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Reporting of environmental outcomes in randomised clinical trials: a protocol for a scoping review

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ABSTRACT

Introduction To increase the sustainability of healthcare, clinical trials must assess the environmental impact of interventions alongside clinical outcomes. This should be guided by Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) and Consolidated Standards of Reporting Trials (CONSORT) extensions, which will be developed by The Implementing Climate and Environmental Outcomes in Trials Group. The objective of the scoping review is to describe the existing methods for reporting and measuring environmental outcomes in randomised trials. The results will be used to inform the future development of the SPIRIT and CONSORT extensions on environmental outcomes (SPIRIT-ICE and CONSORT-ICE).

Methods and analysis This protocol outlines the methodology for a scoping review, which will be conducted in two distinct sections: (1) identifying any existing guidelines, reviews or methodological studies describing environmental impacts of interventions and (2) identifying how environmental outcomes are reported in randomised trial protocols and trial results. A search specialist will search major medical databases, reference lists of trial publications and clinical trial registries to identify relevant publications. Data from the included studies will be extracted independently by two review authors. Based on the results, a preliminary list of items for the SPIRIT and CONSORT extensions will be developed.

Ethics and dissemination This study does not include any human participants, and ethics approval is not required according to the Declaration of Helsinki. The findings from the scoping review will be published in international peer-reviewed journals, and the findings will be used to inform the design of a Delphi survey of relevant stakeholders.

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STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The methodology of the present review is thoroughly described and up to date to ensure methodological integrity.
⇒ The review will be conducted in two phases and will include existing guidelines, reviews, methodological studies and randomised trials reporting environmental outcomes.
⇒ The included studies will not be restricted regarding interventions, comparisons or trial populations, allowing the review to include all aspects of clinical intervention research without being limited to specific medical fields or specialties.
⇒ There is a risk of only identifying a limited number of existing guidelines, reviews, methodological studies or randomised trials reporting environmental outcomes.
⇒ If the review results are based on limited data, developing robust, evidence-based recommendations for the SPIRIT-ICE and CONSORT-ICE extensions may be challenging.

INTRODUCTION

Humanity has exceeded several planetary boundaries, putting the planet at risk of severe instability.[1] This poses a risk of devastating impacts on the climate and other aspects of the environment.[1] The resulting environmental changes adversely impact human health through interconnected effects.[2] Climate-related impacts on human health include, for example, heat-related deaths, alterations in the epidemiology of infectious diseases, malnutrition, injuries from extreme weather events and mental health challenges.[3] In addition, other aspects of environmental degradation—such as air quality deterioration and forced migration and displacement—also negatively affect human health.[3] These impacts are compounded by other environmental impacts such as freshwater depletion, land degradation, air pollution, ocean acidification, reduced biodiversity and wetland loss.[2] Consequently, the WHO has declared climate change the defining issue for public health in the 21st century, and the United Nations'

Sustainable Development Goals include environmental goals and targets.[4 5] Likewise, in 2015, 196 members of the United Nations Framework Convention on Climate Change decided on the Paris Agreement, an international, legally binding treaty on climate change.[6] The treaty includes a long-term temperature target of limiting global warming to lessen the consequences of climate change.[6]

Healthcare and the environment

Healthcare is resource-intensive, accounting for over 4% of global carbon emissions—surpassing, for example, aviation, which accounts for 2.5%.[7 8] Therefore, reducing the environmental impact of healthcare delivery is crucial to keep global warming within the limit set by the Paris Agreement and to achieve the Sustainable Development Goals.[6] Several aspects of healthcare contribute to its climate impact.[3] Among these, the healthcare supply chain is responsible for most greenhouse gas emissions, encompassing the production, transportation and disposal of medicines, medical devices, equipment and instruments.[3] To improve the sustainability of healthcare, it is essential to reduce the climate and environmental impact of products, procedures and services, and thus the treatments provided.[9]

Environmental considerations in evidence-based healthcare

Healthcare relies on evidence-based medicine, in which potential new interventions are tested in randomised trials to determine which treatments to implement.[10] To reduce the environmental impact of healthcare, assessments of environmental impacts, such as climate impact, must be incorporated into the trials that guide healthcare decisions.

Guidance for quantifying the climate impact of conducting clinical trials themselves has already been developed.[11] This allows researchers to identify processes with significant environmental impacts and consider design alternatives when testing new interventions in clinical trials.[12] However, to improve the long-term sustainability of healthcare, it is also necessary to assess the environmental impact of the interventions being tested before they are implemented in routine practice.

Currently, randomised trials primarily compare interventions based on patient-related outcomes such as mortality, hospitalisations, serious adverse events and other outcomes related to clinical safety and effectiveness. To incorporate environmental considerations, these clinical outcomes must be supplemented by environmental outcomes. This would allow decision-makers to consider the environmental impacts when selecting treatments, thereby considering the broader implications for global health. In the long term, this approach would increase the sustainability of healthcare by allowing decision-makers to implement interventions with a lower environmental impact.

Measuring the climate and environmental impact of clinical interventions

The climate and environmental impact of clinical interventions can be measured as outcomes using life cycle assessments (LCAs) or similar methods. LCAs are often used when assessing the environmental impact of healthcare interventions, but other methods exist such as greenhouse gas protocol and material flow analysis. LCA is a quantitative method used to model the environmental impact of a product or process by accounting for all stages of its life cycle.[13] The method is divided into four steps: (i) definition of goal and scope, (ii) life cycle inventory of materials' and processes' input and outputs, (iii) life cycle impact assessment, where the inputs and outputs are characterised into several different environmental or health impacts and (iv) interpretation of results, including sensitivity and uncertainty analyses. LCA is a well-known method with International Organisation for Standardisation standards for how to perform the analyses.[14–16] It has been used outside medicine for many years, and the method can be adapted to fit many different scenarios.[13] Using LCAs, or similar methods, the climate and environmental impact of all kinds of interventions—such as medications, surgeries or psychological treatments—could potentially be assessed and compared.

Incorporating climate and environmental outcomes in randomised trials

Planning and reporting clinical trials are complex processes. Evidence-based guidelines, such as the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) and the Consolidated Standards of Reporting Trials (CONSORT), have been developed to guide researchers on how and what to report.[17 18] SPIRIT provides recommendations for the minimum content of clinical trial protocols, while CONSORT provides recommendations for the minimum content of primary reports of completed clinical trials.[17 18] The guidelines are continuously updated to accommodate new aspects of research, new methodologies and feedback from users.[19] When there is a need to address a specific trial design or reporting issue not covered by the main guidelines, extensions to SPIRIT and CONSORT are developed.[19] Several extensions to the guidelines exist to address issues such as harms, patient-reported outcomes, adaptive trials and cross-over trials.[19] However, no extensions to SPIRIT or CONSORT have previously been developed on incorporating environmental outcomes in trials.[19]

If the reporting of environmental outcomes is to be successfully incorporated into clinical trials, researchers will likely require a complementary framework for unbiased and transparent planning and reporting. Therefore, we have established the Implementing Climate and Environmental Outcomes in Trials Group (ICE Group), which includes international experts from various fields such as research methodology, clinical trials and environmental science.[20] We aim to develop a SPIRIT and a CONSORT extension focusing on climate and other

Table 1 Process for developing SPIRIT-ICE and CONSORT-ICE extensions

Phase	Process
Project launch	Registration with the EQUATOR network, establish organisation and project launch
Literature review	Conduct a scoping review of current methods used to report and measure environmental impacts of interventions in clinical trials and generate a preliminary long list.
Delphi survey	Conduct an international Delphi survey with a diverse range of stakeholders on potential ways to incorporate reporting of environmental outcomes in clinical trials.
Consensus meeting	Reach consensus on items to include in the SPIRIT and CONSORT extensions on environmental outcomes in clinical trials.
Dissemination and implementation.	Outline the SPIRIT and CONSORT extension and E&E documents on environmental outcomes in clinical trials. Pilot the SPIRIT and CONSORT extensions in randomised clinical trials. Develop dissemination materials targeting researchers, eg, through journals, conferences, international trials methodology networks and educational institutions.

CONSORT, Consolidated Standards of Reporting Trials; E&E, Explanation and Elaboration; EQUATOR, Enhancing the Quality and Transparency of Health Research; ICE, Incorporating Climate and Environmental Outcomes in Trials; SPIRIT, Standard Protocol Items: Recommendations for Interventional Trials.

environmental outcomes in clinical trials termed SPIRIT-ICE and CONSORT-ICE.[21 22] Our vision is that, in addition to clinical outcomes, all major trials will assess environmental outcomes, guided by these SPIRIT and CONSORT extensions.

Previous evidence

Two previous reviews have provided an overview of reporting the carbon footprint of conducting clinical trials themselves,[23 24] and guidance on quantifying this footprint has been developed.[11] However, no previous reviews have described how environmental outcomes are reported in randomised trial protocols or final reports of randomised clinical trials.

Why is this review important?

Conducting a scoping review of existing methods for reporting and measuring environmental outcomes in clinical trials is necessary as the first step in developing the SPIRIT-ICE and CONSORT-ICE extensions (table 1). The development of SPIRIT-ICE and CONSORT-ICE will be conducted in five phases: phase 1, project launch; phase 2, review of literature; phase 3, Delphi survey; phase 4, consensus meeting; and phase 5, dissemination and implementation (table 1). The results of the review will inform the future development of the SPIRIT and CONSORT extensions by providing the basis for the long list generation, which will inform the Delphi survey. A protocol describing the methods and processes for development of SPIRIT-ICE and CONSORT-ICE has been submitted to BMJ Open.

METHODS

This protocol outlines the methodology for a scoping review based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses: extension for Scoping Reviews (PRISMA-ScR) guidelines.[25] This review will be conducted in two distinct sections: (1) identifying any existing guidelines, reviews or methodological studies describing the climate or environmental impacts of interventions and (2) identifying how environmental outcomes are reported in randomised trial protocols and randomised clinical trials. The results of the review will be used to develop a preliminary list of items for the SPIRIT and CONSORT extensions (box 1).

Search strategy

In the first section of the review, Enhancing the Quality and Transparency of Health Research (EQUATOR) Network will be searched for existing SPIRIT and CONSORT extensions to confirm that no overlapping extensions already exist or are being planned. Furthermore, a search will be performed to identify other relevant existing guidelines, reviews or methodological studies describing

Box 1 Examples of questions to be explored in reviews, clinical trial protocols or trial reports reporting climate and other environmental impacts

⇒ What impacts are reported (eg, climate impact, resource depletion, water use, other or all)?
⇒ Which method is used to assess impacts (eg, LCA or other method)?
⇒ Which are the units of measurement for the impacts?
⇒ If LCA is used, how are the system boundaries set (eg, is the environmental impact of producing an autoclave to be included in a study, or only the energy, water and chemicals used to run the autoclave)?
⇒ If LCA is used, do the authors use an attributional LCA, consequential LCA or both approaches?
⇒ How do the authors collect input data?
⇒ Do the authors report any sensitivity analyses (eg, using different energy sources)?
⇒ How are the statistical analyses carried out and reported?

LCA, Life cycle assessments.

environmental impacts of interventions (see description of search below and online supplemental additional file 1).

In the second section of the review, a search will be conducted to identify reviews, randomised trial protocols and final reports of trials assessing environmental outcomes. This search will be divided into two components: one focusing on relevant reviews of randomised trials and one targeting relevant randomised trial protocols and trial results (see description of search below and online supplemental additional file 1).

A search specialist will search relevant medical databases, including Cochrane Central Register of Controlled Trials, Medical Literature Analysis and Retrieval System Online, Excerpta Medica database, Latin American and Caribbean Health Sciences Literature, Science Citation Index Expanded, and Conference Proceedings Citation Index— Science. Furthermore, the reference list and citations of relevant trial publications and clinical trial registries will be checked for any unidentified publications. All searches will be performed from their inception to the present date. We expect to run the search at the end of 2025. See online supplemental additional file 1 for the complete search strategy.

Study selection

Results will be uploaded to Covidence for each search for both sections of the review, and duplicates will be removed.[26] Machine learning in Covidence will be used to sort the abstract and title screening results.[26] Machine learning within Covidence identifies and analyses patterns in the inclusion and exclusion of studies during the title and abstract screening phase of a systematic review.[27] Based on the pattern, any remaining studies will be sorted by relevance, and the most relevant studies will be presented first. Thus, the probability of encountering relevant studies is much higher initially and gradually drops.[27] When the review authors exclude 2000 hits consecutively, the screening will be stopped, and the included studies will be considered the final search results for full-text screening. Two review authors will independently screen titles and abstracts, and any discrepancies will be solved through discussion or, if required, by consulting a third author. Full-text trial reports will be sought for all publications included in full-text screening. Two review authors will perform full-text screening independently, and any discrepancies will be solved through discussion or, if required, by consulting a third author. The relevant randomised trial protocols will be retrieved, if possible, for all the randomised trials included. The protocols will be identified through the searches (described above), trial registries and supplementary material of the included final reports of the randomised clinical trials. The study selection process will be described in a PRISMA flow chart.

Eligibility criteria

The first section of the review will include any existing guideline, review or methodological study considering the environmental impacts of interventions or reporting of such impacts in clinical trial protocols or final reports of trials. In this section of the review, methodological studies describing the environmental impact of selected clinical interventions will also be included.

Relevant reviews, trial protocols and randomised trials that assess environmental outcomes will be included in the second section of the review.

There will be no restrictions regarding interventions, comparisons or trial populations for the included studies in the first or second section. Environmental impacts or environmental outcomes are defined as any reported assessment related to the environmental effects of healthcare interventions. This may include, but is not limited to, measures such as climate impact, water use, land use or other resource-related indicators. Studies will be eligible if they report at least one component or modality of the intervention.

Data extraction

In both sections of the review, the characteristics of included studies will be extracted independently by two review authors in a predefined form. Data extractions will be compared, and any disagreements will be solved by discussion or, if required, by consulting a third author. Published papers, trial protocols, study reports, clinical trial registries and supplementary materials will all be used for data extraction. Each study will be named after the first author and the year of the primary publication. Data will be extracted for study characteristics, intervention characteristics, control characteristics and reporting of climate and environmental outcomes. The data included in the data extraction sheet can be found in online supplemental additional file 2.

For both sections of the review, all reviewers will first evaluate a sample of study reports to test the data extraction process and ensure a consistent approach before extracting data from the included studies. If needed, authors of relevant publications will be contacted to specify any missing or unclear data.

Data analysis and presentation of results

In the first section of the review, data from existing guidelines, reviews or methodological studies describing climate or environmental impacts of interventions will be presented descriptively in a table outlining the characteristics of each project.

In the second section of the review, the characteristics of the identified reviews, trial protocols and randomised trials will be described using frequencies and percentages for categorical data and means and SD for continuous data. Additionally, all included publications will be described and presented in a table with descriptions of climate and other environmental outcomes reporting in protocols and reports.

Based on the included studies, a preliminary list of possibly relevant items to consider for the SPIRIT and CONSORT extensions will be developed. This list will

inform the design of a Delphi survey of relevant stakeholders. Based on the Delphi survey, consensus will be reached on items to include in the SPIRIT and CONSORT extensions on environmental outcomes in clinical trials.

ETHICS AND DISSEMINATION

This study does not include any human participants, and ethics approval is not required according to national laws and the Declaration of Helsinki. The findings from the scoping review will be published in international peer-reviewed journals, and the findings will be used to inform the design of a Delphi survey of relevant stakeholders.

Patient and public involvement

Patients and the public were not involved in the writing of the protocol. However, a patient and public representative will be included in the conduct of the scoping review and the future work of ICE Group.

DISCUSSION

This is a protocol for a scoping review. The review will be performed in two sections: (1) identifying any existing guidelines, reviews or methodological studies describing climate or environmental impacts of interventions and (2) identifying how environmental outcomes are reported in randomised trial protocols and randomised clinical trials. The results will be used to develop a preliminary list of items for the SPIRIT and CONSORT extensions.

This protocol for a scoping review has several strengths. First, the methodology is thoroughly described and up to date, and the scoping review will be conducted according to this preplanned methodology, ensuring methodological integrity. Second, the scoping review will be performed in two sections, each addressing necessary aims. The first section will explore whether there is a need for the SPIRIT and CONSORT extensions by identifying and presenting any existing guidance on reporting environmental outcomes in clinical research, including methodological studies on the environmental impact of selected clinical interventions. The second section will show the methods and reporting of climate and other environmental outcomes in clinical trial protocols and trials, providing insights into current practices. Thus, the scoping review has a precise aim, with each section contributing essential information to guide the development of a preliminary list of items for the SPIRIT and CONSORT extensions. Furthermore, the scoping review will have no restrictions regarding interventions, comparisons or trial populations in the included studies. Thus, the results of the review will represent all aspects of clinical intervention research without being limited to specific medical fields or specialties.

This protocol also has limitations. First, there is a risk of only identifying a limited number of existing guidelines, reviews or methodological studies describing climate or environmental impacts of interventions in section one. Similarly, in the second section, there is a risk of finding only a limited number of clinical trial protocols and trials assessing the effects of interventions on climate or environmental outcomes. To identify as many relevant studies as possible, the search strategies may need to be very broad, potentially resulting in a large number of hits to screen in Covidence. Second, there might be a limited amount of data of relevance reported in the included studies if climate and other environmental impacts of the interventions are not extensively described. As a result, the review might end up with limited data, which makes it challenging to develop robust, evidence-based recommendations for the SPIRIT-ICE and CONSORT-ICE extensions. However, the input for the Delphi process in developing the SPIRIT-ICE and CONSORT-ICE extensions will be based not only on the results of this scoping review but also on input from the ICE Group.

Despite these limitations, conducting this scoping review of existing methods for reporting and measuring climate and environmental outcomes in clinical trials is necessary as the first step in developing the SPIRIT-ICE and CONSORT-ICE extensions. The results of this review will guide the future development of the SPIRIT and CONSORT extensions.

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