

# **The NIHR Carbon Reduction Guidelines**

## Foreword

**As the largest organisation in the UK, the NHS has made a commitment to meet the targets set by the Climate Change Act, through the publication of the Carbon Reduction Strategy for the NHS in England. Research is a core part of the NHS and the National Institute for Health Research (NIHR) must play a role in reducing the carbon emissions from health research.**

The NIHR Carbon Reduction Guidelines have been developed by researchers for researchers, with input from stakeholders across the NIHR. The document highlights areas where sensible research design can reduce waste without adversely impacting on the validity and reliability of research. I thank Professor Ian Roberts, the NIHR Carbon Guidelines Working Group and everyone involved in bringing the guidelines together.

The NIHR supports outstanding research and it is important that we continue to support excellence and act responsibly towards the environment. I therefore welcome the NIHR Carbon Reduction Guidelines, demonstrating how the principles of good carbon management and sensible study design can apply to many studies funded by the NIHR, reducing our carbon footprint without increasing the administrative burden to researchers.



A handwritten signature in black ink that reads "Sally C Davies". The signature is written in a cursive, flowing style.

Professor Dame Sally C Davies

Director General of Research and Development  
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## Executive Summary

### *The NIHR needs Carbon Reduction Guidelines*

The provision of healthcare, like other sectors of the economy, results in the emission of greenhouse gases into the atmosphere. The NHS has a carbon footprint of about 21 million tonnes of CO<sub>2</sub> per year, representing around 25% of public sector greenhouse gas emissions. Health research is central to the delivery of high quality healthcare within the NHS and the research community must take appropriate steps to minimise greenhouse gas emissions from research activities. As the leading funder of health research in the NHS, the National Institute for Health Research (NIHR) must play a role in reducing carbon emissions from health research. The NIHR Carbon Reduction Guidelines are for researchers conducting research funded by the NIHR outlining approaches to help reduce carbon emissions from health research.

### *Health research helps patient care and the environment*

High quality health research ensures that only safe and effective healthcare interventions are used. By providing unbiased and reliable evidence on the safety and effectiveness of interventions, high quality health research protects NHS patients from harm whilst also protecting the global environment from unnecessary waste. Health research therefore not only plays a key role in patient care but also helps to protect the environment.

### *The NIHR Carbon Reduction Guidelines are for researchers*

The guidelines outline strategies to reduce the carbon emissions from health research. Because most publicly funded health research is conducted in NHS hospitals and universities, general institutional strategies to reduce carbon emissions would also reduce the carbon emissions from health research. However, strategies to reduce carbon emissions from buildings and from travel to work have been outlined in previous guidance and are not considered here.

The focus of the guidelines is on how methodological and practical aspects of health research impact on the associated carbon footprint. It has been developed in consultation with clinical researchers and methodologists from across the NIHR. The guidelines provide a framework, rather than mandatory guidance, to identify areas where sensible research design can reduce waste without adversely impacting on the validity and reliability of research.

Case studies are drawn from clinical trials to provide illustrative examples of the principles of good carbon management and sensible clinical study design, but the principles apply to all research funded by the NIHR, not just clinical trials.

The recommendations of the document fall under two main headings: sensible study design and reducing the environmental impact of the NHS through research. A summary of the recommendations for researchers is shown in Table 1.

*The NIHR Carbon Reduction Guidelines are a first step*

Sensible research design can reduce carbon waste and these guidelines are an important and necessary first step to help shrink the carbon footprint of research funded by the NIHR. Further research is required to estimate with greater accuracy the carbon footprint of NIHR funded studies, to understand the carbon impact of NIHR research infrastructure and to estimate the dividends of strategies for reducing carbon production in research.

## NIHR Carbon Guidelines: Key recommendations for researchers

<b>Setting the research question and making full use of existing evidence</b>	
1	Involve patients and clinicians in shaping applied research agendas and specific questions
2	Carry out systematic reviews of existing evidence before submission of new grant proposals
<b>Efficient study design</b>	
3	Make good use of resources such as patient populations and patient time
4	Consider whether it is possible to answer several questions through one study (factorial design)
5	Involve methodologists in the design of research
<b>Study set up and conduct</b>	
6	Where appropriate, engage with the NIHR networks, other researchers and research managers to facilitate study set up and progression
7	Work with the appropriate NIHR Topic Specific or Comprehensive Local Research Network if this can facilitate setup and recruitment of research participants. In addition, work with those directly involved in recruitment (e.g. patients, clinicians and network staff) to optimise procedures for recruitment and retention
<b>Avoiding unnecessary data collection</b>	
8	Study protocols should clearly set out what will be measured, when it will be measured, and how the measures will be used in the analysis, as illustrated in shell/dummy tabulations
9	Outcomes should be measured remotely by phone, mail, or the internet whenever possible
10	When patient contact is necessary, outcome assessors and patients should be geographically close together where possible
11	Depending on the study, not all outcomes need to be measured in all patients at all times
<b>Sensible clinical trial monitoring</b>	
12	Focus on issues that are critical for the safety and wellbeing of study participants and the reliability of the results
13	Avoid inefficient or ineffective monitoring practices, particularly those that require extensive travel to sites
14	Use centralised, systematic methods to assess quality and identify issues
15	Site visits should be targeted to sites where there are concerns or a need for additional training
<b>Good practice in reporting research</b>	
16	Set the results of new primary research in the context of updated systematic reviews of other relevant research
17	Ensure that reports of research contain the information needed to make them usable to readers
<b>Reducing the environmental impact of the NHS through research</b>	
18	Ensure that the results of research are rapidly and appropriately disseminated
19	Where appropriate, consider assessing the environmental impact of proposed interventions or changes in service provision within research studies

Table 1: Summary of the recommendations for researchers

# The NIHR Carbon Reduction Guidelines

## 1. Introduction

High quality health services are central to society's efforts to tackle the challenges posed by disease and ill health. However, the provision of healthcare, like other human activity, results in the emission of greenhouse gases, the build-up of which threatens the integrity of the ecosystems on which our health depends. The NHS has a carbon footprint of about 21 million tonnes of CO<sub>2</sub> per year which represents about 25% of public sector greenhouse gas emissions. Health services must therefore minimise their impact on the global environment and the NHS Carbon Reduction Strategy, published in 2009, sets the ambition for the NHS "to play a leading and innovative role in ensuring the shift to a low carbon society" and documents how this will be achieved<sup>1</sup>. The National Institute for Health Research (NIHR) will play its part in supporting the NHS in this task.

High quality health research, by ensuring that only safe and effective healthcare interventions are used, plays a key role in improving patient care but also helps to protect the environment. For example, a significant part of the carbon footprint of the NHS is related to greenhouse gas emissions arising from the production of pharmaceuticals<sup>1</sup>. By providing unbiased and reliable evidence on the safety and effectiveness of pharmaceuticals, high quality health research protects NHS patients from harm whilst also protecting the global environment from unnecessary waste. Ensuring that only safe and effective treatments are used within the NHS is therefore good for both patients and the environment and this is what high quality health research aims to achieve.

The health research endeavour must take appropriate steps to minimise greenhouse gas emissions from research activities. The need to exercise caution in the conduct of research that may harm the environment is enshrined in the World Medical Association (WMA) Declaration of Helsinki.

This document is aimed at researchers conducting research funded by the NIHR and outlines some approaches for reducing the greenhouse gas emissions from health research.

## 2. The need to reduce greenhouse gas emissions

Climate change is a reality. Greenhouse gases are changing the global climate, with serious implications for human health and for the integrity of the ecosystems on which human life depends. The Intergovernmental Panel on Climate Change predicts an increase of between 1.5°C and 6°C by 2100 depending on the extent of future emissions.

The possible consequences for the environment and for human health could be extremely serious. There are uncertainties in climate change predictions, particularly in regard to the timing, extent, regional patterns and health impacts of climate change, but it would be inappropriate to wait until there was complete scientific certainty. Decisions have to be made now on the basis of the best available information.

We must do all we can to restrict any rises to 2 degrees or less in order to minimise the risk of severe climate change with the health consequences that would entail. In recognition of this urgency, Parliament has passed the Climate Change Act, which stipulates that carbon emissions must be cut by at least 80% by 2050, with a minimum reduction of 26% by 2020.

### **3. Reducing the environmental impact of health research**

The release of greenhouse gases into the atmosphere has a global effect although it is now increasingly recognised that global warming will have a far greater impact on poor people living in poor countries<sup>2</sup>. Because the environmental impacts of health research have the potential to affect everyone, including future generations, it is important that the questions that health research studies seek to answer should have the widest possible patient and public relevance and that new knowledge produced by health research should be made publicly available.

Exercising appropriate caution in the conduct of research that may harm the environment would imply that new research should only be conducted if the answer to the research question is not already known. Environmental considerations thus reinforce the scientific and ethical arguments that all new studies should be underpinned by a systematic review of the existing research. Because the conduct of a scientifically valid systematic review requires that the existing research is publicly accessible, environmental considerations underscore the importance of good publication practice.

Healthcare itself is a major source of carbon emissions, therefore by ensuring that only safe and effective healthcare is provided, health research plays an important role in improving patient care and avoiding medical waste. The number of clinical study participants is typically only a fraction of the patient population, and the duration of most studies is often much shorter than that of the disease and any subsequent complications. As a consequence, the carbon cost of obtaining reliable information from well-conducted clinical studies is likely to be dwarfed by that of using treatments that are ineffective or potentially unsafe.

The aim of health research is to provide information that will improve patient care. When generating information, researchers should endeavour to minimise the environmental harm caused by their activities. Of course, these endeavours should not compromise the scientific validity of the research, since biased or unreliable research cannot be justified on scientific, ethical or environmental grounds. However, as outlined in this document, there are many ways that researchers can minimise the environmental impact of health research without compromising scientific validity.

### **4. What do we know about the environmental impact of health research**

Two recent studies have quantified the greenhouse gas emissions from clinical research<sup>3,4</sup>.

*Pragmatic trials funded by NIHR:* A 2009 study calculated the CO<sub>2</sub> emissions from a sample of twelve randomised controlled trials (RCTs) funded by the NIHR Health Technology Assessment (HTA) programme, a leading funder of research in the NHS. The average CO<sub>2</sub> emission per RCT was 78.4 tonnes,

corresponding to 306 kg of CO<sub>2</sub> per randomised participant. Across all of the trials, trial team commuting to work accounted for the most CO<sub>2</sub> emissions (26%), followed by fuel use at trial centres (23%) and trial team related travel (19%). Participant travel accounted for 16% of emissions, while trial technologies and IT equipment accounted for 14% and 2% of emissions respectively.

*The MRC CRASH Trial:* The CRASH trial was a multi-centre international randomised controlled trial of the effect of corticosteroids on death and disability in 10,008 adults with head injury. The trial generated a total of 630 tonnes of CO<sub>2</sub>, corresponding to 63 kg of CO<sub>2</sub> per randomised participant. The trial centre accounted for the largest proportion of emissions (39%) followed by distribution of trial materials (28%) and trial related travel (23%). Just over 45 of the 50 tonnes of carbon dioxide equivalent emissions associated with the coordination centre were from the use of electricity. Most (94%) of the emissions related to travel were from air travel and hotel stays for site visits, on-site data verification, and collaborators' meetings. Although only 22% of the air travel mileage was short haul, because it produces more greenhouse gases per mile than long haul travel, it accounted for 31% of air travel emissions. Most (97%) emissions from the distribution of drugs and documents were from air freight of treatment packs and documents to hospitals.

## **5. What can NIHR researchers do to reduce carbon emissions?**

This document outlines strategies to reduce the carbon emissions from health research. Because most publicly funded health research is conducted in NHS hospitals and universities, general institutional strategies to reduce carbon emissions would also reduce the carbon emissions from health research. In both of the carbon audits outlined above, energy use by the trial centres and trial team commuting were important sources of carbon emissions. However, strategies to reduce carbon emissions from buildings and from travel to work have been outlined in previous guidance such as the NHS Carbon Reduction Strategy for England<sup>1</sup> and so are not considered here.

The focus of this document is on how methodological and practical aspects of health research impact on the associated carbon footprint. It has been developed in consultation with clinical researchers and methodologists from across the NIHR. The document provides a framework to identify areas where sensible research design can reduce waste without adversely impacting on the validity and reliability of research. Many of the case studies are drawn from clinical trials to provide illustrative examples, rather than mandatory guidance, but the principles of good carbon management and sensible clinical study design apply to many studies funded by the NIHR.

## 5.1 Sensible study design

### 5.1.1 *Setting the research question and making full use of existing evidence*

#### **Rationale**

Answering the research questions that are most important to patients<sup>5</sup>, making the best use of the available evidence before conducting new research and requiring that scientists cumulate scientifically through the continuous updating of systematic reviews will help to minimise the environmental harms of research as well as improving its scientific quality.

In the HTA Programme, 154,081 participants are currently involved in clinical trials. At an average of 306.2 kg of CO<sub>2</sub> per participant<sup>3</sup>, this equates to over 47 thousand tonnes of CO<sub>2</sub>. The carbon cost of conducting randomised controlled trials highlights the need to ensure that existing evidence is used to the full. A number of questions of importance to clinicians and patients could potentially be answered using existing evidence. Adopting such an approach may help reduce carbon emissions associated with the production of research evidence. Based on the methods reported by Lyle et al.<sup>3</sup>, the average carbon footprint of 14 evidence synthesis projects currently ongoing within the HTA portfolio was estimated<sup>6</sup>. The average CO<sub>2</sub> emission generated by an evidence synthesis project was 10.1 tonnes. This figure is nearly 13% that of the emissions from a clinical trial and is the equivalent saving of taking 27 cars off the road.

#### **Key recommendations for researchers:**

- 1 Involve patients and clinicians in shaping applied research agendas and specific questions;
- 2 Carry out systematic reviews of existing evidence before submission of new grant proposals.

### 5.1.2 *Efficient study design*

#### **Rationale**

'Efficiency' in trial design often relates to statistical efficiency, in other words, getting as much information on the question(s) of interest as possible within a given sample size. However, more generally, efficient trials make good use of scarce resources, such as patient populations, patients' time and resources. Sometimes it is possible to answer several questions though one trial, which, in addition to the efficiencies already described, can also yield a carbon saving relative to answering the components via separate studies through the use of common procedures such as follow-up visits, monitoring and so on.

There are currently 125 ongoing trials funded by the HTA programme, which would generate around 9,800 tonnes of CO<sub>2</sub> (125 x 78.4 tonnes<sup>3</sup> CO<sub>2</sub> per trial). However, only a small percentage of these trials are factorial trials.

### Key recommendations for researchers

- 3 Make good use of resources such as patient populations and patient time;
- 4 Consider whether it is possible to answer several questions through one study (factorial design);
- 5 Involve methodologists in the design of research.

#### Case Study

The Women's Health Initiative (WHI)<sup>7</sup> addressed three questions in preventive medicine simultaneously by offering each participant multiple randomizations (a 'factorial' structure), as well as building in an observational study. The WHI study had three components: an RCT, an observational study, and a community prevention study. The RCT enrolled a total of 68,132 postmenopausal women. By applying the figure for the average CO<sub>2</sub> emission per randomised participant obtained in the NIHR study<sup>3</sup> (306 kg CO<sub>2</sub> per randomised participant), we estimated that this trial would have generated about 20,850 tonnes of CO<sub>2</sub>. The WHI study, however, had three study components. Eligible women could choose to enrol in one, two, or all three of the components:

*Hormone Therapy (HT):* This component examined the effect of HT on the prevention of heart disease and osteoporosis, and any associated risk for breast cancer. Women participating in this component took hormone pills or a placebo (inactive pill). (*n*=27,347)

*Dietary Modification:* The Dietary Modification component evaluated the effect of a low-fat, high fruit, vegetable and grain diet on the prevention of breast and colorectal cancer and heart disease. Study participants followed either their usual eating pattern or a low-fat eating program. (*n*=48,835)

*Calcium/Vitamin D:* This component started up to 2 years after a woman joined one or both of the other studies. It evaluated the effect of calcium and vitamin D supplementation on the prevention of osteoporosis-related fractures and colorectal cancer. Women in this component took calcium and vitamin D pills or a placebo. (*n*=36,282)

If these studies had been carried out individually, recruiting separately 112,464 participants, then using the NIHR estimate of CO<sub>2</sub> emissions per participant, a total of 34,400 tonnes of CO<sub>2</sub> would have been emitted. Encouraging women to enrol in more than one study therefore resulted in a saving of about 13,550 tonnes of CO<sub>2</sub>.

### 5.1.3 Study set up and conduct

#### Rationale

Major components of CO<sub>2</sub> production by trials, such as study centre fuel use and trial team travel<sup>3</sup>, are related to the time it takes to complete a study. Timely delivery of a trial's findings would thus not only lead to early benefits for patients and the NHS through evidence-informed decision making but also substantially limit the associated carbon production. Currently, trials commonly take longer than anticipated, with reports of as many as 50% having time extensions due to a failure to achieve their original recruitment target<sup>8</sup> or because of bureaucratic obstacles. While important steps have been taken to provide a more efficient research environment, such as the introduction of the Integrated Research Application System [IRAS], the NIHR

Coordinated System for gaining Research Permission [CSP], and the Research Passport, delays remain, the reasons for which are multiple and sometimes complex.

Failure to recruit on schedule is a major reason for study delay. The success of the Cancer Research Network in promoting recruitment to trials has led to the development of six further NIHR topic specific networks which cover much of England and Local Comprehensive Research Networks covering all areas. The primary role of these networks is to work with researchers to facilitate the delivery of high quality studies and there are encouraging signs of a positive effect on recruitment in those studies which have been adopted by the networks. Involvement of patients and public as well as relevant clinicians from appropriate disciplines in all aspects of study design and delivery is likely to improve recruitment and retention.

### **Key recommendations for researchers**

- 6 Where appropriate, engage with the NIHR networks, other researchers and research managers to facilitate study set up and progression;
- 7 Work with the appropriate NIHR Topic Specific or Comprehensive Local Research Network if this can facilitate setup and recruitment of research participants. In addition, work with those directly involved in recruitment (e.g. patients, clinicians and network staff) to optimise procedures for recruitment and retention.

#### ***5.1.4 Avoiding unnecessary data collection***

##### **Rationale**

Measuring patient outcomes is a key component of clinical studies and decisions about when, where, in whom and how to do this will impact on the carbon footprint of the trial. Many studies collect more outcomes and at more time points than are ever used in the analysis. This is not only bad science, leading to potential bias in the selection of outcomes, but produces unnecessary carbon. Study protocols should therefore clearly set out what will be measured, when it will be measured, and how the measures will be used in the analysis, and any redundancy should be avoided. A useful way of distinguishing essential data collection is to draft shell/dummy tabulations as part of the study protocol.

Outcomes should be measured remotely by phone, mail, or the internet whenever possible. When patient contact is necessary, outcome assessors and patients should be close together using, for example, local GP surgeries to measure outcomes rather than in centres remote from patients.

Information about the occurrence and nature of many outcomes can be obtained via record linkage (with participant consent) with routine data, as has been done in a number of previous clinical trials, such as the MRC/BHF Heart Protection Study<sup>9</sup> and the West of Scotland Coronary Prevention Study<sup>10</sup>. The NHS Connecting for Health Research Capability Programme plans to provide a means of linkage to data on death, cancer, hospital admissions, prescription medicines, and procedures (such as renal dialysis or transplantation).

**Case study**

An HTA trial comparing 3 different treatments required each patient to visit the hospital a total of 24 times to have their dressings changed. This resulted in over 3394 hospital visits. We assumed that the average distance travelled for a secondary care visit was 17.4 km<sup>11</sup> and, using a standard conversion factor of 0.25 to calculate the CO<sub>2</sub> emissions per kilometre travelled<sup>1</sup>, calculated that patient travel in this trial produced 14.8 tonnes of CO<sub>2</sub>. By contrast, the average distance travelled for primary care visits is only 2.4 km<sup>3</sup> therefore changing the dressings locally at a GPs surgery would have produced 2.04 tonnes of CO<sub>2</sub>, saving 12.76 tonnes of CO<sub>2</sub>.

Not all outcomes may need to be measured in all patients at all times. When trials are powered on dichotomous outcomes, secondary continuously measured outcomes might be measured on a smaller sub-sample<sup>5</sup>.

**Key recommendations for researchers**

- 8 Study protocols should clearly set out what will be measured, when it will be measured, and how the measures will be used in the analysis, as illustrated in shell/dummy tabulations;
- 9 Outcomes should be measured remotely by phone, mail, or the internet whenever possible;
- 10 When patient contact is necessary, outcome assessors and patients should be geographically close together where possible;
- 11 Depending on the study, not all outcomes need to be measured in all patients at all times.

**Case study**

In the ongoing Study of Heart and Renal Protection (SHARP), blood lipids were measured centrally at 1 year in only 10% of the 9438 participants at around 30% of the 380 participating hospitals in 18 countries. In the same study, measurements of liver and kidney function (safety assessments) have been made at every visit (an average of 10 visits per participant), but are measured in the local hospital laboratory, obviating the need for transport of over 900,000 samples from the site.

**5.1.5 Sensible clinical trial monitoring****Rationale**

In all clinical studies it is essential that the rights, wellbeing and safety of participants are maintained whilst ensuring that the data are sufficiently reliable to allow appropriate conclusions to be drawn. Although guidelines and regulations (such as ICH-GCP) permit flexibility in how studies are monitored, the traditional approach has been to rely on frequent site visits by clinical trial monitors, despite no convincing evidence on the effectiveness of this strategy. As a consequence, monitoring procedures have become increasingly expensive, bureaucratic and inefficient, making it harder for studies to succeed in answering important questions, whilst adding substantial financial and carbon cost. For studies of common disorders with hard clinical outcomes, undue emphasis on minor data or procedural discrepancies (often entailing frequent site visits) are usually counter-productive. It may be more efficient to

recruit a larger number of participants and use less intensive monitoring. Any monitoring that takes place must be effective in identifying and rectifying relevant problems, rather than simply checking aspects that are easy to inspect.

Quality should be “designed-in” to studies from the outset. The protocol, study procedures and data collection systems should be streamlined and focused. For example, only collecting data relevant to important baseline characteristics and clinical events; using computerised systems to enforce the protocol and to check completeness and validity of data (rather than relying on post hoc detection and correction of mistakes); avoiding re-keying of data by using electronic approaches to data transfer; and making full use of information already stored on routine systems, including laboratory data, clinical records and disease registries.

### **Key recommendations for researchers**

- 12 Focus on issues that are critical for the safety and wellbeing of study participants and the reliability of the results;
- 13 Avoid inefficient or ineffective monitoring practices, particularly those that require extensive travel to sites;
- 14 Use centralised, systematic methods to assess quality and identify issues;
- 15 Site visits should be targeted to sites where there are concerns or a need for additional training.

### **Case study**

The international WOMAN trial<sup>12</sup> aims to recruit 15,000 women with post partum haemorrhage over 4 years. Patients will be recruited from about 400 hospitals in 40 countries. According to ICH-GCP “there is a need for on-site monitoring, before, during, and after the trial.” Such an approach in the context of a trial like WOMAN would mean a minimum of three site visits to all 400 hospitals, a total of 1,200 visits. However, by using a streamlined clinical trial protocol, an experienced network of trial collaborators, and multiple methods of providing training, including a video available on Youtube ([www.youtube.com/watch?v=azFdyjyS-HQ](http://www.youtube.com/watch?v=azFdyjyS-HQ)), conference calls and on-line GCP training, the number of site visits can be dramatically reduced. The need for monitoring will be informed by the results from routine data checks and statistical data monitoring so that on site monitoring is conducted only where indicated.

In previous, similar trials, the use of such methods has meant that on-site monitoring is conducted in around 10% of hospitals. Based on unpublished data from the CRASH2 study regarding travelling distances, if all hospitals were visited three times, the carbon cost would be about 312.6 tonnes. However, if as a result of the use of extensive distance training, central monitoring of consent procedures, and statistical data monitoring, only 10% of hospitals were visited once only, the carbon cost would be reduced to about 4.8 tonnes, representing a saving of 307.8 tonnes of carbon. This carbon saving would be the equivalent to that emitted by 226 round trip flights between London and New York. Additional carbon savings could also be achieved by reductions in transport for study materials (such as study medication, documents and equipment).

### **5.1.6 Good practice in reporting research**

#### **Rationale**

Insisting on good scientific practice in the reporting of research evidence is entirely compatible with reducing the carbon intensity of clinical research<sup>13</sup>. Lyle et al.<sup>3</sup> estimated that the average CO<sub>2</sub> emission of randomised trials is 78.4 tonnes. This carbon cost occurs whether or not a trial is published. The environmental cost of under-reporting of research is in addition to its scientific and ethical costs.

#### **Key recommendations for researchers**

- 16 Set the results of new primary research in the context of updated systematic reviews of other relevant research;
- 17 Ensure that reports of research contain the information needed to make them usable to readers.

#### **Case study**

Poor publication practice can have serious environmental consequences. We estimate that every year, at least 12,000 trials are completed but remain unpublished. Using the recently published figure for the average CO<sub>2</sub> emissions per clinical trial of 78.4 tons<sup>3</sup>, we estimate that just under a million tons of carbon dioxide is wasted every year (12,000 x 78.4 = 940,800) in conducting clinical trials that do not contribute to the scientific knowledge base. This is equivalent to the carbon emissions from about 800,000 round trip flights between London and New York.

### **5.2 Reducing the environmental impact of the NHS through research**

#### **Rationale**

Using ineffective interventions or failing to use effective ones can lead to inefficient use of NHS resources, consequently resulting in a negative impact on the environment. Good research which is appropriately communicated to NHS decision makers can be seen as a carbon sparing technology.

Moreover, if policy makers are to make sustainable decisions, it is important that they are able to consider the environmental impact of proposed interventions and services alongside clinical and cost effectiveness. Researchers can facilitate this decision making by considering the environmental impact when evaluating interventions. This is likely to be particularly important where comparisons of different patterns of service provision are being carried out.

#### **Key recommendations for researchers**

- 18 Ensure that the results of research are rapidly and appropriately disseminated.
- 19 Where appropriate, consider assessing the environmental impact of proposed interventions or changes in service provision within research studies.

## **6. Conclusions**

These guidelines demonstrate how researchers in the NIHR can reduce the carbon footprint of health research. This document provides a framework with illustrative examples, rather than mandatory guidance. Sensible research design can reduce carbon waste and these guidelines are an important and necessary first step to help shrink the carbon footprint of research funded by the NIHR. Further research is required to estimate with greater accuracy the carbon footprint of NIHR funded studies, to understand the carbon impact of NIHR research infrastructure and to estimate the dividends of strategies for reducing carbon production in research.

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# Background and Methods

## A. Background and scope of the project

- i The NIHR Carbon Reduction Guidelines project was instigated at the request of Professor Dame Sally C. Davies, Director General of R&D Department of Health. It built on NETSCC's audit of the carbon cost of HTA trials, published as *Carbon cost of pragmatic randomised controlled trials: retrospective analysis of sample of trials* (BMJ; 2009; 339:b4187).
- ii The NIHR Carbon Reduction Guidelines are aimed at researchers conducting research funded by the NIHR. The focus of this document is on how methodological and practical aspects of health research impact on the associated carbon footprint. The document provides a framework to identify areas where sensible research design can reduce carbon emissions without adversely impacting on the validity and reliability of research. The document does not cover broader sustainability issues nor does it deal with research into how to reduce the carbon costs of healthcare.

## B. Development of the guidelines

- i A working group, chaired by Professor Ian Roberts from the London School of Hygiene and Tropical Medicine (LSHTM), was set up to develop the guidelines. Membership of the working group included:
  - o Professor Deborah Ashby, Chair in Medical Statistics and Clinical Trials, Imperial College London
  - o Sir Iain Chalmers, James Lind Initiative
  - o Professor Ray Fitzpatrick, Programme Director, NIHR HSR Programme
  - o Professor Adrian Grant, Director, NIHR Programme Grants for Applied Research
  - o Dr David King, Director, NIHR Central Commissioning Facility
  - o Dr Martin Landray, Reader in Epidemiology, MRC/Cancer Research UK/BHF Clinical Trial Service Unit & Epidemiological Studies Unit, University of Oxford
  - o Professor Stuart Logan, Professor of Paediatric Epidemiology and Director, Institute of Health Service Research, Peninsula College of Medicine & Dentistry
  - o Professor Jon Nicholl, Deputy Director NIHR Health Technology Assessment Programme, and Chair, HTA Commissioning and Clinical Trials Boards
  - o Dr David Pencheon, Director NHS Sustainable Development Unit.
- ii The Working Group was supported by a secretariat at NETSCC:
  - o Dr Ruairidh Milne, Director of External Relations
  - o Dr Alison Mortlock, Senior Programme Manager (Project manager)
  - o Dr Lisa Cashmore, (Project support)
- iii The working group met on three occasions, once by teleconference.
- iv An early draft of the guidelines was presented at a workshop on the 22<sup>nd</sup> January 2010 attended by clinical researchers, methodologists and other

senior experts from across the NIHR and chaired by Professor Roberts. The purpose of the workshop was to obtain input and advice from senior researchers and representatives from across the NIHR regarding the content of the NIHR carbon guidelines.

- v A full account of the feedback from the workshop is available at: [www.netscc.ac.uk/supporting\\_research/carbon\\_guidelines.asp](http://www.netscc.ac.uk/supporting_research/carbon_guidelines.asp)
- vi The guidelines were revised to incorporate feedback from the workshop before circulation to a wider audience during an electronic consultation phase.
- vii The guidelines and a link to an electronic questionnaire were e-mailed to 300 NIHR stakeholders (including communication leads for further dissemination). The consultation period was open for two weeks and forty nine people took part in the online survey (an estimated response rate of 14%).
- viii The online questionnaire consisted of twelve questions, of which seven contained multiple choice answers. The responses in the free-text boxes included some very thoughtful and constructive comments and the project team is extremely grateful to those who took the time to complete the survey. The responses to the questionnaire, together with a brief summary of some key points from the free-text responses, are available at: [www.netscc.ac.uk/supporting\\_research/carbon\\_guidelines.asp](http://www.netscc.ac.uk/supporting_research/carbon_guidelines.asp)
- ix Certain elements of the feedback were considered out of scope of the guidelines but captured as areas for future development.

The feedback was reviewed by the Chair of the working group and the project team. The guidelines were revised to incorporate feedback from the electronic consultation phase where appropriate. In addition, revisions were carried out where there was a lack of clarity or potential misunderstandings.

