



Measuring environmentally sustainable health care: a scoping review

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Work to reduce environmental pollution from the health system is hampered by an absence of consensus on the definition of environmentally sustainable health care and the relevant measurement needed. This scoping review aims to encourage standardisation across sustainability efforts by examining how environmentally sustainable health care is defined and measured in current literature. We conducted a scoping review to identify candidate publications that included either a definition or description of environmentally sustainable health care or a measurement of the impact of health care on the environment. 328 publications were included in the final analysis. 52 publications included definitions or descriptions of environmentally sustainable health care. Results of the study highlight the heterogeneity in the current definition, measurement, and measurement calculation methods of environmentally sustainable health care in published literature. Work is needed to create more harmonised definitions and measurement to support progress and reduce environmental pollution from health care.

Introduction

Health-care systems globally have a substantial role in generating greenhouse gases and other pollutants that have direct and indirect impacts on human and planetary health.¹⁻⁴ Recognising this role, many health-care systems have committed to reducing pollution and are taking steps towards environmental sustainability. As of June, 2024, 84 countries across all income levels have pledged to develop health systems that are resilient to climate change and have low carbon footprints.⁵ In March, 2023, over 100 health organisations in the USA endorsed a climate pledge aiming to achieve net-zero emissions by 2050.⁶ Similar initiatives and pledges are also being signed across Europe.^{7,8}

Although these pledges mark important strides in addressing pollution related to health care, efforts in this area remain fragmented and are not guided by standardised definitions and measurements. For example, measurements of greenhouse gas emissions in health care can be estimated using a wide range of techniques and approaches that might not be comparable with one another.^{9,10} Practice Greenhealth, a fee-based hospital membership organisation dedicated to health-care sustainability advocacy, publishes the only annual benchmarking report for US hospital members, on a range of environmental sustainability measures.¹¹ However, the report is limited to paying members who choose to voluntarily submit data. Without rigorous, standardised tools, decision makers might find themselves uncertain about which interventions to pursue or might be missing evidence regarding the effectiveness of implemented changes.

Various nascent national and international reporting schemes for sustainability in health care exist, but none has yet produced standardised, understandable, actionable, and comparable metrics.^{12,13} To guide and facilitate progress on this topic, a clear operational definition of environmentally sustainable health care is needed, as well as robust, comparable, and timely

measurements, to support the most effective policies, measure progress, and benchmark success.¹⁴⁻¹⁶

This scoping review aims to contribute to the development of standard definitions and measurement of environmentally sustainable health care by addressing the following questions: how is environmentally sustainable health care defined in the existing literature? Which environmental impacts of health care are measured and at what levels of analysis? Which measures are used? What are the underlying data sources? Which measurement techniques are applied?

Methods

Search strategy and selection criteria

The following electronic databases were searched on Feb 23, 2023: PubMed, Embase, Web of Science Core Collection, and Google Scholar. Articles were identified by the presence of specific search terms in either the titles or abstracts. Search terms used were “health care system”, “health system”, “health care”, “healthcare”, “health sector”, “environmental footprint”, “environmental sustainability”, “environmental impact”, “climate change”, “carbon footprint”, “carbon emission”, “greenhouse gas”, “energy use”. Articles were limited to those published between January, 2010, and Feb 23, 2023, and written in English.

The search strategy was devised for use in MEDLINE (accessed via PubMed) and adapted for other databases. The search in Google Scholar was restricted to the first 20 hits per search to limit irrelevant results.

Inclusion criteria were that publications had to include either a definition or description of environmentally sustainable health care, a measurement of the impact of health care on the environment, or both. Exclusion criteria included a focus on the health impacts of the environment, the adaptation of health care in response to climate change, or environment and health educational efforts.

All study types were eligible for inclusion, including research articles, reviews, editorials, and opinion pieces.

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For more on inconsistent
techniques and approaches
used to measure greenhouse
gas emissions in health care see
<https://ielab.info/> and
<https://ghgprotocol.org/>

For more on
Practice Greenhealth see
<https://practicegreenhealth.org/>

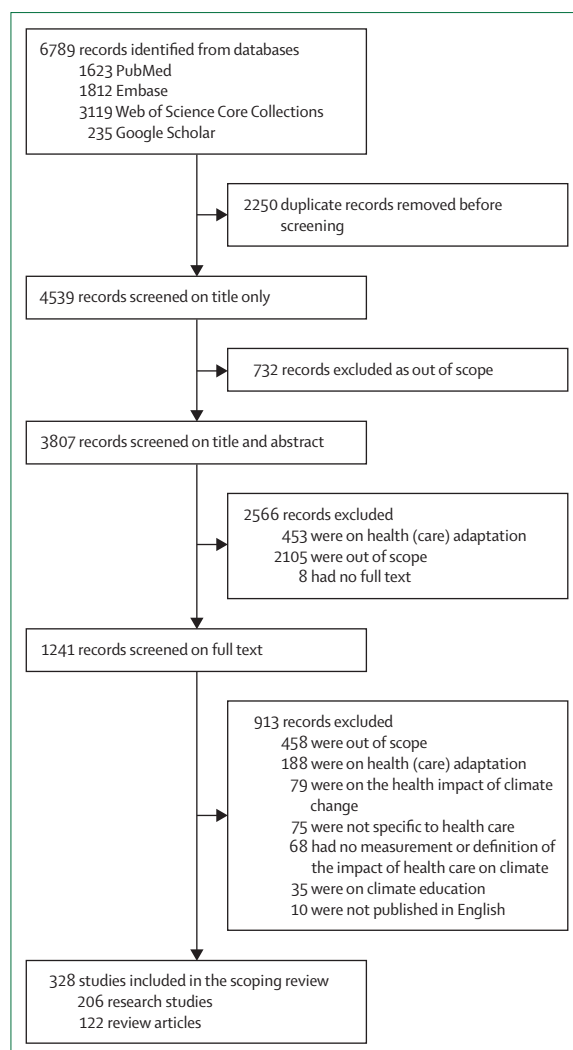


Figure 1: Scoping review PRISMA flowchart

Results from grey literature were also eligible for inclusion if they met the aforementioned criteria, were retrieved from our search strategy, and were accessible (ie, able to be viewed without payment or other barriers to access).

Methods of screening and selection criteria

To select publications for inclusion in this scoping review, the PRISMA Extension For Scoping Reviews was followed.¹⁷ The procedure is depicted in the PRISMA flow diagram (figure 1).

In the first step, search result titles were screened by one researcher (MP, AD, DK, GM, or IB) for inclusion. To avoid removing relevant articles, investigators sought to remove only articles clearly out of scope during this initial review. Next, a screening of titles and abstracts was conducted by two reviewers (two of MP, AD, DK, GM, and IB) independently. Finally, after title and abstract screening, the full texts of the resultant studies were assessed for inclusion by two reviewers independently (two of MP, AD,

DK, GM, and IB). Any discrepancies between reviewers during either the title and abstract or the full text screening were discussed among reviewers and resolved by a third reviewer if necessary (MP, AD, DK, GM, or IB).

Data extraction

The following information was extracted for all studies: author, title, year of publication, journal, presentation of original research (yes or no), the definition or description of environmentally sustainable health care, and the medical specialty or the type of care on which the research focused. Data on the medical specialty and care context were further grouped into four categories: perioperative care and surgical care, procedural care, specialty-based care, and care provided in other settings. The definitions or descriptions of environmentally sustainable health care were evaluated for thematic and keyword focus and the source of the definition (eg, WHO) or description was recorded.

For articles presenting original research, the following data were extracted: sustainability measures reported, the health system level to which measures apply (eg, greenhouse gas estimates of a hospital's activity are categorised as hospital level), the impact category to which measures belonged (eg, greenhouse gases or solid waste), the measured data sources, and the measure calculation methods. Many studies included multiple measures and multiple corresponding impact categories. Possible values for selected variables can be seen in the panel. Table 1 provides an example data extraction. Additional information, definitions, and examples of extracted data, including the generation of impact categories, medical specialty classifications, and other variables, are available in the appendix (pp 1–7). Tables including all articles and extracted data are available in the appendix (pp 8–49).

Each measure reported by a publication was assigned to an impact category. Impact categories were determined during data extraction (ie, as individual measures were extracted they were classified into novel or existing impact categories). If more than one measure was assigned to the same impact category for a single publication, only one impact category was generated for counting purposes. For example, an article reporting two measures of carbon dioxide equivalent emissions and one measure of waste produced by a hospital would generate one occurrence of the greenhouse gases impact category with two associated measures and one occurrence of the solid waste impact category with a single associated measure. Only the measures reported in the study were included in the measures category. Data used as an input to reported measures were assigned to the data sources category (rather than the impact category) even if these inputs might be considered measures of environmental impact themselves.

For each impact category identified, corresponding data sources and methods were determined based on data reported in the publication.

Panel: Selected data extraction categories and response options**System level**

- Global
- National
- Regional or local
- Specific-programme
- Hospital
- Other facility types
- Procedural
- Service or department
- Product or device

Impact categories

- Air pollution
- Energy use
- Greenhouse gases
- Recycling
- Resources consumed
- Solid waste
- Travel
- Varied environmental impacts*
- Water use

Data source†

- Conversion database
- Demographic data
- Input-output database
- Maps

- National and subnational databases
- Public spending data
- Published literature
- Administrative data
- Patient records
- Direct observation
- Expert knowledge
- Interviews
- Assumptions
- Survey
- Manufacturer data
- Lifecycle inventory database

Methods‡

- NA
- Simple calculations
- Multistep calculations
- Conversion calculations
- Lifecycle assessment calculations (process based)
- Lifecycle assessment calculations (input-output based)
- Lifecycle assessment calculations (hybrid)
- Mapping
- Modelling

Definitions and examples for data categories and response options can be found in appendix pp 1–7. NA=not applicable. *Environmental impacts not already included in other categories, such as nitrogen equivalent emissions; further examples are available in appendix p 5. †Source of data used to calculate measures. ‡The calculation methods used to transform raw data from the data source into reported measures.

As the goal of data extraction was to identify definitions and measures of environmental sustainability, rather than assess the quality of the measurement results themselves, we did not assess article quality.

Results

A total of 328 publications were included in our analysis. Of these, 206 presented original research, whereas 122 were opinion or review articles. Four articles from the grey literature were retained. One publication from National Health Service England and one publication from the Dutch National Institute for Public Health and the Environment were included in the original research category;^{7,18} one publication from WHO and one publication from the Commonwealth Fund were included in the review article category.^{19,20}

152 publications focused on a specific medical specialty or specific care context (104 research articles and 48 review articles). The most common category was specialty care (n=101), among which nephrology (n=21), anaesthesiology (n=14), and dentistry (n=12) were the most reported specialties. 39 articles reported on perioperative care, with those focused on surgery being the most common (n=10). 12 articles focused on other care contexts and three on procedural care.

Definitions of environmentally sustainable health care

52 publications included definitions or descriptions of environmentally sustainable health care. A full list is available in the appendix (pp 50–56). Of these publications, 17 referenced existing definitions either explicitly or implicitly, including 14 that referred to a definition from Our Common Future (often referred to as the Brundtland report).²¹ Five studies cited definitions or reports from WHO.^{22–26}

Two publications included original definitions or descriptions. McGain and colleagues defined environmentally sustainable health care as care that “encompasses emissions to air, water, and soil, enables holistic environmentally preferable choices, and addresses efficient use of natural resources towards a circular economy”,²⁷ whereas Kaplan and Forst described it as encompassing “leaner energy, less waste, safer chemicals, smarter purchasing, healthier food, and engaged leadership”.²⁸

The most common themes identified in these definitions and descriptions included: the environment (n=26); health (including public, environmental, planetary, clinical, and social health; n=22); economics and cost (including health-care spending, environmental economics, and circular economy; n=16); carbon emissions (n=14); impact on future generations (n=14);

	Title	Year	Journal	Review or research	Definition of environmentally sustainable health care	Medical specialty	Level	Impact categories	Measures
Imran Abdullah et al	Energy performance contracting initiative in Malaysian public hospitals	2020	International Journal of Integrated Engineering	Research	NA	NA	Hospital	Greenhouse gases and energy use	Greenhouse gas was measured in tonnes CO ₂ e/year using administrative data and conversion calculation methods; data on greenhouse gases were also sourced by direct observation, interviews, and conversion database; energy use was measured in kWh/year and kWh/m ² per year using administrative data
See appendix (pp 8–42) for full list of measures reported. NA=not applicable.									
Table 1: Example data extraction of a research article									

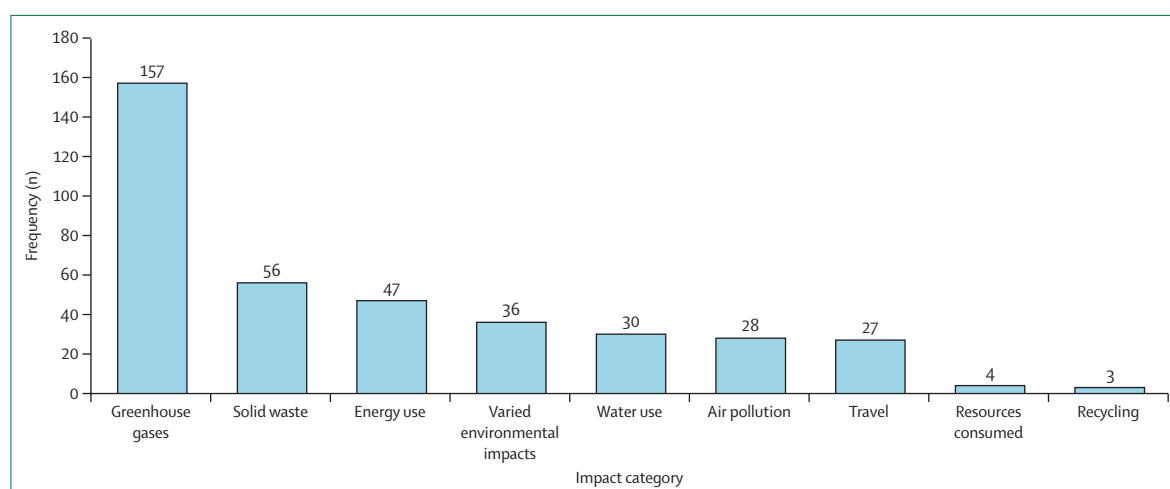


Figure 2: Frequency of impact categories among research articles

resources (including use and preservation of natural resources, resource consumption, and goods and services; n=12); and wellbeing (n=11).

Impact categories

Across all 206 original research articles, nine impact categories were identified. The category with the most occurrences was greenhouse gases (157 occurrences), followed by solid waste (56), energy use (47), varied environmental impacts including those not already included in other categories (36), water use (30), air pollution (28), travel (27), resources consumed (four), and recycling (three; figure 2). More information on these categories is available in the appendix (pp 5,8–42).

Impact categories by system level

The frequency of impact categories varied substantially between health system levels. 83 impact categories were identified at the product or device level, whereas nine were identified at the global level (figure 3). Greenhouse gases were investigated across all system levels and this impact category was the most common in nine of ten system levels. The solid waste impact category was identified at all system levels, except for the specific-programme level, and was the second most

frequently identified category in five of ten system levels.

Measures reported

Frequently reported measures were identified in three of the impact categories (table 2). Carbon dioxide equivalent was the most commonly reported greenhouse gas measure, representing 90% of all greenhouse gas measures. Weight of waste was the most common solid waste measure (89% of all waste measures), and kWh was the most commonly reported energy measure (80% of all energy measures). The most frequently reported air pollution measure was weight of trichlorofluoromethane, representing 27% of all air pollution measures. No measure in the varied environmental impact category represented more than 10% of the total measures reported in this category.

In addition to measures reporting outcomes, four articles also reported structural or process-type measures associated with environmental outcomes that were not included in our impact categories.^{29–32}

Measure denominators

Among the most frequently reported measures, time was the most common denominator (eg, year, day, observation period) across all impact categories when reported at the

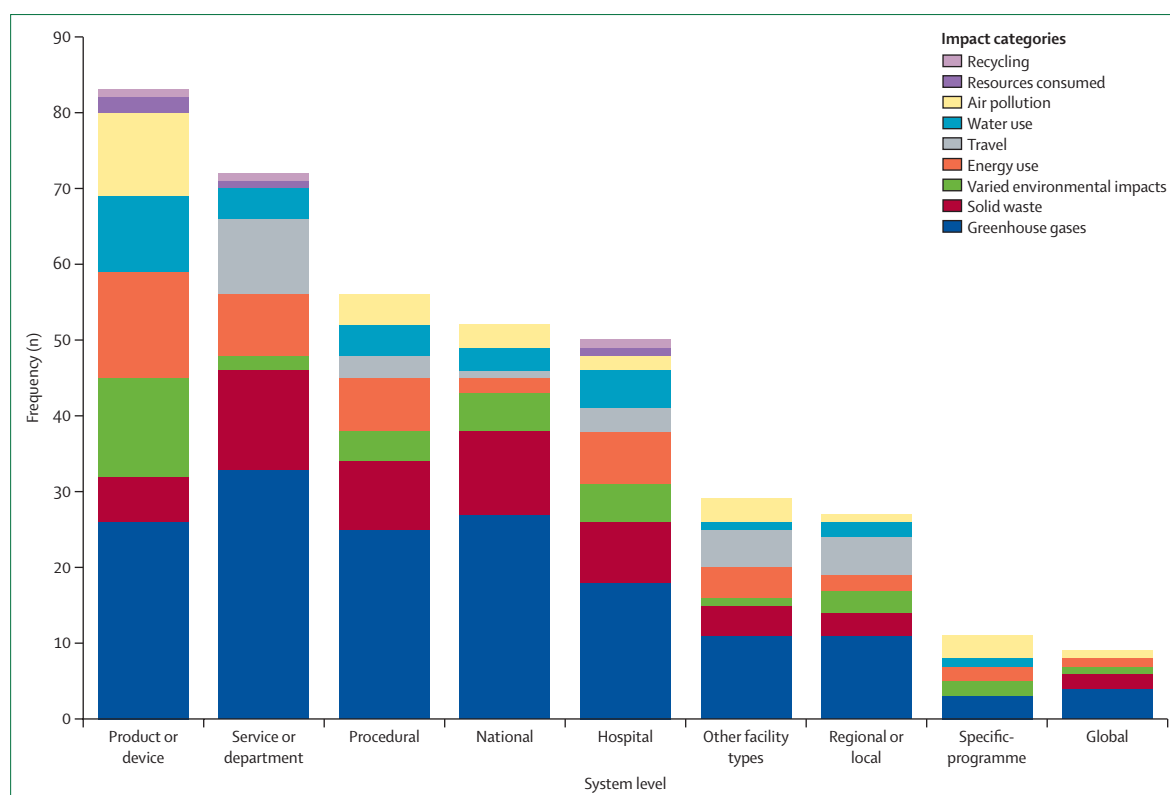


Figure 3: Frequency of impact categories by system level

hospital, other facility, specific services, and system levels. For measures reported at the procedure level, the procedure was the most commonly reported denominator (eg, the water use in nephrology could be expressed as gallons of water or haemodialysis treatment [procedure] as opposed to water use of the nephrology unit).

Data sources and calculation methods

The nine impact categories were identified a total of 392 times among research articles. Of these, 179 (46%) occurrences used the same combination of data sources and calculation methods as at least one other occurrence in the same impact category. The remaining 213 (54%) occurrences used data source and calculation method combinations unique to their study. The frequency of calculation methods and data sources by impact category are presented in table 3.

Of the 157 occurrences of the greenhouse gas category, the most common calculation method was conversion calculation, with 72 (46%) studies using this technique. 45 (29%) occurrences used process-based lifecycle assessment (LCA) calculations and 21 (13%) used input-output-based LCAs or a hybrid LCA that used both process-based and input-output-based approaches.

Simple or no calculations were the most common calculation method among the 56 occurrences of solid waste, the 40 occurrences of energy use, and the

26 occurrences of travel impact categories. Process-based LCA calculations were the most common calculation methods for the varied environmental impacts, water use, and air pollution categories.

Across all impact categories, process-based LCAs were used 132 times. 62 (47%) uses were for measures corresponding to the product or device level. 22 (17%) of these uses corresponded to the procedural level, 15 (11%) to the hospital level, nine (7%) to the service or department level, nine (7%) to the specific-programme level, six (5%) national level, five (4%) to the regional or local level, and four (3%) to the other facility type level. System levels corresponding to measurements generated using input-output-based LCAs included the national level (nine occurrences), the global and regional levels (three occurrences each), and the procedural and service or department levels (one occurrence each). Measures using hybrid LCA procedures corresponded to the national level on nine occurrences, the service or department level on three occurrences, and the procedure level on one occurrence.

Discussion

Our scoping review highlighted the heterogeneity in the definition and measurements of environmentally sustainable health care in published literature. This absence of standardisation is an important impediment

	Total number of measures reported	Most common measures (% of total reported)	Other measure examples
Greenhouse gases	269	Weight (eg, g, kg, tonnes) of CO ₂ equivalent (90%)	Volume of specific anaesthetic gases
Waste	97	Weight (eg, g, kg, tonnes) of type of waste (89%)	Percentage of materials disposed of (as opposed to recycled, reprocessed, or reused)
Air pollution	74	Weight (eg, g, kg, tonnes) of trichlorofluoromethane equivalent (27%)	Smoke density
Energy use	70	Amount of energy (kWh, megajoules; 80%)	Litres of oil

Table 2: Common and divergent measures for common impact categories

to creating a common approach necessary to guide progress through shared goals, methods, and learning.

Definitions of environmentally sustainable health care

Under 20% of all included publications provided a definition or description of environmentally sustainable health care. Of these, under half of the publications referenced existing definitions, with many citing general definitions of environmental sustainability, such as one from Our Common Future that defines sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs”.²¹ Other definitions focused on specific environmental impacts of the health sector, such as the production of greenhouse gases. This diversity of definitions is not unique to health care and can lead to a corresponding diversity of management approaches.³³

General definitions of sustainability, including those from organisations, such as WHO, might not have the specificity necessary for non-experts in the health field to operationalise them through measurement, interventions, and goals. One description of environmentally sustainable health care that corresponds directly to operational goals came from the Dutch Green Deal Sustainable Care initiative to improve the sustainability of the health-care sector; the initiative focused on reduced carbon emissions, stimulation of circular practices, creation of a health-enhancing environment, and reduced medicine residues in surface water and groundwater.¹⁸ Wider adoption of a definition clearly aligned with specific goals and the actions necessary to improve sustainability might be useful to guide work in this area.

Along with more precise and more easily operationalisable elements that refer to specific types of environmental impacts, a useful definition of environmentally sustainable health care might also include the concept of health. Over 40% of all definitions and discussions in the reviewed manuscripts referred to health. The incorporation of this idea into a common definition, and with links to specific environmental impacts, could provide additional justification for environmental work in the health sector.

Accounting for existing health system priorities is an important aspect of promoting environmental

sustainability goals.³⁴ *The Lancet Commission on Sustainable Health Care* provides a definition of sustainable health-care systems that focuses on optimising care for patients while maintaining other system goals, including sustainability.³⁵ A general definition might also make conceptual links to the more traditional concept of (economic) sustainability to leverage existing efforts in this area, such as reduction of low-value care that can have both financial and environmental benefits.

Reported measures and impact categories

Our scoping review showed frequent reporting of greenhouse gas measures. This focus on greenhouse gases is also reflected in common environmental goals in the health sector and elsewhere that focus on net zero carbon emissions or other carbon emission reduction goals.^{5–7} In contrast, reported definitions of environmental sustainability generally focused on a wide range of elements and only one in four definitions specifically mentioned greenhouse gases. The focus of measures and goals on carbon emissions might lead some systems to overlook other important aspects of environmental sustainability, such as resource use, which can have additional environmental impacts in addition to carbon emissions, and other types of pollution, including air, water, or others. Organisations working on health-care sustainability have used a wide range of measurement categories, including leadership, waste, chemicals, food, the operating room, transportation, purchasing, energy, water, buildings, and climate.^{7,12,36} Considering a wider range of environmental impacts might help health systems to better manage their total environmental footprint.

The frequencies of impact categories were heterogeneous across system levels, with the highest frequency of impact categories identified at the product or device, service or department, and procedure levels. The increased frequencies at these levels might reflect data availability or the interests and perspectives of the researchers conducting the study.

Heterogeneity of impact categories across study levels is not necessarily a weakness, so long as measurement can appropriately inform policy action. If water reduction strategies, for example, are most effective at the hospital

level, then focusing on water measurement at this level is appropriate. Some goals might require multiple levels of action and thus multiple levels of measurements would be needed. An analysis of the levels and targets of currently used and proposed environmental policy action might be useful in shaping future measurement goals. Different policies might also require different types and quantities of data, necessitating different methods. Decarbonisation strategies on a system-wide level might require a single system-wide carbon emission study using an input–output-based LCA, whereas decisions on a product level might need very precise comparative data across a wide variety of products, using process-based LCA studies.

Reported measures showed relative homogeneity within the greenhouse gas, waste, and energy use categories, indicating some consensus around measurement and reporting in these categories. However, most of these measures were not normalised, preventing comparison across contexts or studies. Comparability might benefit from identifying standard denominators by level, with a focus on patient-oriented or service-output metrics. At the hospital level, for example, results might be normalised by hospital beds, patient-days, adjusted patient-days, or, if necessary, square feet, or some financial measure, depending on measurement type. Additional work is needed to expand previous efforts to identify and build consensus on normalisation techniques.¹²

Comparability of measures was hindered in some cases by the heterogeneity of data sources and calculation approaches. Of the 157 studies reporting greenhouse gases, there were 102 (65%) unique combinations of calculation methods and data sources. Although heterogeneity is expected and even necessary across contexts, measurement levels, and policy objectives, strong heterogeneity, even among similar impact categories at the same level, hindered comparability. Along with a consensus about which measures are relevant to report, work is also needed to standardise calculation methods and data sources.

A very small number of studies reported structural or process measures, such as the presence of environmental sustainability-related protocols. These types of measures are generally easier to collect and compare across settings and can be useful in supporting implementation science research. However, the links between structural measures and desired outcomes are often indirect. Additional development and validation of these measures, linking them to important outcomes, might facilitate reporting in some cases.

Measurement methods

Across all impact categories, LCA was the most used method. LCA studies provide a holistic environmental assessment of a process, product, or service, including impacts from across the lifecycle, and produce

	Frequency of calculation method	Number of unique data source combinations by calculation method	Common data sources by calculation method
Greenhouse gases (n=157)			
Conversion calculations	72	41	Conversion database, administrative data, direct observation, published literature
Process-based LCA	45	27	LCI database, direct observation, manufacturer data, administrative data
Input-output-based LCA or hybrid LCA	21	18	National and subnational databases, input–output database
Solid waste (n=56)			
Simple or no calculations	40	19	Direct observation, administrative data
Modelling	7	5	Published literature
Energy use (n=47)			
Simple or no calculations	22	13	Administrative data, direct observation
Process-based LCA	19	14	Manufacturer data, direct observation, LCI database
Varied environmental impacts (n=36)			
Process-based LCA	27	20	Manufacturer data, direct observation, LCI database, administrative data
Water use (n=30)			
Process-based LCA	16	12	Direct observation, manufacturer data, LCI database
Simple or no calculations	10	7	Direct observation, administrative data
Air pollution (n=28)			
Process-based LCA	21	15	Direct observation, manufacturer data, LCI database, administrative data
Travel (n=26)			
Simple or no calculations	17	19	Survey data, patient records, maps
Mapping	6	3	Maps
Impact categories are presented with total frequency. See appendix (pp 8–42) for a full list of calculation methods and data sources reported. LCA=lifecycle assessment. LCI=lifecycle inventory.			
Table 3: Calculation methods and data sources for common impact categories			

environmental impact measures that are not regularly reported outside of studies of this type, such as the amount of 1,4-dichlorobenzene equivalent (ecotoxicity) or particulate matter produced. Although this approach is useful for assessing total environmental impacts, LCA techniques require a high level of specific expertise and can be time-consuming to conduct. A simplified, standardised LCA option might be one way of making this technique more accessible.³⁷

Although our analysis did not focus on this topic, many articles used a variety of scopes and boundaries when calculating measures that negatively impact cross-study comparability. Outputs from studies using LCA techniques are not directly comparable with results from studies using other methods with reduced scope (eg, studies not including the upstream or downstream impacts of a process). Incompatibility of scopes might also apply to comparisons between studies using LCA techniques. Additional work on health-care specific guidelines for LCA to enable adequate cross-study comparisons is currently under development.³⁸

Limitations

Our study includes several limitations. Our data search was limited to online databases and English language articles, which might have resulted in fewer articles from non-English speaking countries. We also did not conduct a specific search of grey literature, although these publications were eligible for inclusion if they were retrieved in our searches.

Data extracted from articles included in our study did not always fit neatly with the available values for variables, such as calculation technique or data sources. Different possible response options might have modified results although most studies did fit well with existing options.

Moving forward

Advancing and harmonising environmental sustainability definitions and measurements in the health-care sector will require substantial effort. This work might benefit from adopting approaches used for the evaluation and reporting of health quality metrics, including established measurement criteria.^{14,16,34,39,40} This approach includes consensus building techniques, such as expert panels along with empirical analyses that could be supported by groups, such as the Agency for Healthcare Research and Quality, the Care Quality Commission in England, or the Organization for Economic Cooperation and Development. Initial work on this topic at organisations, such as the National Academy of Medicine, The Joint Commission, and The *Lancet* Commission on Sustainable Health Care, should continue, as these bodies can have important roles in building consensus, aligning goals and standards, and providing technical expertise. External pressure applied from reporting bodies both inside and outside health care might also help to spur progress in this area and recent efforts from the corporate and financial sector might generate progress in the health-care system.^{15,41,42}

Environmental sustainability in the health-care sector is a multifaceted issue and will need expertise across a wide range of areas, including those that are not frequently considered to be part of health care, such as sustainability science, building design, waste services, transportation, and others. Incorporating these voices into measurement development will be crucial to create appropriate, actionable, and understandable metrics for stakeholders.

Work on measurement should also include consideration of the setting and relevant actions for improvement. Decarbonisation goals on a health system level might need very different types of measures to waste segregation improvement goals in a local clinic.

Conclusion

Environmental sustainability in the health-care sector is a growing topic with important human and planetary health consequences. Although interest is growing, there remains substantial work to define and measure goals and track progress.

Overcoming the current heterogeneity in measuring and defining environmental sustainability in health care necessitates collaborative efforts. By fostering partnerships among stakeholders, including researchers, policy makers, health-care providers, and environmental experts, and using rigorous, standardised approaches, we can address methodological inconsistencies and develop common frameworks. Through collaborative action, we can advance the field, driving progress towards more accurate, comprehensive, and actionable measures of environmental sustainability and help the health-care field to achieve its important sustainability goals.

Contributors

MP, AD, and DK conceived the project and the methodology. MP, AD, IB, GM, and DK conducted the literature review, data extraction, and data analysis. A-CD and JS contributed to data extraction and categorisation methodology. MP led the writing of the scoping review. All authors provided critical feedback and helped shape the analysis and manuscript.

Declaration of interests

MP received payment for lectures at École des Hautes Études en Santé Publique, Public Health School, Rennes, France. IB received consulting fees and travel support from London School of Hygiene & Tropical Medicine; payment for a lecture from The Medical Society Consortium on Climate and Health; and travel support from the conference organisers of the Climate & Health 2023 Conference on Oct 21–22, 2023, at the Zucker School of Medicine, NY, USA. WA received an honorarium for lectures from Harvard Medical School and travel support from Massachusetts General Hospital. JDS received royalties or licences from Up to Date; consulting fees from the Institute for Healthcare Research; payment for lectures from several medical societies and academic institutions; and travel support from the World Innovation Summit for Health, American Thoracic Society, National Academy of Medicine, Johns Hopkins University, and the Health Summit at Sundance. JS received consulting fees from Gerson Lehman group, AlphaSights, CapVision, and Teleflex; payment for lectures from AstraZeneca, University of New Mexico, Columbia University, University of Colorado, Harvard University, Institute for Healthcare Improvement, and University of California at Los Angeles; and travel support from Vizient, AstraZeneca, University of Colorado, and Institute for Healthcare Improvement. All other authors declare no competing interests.

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