Climate Change Mitigation in England's Healthcare Sector
Doctors' efforts to enact change 2008-2020

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1   Introduction

This report summarises the findings of a research study about how doctors in England attempted to reform medical practice to reduce the carbon footprint of the healthcare sector between 2008 and 2020[1]. It documents the experiences of doctors who took pioneering actions to embed climate change mitigation and environmental sustainability as integral elements of good medical practice. It presents a snapshot of the activities that have resulted in the institutionalisation of sustainable healthcare as a key priority for the country's National Health Service (NHS).

The study examines how eighteen doctors at different stages of their professional careers, belonging to different clinical specialties, holding a range of official positions, have sought to reduce the greenhouse gas (GHG) emissions of the country's healthcare system, without compromising on patient safety or quality of care.

Using qualitative research methods, the study analyses:

(a) How they perceived the need to reform medical practice to contribute to climate change mitigation, and became motivated to take action for change

(b) How they conceptualised and planned reform initiatives

(c) How they enacted reform

(d) What enabling conditions and barriers they encountered in the process

(e) How they regard the consequences of their efforts, and envision future action

The study highlights how clinicians' efforts for change between 2008, when the UK Climate Change Act was passed, and 2020, when the NHS Net Zero Policy[2] was announced, contributed to climate change mitigation becoming a key priority for the National Health Service (NHS) in England. It documents the broad range of ideas and efforts used to enact change during this time. It offers valuable insights that can enhance ongoing efforts to create net zero healthcare systems in the UK and internationally.

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[1] In the context of this study, the term 'reform' refers to actions to improve medical practice and healthcare systems to achieve their existing goals (Keiffenheim, 2022). It emphasises efforts to improve current activities in the healthcare sector in England to ensure high quality care provision with Net Zero GHG emissions.

[2] Net Zero emissions means cutting greenhouse gas emissions to as close to zero as possible, with any remaining emissions re-absorbed from the atmosphere, by oceans and forests for instance. The NHS Net Zero policy reflects the commitment of NHS England as a corporate organisation to reduce its cumulative emissions to net zero by the year 2045.

2   Research Design

This project was designed and implemented as an 'interview study' (Bhattacharya, 2017; de Marrais, 2004; Kvale & Brinkmann, 2009). Interview studies investigate social realities through the interpretation and analysis of data collected from semi-structured, open-ended interviews. This research design was chosen to accommodate the health and safety requirements of the COVID-19 pandemic.

Study participants were selected using a reputational sampling strategy. Reputational sampling is a form of purposeful (as opposed to random) selection where research participants are selected on the basis of their reputation as experts or insiders in the community being studied (Denzin & Lincoln, 2005; Bhattacharya, 2017).

Based on their extensive knowledge of this field, collaborators at the Centre for Sustainable Healthcare recommended a pool of potential participants. These recommendations were assessed to create a final sample of participants whose experiences reflected 'maximum variation' in efforts for change; i.e. the broadest possible range of initiatives, enacted at different points in time, across clinical specialties, and at different levels of the healthcare system (Patton, 2007). Twenty doctors were invited to participate in the study, and eighteen of these accepted and were interviewed between June and August 2021[3].

Below are the main characteristics of doctors selected in the study sample:

- All participants have enacted efforts for change in the domains of clinical innovation, clinical leadership, and systemic reform

- Four participants began working in this area between 2006 and 2010; another four between 2011 and 2015; and the remaining eight after 2015

- Six participants were GPs, two were public health doctors, and 10 worked in secondary care (anaesthesia, internal medicine, infectious diseases, nephrology, psychiatry, surgery)

- At the time of interview, six participants were working as junior doctors, six as senior doctors, four as medical researchers, and two as healthcare system leaders

- Nine participants were male, and nine were female

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[3] Research studies that apply qualitative methods emphasise depth over breadth, and caution against the creation of large data sets that cannot be analysed in sufficient depth and result in thin, superficial conclusions. Accordingly, based on recommendations in the literature, this study is based on a sample of between 15-20 'analytical cases' (in this case, interview participants). This helps balance considerations of ensuring a manageable data collection process, and balancing tensions between the generalisability versus the richness of research data (Miles, Huberman & Saldaña, 2018).

- Fourteen participants were White, and the remaining four were British South Asian[4]

- Fourteen participants were from professional-middle class backgrounds, and the remaining four were from working class backgrounds[5]

3 Findings

The study's key findings are presented in the following sections. Observations from and analyses of interview data are discussed, interspersed with direct (anonymised) quotations from interviews to emphasise key evidence, ideas, and reflections.

3.1 What did doctors do?

(a) Clinical Innovation

Interviewed doctors made efforts to reform procedural and technical aspects of clinical practice to reduce GHG emissions. This includes:

(1) Incorporation of considerations about climate change mitigation into everyday work routines; for example:
- Consideration of social and environmental determinants of health in diagnostic consultations
- Exploration of treatment pathways that emphasise health promotion, nature connection (green social prescribing), and optimal use of medication (de-prescribing)
- Reduction of inputs, and streamlined waste management in resource-intensive secondary care specialties (surgery, nephrology, anaesthesia)
- Coordination of on-site waste recycling at GP clinics and hospitals to minimise diversion for off-side disposal or recycling

(2) Piloting new technologies to reduce the environmental impact of healthcare provision in their specialties; for example:
- Heat exchange retrofits in dialysis machines to reduce their energy consumption.
- New sterilisation devices and procedures in surgery
- Gas capture technologies to minimise the quantity of GHGs released through anaesthetic procedures
- Replacement of metered-dose inhalers with dry powder inhalers

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[4] As per APA citation conventions, terms to describe racial-ethnic groups are capitalised as proper nouns.

[5] Drawing on the methods used to research social mobility in the UK, I asked participants to self-report their class background in terms of the occupation that was the main source of livelihood of the families in which they grew up (Jackson et al., 2005; McGovern et al., 2007). I then categorised their responses in terms of National Statistics Socio-Economic Classification (NS-SEC) categories, the official classification scheme used to measure employment relations, conditions of occupations, and their correlations with indicators of socio-economic well-being in the UK.

(3) Development and implementation of tools and procedures to audit the sustainability of medical practice in GP clinics and hospitals; this includes both estimation and reporting of direct and indirect carbon footprint of medical activity, and consideration of low-impact alternatives with similar or better clinical outcomes.

(b) Clinical Leadership

Participants made efforts to encourage, support, and guide colleagues to reform medical practice in clinical settings for climate change mitigation. These efforts include:

- Institutionalisation of new procedures and guidelines to address health-climate change links in NHS Trusts, GP clinics, professional bodies, and regulatory organisations
- Coordination of consultation processes in GP clinics, hospital departments, and within and across NHS Trusts to build consensus for change projects
- Formal and informal peer education and mentoring, focused on empowering doctors to take action for change in work settings

(c) Systems Change

Interviewed doctors have engaged with NHS leaders, allied regulatory bodies, and government agencies to change healthcare system policies, guidelines, and procedures to enable climate change mitigation. Six participants made these efforts when they themselves held leadership positions in NHS Trusts, regulatory bodies, and Royal Colleges. Others pursued change through a variety of advocacy initiatives. These efforts aimed to:

- Change clinical, procurement, and estates policies and processes that contribute to the healthcare sector's GHG emissions
- Secure predictable financial support for change efforts
- Create full- and part-time paid positions for clinicians to work on climate change and sustainability projects
- Persuade industry actors to address GHG emissions associated with the manufacture and supply of medical equipment

(d) Education and Training

Fourteen participants have enacted education and training initiatives to facilitate change. These include:

- Consultation and advocacy to include capacities for sustainable healthcare provision in the General Medical Council's (GMC) 'Outcomes for Graduates' for newly qualified doctors in 2018[6]

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[6] See outcomes 25f and 25h here. Despite this mandate, in 2023, the General Medical Council's updated guidance on ethical standards for doctors ('Good Medical Practice' guidelines) did not adequately highlight issues pertaining to environmental sustainability.

- Inclusion of topics about health-climate change links in undergraduate, post-graduate, and specialty curriculum and examinations
- Teaching about health-climate change links and sustainable healthcare in undergraduate, post-graduate, clinical, and professional development settings
- Creation of learning materials and resources for medical students and clinical and non-clinical healthcare staff.

(e) Research and Knowledge Creation

Interviewed doctors who became involved in efforts to reform healthcare for climate change mitigation between 2006 and 2015 published academic and professional research that helped legitimise climate change mitigation as a valid healthcare problem, and set the agenda for change.

Participants regard research as an important strategy to enact change. This idea is based on their observation that advocacy for change is more likely to succeed when based on robust empirical evidence that is presented in a reasonable manner. Such research focuses on the identification of significant carbon hotspots, and advocacy for mitigation plans that will reduce the carbon footprint without negatively impacting clinical outcomes. To this end, they have carried out formal empirical studies, scoping reviews, and smaller action research projects in their own workplaces.

Four participants have been involved in efforts to communicate ideas about health and climate change to the general public. They do this to strengthen wider social movements focused on climate change mitigation, and to achieve government policy changes that can enhance reforms within the healthcare sector.

(f) Network-Building

Almost all participants coordinate or participate in peer-learning networks to help interested doctors to develop knowledge and skills to enact change. Thirteen interviewed doctors have taken action to build voluntary professional networks for knowledge-sharing and practical collaboration that can enhance change efforts.

Participants who have been working on healthcare-climate change links for more than a decade shared that the origins of their work can be traced back to voluntary exchanges of ideas, knowledge, and strategies among passionate doctors. These networks played a key role in supporting early efforts for reform that set the agenda for more comprehensive efforts from 2009 onward.

Some of them are involved in broader social movements for climate change mitigation. They focus on building public goodwill for change efforts in the healthcare sector, lending professional

credibility to the advocacy efforts of broader social movements, and building connections among doctors who are interested in climate change mitigation.

3.2 How did participants become aware of the need to take climate action in the healthcare sector?

Four participants have been working on issues of climate action in the healthcare sector since before 2010. During this period, climate change and environmental sustainability were fringe issues in healthcare. These doctors developed their understanding of the issue by reading research and policy literature on climate change science, attending climate change conferences, and participating in environmentalist activism. They also created informal networks to exchange ideas, collaborate, and plan action for change, and strengthened their understanding through these interactions. A lot of their early projects were focused on framing climate change as a healthcare problem, and persuading their peers to engage with the issue.

> *"There were very, very few people in the world that actually recognised the problem. So the first thing was we started connecting up a little bit to see what we could do. But the main thing is that no one took any notice. I mean, you were shouting in the wind really. And so, in general, [reform] has really relied on finding people who are open to listening. That's what [influences] the successes we've had. You can go to lots of meetings and shout about it, but no one really cares. I was [once] asked to give a lecture by the President of a Royal College, and I could choose my subject, and I gave it on the climate change stuff, and he listened, and he got it. And over dinner he talked to me, and asked, 'If it is this true, what about this, and what about that', and then said, 'Right. We're going to do something about this'. So, we hosted the first national meeting on this. So, when you find people who are open to listening and will act, that's the important part. And they take time to find, but we have found them, and there are more and more people coming into the cause now over time. It takes time to get a voice, I think. For a long time, it was very few of us."*

These participants contributed to the:
- Articulation of policy goals for the NHS based on the UK Climate Change Act 2008
- Facilitation of the [first comprehensive calculation of the carbon footprint of the NHS](#) (published in 2008)
- Definition of the aims and contents landmark [NHS Carbon Reduction Strategy, 2009](#)
- Launch of initial projects aimed at meeting the aims of the NHS Carbon Reduction Strategy

The other fourteen doctors who participated in the study began working on this issue after 2009. They came to understand the need for climate action in the healthcare sector as a result of these pioneering efforts to legitimise climate change mitigation as a health problem. They developed their initial understanding through:

- Undergraduate, Postgraduate, Continuing Professional Development (CPD) courses and workshops
- Participation in conferences
- Participation in research and advocacy projects
- Formal professional opportunities to do this work (Fellowships, Royal College leadership)
- Membership in peer-learning networks

It is important to note that the data does not show any strong correlation between doctors' seniority, specialty, or designation, and the manner in which they become aware about the need for healthcare to address climate change. Becoming engaged in this area provided doctors at different career stages and in different specialties opportunities for learning and collaboration.

> *"I remember a point when I was working on an advocacy project when I was a medical student. I was trying to move things forward, and suddenly realised, hang on, these are really quite important people that I'm emailing and telling to write blogs, or come for meetings. And so I think one of the interesting things about this area of work is that it's kind of overturned hierarchies in terms of what needs to be done, who it needs to be done for and by."*

> *"There is something about [working on] sustainability... there is an openness that as long as I can do the work, people are happy to have me. So I think there's something about this community for the time being which is very open-minded. I've had opportunities for mentorship, and people have been comfortable giving me more responsibility [even though I am a junior doctor], which I really like."*

3.3   What factors motivated participants to work on climate action in healthcare?

Participants' motivations to become engaged in climate change mitigation were grounded in existential concerns and fears about climate change, and a desire to protect the natural world. They came to regard climate action as an extension of their sense of vocation to help people lead healthy lives, and their personal environmentalist commitments.

> *"When I was at secondary school, I remember my teacher talking to me about global warming in science and saying it would not affect me in my lifetime. Whereas now I'm seeing it, I'm seeing it with the heat wave that this is happening, and we have to act because this is only 20-30 years from when I was sat in a classroom learning about it. I can see it happening now. So, to protect the nice coastal areas and the forests, that I want my children to be able to go with and see as adults, that I've got to do something now."*

Several participants were critical of existing resource-intensive approaches to healthcare practice that sidelined public health issues, and were working to promote alternatives. They broadened the scope of their thinking and advocacy to incorporate considerations about climate change mitigation.

> *"When I got into a specialty training programme, I could see my career stretching ahead in front of me, and it didn't really have any place for environmental sustainability in it... And I think the dissonance just got really strong, and so I questioned whether I was doing the right career altogether, and I stopped. And then actually, I was thinking I'll just go and do something completely different that's just about sustainability. But the reason I've ended up working on sustainable healthcare is that I just felt ethically, having been trained as a doctor, and worked only for a few years, and having had tens of thousands of pounds worth of taxpayer funded training, and years of my life dedicated to learning something, that I should try and use that."*

Others became engaged in this work as an extension of their ongoing involvement in projects promoting global health equity.

> *"I was probably predisposed to issues of human rights because I didn't grow up from a particularly wealthy background. My parents were immigrants, we didn't have a lot of money growing up, but that was fine."*

> *"I spent eight months in India between school and university, and this combination of, really, really struggling with the heat myself, even though I had a fan, but then seeing the basic buildings that people were living in without fans and corrugated iron roofs, and just thinking, if it's this bad now, what's it going to be like in 10-20 years? And I think that spurred me to go and do quite a bit of my own reading and learn more about the issues, which initially I found pretty overwhelming, and quite depressing. But it gave me the sense that this is something really, really big, and I can't just ignore this, I want to be involved in doing something about this."*

Participants who became involved in climate action efforts after 2010 were inspired to take action for change by various initiatives that were launched to reduce the carbon footprint of healthcare from 2008 onward.

> *"[Around 2010-11], I started to do some work on developing educational modules. Some of the early advocacy work was already in place by then, which focused on trying to get top level statements about this stuff, trying to get Royal Colleges to act on it. It was very much about trying to get this into the consciousness of clinicians, and making sustainability audit tools available in ways that people could engage with it."*

"I got active in climate change and health when I was in my first year of medical school. The NHS Sustainable Development Unit organised a weekend workshop. They brought together [a small group of students] from around the country to be skilled-up as ambassadors on this. [This opportunity] for me felt like, oh, these are two things I'm interested in. I have this environmental interest that I've not really done anything about, but I've always thought when I've learned about it that this doesn't seem very good. And then I know I'm interested in health and global health, and it was [an opportunity] for bringing those things together."

"In 2015 I was elected to be a trainee member of the environmental task force of the professional body of anaesthetists. And that's really when I got to learn about the damaging effects of our profession, about anaesthetic gases and things that we use. I had no idea about how harmful they were to the environment before that. I've always recycled, and throughout the entirety of my career it has been easy to see all of the waste that we produce in the operating theatre, and we produce a lot of waste compared to other specialties, and we use a lot of single-use items and plastics. But I hadn't really thought about anaesthetic gases at all really before then, so I guess that would have been when I started my sustainable healthcare journey."

3.4   Defining Goals and Strategies

(a) Justifying the need for climate change mitigation in healthcare

Interviewed doctors emphasised four issues when justifying the need to reform medical practice in England for climate change mitigation.

<u>(1) Existential threats associated with climate change</u>

As mentioned above, participants justified the need for change in the healthcare sector to mitigate existential threats associated with climate change. These include direct impacts of unpredictable and extreme weather, and indirect impacts resulting from changing ecological and social conditions, on human health and survival.

<u>(2) Contributions of the healthcare sector to climate change</u>

Participants pointed out that healthcare practices and systems exacerbate climate change through direct and indirect GHG emissions. They highlighted the different ways that existing norms and rules which guide medical practice largely emphasise the treatment of physiological illness at the individual-level in cost effective ways, with inadequate consideration for the social underpinnings or ecological consequences of healthcare. This includes:
- Insufficient emphasis on wider social and ecological determinants of health in medical practices and policies
- Normalisation of resource-intensive practices involving single-use disposable equipment

- Formal rules and professional norms that dis-incentivise doctors from engaging with climate change mitigation as a legitimate concern of medical practice (lack of formal opportunities, low status)

> *"Something like intensive care, overall, it doesn't make very much difference to human health and happiness, does it? It matters to individuals, and I'm not suggesting that we just get rid of acute medicine everywhere in the world. When people are sick, you need to try and help them, but it's a foolish way of approaching the problem. If you look at most intensive care patients for instance, you could get rid of 14 out of 15 beds if you've dealt with tobacco, alcohol, drugs, poor diet, lack of exercise, polluted air, and most of those are caused by poverty and inequity, so if you address the primary determinants of health, you wouldn't need to spend 3000 pounds a day on each ITU bed."*

> *"And of course what we know is that only about 5-10% of health inequalities are amenable to a medical intervention, and most of it is a societal change."*

> *"I had this dawning realisation that a lot of this was just built into our supply chains, and into our systems of working, things that we didn't have a great deal of control over, if any. So although we could effect some change at the unit level, you know, our reach into the supply chains were really, really limited. And then coming with this, there was an understanding of actually how little impact we were having. If you've got the waste segregation just right, then you've saved no more than 5% of the total carbon footprint of that particular care pathway."*

<u>(3) Potential Benefits</u>

Participants emphasised that climate action in the healthcare sector can contribute to mitigation efforts in society-at-large. The NHS itself is responsible for ~4% of the UK's total carbon footprint, so actions for change can have direct environmental benefits. In addition to this, the high level of public trust accorded to doctors means that they can influence broader change. The NHS employs over a million people, and that coordinated efforts by such a large number of people for climate change mitigation can enable wider social changes. Initiatives to reduce the carbon footprint of medical practice can also have positive impacts on population health. Accordingly, attention to and achievement of health-climate co-benefits can enhance broader social and political changes for climate change mitigation.

> *"Sustainability is completely aligned to what we would do for better healthcare anyway. So you would do all of these things because they're in the interest of public health, you'd do them because they're in the interest of your individual patient, and the vast majority of what we're talking about is completely aligned to good, evidence-based, person-centred practice."*

"I looked at the NHS and thought about how it has a million staff, and comes into contact with so many people. And I basically felt a bit hopeless that as an individual I couldn't do anything, but I thought within the NHS, it was quite a good place to find other like-minded individuals. So that, along with the things I learned about how much healthcare professionals are trusted, led me to start working on these issues"

(4) Health Equity

Interviewed doctors pointed out that climate change will widen existing health inequities and disparities in England and globally, and that this is an important reason to enact change. They argued that initiatives to reform medical practice for climate change mitigation can also enhance health equity.

"I work in a practice which works with a very deprived community. So I guess all of my work is trying to reduce health inequalities, and all the things that we do around prevention are going to be particularly helpful. So, for instance, as research evidence suggests, nature-based interventions are particularly useful to those who are the most disadvantaged in our societies. So they disproportionately benefit, and that makes sense for so many different reasons. So, I would be really keen that when we do this work, that we focus on building these interventions in the areas where people are suffering the most. Similarly, people suffering most from respiratory conditions live in more deprived communities. So, if we're going to try and improve outcomes, then we need to focus on our efforts in that area."

"Recently, our hospital got flooded. The power was knocked out, and we had to cancel all our surgery until we could get up and running. Luckily, it happened on a Sunday in the middle of the night, but there were patients on wards that needed to be rapidly moved to other areas where the power was still running, and to other hospitals. But my question was, what would have happened if I was operating, because I use an instrument that uses electricity? It would have been very dangerous if suddenly everything had stopped."

(b) Goals of Change Efforts

On the whole, interviewed doctors' efforts are aimed at reducing the direct and indirect GHG emissions from medical practice to restrict average global temperature below 1.5 °C (as per the Paris Agreement), without compromising on the quality of healthcare provision and patient safety. They consider the NHS Net Zero policy as a useful and appropriate roadmap to guide these efforts, and refer to it explicitly in their planning, advocacy, and actions.

Some participants think that the 1.5 °C global warming threshold and Net Zero policies are inadequate responses to the scale and pace of the climate crisis. They cite recent evidence about projected climate change trajectories during the next two to three decades, and shared that these policies might be too little, too late. They observe that the increased mainstream focus on climate

change as a social and political issue since 2015 (the year of the IPCC Paris Agreement) has diverted attention away from equally important considerations about large-scale species extinction and biodiversity loss that also have serious implications for individual and population health (Díaz et al., 2019; Roe, 2019). Despite these reservations, they frame their efforts in terms of NHS Net Zero Targets, as it offers an effective starting point for change initiatives.

> *"It's a worthy thing to have done, and it will have some value, but we're looking at time frames of 25 years from now, to get to, quote, "Net Zero". Well, we don't have 25 years to get to anywhere, and we certainly don't have it to get to Net Zero, which isn't 'real zero'. If you own a piece of forest and photograph it now, and then you're showing me a photograph of it five years later saying you haven't chopped it down, I'm able to pay you to offset my emissions. I'll give you money to make up for all the emissions I released and I'm now Net Zero. Well, I'm not Net Zero, I emitted a truckload of CO_2 that wouldn't otherwise have been there. The fact that you haven't chopped down some trees is irrelevant to the fact that I've added CO_2 to the atmosphere. It's nice that we've got the legislation but it's pretty meaningless actually globally."*

> *"In my work, I try to go to where other people are, and reach them where they are. But I'm not sure that that is actually appropriate for this crisis, which is on such an enormous scale and requires systemic action."*

Most participants argue that change efforts need to be based on public health principles of illness prevention and health promotion. They argue that initiatives aimed at enhancing the social and environmental determinants of health (clean air, social protection, community development, food security, active living) can help mitigate climate change by reducing resource use and GHG emissions in the healthcare sector. One way that they are attempting to do this is to increasingly use the planetary health framework (which combines public health principles with the planetary boundaries framework) to conceptualise and enact change efforts.

3.5   Theory of Change

Broadly, interviewed doctors' efforts are informed by the idea that mitigation of the negative climate change impacts of the healthcare sector requires changes in healthcare system policies and processes, and changes in the norms and values guiding professional culture of medicine.

(a) Systemic Change

Collectively, participants emphasised the need for four kinds of systemic changes to mitigate the climate change impacts of England's healthcare sector:

(1) Healthcare professionals need dedicated, structured opportunities to learn about health-climate change linkages and the need to reform medical practice for climate change

mitigation. These opportunities need to be accompanied by incentives and encouragement to incorporate this understanding into their regular professional duties.

(2) Climate change mitigation actions need to be integrated into existing rules, standards, guidelines, and techniques that guide medical practice. Such integration can legitimise climate change mitigation as an aspect of good medical practice (akin to earlier efforts around standardising patient-centred care, quality assurance, and gender equity in medical practice).

(3) Knowledge, skills, and dispositions pertaining to climate change mitigation need to be taught and assessed in undergraduate medical education and postgraduate medical training. This can ensure that healthcare professionals factor climate change (and environmental considerations) into their work from early in their careers, and help normalise climate change mitigation as an integral aspect of medical practice.

(4) Climate change mitigation actions need to be integrated into financial decision-making processes in the health system as a whole. Such changes can help normalise considerations of environmental sustainability in the manufacture, supply, and use of medical equipment, and simultaneously reduce emissions while improving health outcomes.

(b) Cultural Shifts

Participants also highlighted the need for three kinds of cultural shifts to mitigate the climate change impact of England's healthcare sector:

(1) Dominant biomedical understandings of health and illness that *de facto* guide medical practice need to change for reform to succeed. Doctors need to reconsider what health is and how to provide healthcare in light of the realities of climate change. Considerations about the social and ecological determinants and consequences of health need to be integral to this process.

(2) During the last two decades, consumerist notions of limitless demand and supply, and financial capitalist notions of profitability have become key assumptions that guide medical practice and decision-making. These need to be replaced by alternative norms and values that emphasise health promotion, illness prevention, lean care pathways, and low-carbon technologies.

(3) Considerations about how to integrate social and environmental issues into medical practice need to be accompanied by wider re-conceptions of what it means to be a doctor and what a doctor's work entails. Reflecting on this question and the pursuit of alternatives can enhance efforts to reform medical practice for climate change mitigation.

> *"I'm interested in the need to shape professional identity, and to normalise caring about environmental impact and social impact, and to look at what is currently valued. I think there's a lot of status around high tech specialties, or specialties where people have very acute and complex needs, and those things are high status, and then people who work on*

care of the elderly or whatever, that's considered woolly and low status. I mean there are obviously lots of people who recognise the importance of those different things and primary care, but I think it's no good to just say, you should care about this or that more. I think you need to describe something that's aspirational that people want to emulate, and show what's so great about it, and really show how a clinician can think and work holistically for sustainability, and that that is respected… I also think that people need to reflect on the role of the doctor in society. I think there are different types of doctors, who will take on different roles. But it tends to be clinical, and I think that we need a lot more people who look beyond that and ask, what's causing these people to have these problems, or not to be able to take control of their health, and is there anything else we should be doing? And [asking these questions] as doctors rather than in their spare time."

"I think that there is need to teach people who are going into healthcare about the real complexity of health, and that we don't have all the answers, and that we have to look at health in a much more broader sense, and that change happens at many different points, and that all of our actions have consequences that are seen and not seen. In terms of developing a future model of healthcare professional identity that seems essential to me."

3.6 Strategies to Enact Change

Participants used six types of strategies to enact change.

(1) Advocacy with health system leaders (clinical and management) to support climate change mitigation initiatives; in particular, advocacy for funding and dedicated work roles for mitigation

"If you look at all organisations, it's the leadership that's important. If you want to effect change, it's about talking to the person who can effect change. So I would say to people, if the person who writes the cheque isn't in the room, you're in the wrong meeting, because you can't do anything. Certainly in our National Health Service if you go to these meetings where there's nobody in the room with any power it's a completely pointless meeting. All they do is talk, and nothing ever happens. So it's working out what level you're at, and making sure you're at the right level, and that's not always easy, because you don't have access to those particular people, or it's not on the agenda."

"A lot of change will come from the grassroots, from the workforce. But it also needs support from the top down, so looking at the hospital trust boards and executive level, because some of these initiatives and projects will require financial investment in order to make savings, some of the bigger ones and the more complicated ones. It's all well and good with the little projects, you can usually get [them] off of the ground, they don't need any money to do. It's just making simple switches and things. But actually, some of the things that we're talking about in terms of thinking about the anaesthetic gas capture,

technology that's going to require significant financial investment. So you need to have engagement from board and executive level high up in the trust to be supportive of business cases that are put forward. And certainly there should be representation on board and executive level of sustainability."

(2) Development and communication of clear, easy-to-understand messages about reform, in consistent and creative ways

"In the COVID-19 pandemic, we had the alignment of several things. News stories are talking about the pandemic, politicians are talking about the pandemic, and the general public was seeing the pandemic. There were notices everywhere. You couldn't walk five metres without seeing one: bus stops, train stations, train carriages, doctors' surgeries, supermarkets, even drawn on the ground. So there was a congruence to the messaging which was clear and present in the whole of society. And the government knows that. They know that that's what you need to do to get people to do something. You need a congruence of messaging, and they're not doing that with climate change. All you're getting is, people seeing the stories in the news, and then nothing from leaders, pretty much nothing, and then nothing in the public domain and civil society.

And so what you then get is, people's subconscious saying, well if it was a big problem there'd be notices everywhere. And so what I want to see is in every hospital we should have climate change notices. I know that we've already got too many notices about everything, but this is the biggest problem that we have. And, you know, everyone consults their doctor, everyone goes to the hospital at some point or has a relative there. There should be notices outside, climate change is a health problem, what's your next step or something like that. Something that's an indicator to people that this is a health problem, it doesn't have to be preach-y or lecture-y or anything like that. It just has to say, this is a health problem, a small indicator."

(3) Education and training to develop capabilities to enact change

"What I wouldn't want to see is a module on climate change in every curriculum. That's just standalone. I think it's got to be seen as a package, it's got to be seen as an integrated approach. So making climate change, or ecological collapse, or the climate and nature crisis as a meaningful part of the education of health professionals is incredibly important. Which brings us back to why prevention of illness is so important. When I was at medical school, no one ever taught me about the causes of health. I'd spent six years learning about the causes of disease, and no one taught me about the causes of health. And you know, I'm not a disease professional, I'm a health professional, so what are the causes of health? So anything that would bring a bit of humility and non-hierarchical and true partnership into education would be good. And I suppose also

to keep people questioning and critical, but at the same time co-operative in really being questioning about is the healthcare system doing more good than harm, or vice-versa."

"What I would like to see is more [attention to climate change and sustainability] in the undergraduate and postgraduate curriculum. In the UK, in a couple of years, we'll be moving to a national licensing exam. And so [we need to make] sure in that process that it is clearly represented, the impact of delivering health care and how you can minimise that impact as an individual clinician. Also to actually understand why you should do it, and what the likely impact will be on health if we don't. That's essential to get traction for change."

"The reasons that [educators] have been [resistant to change include considerations such as] 'the curriculum is overcrowded', 'we don't have space', 'who's going to assess it', 'I don't have time or headspace to this', 'Is this really medical', 'Isn't this a wider weather issue or a wider societal problem, is it really a health connection'. So there's still that mind-set problem of just not understanding the connection. But it's the biomedical paradigm in medical education that educators have, which goes with [an emphasis on] content learning, that actually means that they then don't respond very well to bringing in planetary health, because they see it as another thing that they have to do, as opposed to seeing actually it is an issue of principles. These are principles that can be integrated in every single learning process that you do, and what it's about asking questions in each situation."

(4) Research to develop evidence-based guidelines for reform

"The thing I've always tried to do is make a reasoned, intelligent, informed argument… And I think I've been fortunate [in that when I have] presented data in a measured way, highlighting difficulties and complexities, but still holding values, people tend to come on board. A combination of academic robustness and values gives us the ability to speak with authority."

"A lot of anaesthetists and doctors and healthcare professionals like to have things that are evidence-based and research-based, and we don't have all the answers about these things. Some of them we don't have very much information about at all, it just feels like it should be the right thing to do, others we've kind of got half answers. So with the anaesthetic gases side of things, you know, the work that we've got about the global warming potential and the environmental impact that they have, has come from work that's been done with some scientists and anaesthetists from first principles. Pharma won't actually share the recipes they use to make these drugs. So I think it requires a really coordinated approach, and we do need manufacturers and big pharma to be engaged and actually helping to conduct independent life cycle analyses for these products."

"What my research has shown me is that you have to get down to the details, because there are often quite counterintuitive findings, or things that are surprising. [For example], previously, within narrative reviews and commentaries, people had advocated for the streamlining of reusable instrument sets as a way to reduce our environmental impact. But the consequence of that is usually those items that are streamlined and removed get individually wrapped as supplementary instruments. And say if you're then having to use those items say 20% of the time, then counterintuitively, there's actually an increased carbon footprint, and an increased financial burden. The actual carbon footprint of sterilising a reusable set is relatively consistent, and not dependent on the number of instruments on that set. So, I'd say that the moral of environmental accounting is that the answer is always 'it depends'."

(5) Movement-building within the healthcare sector to create a groundswell of momentum to drive change, achieved through collaborative activities such as mentorship programmes, knowledge sharing initiatives, action research, and peer-learning processes.

"[We created a Sustainable Practice Toolkit for GPs], and because we then had something to give to other people, rather than give them a problem we could give them a solution. We started off with an annual cycle [where] in the first year we had eight local pilot practices [in one city]. Then they were extended to a geographical region, and it doubled to 14, and I thought, 'Wow, we're doubling'. And then the next year we extended it nationally to something like 28 practices. Then the next year we got 30, and the next year was only 50, and so then it seemed to stall quite a lot. And then with the Extinction Rebellion and things like that, it then started to take off, and was up to 300, and then up to 750 in February 2020, and then everything stalled through the pandemic."

"We appointed a sustainability scholar in our department, and she's got a project looking at things like the carbon impact of telephone clinics versus face-to-face clinics, and she's piloted a carbon footprint calculating tool which looks at travel."

"I asked a small group of local people to meet, and that's when I started a peer-learning and advocacy group for GPs. We decided that we wanted to create a hub of information for primary care clinicians to learn about the climate crisis, learn about how it was connected to health, and then learn about what they could do in their practice to improve the sustainability of a planet, and also include the healthcare of their patients."

"In 2019, when Extinction Rebellion kicked off, I remember watching the organisation with admiration but being on the edge, like, I want to join in, but I feel scared, I'm worried about how it will look. But then I watched an interview on the news where the interviewer, who was in his 50s or 60s, basically bullied a young climate activist. And I remember thinking, he would not dare do that to a doctor, a nurse, or a professor. And I had this lightbulb moment, that there needs to be a doctors' branch of it, and it needs to

happen now. So I [contacted colleagues about] starting a '[Doctors for Extinction Rebellion](#)' group."

3.7   Enabling Conditions

Interviewed doctors highlighted six factors that enabled the success of their efforts.

(a) Personal characteristics

Some participants reflected that aspects of their personality and mind-set enabled them to attempt to change medical practice for climate change mitigation. These include:
- Capacities for self-learning and critical thinking
- Confidence, courage, and grit
- Can-do attitude

Participants also highlighted that prior knowledge about environmental science, climate change, and environmentalism enabled them to understand the importance of action for change. Despite completing schooling in different eras (ranging from the 1980s to the first decade of the 2000s), they reported that they carried their interest about these issues from high school into their higher education and subsequent medical careers.

Five participants said that making unconventional career choices had enabled them to become part of reform initiatives. For different reasons, these doctors took breaks in their medical training, and this enabled them to develop broader perspectives and skills that they were then able to apply to enact climate change mitigation efforts in the healthcare sector.

> *"When I worked in hospitals [during Foundation Years training], at times I really liked it. I liked the patient contact, and I liked the very meaningful interactions that you sometimes do have, but I found the system extremely frustrating to work in. I felt that we were constantly apologising to people for system failures, and I felt quite frustrated at that. And I found the fact that really your ability to do anything in terms of prevention and changing what it is that's making someone ill was almost zero. We don't have the right levers to address often the underlying causes, and we then resort to just telling people to change their behaviours; which is fine if that patient has agency and has resources and a good support network. You know, some people will be able to make changes to their behaviour with a bit of a prompt from a medical professional, but a lot of people, and the most disadvantaged people really won't be. So I think there was this kind of consciousness that I'm seeing kids coming in with asthma, or I was seeing old people having heart attacks, or whatever it might be, and knowing that this combination of air pollution and unhealthy diets and a lack of exercise and maybe cold homes in the winter, but without being able to meaningfully really change any of those things. I am now able to work on these issues in my public health training."*

(b) Interpersonal interactions

Direct, personal interactions significantly contributed to the success of their efforts for reform. Most participants initially became involved in health-climate change initiatives through interactions with, or invitations from, like-minded peers. Direct engagement with clinical and administrative leaders improved the odds of successful advocacy. Interactions with mentors and colleagues played a key role in helping participants gain knowledge and skills to conceptualise and enact change projects.

(c) Systemic Enablers

(1) Policy

The existence of official policies for climate change mitigation within the healthcare system in England has provided an overarching framework to enact change. Participants referred to the NHS Carbon Reduction Strategy of 2009 and the NHS Net Zero policy of 2020 as frameworks to justify and guide their work on these issues. Some participants cite the 2018 GMC 'Outcomes for Graduates' about doctors needing to develop capabilities for providing healthcare sustainably as an enabler of their educational and professional development initiatives. Others highlighted that Royal College policies for reducing the carbon footprint of specialist clinical activity have significantly enhanced their work. Examples of these include climate emergency declarations, official changes in curriculum and qualifying examinations, and the revision of guidelines for good clinical practice within specialties.

(2) Support from management

Support from senior clinicians and healthcare system leaders was an essential condition for conceptualising and attempting change efforts.

> *"Well, in the hospital trust where I work, they're really forward-thinking as an organisation and they have a very strong sustainability team. A lot of hospitals might have a sustainability officer who doesn't do that as a full-time job, it might be that they are double hatching that job with something else like a waste manager. Whereas our hospitals have, I think, seven full time equivalents who are working in sustainability, looking at various aspects, and they have input into the trust board and executive level. So they can help us as departments when we come up with these projects."*

> *"My specialty's professional body set up a paid fellowship with support from my hospital trust. And I thought that this is something that I'd really like to do. So I applied for the fellowship, got it, and worked on [issues of sustainable healthcare] for 18 months. I was able to use that platform to do a lot of things. The fellowship [provided me with paid time], 20 hours a week, to work on those issues both locally and nationally."*

(3) Holding leadership positions

Senior clinical and academic positions in Trusts, professional bodies, and medical schools enabled some participants' change efforts. The positions provided the authority, autonomy, and financial means to facilitate and institutionalise climate change mitigation projects.

> *"The opportunity [to work on environmental sustainability] really arose about two, three years ago… [Before then] I wasn't necessarily in a senior leadership position to be able to really push those ideas forward. But the opportunity really came when I joined [my current organisation] as a consultant."*

> *"I was very lucky, because if I had started on this journey earlier on in my training, I don't think I would have had time to have achieved as much. So as a consultant, you get an SPA day. So that is your non-clinical time, so it's a day to sit in an office. The way mine works, it's two half days. So I had time to do the required reading and learning."*

> *"One of the advantages that I had was that I was in a parallel academic-clinical career, which meant that I could use my academic time [as I liked]. I mean, no one was looking at where I was at any given point of the day, and as long as I did my academic work, produced papers, wrote grants, did research, what else I was doing was irrelevant. So I've had more flexibility in my life perhaps than others have. And, of course once you've got tenure, you've got a bit of an academic platform, and you're able to say things because you're a professor of medicine, which [makes a difference] because people wouldn't listen to you if you were just a jobbing doctor, and it's important that you've got some sort of credibility."*

(d) Aspects of Professional Culture

Aspects of the professional culture of medicine have helped legitimise climate change mitigation as a healthcare challenge, and have enhanced change efforts.

Given the hierarchical nature of professional culture within the field of medicine, top-down endorsement through official policies and statements from leadership figures have prompted doctors to take reform seriously.

> *"When I worked as a sustainable healthcare leader in the NHS, on a regular basis quite important people, you know, chief execs of big hospitals, or chief execs of national health bodies, would come up to me in some [professional] setting, and say to me, can I ask you a personal question? And they'd say, I'd quite like to do something with my organisation about climate change, or sustainability, but, I'm not sure what, could you help me? I'd say of course I'll help you as much as I can. But they would always do it rather apologetically, under the radar. So it's almost as if somehow it wasn't quite the right thing to be doing bureaucratically, but ethically, it clearly was the right thing to be doing. But*

in the last seven years or so, people have become very overt about it, and are saying, this is now a dimension of quality in the health and care system, you've done a lot of work on it, I'd like you to help. There's no embarrassment about it."

During the 2010s, advocates of reform made consistent efforts to demonstrate how actions for change are embodiments of recognised elements of good clinical practice such as the duty to do no harm, quality assurance, patient safety and patient empowerment. This has also helped persuade doctors that climate change mitigation is not merely an environmental problem, but is also a health problem.

"When we started, sustainable healthcare was all about the hospital boiler, and the fact that you can't turn the heating off even in the middle of summer, etc. And obviously those things are important, and where they haven't been fixed still need fixing, but I think we have really helped to bring about the recognition that it's absolutely also about the care itself. That everybody has a role, and that you don't have to stop being a clinician and do two days a week in the estates department to be tackling sustainability. When you think about sustainability, you can improve care."

Some doctors highlighted that there has been a significant increase in the creation and spread of empirical evidence about the need for and effectiveness of change efforts during the past decade. This helps drive change, as doctors try to base their professional activities on available empirical evidence to the maximum extent possible.

Several participants shared that there has been a generational shift within healthcare during the last decade. A significant number of medical students and junior doctors are entering the field of medicine with a sound prior understanding of climate change science, and with concerns about contributing to mitigation through their professional work. They are playing a key role in advocating for and driving changes particularly in the content and rules of medical education and training.

Advocacy for reform that highlights considerations about financial savings and benefits receives attention from health system leaders. The reason for this is that financial considerations play a key role in driving decision- and policy-making in the NHS.

"In my Trust, I was one of the few clinicians who was engaged with the sustainability officer. And I think by demonstrating the cost savings that you can make through green initiatives, I think he was [persuaded] to expand his remit and take actions in one of the biggest healthcare organisations in the country for [climate change mitigation]."

"We're actively looking at the financial side of things as well. With every single environmental output that we estimate, we're trying to quantify and show financial savings. That helps the argument."

Appealing to the culture of high achievement and competition that characterises healthcare plays an important role in promoting reform. The promise of official recognition for excellence significantly motivates doctors to engage in good clinical practice and instituting awards and competitions that reward doctors for participating in reform has resulted in doctors taking action for change.

> *"Doctors in countries worldwide are recruited from those who are highest achievers. There is something cultural about the importance of having children as doctors, and that means that you have some very competitive people who have trained to become doctors. And competitive people in my experience often want to prove that they're better than their colleagues"*

> *"Targeted competitions can help raise awareness whilst also encouraging innovation, and implementation of sustainable solutions."*

(e) Education and training

Medical education and training covers a wide range of content that effectively prepare doctors to understand the geo-physical, ecological, biological, and sociological issues associated with climate change. Efforts for change can build on knowledge, skills, and dispositions that are already emphasised in curriculum, pedagogy, and assessment, such as: interpretation of evidence, systems thinking, diagnostic skills, treatment planning, and communication.

(f) Favourable Socio-political and Cultural Conditions

Socio-political and cultural conditions outside healthcare have played a significant role in enabling the success and spread of reform. Climate change mitigation legislation by the UK government from 2008 onward has granted broader legitimacy and mandate for change efforts within the healthcare sector. Growing public awareness of climate change mitigation, and emphasis on climate action by social movements from 2015 onward (following the Paris Agreement), helped enhance action for change within the healthcare sector.

> *"I started this journey in 2019. That was when, in the UK, lots of things were going on in terms of climate action. So, there was Extinction Rebellion; I'm in London, they were on the streets doing protests, and Greta Thunberg was organising the school strikes, and the UK government had just declared a climate emergency, and the Royal Colleges followed suit and declared a climate emergency. Around that time, a few of my friends and family were recommending books and things to me because I just wanted to know why people seemed so emotional about it. So I read a couple of books, and I just got really scared basically, and thought, I can't believe I haven't been told this, I can't believe it hasn't been part of my medical education, I can't believe I'm not aware of this as a GP, where we spend so much time talking about prevention. So I just tried to find a group that was*

doing something. And as part of that I looked at the UN and goals, and it said, 'think about your workplace'."

Between 2008 and 2015, higher education institutions began to work on sustainability. They incorporated sustainability across the curricula of different university programmes, and undertook actions to make higher education facilities more sustainable. This work expanded to medical schools affiliated with universities across the country and became another source for initiating reform.

The increasing instances of visible extreme weather events in the UK itself was further driving home the facts of climate change, and making people feel concerned about the need to take action for change. This awareness has increasingly motivated doctors to become interested in questions of taking action within their workplaces to mitigate climate change.

The presence of NHS staff members from working class and Global South backgrounds have enabled positive engagements on questions of reform. This is because healthcare professionals come from backgrounds of material scarcity, and are familiar with practices of carefully using the resources at one's disposal, and minimising waste. This cultural diversity can ensure the success of reform initiatives.

3.8   Barriers to Enacting Change

Reflections about the barriers that impeded efforts for reform fall into six categories: (1) personal characteristics; (2) interpersonal interactions; (3) systemic barriers within healthcare (restructuring of the NHS; prevailing rules and policies; and prevailing systemic processes); (4) cultural barriers within healthcare; (5) education and training; and (6) socio-political and cultural barriers. I discuss these in detail below.

(a) Personal characteristics

It takes considerable time and effort to develop an understanding of health-climate change links and the contribution of the healthcare sector to the problem. This is a serious and complex issue, and it is challenging to internalise this new perspective, and translate it into the necessary convictions and capabilities to take action for change. In a work context where doctors are already under significant pressure and stress, it is even more challenging for doctors to become involved in change efforts.

Doctors are trained to be cautious and make decisions based on officially recognised best practices. This impedes change efforts because the scientific evidence base about climate change and medical practice is still evolving, and doctors are unwilling to change their practices in light of this uncertainty. Doctors are more likely to follow existing rules and standards than attempt new, untested ones.

Many doctors tend to regard climate change as an environmental issue, and do not consider mitigation to be part of their professional duties. Many doctors believe that they are already doing good by providing good healthcare, and leave additional efforts for climate change mitigation to others.

(b) Interpersonal interactions

Advocacy for change takes time and effort, and is not predictably successful. It takes immense collective effort to generate, consolidate, communicate, and reflect on evidence about the need for change, and that doctors' do not have the time or space to do this in the course of their regular professional activities. Also, advocacy can often involve conflict, which also slows down processes of change.

> *"You have to be careful about how you bring people along with you. Some of the enthusiasts who joined in were less sensitive to their colleagues, and, you know, there were one or two instances where people started to rub each other up. It just needed reining in a little bit, and more careful handling."*

Doctors advocating for change are often lone voices who are not taken seriously in organisational settings.

> *"We're not at any tipping point. A good example is that we've got 950 [primary care] practices who work with our Sustainability Toolkit. Each practice probably employs about 60-70 healthcare workers full and part-time. And in those 950 practices, the average number of active people per practice [working with the toolkit] is one and a half. So actually there is one lonely person in each practice pushing at this, maybe with a little bit of help from others, but mostly still one person in 50 or 60 or 70, pushing at it, doing the work by themselves. So we're a long way from getting the tipping point to where [sustainability is] the default norm."*

(c) Systemic Barriers within Healthcare

(1) Organisational Restructuring of the NHS

The near-constant organisational restructuring of the NHS during the last three decades has created systemic unpredictability and additional work for administrators and clinicians. This prevents mid- to long-term stability in leadership needed to enact enduring reform for climate change mitigation.

In particular, NHS restructuring in the wake of the Health and Social Care Act, 2012, took away the time and resources that were crucial for conceptualising, enacting, and embedding reform for climate change mitigation based on the 2009 NHS Carbon Reduction Strategy. In addition to

this, the policy further widened the division between healthcare and public health systems, hindering the scope of collaborative action for change.

One participant who has experiences of working as a doctor with both NHS England and Public Health England remarked that the 2012 restructuring further marginalised the status of public health by separating it from the NHS, making it the responsibility of already under-funded local administrative authorities, and reducing direct state funding. This creates a significant barrier for reform because it prevents engagement between clinicians, public health doctors, and non-clinical public health professionals that could enable change.

Similarly, some participants highlighted that this round of restructuring widened the gap between primary and secondary care, preventing coordinated action for change. The new commissioning protocols institutionalised in the 2012 policy created a system where the main interactions between primary and secondary care doctors mainly occur in situations of referring patients for advanced care, or in purchasing services (through Clinical Commissioning Groups). This has resulted in a situation where primary and secondary care clinicians have largely tended to enact change efforts independently of each other.

The 2012 policy also hinders climate action through its new decentralised budgeting and procurement rules that prevent coordinated advocacy with industry actors. These rules have not only paved the way for further privatisation of the NHS, but also created systemic barriers to the kinds of collaborative and integrative thought and action needed to address the health impacts of climate change.

> *"I was a clinical governance lead on a primary care trust before it became a clinical commissioning group, and there were four GPs from the county representing General Practice in the organisation. And I'll never forget what they said to us at one of the very first meetings, which is, the most important thing facing us is to balance the budget this year, and everything else is of second order importance. And it really just illustrated the constraints that are put there because of the financial cycle. And then thinking about the political cycle as well, you know, what drives change in the healthcare system. I'm quite cynical about what drives change, because the frequency of change in healthcare in the NHS, and the way in which it is delivered manages to get it just right so that it's not been in place quite long enough to actually hold it to account. Then as soon as it has been there that long, they say, 'Well, there's not much point to doing that because we're just about to change'. So there's this continuous change churn which gets in the way of serious long-term planning."*

> *"The NHS has a big budget and potentially could have significant leverage over what happens in companies, but now most of these companies that are selling medical equipment are multinational, so actually the UK market is quite small. And then within that the NHS doesn't buy things as a single entity, it buys things as lots and lots of tiny*

contracts. So, there isn't necessarily a dialogue with suppliers saying, 'we want to move in this direction', you know? How can we set things up that will align incentives for that, and can we help innovate in this direction to meet these needs, and that just doesn't seem to be the way things work."

<u>(2) Rules and Policies</u>

Participants highlighted three sets of rules and policies that create significant barriers for change efforts. First, they observed that budgetary and financial rules and policies prevent reform. These barriers are linked to the influence of neoliberal New Public Management ideas on healthcare policy (Simonet, 2015). In accordance with these principles, cost containment and balancing budgets have become significant concerns for NHS leadership for at least the past two decades. This has resulted in a situation where short-term necessary spending on transitions to environmentally sustainable healthcare practices is often regarded as financially unviable. Combined with the increased decentralisation of budgeting and procurement as discussed above, this has resulted in a situation where financial resources needed for climate change mitigation are not made available.

Second, participants highlighted that prevailing infection control rules and policies have normalised the use of single-use disposable items and equipment in healthcare settings. These rules were first implemented in a major way in the late 1990s in response to the outbreak of Bovine Spongiform Encephalopathy, and have expanded since then to address a broader range of infection risks and threats, the latest of which is COVID-19. This has resulted in a situation where it is extremely difficult to enact rules for sterilising and reusing medical equipment, even though the evidence base for current rules has not been revisited in a long time. By raising these concerns, participants are not arguing for a wholesale disregard of existing infection prevention and control rules; rather they are making a case for more nuance, and revised guidelines in response to the challenges of climate change.

> *"Well interestingly, we used to offer the full panoply of services in our practice including minor surgery. When I started we had an autoclave so that we could re-sterilise metal equipment for things like pap tests, all the instruments you use for doing small skin operations and stuff like that. Because of bovine spongiform encephalopathy, we've been forced to get rid of all our autoclaves, and use stuff that was being autoclaved elsewhere. And a lot of practices gave up doing minor surgery, and started buying plastics. We had a deal with our local hospitals that we would use their autoclave, but then they just stopped the deal, they just said 'We're not doing it any more'. So then we're forced to buy single-use products. So we're trying to avoid using single-use products, but using single-use products has been forced upon us."*

> *"I've been speaking to a number of infection control and microbiology experts. I've found that that's one of the biggest barriers, concerns about infection control. Most of the*

ones I've spoken to, to be honest, are fairly conservative. It almost seems like it's their role to see infection everywhere. But I have recently found a consultant academic microbiologist who seems very much on board and sensible in approach, and I think that's going to provide again that real voice to counter that argument about infection control. Yes, infection control, but let's be sensible about it."

"I've gone through my whole career not doing anything about it, and, you know, not thinking twice about using single-use instruments. We're all programmed to use the single-use things now, use it, chuck it, use it, chuck it. And we've been somewhat 'brainwashed' by the risks from vCJD (that was one of the triggers, especially in the UK, to move to the single-use instruments) because it was like the sterilisation techniques aren't going to destroy these viruses. So you just use and throw things away."

Third, some participants pointed out that rota rules in Foundation Years training prevent junior doctors from developing capabilities to integrate principles and practices for climate change mitigation into their work. These rules require doctors-in-training to work in multiple organisations, usually for a maximum duration of four months at a time in order to gain the benefits of experiential learning in multiple settings, and from a variety of professionals. This results in situations where both mentors and trainees who are interested to reform medical practice for climate change mitigation are limited in their ability to learn and apply requisite knowledge and skills for change. This especially affects junior doctors who are increasingly learning about sustainability in healthcare in medical school, but unable to apply their understanding in practice settings.

(3) Systemic Processes

Healthcare system processes prevented some participants from enacting successful change efforts. They observed that clinical leaders and system administrators often neither formally endorse change activities, nor provide tangible financial and material resources needed for enacting change. They do think that this situation is slowly changing following the enactment of the NHS Net Zero policy in 2020.

They also reflect that, in general, formal processes to enact and change NHS rules and policies are extremely slow. The NHS is a large and complex organisation with ties to the national government, and as such is risk-averse and slow-to-change. Many rules and processes for climate change mitigation need to be created from scratch and doing this successfully requires a lot of political will and time commitments from passionate individuals, both of which are challenging to secure. Participants reflect that getting different actors together at one place, and pulling in the same direction is extremely challenging.

Several participants emphasised that difficult work conditions and high levels of burnout among NHS staff have been making it increasingly challenging for doctors to perform their regular

duties with enthusiasm, let alone engage in additional efforts for climate change mitigation. They share that these trends existed before the COVID-19 pandemic, and have been exacerbated significantly during the last three years. Their reflections are supported by news media, professional, and academic publications that point to different ways in which frequent organisational restructuring, top-down accountability processes, results-based remuneration, and withdrawal of social security benefits have contributed to increasing work pressure among NHS staff (Taylor, 2020; Campbell, 2022; The King's Fund, 2022c). Collectively, these trends have resulted in a situation where even doctors who are keen to enact change find it extremely difficult to do so.

Some participants highlighted that communication about NHS climate action policies, the means to enact them, and the resources available to do so have been inadequate, and contributed to the slow, inconsistent spread of efforts for reform among a minority of interested doctors.

> *"When we look globally, some of the most innovative approaches to healthcare and sustainability have come from as far apart as the poorest parts of China, to the wealthiest parts of the United States. So there are great things going on everywhere, and that's an asset. One of the assets of global healthcare systems is that they're so big, and you'll always catch someone doing something right or future-proof now. So if I challenge you now to say, just imagine the most sustainable thing you can do in the healthcare system. You came with some radical idea, and I'd say, well, funnily enough that's already happening. It's happening in South Island, New Zealand, but it's just not taking off anywhere else. So the biggest barrier is not innovation, it is the spread of innovation."*

> *"The NHS has got a lot to deliver. It's chronically underfunded, and so we have lots of amazing plans, but when it comes to delivering it in the end, we're just doing a lot of firefighting in trying to deliver a free health service to everybody. And so climate change has probably just dropped to the bottom of the pile. I mean, I was quite surprised to see that. I'd maybe read [the NHS Carbon Reduction Report] when it came out, and then forgotten about it. It wasn't until I started writing project reports and preparing presentations that I started to read up the publications, and then suddenly found that, hang on, the NHS has had this in place for so long."*

(d) Cultural Barriers within Healthcare

Despite consistent efforts to emphasise social and environmental issues in medical practice, the biomedical paradigm still strongly guides everyday professional practice. This creates a professional culture which prevents reform.

The public health principles of illness prevention and health promotion tend to be marginalised in mainstream medical practice, making resource-intensive practices of treating bio-physiological illness in individuals at all costs the default norm in the sector. This

dis-incentivises doctors from engaging with questions of climate change mitigation that highlight health-climate co-benefits, reducing the need for clinical care, and cautious use of resources in healthcare.

The predominance of the biomedical paradigm has resulted in a knowledge-based status hierarchy within medical practice. More value is placed on uncovering new, sophisticated, and advanced knowledge about human illnesses, at the expense of according lesser importance to better understood, albeit more common ailments. Resources are disproportionately directed towards developing such understanding, and doctors who engage in such work are accorded high professional status.

> *"There is a hierarchy around knowledge of illness. Doctors at medical school are certainly seen as being better if they are better on their knowledge of illness, rather than in their communication skills, or their understanding of overall needs, or their ability to find balance or engage with people, or create community. Those are not valued skills in that competitive community. So the illness model and the disease focus is prioritised above the community, or the political, or the public health."*

This has resulted in a culture of high achievement and competition associated with securing official positions and resources to learn about and treat complex illnesses. This creates a structure of aspirations that dis-incentivises doctors from developing the broad sensibilities and capabilities needed to conceptualise and enact reforms for climate change mitigation.

In addition to barriers associated with the biomedical paradigm, several participants reflected that the professional culture of medicine is strongly characterised by risk aversion, and that this prevents change. They pointed out that given the responsibility involved in caring for people, doctors tend to be very cautious about changing their ways of working without strong evidence. Further, there is considerable wariness about potential professional and legal consequences of causing harm to individuals due the violation of established rules and standards. In contrast to this, advocacy to reform medical practice for climate change mitigation emphasises the need for urgent and fundamental changes. While this advocacy is based on sound principles and reliable (though not comprehensive) empirical evidence, adhering to it requires clinicians to make decisions that do involve some uncertainty. Comprehensive and formally approved evidence takes time to generate, and attempting to pursue reforms through this mechanism alone is unhelpful given the urgent need to take action.

> *"There are so many drugs that we use, so many products that we use that to do life cycle analyses for. All of those would take decades, if not hundreds of years to do them thoroughly. So I think we have to adopt a measured approach and maybe accept that we're not going to have all the answers for everything, which we don't anyway in other parts of clinical medicine, as well as this more, non-clinical stuff. We need to make do with what we think to be the right thing at the time, knowing what we know and accepting*

that if more evidence comes out, that we might not quite have got it right, and need to make further changes. I guess we need to be flexible and malleable and be able to react quickly and change, which is something that an organisation the size of the NHS is not always the best at doing."

Some participants observe that these tendencies for risk aversion are further compounded by the fact that professional culture in medicine emphasises the pursuit of specific short-term goals (the treatment of illness in an individual using known expertise) rather than less specific long-term goals like addressing upstream causes of ill-health and climate change mitigation. Related to this, they reflect that doctors tend to think about their work in narrow and linear causal terms. This is inadequate for addressing the challenges of climate change which requires complex systems thinking.

> *"One of the things that people like to do a lot in sustainable healthcare is to have lists of ten things to do, or the five top tips, or whatever it is. I find those kinds of things quite panic-inducing because they're a list of unrelated actions, often acting at different levels in the system, with no inherent logic to how they relate to one another. When I see them I think, 'are these the most important ten?'. I mean if someone gives a reason, for example this is the biggest part of the carbon footprint, and therefore we need to do that, I much prefer that kind of thing. I like to have a kind of a way of thinking about something that reassures me that I'm not missing something, and that if I apply this logic, it will tackle the problem at hand in a logical manner and move things forward."*

(e) Education and Training

On the whole, participants argue that medical education and training socialises doctors into regarding both human health and their work as healthcare providers in terms of the biomedical paradigm. Social and ecological determinants of health are not adequately emphasised as aspects of core medical science, and insufficiently emphasised as integral to their work in public health courses. This results in a situation where doctors tend not to actively think about their work in broad terms, making it difficult for them to learn about health and climate change mitigation later in their careers.

Undergraduate medical education focuses on the transaction of content that would be tested in qualifying examinations, and does not sufficiently emphasise critical thinking and developing a broad professional identity. This fact, combined with the lack of emphasis on sustainability and climate change in qualifying examinations makes it difficult for doctors to see the links between their professional practice and action to mitigate climate change. This is further reinforced by educators' own lack of knowledge about these issues, and their conviction that climate change mitigation is not a valid concern in the preparation of doctors.

"I [became] involved with the curriculum and the writing of the exam, [and tried to] use the examination and assessment as a lever for change. It was an uphill battle, and as far as I'm aware, there was minimal representation of it in formal assessment. What we know is that if you don't flag to young candidates, doctors-in-training, 'You need to learn about this because you're probably going to be asked about it, and you're going to need to demonstrate your competence in this area', then they prioritise something else."

"I had a funny experience. So I've been telling everyone that I'd never heard anything about climate change, I can't believe it wasn't in my medical education. And then I was looking for something on my computer, and I found this document from second year medical school that did have a section on climate change. So clearly I did have something in there but it didn't stick with me, and I don't remember writing that. So I guess if you were going to make small changes to the curriculum, it's how you're going to make them impactful, so it sticks with students as saying this is core to what you're learning. When I think of my medical school education, I thought I needed to know about heart disease, and I needed to know about diabetes, and in a way, all of the 'softer' stuff, I could leave aside. Because a lot of it, you feel as common sense, or you feel you can learn it quickly, whereas learning the hard, so to speak, material about medical science is difficult, and it worries me about how you get medical students interested in that softer side."

Medical educators do not receive adequate support from professional and regulatory bodies or teaching hospital leaders to either learn about issues involved in reforming healthcare for climate change mitigation, and to develop skills to take these steps themselves. As such, whatever action has been taken for change in medical education and training has relied on the voluntary efforts of passionate and motivated individuals. This is further complicated by the fact that medical educators already find existing curricula to be content-heavy and challenging to teach, and that as such, they regard advocacy to engage with issues of climate change mitigation as additional work in both the short- and long-term.

In addition to these considerations, the prevailing hierarchical approaches to deciding and enacting educational priorities fails to take advantage of the fact that recent/current students and trainees are knowledgeable and passionate about climate change. As a result, educators and trainers are unable to draw on students' enthusiasm and creativity to make changes in education and training for mitigation.

(f) Socio-political and Cultural Barriers

Right-wing economic policies of austerity, privatisation, and marketisation create barriers to change. One participant reflected that the global financial crisis of 2008 resulted in funding cuts within the NHS. These cuts came on the heels of the passage of the UK Climate Change Act and the first carbon footprint calculation of the NHS as a whole. This had a significant impact on the

ability of the proponents of reform to drive change and engagement within the NHS. Combined with the organisational restructuring of 2012-13, it played a significant role in slowing down reform. Another participant pointed out that austerity measures over the past 15 years have contributed to the increasing privatisation of the NHS, and that this, in combination with outcomes-based performance management has created considerable work pressure for clinicians, impeding their ability to engage in efforts for reform.

Two participants argued that because the NHS is a state-funded organisation means that broader political accountability does limit what healthcare professionals and leaders can say or do. This makes them cautious and risk-averse, and can prevent them from backing initiatives for reform if they are seen as inimical to government interests. It is important to clarify that these two doctors are not making a case against government responsibility for healthcare provision; rather they highlight how this relationship can create unique barriers that need to be identified and overcome. Both doctors were expressly forbidden from contacting the press to share details about how the flooding of a hospital in London during 2020 had resulted in a power blackout that necessitated shifting ill patients, and cancellation of procedures.

Several participants pointed out that doctors are limited in their capacity to address the upstream social and environmental causes of ill-health. For instance, social inequalities play a significant role in how individuals and communities experience health impacts of climate change, and place significant constraints on their ability to choose appropriate avenues for care. Addressing these directly is beyond the scope of what doctors and healthcare system leaders and administrators can actually do, and this mismatch is also a source of important barriers for effective reform.

Industry actors are hesitant to take action to support reform initiated by doctors because partly, they are afraid of potential legal repercussions that could arise from health problems caused by their reformed goods and equipment, and partly, they are afraid of potential financial losses that could be incurred by being undercut by competitors who do not make changes and continue to supply lower priced materials to the NHS.

Some participants highlight barriers linked with misconceptions about climate change mitigation. Mainstream discourse about climate change asserts that climate change mitigation is expensive and financially unviable, and entails significant personal sacrifices by people who have worked hard to secure their material well-being. Such claims are not backed up by empirical evidence, and impede change both in the healthcare sector and in society at large. The mainstream media in the UK was particularly hostile to issues of climate change mitigation prior to 2020 and has played a significant role in creating antagonistic public sentiment about efforts for change.

One participant reflected that, in general, economic life in England has increasingly become dependent on low cost, easy to access, and single-use goods during the last two-three decades. This new and normalised culture of everyday economic consumption has trickled down into healthcare as well. When describing this, she pointed out the prevalence of single-use equipment

in clinical practice, and in ancillary medical services such as catering and laundry that were essential aspects of doctors' work in hospitals. She argued that the normalisation of this fast-paced consumer culture was harmful not only for environmental outcomes and health equity, but also for the well-being of doctors. As such, the challenges around imagining medical practices centred on different practices of economic production, purchasing, and consumption significantly impede efforts for reform.

3.9   Assessing Effectiveness of Change Efforts

(a) How do participants regard the effectiveness of their change efforts?

Participants spoke of three successful outcomes of their initiatives. First, they reflected that their efforts have contributed to reducing carbon emissions from medical practice[7]. They have learned and implemented techniques to estimate and reduce the carbon footprint of their professional practices, and were able to link this to time and cost savings of different medical activities. The four participants who have been doing this work the longest reflected that their efforts have played a key role in legitimising climate change mitigation as a valid concern of medical practice, and contributed to formulating goals, and setting agendas for change.

Second, they highlighted that their actions have directly contributed to changes in NHS policies, rules, and standards. This includes the NHS Carbon Reduction Strategy 2009, the changes to the GMC outcomes for graduates in 2018, the NHS Net Zero policy, and considerations of climate change mitigation in speciality areas. Their actions have also contributed to emerging shifts in the professional culture of the sector to think about health and illness in broader socio-environmental terms.

> *"There's a lot of nervousness about a regulator getting involved in that space, you know, with a fear that the professionals would turn around and say, 'Oh no, you want us to prescribe the right things and have great outcomes for our patients, and now you want us to save the world as well in our spare time', that sort of thing. But what's happened with the wider social movement, is that it's becoming less of a fringe activity.*
>
> *So whereas previously the ideas I was espousing were seen as being a little bit wacky, and not mainstream, now we've made a presentation to our executive team articulating both our own internal credentials, but also to begin exploring how we can actually work as a regulator to encourage the wider system to be more environmentally sustainable. To think about that in its widest concept. So not just purely about carbon budget and aiming for Net Zero, but thinking about how health and social care providers can actually*

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[7] It was beyond the scope of this study to quantify exact carbon reductions achieved from interviewed doctors' efforts, and to link these to broader reductions achieved in the healthcare sector during this period. However, it is safe to assume that study participants' efforts have positively contributed to the overall emissions reductions reported by NHS England during the 2009-2018 period.

engage with the ideas of good corporate citizenship, and thinking about how they might be able to influence the social determinants of health in their own locality. So not just mending people when they present themselves to the door the hospital, but thinking more innovatively about how they can play their part in the community, and then talking about some interesting examples of things that we've seen. There are some hospital trusts that are turning over their lawns to be gardens for people to be able to grow their own vegetables, instead of having to mow their own lawns. Another trust is recycling old aids, walking sticks and walking frames, things like that, so instead of just binning them, they're now employing youngsters from the town, and paying them to recycle and rebadge walking aids and little bits of equipment."

Third, their efforts have helped secure formal organisational and financial support for their fellow clinicians to engage in efforts for reform. They have succeeded in getting various Royal Colleges and professional associations to provide funded opportunities for clinicians to develop capabilities to enact change, and incorporate them into their everyday work as clinicians. These doctors have also helped create formal roles in hospitals and professional associations for their fellow clinicians to work on sustainable healthcare in a dedicated manner. Participants have helped create peer-learning and advocacy networks for doctors to learn about and collaborate on reforms, and that these have succeeded in involving more doctors in this work. With the enactment of the NHS Net Zero policy, they are being invited to expand such education and training offerings.

As they highlighted these successes, participants were careful to also speak about the ways in which their efforts had failed to achieve desired results. In different ways, all interviewed doctors state that they have not succeeded in making climate change mitigation a default consideration of medical practice. At the time of interviews, it was still an issue that a minority of clinicians work on (even though a significant majority of NHS staff were in favour of such change).

In part, this situation is due to the lack of adequate systemic support and an enabling professional culture, and partly it is a consequence of an over-reliance on the voluntary efforts of passionate individuals to drive change. As a result of this, efforts for reform have waxed and waned during the last decade, and not succeeded in gaining momentum to transform into a mass movement of doctors for change. This is a matter of concern given the increasing urgency to not only achieve net zero emissions but drastically reverse trends.

Further, participants reflected that even instances of successful reform often involved making compromises that are inimical to long-term change. For instance, the culture of measuring outcomes of medical activity in specific quantitative terms has resulted in a situation where doctors need to render change efforts in formats such as checklists of behaviours. This obscures the complexity of the problem, and prevents deeper critical engagement. Similarly, efforts to change curriculum need to consider possible resistance from educators, and make modest proposals for change.

Some participants reflected on whether the significant increase in climate action in the healthcare sector after 2018 is as much the result of a generational shift as their concerned efforts for mitigation. In recent years, a significant number of students and junior doctors who are concerned about climate change are entering the profession. This makes them reflect on where they need to direct their energies and attention for driving change in the future.

(b) What Next?

Based on their successes and failures participants reflected on how they and their colleagues could conceptualise and enact change going ahead. Some argued that the overall goals of reform themselves need serious reconsideration. The goal of Net Zero emissions alone may not be enough, and reform needs to focus on achieving 'real zero' emissions. The exclusive focus of reforms on climate change mitigation, while ignoring other environmental disruptions such as biodiversity loss and ocean acidification, is problematic and this emphasis could be changed by engaging with the planetary health perspective. While doctors are increasingly engaging with issues of climate change mitigation, it is probably also prudent to begin conversations about how healthcare provision and practice would have to change in order to adapt to climate change.

They also reflected on further systemic changes that are necessary to create lasting change. They argued that climate change mitigation needs to be embedded more explicitly into rules and standards governing day-to-day medical practice. In particular, they highlighted that changing rules around infection control, patient safety, and procurement of medical equipment is particularly important. They observed that formally freeing up doctors' time and paying them to engage in reforms could be one mechanism to achieve these changes. New official roles can be created for clinicians to dedicate significant time and energy to improving the environmental sustainability of clinical practice, within and across specialties. Dedicated sustainability representatives can be included in governance boards to promote action for further change.

In addition to these systemic issues, several participants argued for the need to change aspects of professional culture. They highlighted the need to expand conceptions of the 'duty to care' and the 'duty to do no harm' to include considerations of climate change mitigation. There is a need to conceptualise alternative models of health promotion and care provision based on the planetary health framework. The processes to learn about and implement such ideas need to be rooted in non-linear, complex systems thinking, as opposed to simple linear causal thinking.

All participants highlighted the need to incorporate knowledge, skills, and dispositions for climate change mitigation into medical education and training to enable broader change within the field of healthcare. Medical education needs to not only support doctors to master the knowledge and skills of medical science, but also develop: (1) the understanding of the links between bio-physiological, environmental, and socio-political determinants of health; and (2) the conviction that engagement with social and environmental issues is an integral part of a doctor's work. Knowledge and skills about health-climate change links needed to be integrated across all

domains and years of education and training, and be highlighted in qualifying examinations. To the maximum extent possible, it will be helpful to achieve this integration by building on existing content and pedagogy, and only create new content as a last resort. Importantly, the healthcare workforce needs to be provided with professional opportunities to learn how to enact reform in primary and secondary care work settings.

Providing doctors opportunities to experiment and take action in their work settings could have significant positive impacts. Appealing to doctors' motivations for caring and helping, and focusing on shifting mind-set barriers rather than delivering information or teaching skills alone can also ensure success. Advocates for change need to balance considerations about generating and communicating new evidence, with the need to enact urgent and immediate change. Lastly, it will be important for doctors to consider how they can more effectively engage in advocacy with actors beyond the healthcare system such as politicians, industry representatives, and patients.

4 Discussion

The doctors who participated in this research study are all environmentally and socially conscious citizens. They became involved in efforts to reform medical practice for climate change mitigation based on intrinsic individual motivation, and through receiving opportunities for collaboration. Their specialties, career stage, and official designation did not stop them from finding meaningful ways to advance change. However, senior career clinicians in leadership positions (clinical and administrative) found that they were in a better position to drive systemic change than more junior doctors in the study sample.

Collectively, participants engaged in six kinds of efforts to enact reform: (1) clinical interventions and innovations; (2) clinical leadership; (3) systems and policy reforms; (4) network-building and advocacy; (5) education and training; and (6) research and knowledge creation. Each participant engaged in a minimum of two or three of these six kinds of efforts for reform, with all of them pursuing some form of systemic change.

Their initiatives involved critical reflection on how the normative assumptions underpinning medicine, official medical knowledge, and established procedures contribute to the climate crisis, and consideration of alternatives. Their efforts were informed by conceptions of healthcare as a public good, public health principles of health promotion, and evidence about the interlinkages between climate change and health.

Participants conceptualised efforts for reform by reflecting on research evidence, collaborating with like-minded peers, and engaging in systems and stakeholder analysis. To enact change, they advocated for policy, procedural, and behavioural changes, and when in positions of power, implemented these changes themselves. To the maximum extent possible, they grounded their advocacy in evidence-based argumentation and appeals to reason. In different ways, they took

steps to leverage their social influence and authority to advocate for mitigation initiatives in society-at-large that can help prevent illness and promote population health.

When their efforts succeeded, it involved a combination of individual intrinsic motivation (especially a love for nature, concerns about climate change as an existential threat, a desire to help people), opportunities for professional collaboration, and enabling systemic factors (such as policy changes, fund disbursals, or the creation of new job roles). Reform failures, on the other hand, were largely a feature of systemic and cultural barriers within the field of medicine: such as, biomedical conceptions of healthcare provision, neoliberal conceptions health system efficiency, normalisation of use-and-throw practices due to fear of infections, decentralised procurement practices, and an emphasis on respecting established rules, processes, and structures. These wider conditions created barriers to the development of the intrinsic motivation and collective action needed to advance change.

When assessing the effectiveness of their efforts, participants highlighted that their efforts have contributed to the reduction in the overall carbon footprint of the NHS, without compromising on the quality of healthcare provision. Along with this, their efforts have helped legitimise climate change mitigation as a valid concern of medical practice in England. This is reflected in policy reform (like the NHS Net Zero Policy), the creation of new work roles (such as sustainability fellows, sustainability leads), and the increasing institutionalisation of mandatory professional development courses on sustainable healthcare. At the same time, they observed that on the whole, the status quo medical rules, norms, and systems still do not favour change. Doctors and health system leaders tend to regard healthcare in narrow terms of treating bio-physical illness in individuals in a cost-effective manner. Even though they are in favour of actions to mitigate climate change, they tend to regard the issue as beyond the scope of their immediate work. Their experiences of work stress due to staff shortages and routine challenges of healthcare provision compound these challenges. Furthermore, political and business actors who influence health systems policies and functioning also think in similar terms. Participants shared that they are actively thinking about how to address these key barriers to achieve meaningful long-term change.

Despite these challenges, participants shared that they are optimistic about further institutionalisation of reform in the coming decade. They anticipate that ongoing policy trends that are favourable to climate change mitigation will persist, and this will gradually increase official mandates, funds, and reputation-based incentives to do such work. This will increase clinicians' participation in initiatives for change. In addition to this, participants pointed out that an increasing number of medical students and trainee doctors are concerned about climate change, and keen to integrate capabilities for mitigation with their medical knowledge and skills. In part this is a consequence of a generational shift wherein students learn about climate change in school and are more aware of the issue. This, in part, is a consequence of the broader mainstreaming of climate change as a political issue after the adoption of the Paris Agreement in 2015. They argued that as these doctors acquire their credentials and take on leadership roles, the

proportion of NHS clinicians who are intrinsically motivated to work on climate change will steadily increase, and drive change. Furthermore, participants think that increasing first-hand experiences of extreme weather events in England (especially flooding and heat waves) will also lead to more doctors becoming involved in efforts for reform. This gives them hope, and motivates them to persist with their efforts despite challenges and failures.

Participants identified education and training as key avenues for implementing reform, and ensuring their long-term success. Several participants have enacted educational changes in official capacities as educators, while several others tried to support educational initiatives while working as clinicians. These include creating new medical knowledge and guidelines, creating learning materials and activities, designing and teaching standalone courses, piloting educational strategies, and policy advocacy for both pre-clinical and clinical education and training at the undergraduate and postgraduate levels. Participants reflected that the quality and quantity of these educational efforts need to increase, and be accompanied by additional initiatives such as changing the aims of medical education and practice, integrating concerns about climate change into all aspects of medical preparation, and providing doctors-in-training opportunities to learn to apply such understanding in clinical settings. They highlighted that existing governmental and NHS policies, mass and staff support for mitigation, and a growing base of evidence and exemplary innovations enable this work. At the same time, they pointed out that the existing rules, processes, and systems governing medical practice created significant impediments to enacting change. They argued that these barriers needed to be addressed by enacting new education policies and rules, promoting learning grounded in critical inquiry (as opposed to mastering information and skills alone), and replacing the biomedical and neoliberal principles underpinning these practices. Participants recognised that enacting changes will take considerable time and effort, and attempt to balance the need for more radical change with pragmatic considerations about what is achievable at present.

5   Limitations

This study has some important limitations. These are highlighted here to situate the discussion of findings in a broader context, and to facilitate further critical engagement with questions of reforming healthcare for climate change mitigation. Future work in this field can address the gaps and limitations of this study.

This study is characterised by the limitations inherent in all interview studies (Cresswell & Poth, 2016; Bhattacharya, 2017). Data and analysis do not involve direct observations or engagement with the issues studied. As such, the insights presented are based on representations of experience rather than first-hand empirical observations. This creates important limitations in understanding the phenomena of interest, and opens room for errors. Efforts have been taken to minimise bias, and ensure transparency about the research process. It is hoped that this can enable critical engagement with, and refinement of this work.

Participants were recruited through the professional networks of the Centre for Sustainable Healthcare. As such, it is possible that the study has not captured important change efforts of doctors in England outside these professional networks, and may limit the broader relevance of its findings. It is hoped that new and additional findings will be put in conversation with the evidence presented here to facilitate further reflection and action on climate change mitigation in healthcare.

The study only examines the efforts of doctors in England to enact change; and thereby does not pay attention to the initiatives of other health professionals (nurses, allied health professionals, estates and facilities, business services, support services), and in context of the other devolved nations of the UK (Scotland, Wales, and Northern Ireland). This choice was made due to practical considerations of conducting this study as an individual, under the funding and timing constraints of a doctoral research programme, and based on a curiosity to explore experiences in-depth (rather than more broadly). Nonetheless, it results in exploration of a somewhat narrow slice of broader efforts being made to address climate change in the healthcare sector in the UK.

The central focus of this study is on climate change mitigation; however, this is only one aspect of the wider global climate and nature crisis. The study has not sufficiently engaged with the ways in which [ecological systems collapse, large-scale biodiversity loss, and transgression of other crucial planetary boundaries will impact human health](#), and the need to reform healthcare in light of these. The study also has not sufficiently engaged with the possibility that the mitigation efforts might fail or be insufficient, and how considerations about adaptation can be made. These remain important areas for future work.

The study does not adequately engage with questions of climate justice. This was neither the starting point for inquiry, nor the central concern of participants' efforts for change. The conceptions of sustainable healthcare and planetary health highlighted in this study reflect considerations of socio-economic fairness and vulnerability in the context of illness prevention (these ideas are drawn from a broad public health perspective). The study explores how efforts for decarbonisation need to account for social differences in vulnerability to illness, and be aimed at addressing upstream socio-political causes of ill-health. However, the role of exploitative socio-economic structures in driving climate change, and the need to transform these structures while pursuing mitigation were not addressed. Given the social inequities involved in causing the climate and nature crisis, and the inequitable distribution of its impacts, it is important for future work to centre these issues more explicitly.

6   Conclusion

The coming decade is a make-or-break period to restrict rising global temperatures to less than 1.5 °C to mitigate severe environmental and social impacts of climate change. In the broadest sense, it is this concern that motivates this study. It is hoped that the experiences and insights shared in this report will inspire healthcare professionals in the UK and internationally to feel empowered to take action for change in their immediate work contexts, and health systems as a whole. Every individual professional has the potential to make significant and meaningful contributions. Greater involvement of healthcare professionals in mitigation efforts will surely help drive change further, and spread the workload, thereby increasing morale and motivation, which is crucial for sustained change and can often be in short supply. There is a lot left to achieve, and everyone has a role to play.

> *"I think climate change is much more than simply a problem about mitigating increases in temperature. When we think about it in this way, there is a moral offsetting that happens. You know, the Global South will be harmed, but at the end it's not our problem, much like malaria is not our problem and Ebola is not our problem. But if you think about climate change as an ecological issue, the existential aspect of it becomes much more prominent because it's about the fabric of the planet, not just about weather changes and rising tides. And then you start really coming to grips with questions about dependence upon a global integrity of natural systems."*

Appendix A: Project Details

This report summarises key findings of a research study entitled "Doctors' Efforts to Reform Medical Practice in England for Climate Change Mitigation: Insights for Medical Education and Training".

The study was conducted between October 2020 and March 2023 to fulfil the degree requirements of the PhD programme in Curriculum and Pedagogy at the Ontario Institute for Studies in Education, University of Toronto, Canada. This report summarises original work; the complete thesis, not published elsewhere, can be accessed here.

Timeline

- Research Design: October 2020-April 2021
- Ethics Approval: April 2021-May 2021
- Data Collection and Organisation: June 2021-September 2021
- Data Analysis and Writing: October 2021-August 2022
- Review, Corrections, and Approval: September 2022-March 2023

Research Ethics

The research design and data collection materials were reviewed and approved by the Social Sciences, Humanities and Education Research Ethics Board, University of Toronto.

Funding

- PhD Fellowship ($8,000), OISE, University of Toronto (September 2020-August 2022)
- Thesis Completion Award ($5,500), OISE, University of Toronto (September 2022-April 2023)
- Ontario Graduate Scholarship ($10,000), Government of Ontario (2021-2022)

Research Advisors

- Prof Sarfaroz Niyozov (Supervisor), Associate Professor, Ontario Institute for Studies in Education, University of Toronto
- Prof Blake Poland, Associate Professor, Dalla Lana School of Public Health, University of Toronto
- Prof Brett Duane, Associate Professor, Dental Science, Trinity College Dublin
- Prof Trevor Gibbs, Inaugural Professor of Medical Education, Sun Yat-sen University, Guangzhou, PRC

Research Collaboration

Staff at the Centre for Sustainable Healthcare, Oxford, UK, provided the following support for this research project:

- Provision of relevant background information about climate change mitigation efforts in the healthcare sector in the UK
- Guidance to define research problem and questions
- Support to identify and recruit participants
- CSH staff were not involved in data collection, data analysis, write-up of findings, and review and approval of the dissertation.

Researcher Statement

I am an applied social science researcher and educator with 12 years of academic and professional experience in India, the UK, and Canada. I am not a medical practitioner nor a medical scientist. I am concerned about the climate crisis, and interested in how educational interventions can enable effective climate action. The efforts of doctors in England for climate change mitigation offer valuable insights in this regard. I have no conflicts of interest to declare, and financial interest to report.

Appendix B: Research Process

All research interviews were conducted online using Zoom between June 2021 and August 2021. Interviews were recorded with participants' consent. A pre-designed questionnaire (see Appendix C) was used to guide conversations in a semi-structured manner, leaving room for clarificatory and unprepared questions.

Interview recordings were used to generate text transcripts, and these were the data analysed to generate research insights. Transcription involved context-sensitive editing of direct speech to extract the meaning of what was said during interviews. Individual transcripts were sent back to participants for verification and corrections before being used for analysis. After member-checking, transcripts were anonymised so a consistent set of data could be used for analysis and writing.

Data were analysed using the method of 'Thematic Analysis'. This is a qualitative data analysis method used in social science research. It involves the identification, analysis, and interpretation of patterns of meaning about social phenomena in data such as text, sounds, and images (Creswell, 2007; Saldana, 2009; Miles, Huberman & Saldaña, 2018). The data analysis process involved two steps: (1) Thematic Coding; and (2) Thematic Interpretation.

Thematic coding is a process of categorising and organising text data to facilitate analytical procedures for answering a study's main questions (Miles, Huberman & Saldaña, 2018). Using NVivo 12, a qualitative data management software, interview transcripts were critically read line-by-line, and blocks of text within and across interviews were grouped into thematic categories related to the interview questions. After coding, key themes, trends, and patterns in the interview data were interpreted and analysed to answer the research questions.

A number of steps were taken to ensure rigour during data coding and analysis. A conscious effort was made to look out for, highlight, and make sense of counter-intuitive data, and data that challenged the normative and conceptual assumptions underlying the study. To the maximum extent possible, ideas and experiences discussed during interviews were cross-checked with empirical evidence in professional and research literature. When contradictory or incomplete information was encountered, it was highlighted. Participants' insights and experiences were put in conversation with each other to triangulate primary data, and minimise bias. Overarching limitations of the study have been acknowledged in detail (see Section 5 above).

Appendix C: Interview Questionnaire

The interview questionnaire created to answer the research questions included the following questions:

(1) What convinced you about the need to reform healthcare practices and systems for climate change mitigation? How did you develop this understanding?

(2) How do you define the aims/goals of your efforts for change?

(3) What efforts have you undertaken to reform healthcare practices and/or systems for climate change mitigation? What was your thinking behind them?

(4) What enabling conditions did you encounter when attempting to enact change?

(5) What barriers did you encounter when attempting to enact change?

(6) What have you achieved from these practices? / What do you hope to achieve through these practices?

(7) What have you learned from these experiences? What do you plan to do next?

(8) In your view, what are the most important changes required in medical education and training for climate change mitigation? How can these changes be achieved?

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