ab. (5337)

2 (correlation* or data or downstream or framework* or indicator\$1 or input or model* or measur* or method* or metric* or "neural network\$1" or output or Pearson\$2 or performance or principle\$1 or regression* or Spearman\$2 or standard* or test\$1 or upstream).ti,ab,kf. (15964225)

3 exp "Environment and Public Health"/ or exp "Health Care Economics and Organizations"/ or "Health Care Facilities, Manpower, and Services"/ or "Health Care Quality, Access, and Evaluation"/ or exp "Health Services Administration"/ (11868675)

4 (ambulator* or clinic\$1 or department\$1 or "health care" or "health service\$1" or "health system\$1" or healthcare or facilit* or hospital\$1 or medicine or medical or pharmacy or pharmacies or NHS or "HCA Healthcare" or "Universal Health Services" or "CommonSpirit Health" or "Encompass Health Corporation" or "Ascension Health" or "Select Medical Corporation" or "Trinity Health" or "Community Health Systems" or "Tenet Healthcare" or "ScionHealth").ti,ab,kf. (4670865)

5 exp "Anesthesia and Analgesia"/ or exp Dentistry/ or exp "Equipment and Supplies"/ or exp Health Occupations/ or exp Investigative Techniques/ or exp Surgical Procedures, Operative/ or exp Therapeutics/ (19820276)

6 (allerg* or "allied health" or anatom* or an?esthesiolog* or audiolog* or cardiolog* or chiropract* or coroner* or dermatolog* or doula* or dental or dentist* or EMTs or emergency or endocrinolog* or epidemiolog* or gastroenterolog* or geriatric* or gynecolog* or "health personnel" or hospital* or internist* or "intenal medicine" or nephrolog* or neurolog* or nurse* or nursing or nutritionist* or obstetric* or oncolog* or ophthalmolog* or optometr* or orthoped* or osteopath* or otolaryngolog* or patholog* or p?ediatri* or pharmacist* or physician* or practitioner* or provider* or psychiatr* or psycholog* or pulmonolog* or radiolog* or residential or rheumatolog* or surger* or surgical or surgeon* or therapist* or toxicolog* or urolog*).ti,ab,kf. (7973693)

7 or/3-6 (24614931)

8 and/1-2,7 (3313)

9 8 not ((exp Animals/ not Humans/) or (animal model* or agri* or agro* or apartment* or asphalt or bio* or bitch\$2 or bovine or canine or capra or cat or cats or cattle or cement or city or cities or concrete or cow\$1 or dog\$1 or domestic or equine or ewe\$1 or feline or goat\$1 or hamster\$1 or horse\$1 or industrial or industry or invertebrate\$1 or livestock or macaque\$1 or maize or manure or mare\$1 or mice or monkey\$1 or mouse or municipal or murine or nonhuman or non-human or ovine or pig or pigs or porcine or pork or primate\$1 or province or rabbit\$1 or rat\$1 or rattus or residential or rhesus or rice or rodent* or sheep or simian or sludge or sow\$1 or urban or vertebrate\$1 or wheat or wood or zebrafish).ti.) (1949)

10 limit 9 to english language (1912)

11 Limit 10 to yr="2008 -Current" (1697)

12 (meta-analysis or systematic review).pt. or (meta-anal* or metaanal* or ((evidence or review or scoping or systematic or umbrella) adj3 (review or synthesis))).ti. (797048)

13 and/11-12 (93)

EBSCOHost Greenfile

Date searched: January 12, 2023

S1 TI (((ALCA or BLCA or CLCA or DLCA or ICLA or LCAM or LCSA or NLCA or OLCA or O-LCA or PLCA or SLCA or LCA or LCIA) or ("ISO 14040" or ((lifecycle or life-cycle) N3 (assess* or analy* or inventory or manag*)))) OR AB (((lifecycle or life-cycle) N3 (assess* or analy* or inventory or manag*))) (5,819)

S2 TI ((correlation* or data or downstream or framework* or indicator* or input or model* or measur* or method* or metric* or "neural network" or "neural networks" or output or Pearson* or performance or principle* or regression* or Spearman* or standard* or test or tests or upstream)) OR AB ((correlation* or data or downstream or framework* or indicator* or input or model* or measur* or method* or metric* or "neural network" or "neural networks" or output or Pearson* or performance or principle* or regression* or Spearman* or standard* or test or tests or upstream)) (575,363)

S3 TI ((ambulator* or building* or clinic* or department* or "health care" or "health service" or "health services" or "health system" or "health systems" or healthcare or facilit* or hospital or hospitals or medicine or medical or pharmacy or pharmacies or NHS or "HCA Healthcare" or "Universal Health Services" or "CommonSpirit Health" or "Encompass Health Corporation" or "Ascension Health" or "Select Medical Corporation" or "Trinity Health" or "Community Health Systems" or "Tenet Healthcare" or "ScionHealth")) OR AB ((ambulator* or building* or clinic* or department* or "health care" or "health service" or "health services" or "health system" or "health systems" or healthcare or facilit* or hospital or hospitals or medicine or medical or pharmacy or pharmacies or NHS or "HCA Healthcare" or "Universal Health Services" or "CommonSpirit Health" or "Encompass Health Corporation" or "Ascension Health" or "Select Medical Corporation" or "Trinity Health" or "Community Health Systems" or "Tenet Healthcare" or "ScionHealth")) (107,842)

S4 TI ((allerg* or "allied health" or anatom* or anesthesiolog* or anaesthesiolog* or audiolog* or cardiolog* or chiropract* or coroner* or dermatolog* or doula* or dental or dentist* or EMTs or emergency or endocrinolog* or epidemiolog* or gastroenterolog* or geriatric* or gynecolog* or "health personnel" or hospital* or internist* or "intenal medicine" or nephrolog* or neurolog* or nurse* or nursing or nutritionist* or obstetric* or oncolog* or ophthalmolog* or optometr* or orthoped* or osteopath* or otolaryngolog* or patholog* or paediatr* or pediater* or pharmacist* or physician* or practitioner* or provider* or psychiatr* or psycholog* or pulmonolog* or radiolog* or residential or rheumatolog* or surger* or surgical or surgeon* or therapist* or toxicolog* or urolog*)) OR AB ((allerg* or "allied health" or anatom* or anesthesiolog* or anaesthesiolog* or audiolog* or cardiolog* or chiropract* or coroner* or dermatolog* or doula* or dental or dentist* or EMTs or emergency or endocrinolog* or epidemiolog* or gastroenterolog* or geriatric* or gynecolog* or "health personnel" or hospital* or internist* or "intenal medicine" or nephrolog* or neurolog* or nurse* or nursing or nutritionist* or obstetric* or oncolog* or ophthalmolog* or optometr* or orthoped* or osteopath* or otolaryngolog* or patholog* or paediatr* or pediater* or pharmacist* or physician* or practitioner* or provider* or psychiatr* or psycholog* or pulmonolog* or radiolog* or residential or rheumatolog* or surger* or surgical or surgeon* or therapist* or toxicolog* or urolog*)) (49,827)

S5 S3 OR S4 (147,014)

S6 S1 AND S2 AND S5 (1,038)

S7 TI ((animal model* or agri* or agro* or apartment* or asphalt or bio* or bitch\$2 or bovine or canine or capra or cat or cats or cattle or cement or city or cities or concrete or cow\$1 or dog\$1 or domestic or equine or ewe\$1 or feline or goat\$1 or hamster\$1 or horse\$1 or industrial or industry or invertebrate\$1 or livestock or macaque\$1 or maize or manure or mare\$1 or mice or

monkey\$1 or mouse or municipal or murine or nonhuman or non-human or ovine or pig or pigs or porcine or pork or primate\$1 or province or rabbit\$1 or rat\$1 or rattus or residential or rhesus or rice or rodent* or sheep or simian or sludge or sow\$1 or urban or vertebrate\$1 or wheat or wood or zebrafish)) (234,058)

S8 S6 NOT S7 Limiters - Publication Date: 20080101-20230131 (550)

Topic-specific resources:

HealthcareLCA | Data driven sustainable health care

- Background: HealthcareLCA | Data driven sustainable health care
- Measuring Healthcare pollution About (healthcarelca.com)
- Charts: Charts (healthcarelca.com)
- Articles/Data sources: (search page > data sources tab) HealthcareLCA database
- Their preferred citation: Drew J & Rizan C. (2022). HealthcareLCA Database [Online Database]. HealthcareLCA. Retrieved from: healthcarelca.com/database.

Value

We assessed the nomination for value. We considered whether or not the clinical, consumer, or policymaking context had the potential to respond with evidence-based change, if a partner organization would use this evidence review to influence practice, and if the topic supports a priority area of AHRQ or the Department of Health and Human Services.

Appendix B. Selection Criteria Assessment

Selection Criteria	Assessment
1. Appropriateness	
1a. Does the nomination represent a health care drug, intervention, device, technology, or health care system/setting available (or soon to be available) in the United States?	Yes.
1b. Is the nomination a request for an evidence report?	Yes.
1c. Is the focus on effectiveness or comparative effectiveness?	No.
1d. Is the nomination focus supported by a logic model or biologic plausibility? Is it consistent or coherent with what is known about the topic?	Yes.
2. Importance	
2a. Represents a significant disease burden; large proportion of the population	The global healthcare carbon footprint in 2019 was estimated to account for 4.4 percent of the world's total greenhouse gas emissions, and between 7.9 to 9.8 percent greenhouse gas emissions in the United States. ¹
2b. Is of high public interest; affects health care decision making, outcomes, or costs for a large proportion of the United States population or for a vulnerable population	The global healthcare carbon footprint in 2019 was estimated to account for 4.4 percent of the world's total greenhouse gas emissions, and between 7.9 to 9.8 percent greenhouse gas emissions in the United States. ¹
2c. Incorporates issues around both clinical benefits and potential clinical harms	Not applicable.
2d. Represents high costs due to common use, high unit costs, or high associated costs to consumers, to patients, to health care systems, or to payers	Yes. There is a great impact or 'cost' to the health of the planet. The global healthcare carbon footprint in 2019 was estimated to account for 4.4 percent of the world's total greenhouse gas emissions, and between 7.9 to 9.8 percent greenhouse gas emissions in the United States. ¹
3. Desirability of a New Evidence Review/Absence of Duplication	
3. A recent high-quality systematic review or other evidence review is not available on this topic	We found seven relevant reviews of various types. However no one review covered the entire scope of the nomination. These reviews could be incorporated into a technical brief.
4. Impact of a New Evidence Review	
4a. Is the standard of care unclear (guidelines not available or guidelines inconsistent, indicating an information gap that may be addressed by a new evidence review)?	There are no guidelines on this issue. The secretary of HHS has set the reduction of emissions from the healthcare industry by 50 percent over the next eight years as a top priority. Representatives from AHRQ want to identify ways to cut healthcare industry emissions without compromising care and request a technical brief that maps out current work on the LCA in the healthcare industry as a starting point for this project.
4b. Is there practice variation (guideline inconsistent with current practice, indicating a potential implementation gap and not best addressed by a new evidence review)?	There are no standard practices on this issue. The secretary of HHS has set the reduction of emissions from the healthcare industry by 50% over the next eight years as a top priority. Representatives from AHRQ want to identify ways to cut healthcare industry emissions without compromising care and have requested a

	technical brief that maps out current work on the LCA in the healthcare industry as a starting point for this project.
5. Primary Research	
5. Effectively utilizes existing research and knowledge by considering: - Adequacy (type and volume) of research for conducting a systematic review - Newly available evidence (particularly for updates or new technologies)	Medline: 23 primary studies in a sample of 200 out of 634 studies. EBSCO Host GreenFILE: 7 primary studies. Healthcare LCA: 30 studies.
6. Value	
6a. The proposed topic exists within a clinical, consumer, or policy-making context that is amenable to evidence-based change and supports a priority of AHRQ or Department of Health and Human Services	Yes. This topic was nominated by AHRQ and supports the organization's focus on climate change and healthcare research.
6b. Identified partner who will use the systematic review to influence practice (such as a guideline or recommendation)	Yes. Representatives from AHRQ would like to identify ways to cut healthcare industry emissions without compromising care and would like a technical brief that maps out current work on the LCA in the healthcare industry as a starting point for this project.

Abbreviations: AHRQ=Agency for Healthcare Research and Quality; HHS= Health and Human Services; LCA=life cycle assessment.