



Climate change impacts and sustainability integration among breast international group members[☆]

Seamus O'Reilly^{a,b,c,*}, Jessica Griffiths^d, Lisa Fox^d, Catherine S. Weadick^a, Nay My Oo^a, Lucy Murphy^b, Robert O'Leary^e, Theodora Goulioti^f, Virginie Adam^f, Evangelia D. Razis^g, Barbro Lindholm^h, Gustavo Werustskyⁱ, David Cameron^j, Judith Bliss^d

^a Department of Medical Oncology, Cork University Hospital, Wilton, Cork, Ireland

^b Cancer Trials Ireland, Royal College of Surgeons, St Stephens Green, Dublin, Ireland

^c Cancer Research @UCC, College of Medicine and Health, University College Cork, Cork, Ireland

^d Clinical Trials and Statistics Unit, Institute of Cancer Research, London, United Kingdom

^e ARUP, London, United Kingdom

^f Breast International Group, Brussels, Belgium

^g 3rd Oncology Department, Hygeia Hospital, 4 Erythrou Stavrou St & Kifisias Av. 15123, Marousi, Athens, Greece

^h Institution of Clinical Sciences, Dept of Oncology, Sahlgrenska Academy at Gothenburg University, Gothenburg, Sweden

ⁱ Latin American Cooperative Oncology Group, Porto Alegre, Brazil

^j University of Edinburgh, Edinburgh, United Kingdom

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ABSTRACT

Background: Integration of sustainability measures into clinical research would translate into less healthcare related climate impacts.

Methods: We assessed climate change impacts, existing sustainability engagement, and challenges and facilitators to climate change mitigation strategies among Breast International Group (BIG) members. A 30 item web based survey assessing climate impacts, sustainability engagement, challenges to and facilitators of engagement, and sustainability integration in funding applications was developed, and circulated electronically between November 2023 and March 2024.

Results: Thirty four members (research groups and data centres) and participating sites across 5 continents, and BIG headquarters responded. Twenty six responses were received from 21 organisations, 20 from 17 participating sites. No responses were obtained from 28 groups. Trial conduct at a third of member groups had been impacted by climate change impacts such as destroyed infrastructure. 78 % of groups agreed that sustainability should feature in future funding applications. Most respondents engaged in sustainability initiatives at a host institute and organisational level. However, 39 % of coordinating centres and 65 % of representative sites had none within clinical trials conducted by their organisation. The majority of respondents foresaw challenges to sustainability engagement including competing time pressure, staff attitudes and resource constraints. Of nine potential facilitators to engagement, funding, an evidence base for sustainable research practice and training were the leading themes.

Conclusion: In the first global survey of its kind, a third of respondents reported that climate change had impacted trial conduct. Integration of sustainability measures was absent in a significant minority. Funding and dedicated resourcing would facilitate increased engagement in cancer clinical trials.

1. Background

Our clinical research enterprise is being conducted in the

Anthropocene era: one in which our activities are substantially altering the earth's surface, atmosphere, oceans and systems of nutrient cycling [1]. This alteration is profound and rapid. Between 2016 and 2021,

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^{*} Corresponding author. Cork University Hospital, Wilton, Cork, Ireland.

E-mail address: seamus.oreilly@hse.ie (S. O'Reilly).

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climate change related events displaced over 134.1 million people including 43.1 million children globally [2]. This devastating reality is compounded by three interlinked related issues that humanity currently faces: climate change, pollution and biodiversity loss [3]. Today, air pollution, comprising both particulate matter pollution, household air pollution from solid fuels, and ambient ozone pollution, is the largest cause of disease (including cancer) and premature death worldwide [4]. Growing anthropogenic impacts on biodiversity have contributed to outbreaks of emerging infectious diseases, increasing the risk of future pandemics. In 2022 a consensus statement from the Regional Action on Climate Change Symposium warned that “the Earth’s climatic, ecological and human systems are converging towards a crisis that threatens to engulf global civilization within the lifetimes of children now living” [5]. Resolution of this triple planetary crisis is needed if we are to have a viable future on this planet.

To date, our Anthropocene era has seen significant advances in modern healthcare and consequently, improvements in life expectancy. These advances have been driven by our clinical and scientific research enterprises. It is clear now that these advances come at great collateral cost to the environment, and paradoxically to human health. Healthcare’s climate toxicity extends from manufacture to transport to procurement to infrastructure and to data storage [6]. Globally this equates to the emissions of the continent of Africa where 1.5 billion people live in 54 countries. Within healthcare, clinical trials have an annual carbon footprint equivalent to 50 % of the annual footprint of Denmark, while the annual footprint of scientific discovery has the same annual footprint as Venezuela [7].

Clinical trial organisations are critically placed to take a leading role in mitigating the climate change impact of health care. They are adept in protocol development and in the dissemination of patient appropriate information. They have demonstrated adaptability during the COVID-19 pandemic, and have prioritized the development of less resource intensive (and consequently less climate toxic) treatment schedules [8]. Their collaborative nature offers the potential for less redundancy, and consequently waste, in cancer discovery. However, sustainability integration in cancer research is low. Funding applications always include forensically detailed financial costings, but rarely include assessments of the environmental cost of proposals [9]. In a predominantly web based assessment of 64 National Cancer Institute designated cancer centres, only 2 centres had independent sustainability plans and 11 centres reported on their sustainability efforts [10]. Similar results were noted in another web based scoping exercise of climate awareness among cancer clinical trial organisations [11]. Seventy-five organisations were identified of whom 46 had search tools on their websites. Eight out of 46 clinical trial groups had at least 1 parameter of commitment to climate change, and 38 organisations had none. An additional global survey of academic research institutes within the National Clinical Trials Centre Network in 2022/3 found that 50 % of respondents did not consider reducing their carbon footprint, whilst the other half were not familiar with the subject at all [12]. In the United Kingdom, a recent workshop forum jointly hosted by the Academy of Medical Sciences, the Medical Research Council and the National Institute for Health and Care Research (NIHR), highlighted 4 key areas for enabling greener biomedical research. These include prioritising sustainability, generating and disseminating evidence on environmentally sustainable research practices, accelerating the introduction of environmentally sustainable practice in research, and promoting and informing behavioural change [13].

With 59 member groups across 5 continents, the Breast International Group (BIG) (<https://bigagainstbreastcancer.org/>) is the largest international network of academic research groups dedicated to finding cures and developing better treatments for breast cancer through clinical trials and research programmes [14]. In recognition of the growing significance of climate change, we conducted an online survey of member groups including both co-ordinating centres (academic collaborative research groups) and representative participating sites (hospitals). The

aim of the study was to assess the impacts of climate change on clinical trial activities among group members, document the levels of engagement with sustainability initiatives, and explore challenges and facilitators to engagement in climate change mitigation efforts.

2. Methods

To answer our research questions, a web-based survey was developed in Jisc online surveys (www.onlinesurveys.jisc.ac.uk). The survey questions and sustainability measures were derived by the authors following review of web-based surveys of medical organisations [11, 15], quantitative and qualitative surveys of sustainability engagement in healthcare [16] and other professions [17], and a literature review conducted in PubMed using the terms “clinical trials and carbon footprint”. A copy of the questionnaire is included in [Appendix 1](#). The 30 item survey was divided into 5 sections assessing the impact of climate change on trials activity in the previous 5 years, both workplace and clinical trial specific engagement with climate change initiatives, challenges to, and facilitators of engagement, and the role of sustainability integration in future funding applications. Study questions were mostly closed-ended with Likert-type responses options where applicable. Free text responses were included, for example to assess ongoing sustainability engagement in an organization.

The survey was promoted at BIG scientific and business meetings and was then circulated to BIG member co-ordinating centre and clinical trial sites, and to BIG headquarters via an email containing an introduction and a web link to the survey. The initial email was sent on November 15th 2023, with follow up emails sent to non-responders until March 15th 2024. The survey did not use any personal data from study respondents. An opt in or opt out consent to disseminate the findings of the study was included in the questionnaire. The questionnaire was conducted in English.

2.1. Data management and analysis

The survey responses were periodically reviewed to identify and follow up with non-responders. The responses were reviewed and sorted by BIG member group coordinating centre, or BIG member group clinical trial site, and the results exported. Maps were prepared to summarise the results using www.mapchart.net.

3. Results

Forty six responses were received from 34 groups and BIG headquarters ([Table 1](#)) located across 4 continents – Asia, Australia, Europe, and America ([Supplement 1](#)). Of these 46 responses, 23 were received from 18 co-ordinating centres and 20 responses were received from 17 clinical trial sites. An additional 3 responses were received from Frontier Science Scotland (a biostatistics and data management centre), the Korean Cancer Study Group (a BIG representative voting member) and the Swedish Association of Breast Oncologists (a group that leads and develops breast cancer trials). Where multiple responses were received for a single organization, one representative answer was taken, unless the responses came from different parts of the organization such as a coordinating site and a clinical trial site. No responses were obtained from 28 groups ([Supplement 2](#)).

3.1. The impacts of climate change on clinical trial conduct

A third of the co-ordinating centres who responded reported that their trials have been impacted by the effects of climate change in the past 5 years ([Supplement 3](#)). Five of 17 clinical trial site respondents had similar reports. These impacts included floods, wildfires, extreme heat, landslides, typhoons and repeated black rainstorms. Trial accrual and conduct and physical infrastructure were affected. Inclement weather including snow, heat waves and floods, and destruction of road networks

Table 1
Breast international group survey respondents.

Continent	Country	Organisation	Number of submitted survey responses	Part of organisation (Coordinating centre, Representative participating site or other)
Asia	China	Hong Kong Breast Oncology Group	1	Representative participating site
	Japan	Japan Breast Cancer Research Group	1	Coordinating centre
	Korea	Korean Cancer Study Group	1	Other
	India	Breast Intergroup of Eastern India	1	Representative participating site
		Indian Co-operative Oncology Network	1	Coordinating centre
	Thailand	Thai Society of Medical Oncology	1	Representative participating site
	Singapore	Cancer Therapeutics Research Group	1	Representative participating site
	Australia/New Zealand	Breast Cancer Trials Australia and New Zealand	1	Coordinating centre
		Trans Tasman Radiation Oncology Group	1	Coordinating centre
Europe	Austria	Austrian Breast & Colorectal Cancer Study Group	1	Coordinating centre
		Central and East European Oncology Group	1	Representative participating site
	Belgium	European Organisation for Research and Treatment of Cancer Breast Cancer Group	2	Representative participating site
		Breast International Group Head Office	1	Coordinating centre
	United Kingdom	Institute of Cancer Research – Clinical Trials & Statistics Unit	1	Coordinating centre
		Frontier Science Scotland	1	Other
	France	Unicancer Breast Group	1	Representative participating site
	Germany	Arbeitsgemeinschaft Gynäkologische Onkologie Breast Study Group	1	Representative participating site
		Westdeutsche Studiengruppe	1	Coordinating centre
		SUCCESS Study Group	1	Representative participating site
	Greece	Hellenic Cooperative Oncology Group	1	Representative participating site
		Hellenic Society of Breast Surgeons	1	Representative participating site
	Ireland	Cancer Trials Ireland	6	Coordinating centre & Representative participating site
	Italy	Gruppo Italiano Mammella	1	Representative participating site
		Gruppo Oncologico Italiano di Ricerca Clinica	1	Coordinating centre
	Norway	Norwegian Breast Cancer Group	1	Representative participating site
	Spain	Spanish Breast Cancer Group	1	Coordinating centre
		SOLTI Breast Cancer Research Group	1	Coordinating centre
		Swedish Association of Breast Oncologists	1	Other
	Switzerland	International Breast Cancer Study Group	3	Coordinating centre & Representative participating site
Latin America	Argentina	Grupo Argentino de Investigación Clínica en Oncología	1	Coordinating centre
	Brazil	Latin American Cooperative Oncology Group	4	Coordinating centre & Representative participating site
	Chile	Chilean Cooperative Group for Oncologic Research	1	Coordinating centre
	Peru	Grupo de Estudios Clínicos Oncológicos Peruano	1	Coordinating centre
North America	Canada	Canadian Cancer Trials Group	2	Coordinating centre & Representative participating site

led to delays in access to trial units for patients and staff. Regional government mandated clinic closures due to typhoons and black rainstorms occurred in Hong Kong.

3.2. Sustainability Integration into funding applications

Twelve of 18 co-ordinating centres (67 %) answered yes/maybe regarding **will** sustainability feature in funding applications in the next 5 years. Fourteen of 18 (78 %) answered yes/maybe regarding **should** sustainability feature in funding applications in the next 5 years.

Similar results were obtained from representative sites, with 13 of 17 sites (76 %) answering yes/maybe regarding **will** sustainability feature in funding applications in the next 5 years. Sixteen of 17 group related sites (94 %) answered yes/maybe regarding **should** sustainability feature in funding applications in the next 5 years. Of the 3 additional groups (FSS, KCSG and SwBCG) all responded that sustainability will and should feature in funding applications.

3.3. Existing levels of engagement with sustainability initiatives

3.3.1. Participating in Host Institution initiatives (eg University, Hospital, External Third Party)

The co-ordinating centres of 7 of 18 groups (39 %) had no engagement with sustainability initiatives within their host institutions (Fig. 1). Eleven of 18 (61 %) were currently engaging with some or all of the following initiatives in the workplace: Host institution climate change

charter or sustainability policy, sustainability task force or working group, education or training on waste reduction and sustainability, partnership with external sustainability initiatives (eg My Green Lab, LEAF, ISO, One Planet Living, etc), a sustainable travel policy, food waste management, climate assessment of organisation investments, climate assessment of procured services or purchases, appointment of climate champions, sustainable plant based diet advocacy, and energy or water stewardship.

At clinical trial unit level, 4 of 17 groups (23 %) had no engagement with climate change initiatives within the work environment in their host institution. Thirteen of 17 groups (76 %) were currently engaging with some or all of the following initiatives: Host institution climate change charter or sustainability policy, sustainability task force or working group, education or training on waste reduction and sustainability, partnership with external sustainability initiatives (eg My GreenLab, LEAF, ISO, One Planet Living, etc), a sustainable travel policy, food waste management, climate assessment of organisation investments, climate assessment of procured services or purchases, appointment of climate champions, sustainable plant based diet advocacy, energy and water stewardship.

3.3.2. Initiatives specific to the BIG member organisations

The coordinating centres of 4 of 18 member groups (22 %) had no engagement with climate change initiatives (Fig. 2). Fourteen of 18 groups (78 %) were currently engaging with some or all of the following initiatives: host institution climate change charter or sustainability

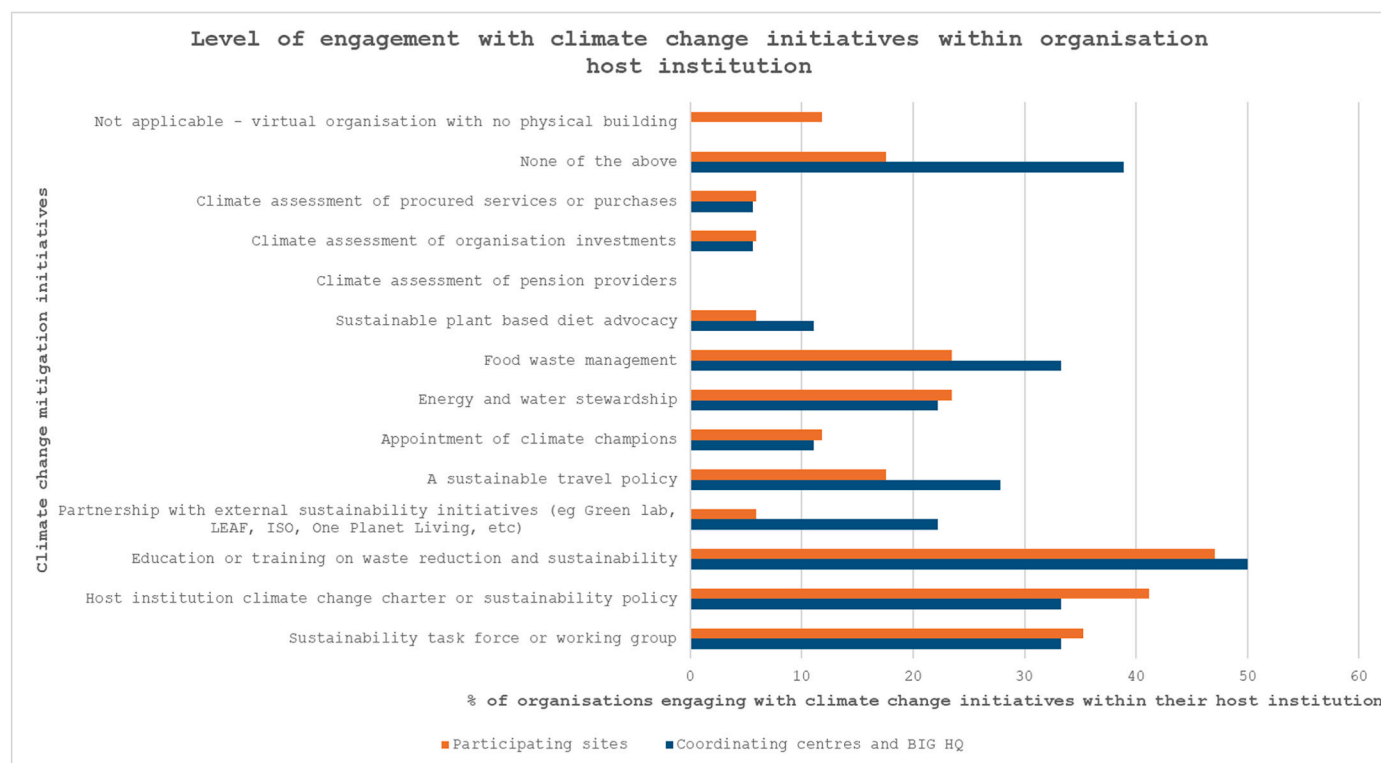


Fig. 1. Level of Engagement with climate change initiatives within organisations host institutions from 17 participating sites and 18 co-ordinating centres expressed as % responses ranging from 0 % (pension provider assessment) to 50 % (education and training which received 9 positive responses).

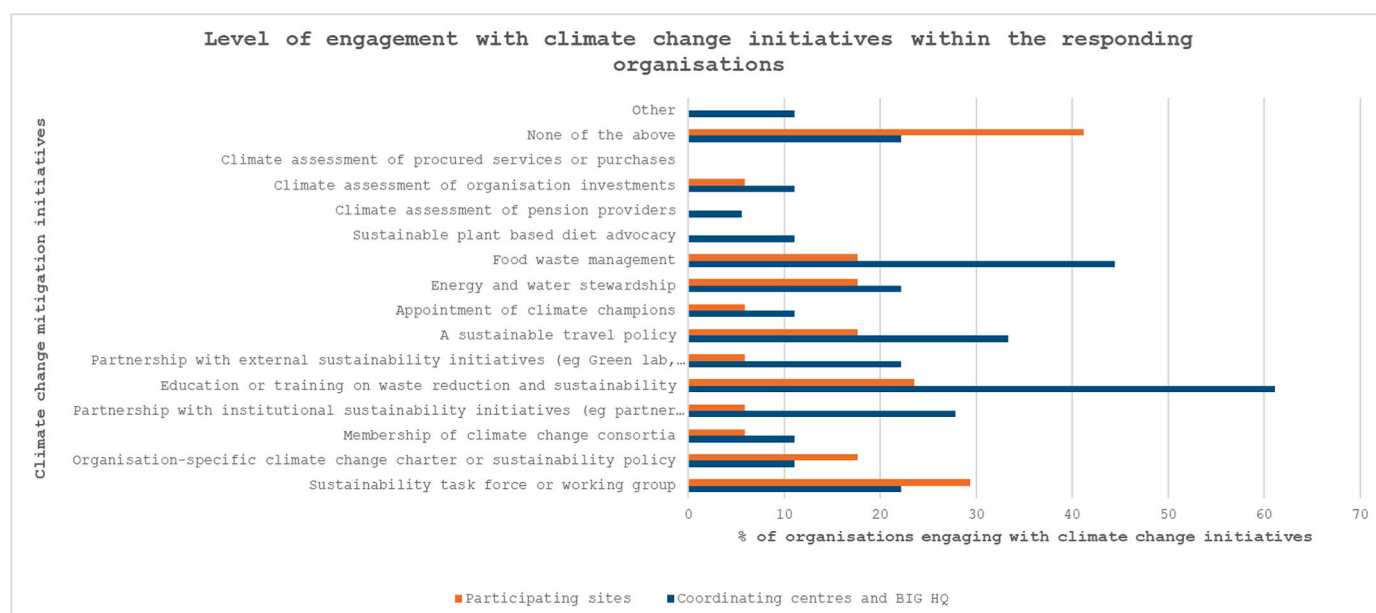


Fig. 2. Level of engagement with climate change initiatives within participating centres from 17 participating sites and 18 co-ordinating centres expressed as % responses ranging from 0 % (climate assessment of procured services) to 60 % (education or training on waste reduction which received 11 positive responses).

policy, sustainability task force or working group, education or training on waste reduction and sustainability, partnership with external sustainability initiatives (eg My GreenLab, LEAF, ISO, One Planet Living, etc), a sustainable travel policy, food waste management, climate assessment of organisation investments, climate assessment of procured services or purchases, appointment of climate champions, sustainable plant based diet advocacy, energy and water stewardship and other. 'Other' answers included NIHR funded project to development of

method/guidance to footprint clinical trials, complete digitization of protocol related documents, facilitation of web conferences and recycling.

At the participating site level, 7 of 17 respondents (41 %) had no engagement with climate change initiatives in their member group. Ten of 17 groups (59 %) were currently engaging with some or all of the initiatives.

3.3.3. Initiatives specific to the clinical trials conducted by BIG member groups

The coordinating centres of 7 of 18 groups (39 %) had no engagement with climate change initiatives within clinical trials conducted by their organisation (Fig. 3). Eleven groups (61 %) were currently engaging with some or all of the following initiatives: patient education, promoting virtual care and telemedicine within clinical trials for sustainability reasons, promoting remote and central monitoring within clinical trials for sustainability reasons, climate assessment of procured services or purchases, consideration of environmental impact at the clinical trial design stage, reducing sample kit waste and minimising shipment frequency of supplies/kits.

At participating site level 11 groups (65 %) had no engagement with climate change initiatives within clinical trials conducted by their organisation. Six groups (35 %) were currently engaging with some initiatives. Within the free text responses of the questionnaire, member groups were asked what the 3 most important climate change mitigation initiatives undertaken at an organisation level were. Recycling and strategies to reduce trial related travel, such as remote monitoring and rationalisation of visits, were most commonly mentioned.

3.4. Challenges to the uptake of more sustainable research practice

The majority of co-ordinating centre respondents (50 %) foresaw challenges to the uptake of more sustainable research practice within their organisations. Fig. 4 illustrates the landscape of these challenges. In addition to the financial and other constraints, respondents noted that “for any clinical trial the amount of paperwork required is substantial, e-signatures are not accepted, there must be a hard copy version of everything - I don't see this culture changing. Almost everything must be done in person, satellite clinics are not utilised so patients are required to travel long distances for clinical visits that could be done locally or virtually. The mechanics of how a trial is run is slow to change - this is beyond the institution or organisation and hampers the ability to

institute change at a local level”. Another noted that “complex oncology trials with biological endpoints require multiple frequent, complex sample collections and in person visits. The trade off between sustainability and scientific value will be challenging in this area”. At participating site level 11 of 17 groups (65 %) foresaw challenges to the uptake of more sustainable research practices. Free text responses highlighted these issues eg “For any clinical trial the amount of paperwork required is substantial, e-signatures are not accepted, there must be a hard copy version of everything – I don't see this culture changing ... The mechanisms of how a trial is run is slow to change – this is beyond the institution or organisation and hampers the ability to institute change at a local level”.

3.5. Facilitators to Engagement in Climate Mitigation Practice

Nine potential facilitators to engagement were assessed using a 5 item Likert score. Examples of facilitators included a charter, guidance documents, training, funding and providing increased evidence base. As demonstrated in Fig. 5 a combination of these measures rather than prioritising a single facilitator was favoured.

4. Discussion

This is the first study of the impacts of climate change on a global clinical trials network. For one third of all respondents climate change had impacted on clinical trials activity. These effects were noted in both the Global North and the Global South. The overwhelming majority of respondents felt that sustainability should, and will be, a pre-requisite for funding applications in the future. While significant engagement in sustainability measures was noted at organizational and site levels, up to 40 % of respondents had no engagement. Reasons for lack of engagement were polyfactorial ranging from apathy to financial factors to time. Domains of the survey pertaining to engagement highlighted the importance of guidance documents, networking and funding. They also

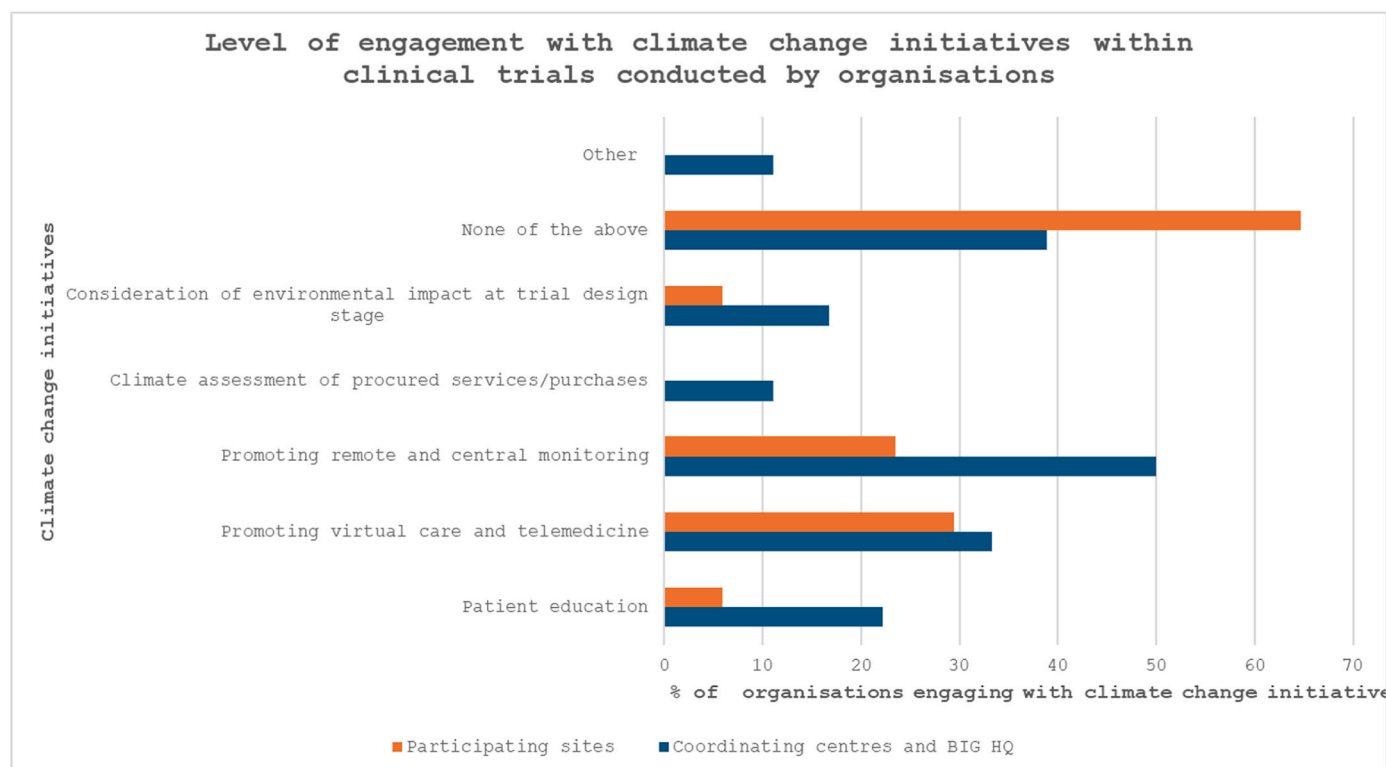


Fig. 3. Level of Engagement with climate change initiatives within clinical trials conducted by organisations from 17 participating sites and 18 co-ordinating centres expressed as % responses ranging from 0 % (climate assessment of procured services) to 50 % (promotion of remote monitoring 9 positive responses).

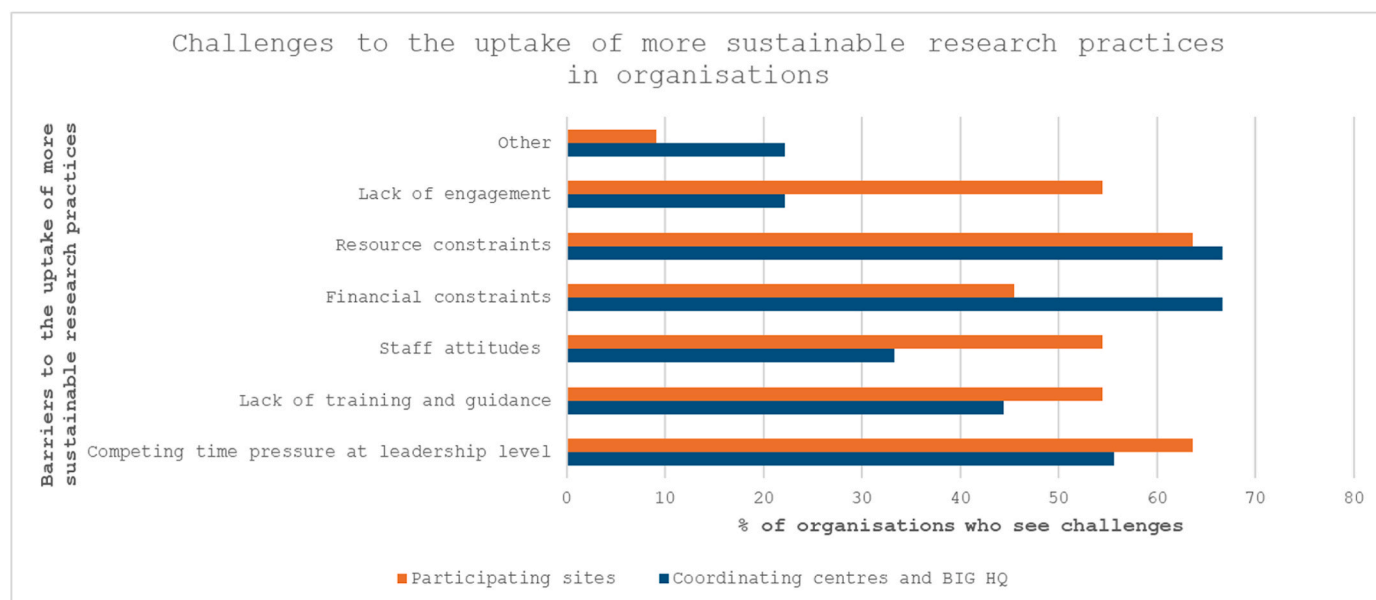


Fig. 4. Challenges to uptake of sustainable practice by organisations from 11 participating sites and 9 co-ordinating centres who did perceived challenges to the uptake of mores sustainable practices expressed as % responses ranging from 9 % (other barriers) to 66 % (financial constraints which received 6 responses).

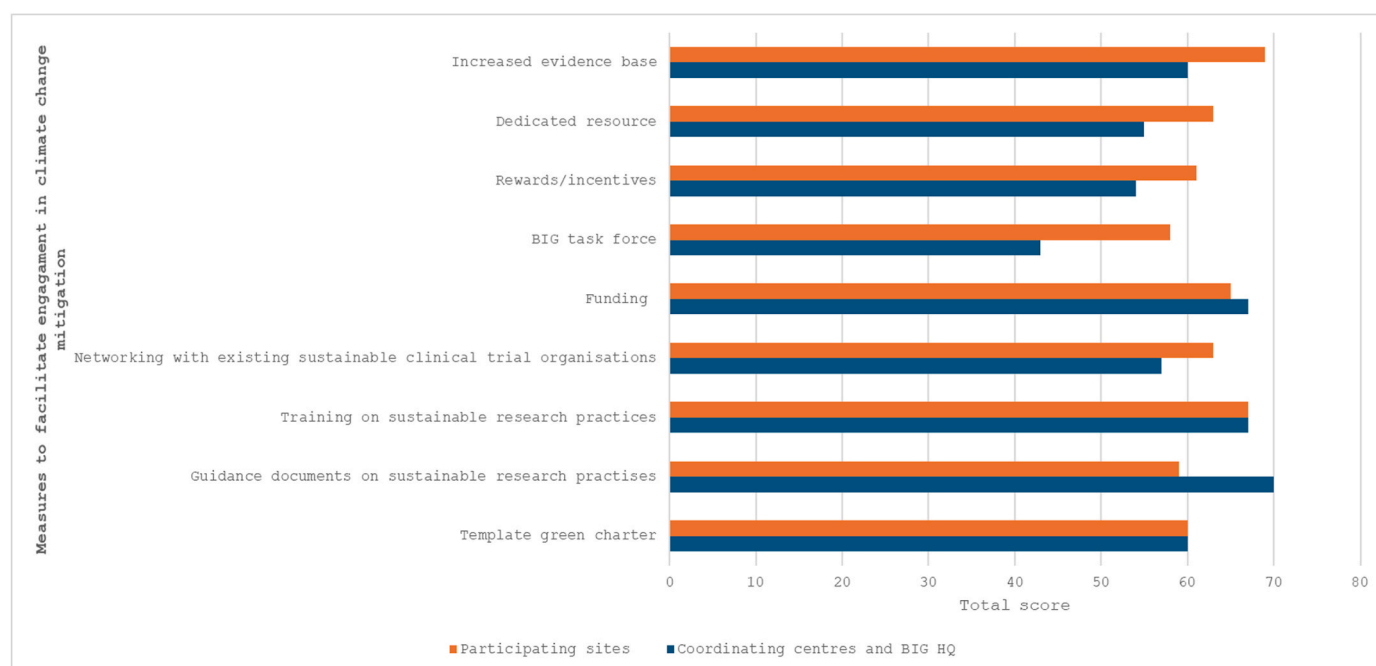


Fig. 5. Facilitators to Engagement in Sustainability Initiatives scored on a scale of 1–5 by the 17 participating sites and 18 coordinating sites and then summed up per group to give a total score for each group.

highlighted the challenges for organisations with competing needs, multiple stakeholder involvement and lack of dedicated staff and funding to implement change.

For a quarter of the survey respondents the threat of climate change was real. By the time the survey was launched in 2023 wildfires in Canada had already destroyed an area 3 times the size of Denmark in that year alone, impacting BIG member Canadian Cancer Clinical Trials Group activities [18]. One month after the closure of the survey, flooding due to severe rainfall led to over 177 deaths, displaced over 600000 people from their homes and impacted the lives of over 2.4 million people in the region of Rio Grande do Sol, Brazil, an area equivalent to that of the United Kingdom [19]. Clinical trials at BIG

member Latin America Clinical Oncology Group's trial units were impacted in the worst climate disaster in the history of Southern Brazil [20,21]. Conventionally, climate change was considered to have been caused by the Global North and suffered by the Global South [22]. The present survey shows that climate change's impacts are increasingly global, and that current global warming at a level of 1.5 °C [23,24], is disrupting cancer care. Environmental experts highlight that these events such as super-hot wildfires, extreme precipitation events and particularly short duration rainfall events, will increase as the earth warms [23,24]. In Porto Alegre, precipitation is forecast to increase by 86 % in the next 80 years [25]. Learnings from these events will be important in integrating environmental resilience into clinical research,

analogous to that resulting from weather events such as Hurricane Katrina [26]. For the clinical research community these reports exemplify how the physical and psychological distance between climate change and the delivery of cancer care is reducing, which may serve to amplify engagement intentions [27].

Our findings highlight a significant level of existing engagement in both workplace and trial specific sustainability initiatives at all levels within the BIG community, including the development of carbon footprinting tools for academic trialists, which is a prerequisite for integrating sustainability into the conduct of publicly funded trials [28,29]. The availability of these tools will promote environmental impact assessments, thereby permitting carbon touch point identification and mitigation. In their analysis of social tipping dynamics for stabilizing the Earth's climate by 2050, Otto and colleagues highlighted that strengthening climate education and engagement, and disclosing information on greenhouse gas emissions were 2 of 6 important tipping points [30]. Initial results from the use of these tools has also increased awareness of less evident environmental touch points such as correlative laboratory studies, and data storage, and data linkage [31]. Its integration resonates with calls to include environmental analysis with carbon footprinting as a trial endpoint [32]. Alignment and coordination between and across all stakeholders (including funders, regulators and publishers) within the clinical research system is also needed to facilitate this necessary development [33].

The survey shows widespread use of telemedicine, digitization of records and remote/central monitoring, a trend accelerated by the COVID-19 pandemic. Such measures are welcome. A typical clinical trial with 2000 patients visiting one of 10 study sites on 9 occasions would require a total of 164,000 sheets of paper for case reports and forms, the study master file and site files [34]. Full digitization of a clinical trial reduces trial associated emissions by over 90 % [34].

It is evident in the survey that engagement with host institutions have facilitated sustainability integration measures such as travel policies and procurement. This may be partly related to the fact that, in contrast to clinical research where certification is developing [35], sustainability initiatives in laboratory based research are well established. There are initiatives such as the LEAF (Laboratory Efficiency Assessment Framework), launched in 2021 and adopted in 15 countries includes an online tool that researchers can use to estimate the environmental impact of their labs and track improvements. Laboratories can become LEAF accredited at three different levels [36]. My Green Lab, a non-profit organisation, established in 2013 includes ambassador and accreditation programs to create a culture of sustainability through science [37]. Recently the Million Advocates for Sustainable Science letter-signing campaign, co-ordinated by My Green Lab and the International Institute for Sustainable Laboratories, has urged funders around the world to set expectations for efficiency and sustainability in research methods [38]. Several respondents in the survey highlighted these initiatives. The proximity and networking between these clinical and laboratory based research communities represents an opportunity to cascade these initiatives into the clinical arena.

Clinical research guides cancer care. The sustainability initiatives outlined in this report resonate with initiatives to streamline clinical research, reducing the over 3 million data points collected in an average randomised clinical trial, to more pragmatic designs [39]. They also resonate with research focusing on less intense, but equally effective, treatment schedules. For instance, in Canada, 25 % of healthcare's greenhouse gas emissions are generated by pharmaceuticals [40]. Strategies to reduce treatment schedules translate into reduced time, financial and climate toxicities for patients. Cancer clinical trial organisations are critically placed to take a leading role in mitigating the climate change impact of health care. The collaborative nature of cancer clinical trial organisations such as BIG can reduce research waste and its associated climate impacts by decreasing research redundancy [41]. Their funding model [9] permits the use of sustainability requirements and resourcing in applications analogous to what has been used by

funders to accelerate gender equality in research [42]. During the COVID-19 pandemic the added value of leveraging the right to the benefits of science through vaccinations and clinical trials to advance the right to health agenda was demonstrated [43]. Similar leveraging of the clinical research enterprise to accelerate more sustainable health-care is needed now given the magnitude of the challenges we face.

The aim of this survey was to gain insight into the impact of climate change, and the level of engagement with sustainability initiatives, in clinical trials in breast cancer through a global lens. Despite proactive engagement 28 groups did not respond to the survey, which is concerning for the non-engagement that it represents. Additional concerns include that over half of the respondents were based in Europe, and that a non-validated survey was used both of which limit the external generalisability of the survey regarding the extent of workplace and trial sustainability engagement reported and cross survey comparisons. Nonetheless the survey highlights the challenges of developing a climate responsive clinical research eco-system and mirrors challenges to climate action present in society [44]. Equally, staff attitudes and lack of engagement were noted as challenges to sustainability integration by respondents. The study did not explore climate anxiety or beliefs about whether individuals or organisations felt their actions would not make a difference, but did identify time, training and resourcing as barriers to involvement. Similar to other studies of sustainability empowerment by health care professionals, time is an endemic problem for individuals [16]. A survey of 1853 researchers from 127 Universities based in the United Kingdom was concordant with these findings [45]. High workload, uncertainty about what actions to take, perceived lack of agency or power, inflexible university policies and pressure to travel were some of the barriers identified. Of these, high workload was identified as the main barrier to action by over half of respondents.

While the environmental tragedies outlined can serve as trigger events in which perception of climate risk and the need to integrate sustainability measures is more favorably viewed, they are not sufficient by themselves [46]. It has been long understood by both behavioural scientists and healthcare professionals that even highly motivated people often don't engage with actions that are consistent with their motivations [16]. Removing or reducing the barriers that make the recommended action difficult facilitates engagement [47]. In the present study, finance, training and resourcing were identified as barriers and facilitators to involvement. Similarly, a study of climate engaged physicians in Canada highlighted the role of education and translational supports to guide climate impact reduction strategies in healthcare [48]. At Cancer Trials Ireland (a BIG member group), a climate change charter has been developed by staff and patients to provide a toolkit for sustainability integration, including additional organisational touch points such as pension providers [49,50].

Clinical trials and those associated with them are agents for change within health systems. Involvement of this group can act as a social tipping element [30]; an action with potential to accelerate spread of new behaviours, social norms, and structural reorganisations. BIG was founded 25 years ago when the challenges of climate change were less evident. Since then over 500, 000 people have died due to climate change intensified weather events, and economic losses from climate change have been estimated at \$23 trillion due to premature mortality, healthcare expenditure and healthcare related work loss [51–53]. Testimonies from those impacted by extreme weather highlight profound physical and mental impacts [54].

5. Conclusion

This survey demonstrates that for BIG members and the communities they serve, climate change has become a devastating reality. Unfortunately, the available scientific evidence indicates that climate change will become increasingly relevant in all communities [55–59]. In the past 25 years BIG has become an anchor organization in breast cancer research with a global network that could serve as a catalyst for

sustainability integration. Its members strongly consider that sustainability integration will and should be part of funding applications in the future. Indeed in the autumn of 2024, Cancer Research United Kingdom (CRUK) have integrated a question on sustainability in grant applications for the first time. The survey demonstrates enthusiasm for integration but concordant with surveys of other communities, demonstrates the need for funding streams to facilitate such integration and build a more climate responsible clinical research (and consequently clinically responsible) ecosystem [47,60–62].

CRedit authorship contribution statement

Seamus O'Reilly: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jessica Griffiths:** Writing – review & editing, Visualization, Validation, Software, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Lisa Fox:** Writing – review & editing, Visualization, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Catherine S. Weadick:** Writing – review & editing, Project administration, Methodology, Investigation, Conceptualization. **Nay My Oo:** Writing – review & editing, Methodology, Investigation, Data curation, Conceptualization. **Lucy Murphy:** Writing – review & editing, Project administration, Investigation, Conceptualization. **Robert O'Leary:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Theodora Goulioti:** Writing – review & editing, Resources, Project administration, Conceptualization. **Virginie Adam:** Writing – review & editing, Project administration, Investigation, Conceptualization. **Evangelia D. Razis:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Barbro Lindholm:** Writing – review & editing, Methodology, Conceptualization. **Gustavo Werustsky:** Writing – review & editing, Methodology, Conceptualization. **David Cameron:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Judith Bliss:** Writing – review & editing, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization.

Data availability

Data from the study are available from the corresponding author by request.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.breast.2025.104469>.

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