GPNET-0

PROTOCOL

Implementation of decarbonisation actions in **G**eneral **P**ractice to help achieve a **net zero** NHS. A mixed methods study of institutional, organisational, professional, and patient factors (GPNET-0 study)

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1. BACKGROUND AND RATIONALE

The 'Delivering a 'Net Zero' NHS' report [1] emphasises the urgent need for all NHS organisations to reduce carbon emissions arising from their operations and embed sustainability within their activities. Healthcare has a significant impact on greenhouse gases emissions: the NHS contributes 25% to all public sector carbon dioxide emissions, or around 4-5% of total UK carbon emissions [1,2]. Primary care contributions to greenhouse gas emissions derive from the direct delivery of care, staff and patient travel, as well as health and care services commissioned by the NHS, supply chain, infrastructure, and prescription of metered dose inhalers and other medications [3]. The 'Net Zero' NHS report recognises general practice playing a key role but does not explain in detail how this should be done. In short there is a need for more research in this area.

In principle there is growing recognition of general practice's role in addressing climate change [1,9]. Since the launch of the NHS Net Zero report [1], a growing number of resources have become available to assist decarbonising general practice. While the report described use of the Green Impact for Health (GIFH) Toolkit as one such resource [11], other resources now available include the carbon calculator for non-clinical general practice [12], the decarbonisation guide [13], and the high quality and low carbon asthma toolkit [14]. In addition, both the Royal College of General Practitioners (RCGP) and the British Medical Association (BMA) provide practical guidance and resources on how to become more sustainable [15,16]. Greener Practice is a growing network that is encouraging action on sustainability in primary care by providing information, convening groups to share learning and raise awareness on a national stage [17]. Additionally, Greener NHS has contracted the RCGP to deliver a Net Zero Hub and Primary Care Development Programme for two years, starting in 2022 [15].

While this is encouraging there remains a lack of evidence about how general practices are using these resources, their reach across practices, their level of adoption and maintenance, their cost impact and their effect on carbon emissions. In addition, evidence is lacking on how certain actions to decarbonise, such as social prescribing, de-prescribing, and low carbon prescribing may affect disadvantage certain groups, especially those that are already underserved [18].

The core issue is the distributed organisational structure of GP practices. For example, in England alone there are around 7000 GP practices in 9000 buildings that need to make changes to address climate change [10]. Achieving net zero carbon emissions requires leadership, culture and behaviour change at all levels of those working within and using health care systems [7]. A coherent and collaborative action, planning and delivery mechanisms that are locality-based yet nationally aligned is needed [8]. Some of these aspects of change require investment at a national level; for example, NHS Property Services is already undertaking a three-year improvement plan aimed at cutting emissions from gas and electricity, installation of smart meters and LEDs, and other building upgrades. Others require action at practice, primary care network (PCN) and commissioning levels [10]. This is where our study will make a contribution.

First, we will develop an understanding how general practice teams and their patients view and experience activities aimed at reducing carbon emissions. Second, we will generate evidence on the use of current resources that support decarbonisation in general practice. Finally, based on these we will be able to inform national and local policies, strategies and interventions.

1.1. Why this research is needed now

The UK is the first country to set its goal of achieving a net zero health service, with "Delivering a 'Net Zero' National Health Service" [1] providing an overarching guide to do so. The report commits the NHS to working towards net zero across the three Greenhouse Gas Protocol (GHGP) scopes: Scope 1 - Direct emissions from owned or directly controlled sources, on site; Scope 2 - Indirect emissions from the generation of purchased energy, mostly electricity, and; Scope 3 - All other indirect emissions that occur in producing and transporting goods and services, including the full supply chain, as well as the emissions from patient and visitor travel to and from NHS services and medicines used within the home [1]. At the moment there is no evidence on how this can be successfully achieved by general practices.

The NIHR HS&DR call for research to support the delivery of a net zero health and social care system highlights the importance of this topic. Our research is designed to rapidly produce findings that will be disseminated towards informing local, regional and national strategies. The need for such evidence is particularly opportune given the 2021/22 NHS Standard Contract requirement for NHS organisations to develop a Green Plan to detail their approaches to reducing their emissions in line with the national strategy. Green Plans are intended to provide a structured way of setting out the carbon reduction initiatives that are already underway and the plans for the subsequent three years, so striking a balance between immediate carbon reductions in some areas alongside strategic development of capability in others. To date, only a small number of Integrated Care Boards (ICBs) have produced Green Plans with a separate primary care section, reflecting the absence of evidence about what is needed to enable and support general practice to decarbonise its activities.

In early 2022, we completed a scoping review (unpublished) to examine existing evidence of the implementation of actions to decarbonise primary care. 52 articles were reviewed, of which 54% were UK based and 40% published in the last three years. Themes focused on mitigation versus adaptation, but also highlighted a lack of evidence of actions supporting decarbonisation in general practice. The review identified the need for future studies to focus on the local efficacy of decarbonisation interventions, the identification of best practice, and patient perspectives. This informed the design of our study.

This need to focus on the GP level is particularly evident when we compare the general recognition that climate change matters with the limited understanding of how important GPs are in this matter. The RCGP has highlighted "the catastrophic effect on human health of not acting decisively and urgently on climate change" [15] and a recent BMA survey found 87% of doctors are concerned about the health impacts of climate change [16]. At the same time a survey commissioned by the Health Foundation found that the NHS's role as a major contributor to carbon emissions is not widely recognised [19]. Making changes to address climate change was low down on the public's priorities for the NHS, especially if this affects individual treatment decisions and care. Hence, if general practice is to make changes to achieve decarbonisation, research is needed to understand how GPs and patient views may facilitate or hinder such actions. The effect that environmental conversations may have on the therapeutic relationship between a health professional and their patient also needs exploring [20]. It is also important that research about the contribution that health care makes to climate change is disseminated in ways that attract the public's

attention and support wider understanding and engagement [21]. Hence, understanding patients' views and wider public engagement are major aspects of our study.

1.2. The role of primary care in achieving a Net Zero NHS

Although there are numerous opportunities to contribute to net zero within general practice, a better understanding of how institutional, organisational, financial, professional and patient factors facilitate or inhibit their introduction and maintenance is needed. This said, the potential of general practice to contribute towards addressing this problem is increasingly cited [9,22,23]. Key opportunities that need to be considered include *where* (e.g. sustainable facilities, minimising 'care miles'), *what* (e.g. prevention and self-management, evidence-based care) and *how* care is delivered (e.g. well-coordinated, integrated care; obtaining maximum value from pharmaceutical, digital and other technologies) [24]. Challenges include the need to engage staff, patients and the wider public; embed a learning culture; engage with sustainable procurement; and address systemic and policy barriers [24]. Our proposed study is designed to generate evidence and recommendations related to these needs.

The World Organisation of Family Doctors (WONCA) has urged general practitioners (GPs) worldwide to commit to act on tackling climate change [25]. General practice staff are well placed for taking the role of agents of systemic and individual change [25-28]. This may be through their connection with the patients and communities they serve [29,30] by taking a social model of health instead of a purely medical model [30] and behaving as role models leading and implementing actions to tackle climate change (e.g., waste reduction, recycling and active travel) and linking them with health benefits [29-31].

Despite increasing calls for health professionals to actively address climate change and related health risks, a recent exploratory review found that literature supporting such efforts is scarce, and too few studies assess the effectiveness of interventions [32]. A recent Lancet report [33] highlights that mitigation efforts should actively generate health co-benefits, reduce environmental impacts, and maintain or improve quality of care. However, knowledge on climate change mitigation and adaptation in primary care is very limited [34]. There is a gap in understanding how patterns of knowledge, practice and values need to change across the organisations that make up the primary health care system; hence our study's inclusion of data collection from general practice and organisational stakeholders at local, regional and national levels.

1.3. Currently available resources to assist general practice decarbonisation

Judging by the number of available tools, GP practices should make a substantial contribution to net zero already. For example, around 1100 general practices are currently registered to use the GIFH toolkit [11]. This offers 100 suggestions to the question "What should we do in general practice?" with advice for reducing carbon footprint under key headings: Water, Travel & Exercise, Quality Improvement, Zero Carbon, News and Communication, Food & Drink, Vulnerable Groups, Energy Saving, Healthy Planet, Waste & Recycling, Learning, and Social Prescribing.

More recently, the High Quality and Low Carbon asthma care toolkit was launched [14]. This contains step-by-step quality improvement projects, downloadable searches and templates and educational information for clinicians and patients to improve

asthma outcomes whilst reducing carbon emissions. Since its launch in 2022, this asthma toolkit has had over 6000 visits to its website, although levels of engagement are currently unknown.

The Decarbonisation Guide [13] is another resource available to all UK GP practices via the SSE sustainability website, at a cost of £50. It is, however, due to be made available for free via the RCGP to their members (launch date to be confirmed). Further to this, geographically specific versions of the Decarbonisation Guide have been made freely available via SE London ICS, NE and North Cumbria ICS and Humber and North Yorkshire ICS. A small evaluation, being carried out by members of our research team to currently evaluating the launch of the NE and North Cumbria ICS Decarbonisation Guide; however, no other evidence is available about adoption of the Decarbonisation Guide.

The problem is that we do not know whether these tools work as there is a lack of evaluation [9]. And what we know points at the need of additional work. In a recent BJGP editorial [35] the GIFH toolkit originators provided insights based on seven years' experience, suggesting three important blocks to implementation and maintenance:

- Most practices find it unsustainable or unreasonable to take on extra un-resourced work.
- A lone enthusiast in a practice may try to make changes but can achieve little without the wider support of colleagues.
- Some practice teams make great progress with the majority of tasks but get stuck with the complex challenges needed to more actively decarbonise.

Three areas for action were suggested, and we have drawn on these in the design of our study:

1. The need for new funding to support decarbonisation.
2. Wider support for individuals to lead decarbonising actions, not just from practices but also from local groups and networks that are emerging.
3. The need for collaborative efforts to learn from data, experience and new ideas; learning from organisations that research, teach and innovate, to discover and disseminate the best solutions faster.

Our study includes a particular focus on the latter. We will identify whether and how decarbonisation resources are being used, what makes GPs and patients use them, and what is needed to increase the overall impact on decarbonisation. It has been designed to address this gap, and the creators/co-creators of several of these interventions have agreed to sit on our Stakeholder Advisory Committee (SAC): Dr Terry Kemple (RCGP/GIFH toolkit), Dr Matt Sawyer (SEE Sustainability/Decarbonisation Guide/non-clinical carbon calculator) and Dr Aarti Bansal (Founder of Greener Practice/asthma toolkit).

1.4. Initial Programme Theory

In developing this research proposal, we theorised a 'preliminary' initial programme theory (IPT) that describes how the 'intervention' (actions linked to currently available decarbonisation resources to support NHS Net Zero within general practice) is introduced within specific organisational contexts, and how specific 'mechanisms' are triggered, thereby leading to outcomes (**Figure 1**). The IPT sought to capture insights and evidence regarding efforts to decarbonise the health sector, including key aspects

and stages envisaged to drive the targeted impacts of net zero primary care and improved public health. The IPT drew on an analysis of elements within the decarbonisation resources, evidence from the literature, and feedback from six health and climate change stakeholders. Drawing on the characteristics identified by Koleros and colleagues [36], we have added mechanisms to the IPT based on:

- Awareness - knowledge of the problem and/or solution.
- Capability - psychological or physical ability to enact a behaviour.
- Opportunity - physical and social environment and resources that enable the behaviour.
- Motivation - reflective and automatic mechanisms that activate or inhibit the behaviour.

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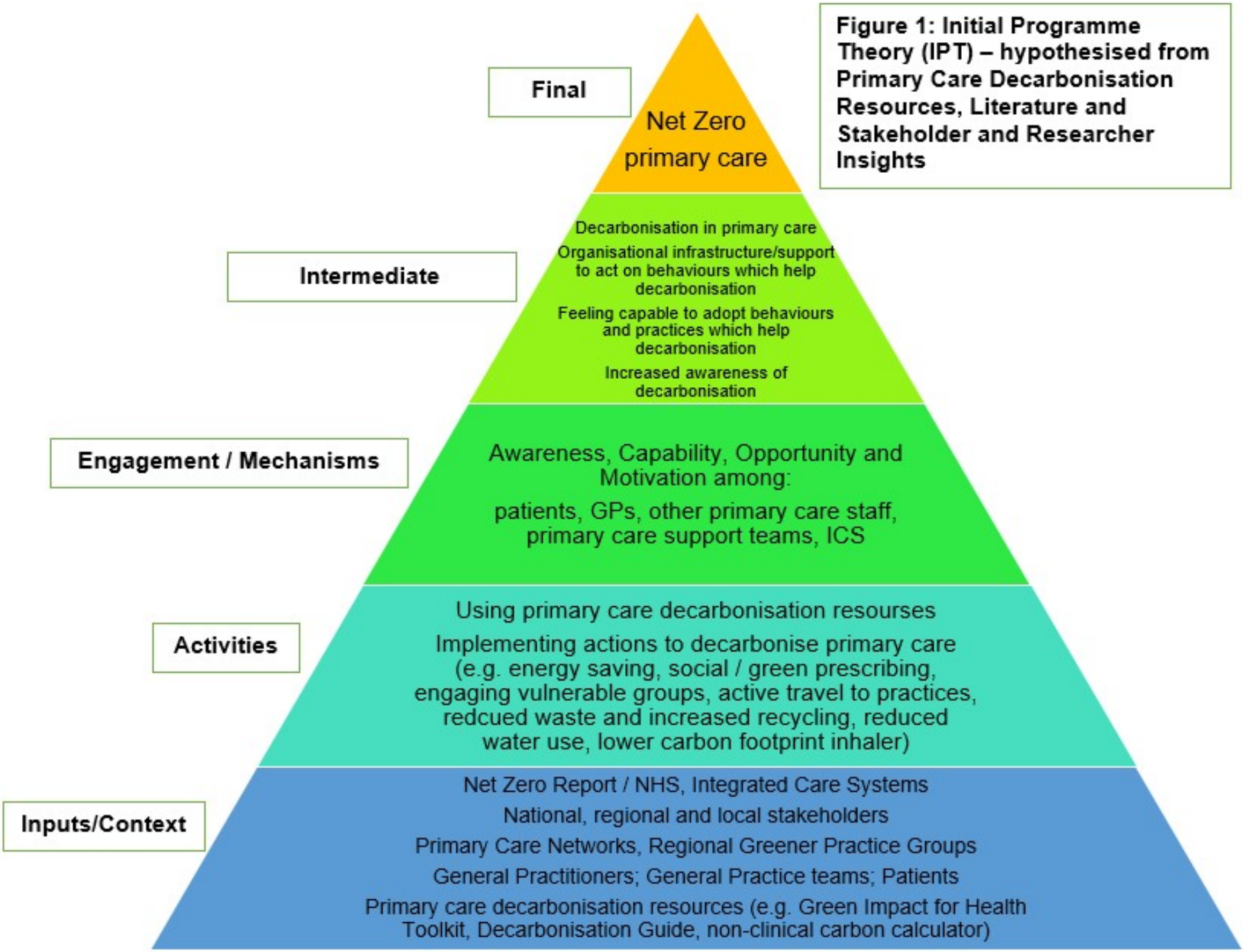


Figure 1: Initial Programme Theory (IPT) – hypothesised from Primary Care Decarbonisation Resources, Literature and Stakeholder and Researcher Insights

2. RESEARCH QUESTIONS, AIMS AND OBJECTIVES

2.1. Research Question:

How do institutional, organisational, professional, and patient factors influence the implementation and sustainability of actions to mitigate the greenhouse gas emissions associated with general practice?

2.2. Aims and objectives

Aims:

- To understand how general practice is implementing decarbonisation actions to help achieve a net zero NHS; and

- To generate actionable recommendations on how to support and accelerate the implementation and sustainability of actions to decarbonise general practice to help achieve a net zero NHS.

Objectives (each mapped to a work package, WP)**:**

1. Conduct a systematic review and refine an initial programme theory, with identification of the components of processes, behaviours and activities that support climate action in general practice. (**WP1)**
2. Conduct general practice level exploration of institutional, organisational and professional factors that influence the implementation of decarbonisation actions. (**WP2)**
3. Conduct patient level exploration of views about the implementation of actions to decarbonise general practice, with particular attention to where such actions may affect the provision of care and/or health inequalities. (**WP3)**
4. Examine the cost implications involved in adopting different approaches to decarbonisation using a primary care Budget Impact Model. (**WP4)**
5. Conduct key stakeholder (local, regional and national policy, commissioning and primary care) level analysis and exploration of views about how to support actions to decarbonise general practice. (**WP5)**
6. Synthesise and integrate all findings into a programme theory that draws together the factors and mechanisms that influence the implementation and sustainability of actions to decarbonise general practice and develop implementation and sustainability recommendations. (**WP6)**
7. Disseminate findings through targeted activities and outputs aimed at providing evidence to inform implementation of the NHS net zero strategy and achieving rapid impact. (**WP7)**

3. RESEARCH PLAN

3.1. Design and theoretical/conceptual framework

This 2.5-year mixed methods study has been shaped by early and ongoing input from the public, our PPI panel, and key stakeholders, many of whom will have continued

engagement as a public co-app, part of our PPI panel, or as a member of our Stakeholder Advisory Committee (SAC). We have already generated an initial programme theory developed from the literature, information from stakeholders and elements of the currently available decarbonisation resources (Figure 1), and this will be refined as each work package is completed. As recommended by the Medical Research Council Framework for developing and evaluating complex interventions [37], throughout the study we will focus on context and mechanisms, developing and refining programme theory, engaging stakeholders, identifying key uncertainties, and economic considerations.

Activities aimed at decarbonising general practice are likely to be affected by institutional, organisational and individual behavioural factors, as well as contextual factors such as the views and experiences of patients. Hence, both sociological (Normalisation Process Theory (NPT)) and behavioural (Theoretical Domains Framework (TDF)) theories are being drawn on to structure data collection and analysis throughout the study. The study adopts the TDF given that it uses a more individualistic stance to understanding implementation thus facilitating the identification of factors that influence individuals' decisions to act in specific situations. Considering this framework is not suited to explore how change takes place or to examine causal mechanisms for success or failure of implementation, the use of NPT is warranted [38]. Combining the two frameworks. This will enable systematic identification of the cognitive, affective and practice environmental determinants relevant to the planning and implementation of decarbonising activities within general practice and understanding of the dynamic social processes (facilitators and barriers) that are involved. This combined approach has recently been successfully used to explain the variable success of an adaptable implementation package promoting evidence-based practice in primary care [39] and starting to gain interest in intervention design [40]and evaluation [41].

The NPT Framework [42] is useful for understanding group behaviours at practice level. NPT acknowledges that healthcare is a collective activity requiring a multitude of interactions between professionals, patients, managers and others. A complex intervention, such as decarbonising general practice, requires system-wide interactions and adaptations, and NPT will be used to help identify how relationships between participants may be affected and how interventions may be modified to support these interactions [43]. In relation to our study, NPT proposes that interventions related to decarbonisation are more likely to achieve their aims when practice staff value the intervention (coherence), commit to engage (cognitive participation), commit staff and resources and work towards change (collective action), and appraise the actions being taken as useful (reflexive monitoring).

TDF is widely used to assess implementation issues and support intervention design [44]. We will use this to provide a systematic and theoretical basis for understanding what affects motivations to adopt measures that support general practice decarbonisation. The TDF simplifies 33 theories and 128 constructs related to behavioural change into 14 domains (1) knowledge, (2) skills, (3) social/professional role and identity, (4) beliefs about capabilities, (5) optimism, (6) beliefs about consequences, (7) reinforcement, (8) intentions, (9) goals, (10) memory, attention and decision processes, (11) environmental context and resources, (12) social influences, (13) emotion and (14) behavioural regulation. These domains include individual-level factors, such as knowledge and skills, social factors, and environment and resource factors, all relevant to consideration of how best to engage general practice teams into decarbonising primary care.

The NPT Framework is used to understand important group level behaviours at practice and organisational level. The TDF is used to describe important individual level factors

such as “knowledge and skills, social factors, and environment and resource factors” affecting general practitioners. Ultimately, it will be important to design and implement actions and initiatives which address the challenges of managing the tensions, trade-offs and co-benefits between health and sustainability outcomes (i.e., improving societal level health outcomes; improving quality of care and equality of access; addressing ecological sustainability).

We therefore anticipate that actions will be required across the following issues and domains: local, regional and national levels; climate mitigation and adaptation; immediate, medium-term, and long-term timeframes of implementation; institutional, organisational, and professional processes, policies, and activities; individual GP level knowledge, skills, practices and values; as well as societal and patient level understanding and support. We have tried to capture these for now under the headings of awareness, capability, opportunities and motivation but will review them based on our systematic review and empirical research. Concrete actions might involve the following:

- Running public and GP specific awareness raising campaigns
- Reviewing job descriptions for GPs, staff, and other NHS functions
- Providing financial and other performance incentives
- Reviewing procurement policies and supplier contracts and agreements
- Offering dedicated staff and GP training
- Supporting the development of local and regional communities of practice as well as collective decarbonisation efforts (e.g., benchmarking, information sharing, collective switch and purchasing)
- Identification of green champions willing to support other practices with decarbonisation and other sustainability efforts
- Showcasing best or leading practices
- Reviewing and revising medical training (i.e., degree training programmes)
- Developing pilot schemes for evaluating effectiveness of different decarbonisation tools and resources
- Facilitating NHS/GP-private sector networks and events for information sharing, collaboration, and innovation
- Develop policy guides to help counties, councils and boroughs to support GP decarbonisation efforts

3.2. Setting

Three Integrated Care Systems (ICS) areas (Coventry and Warwickshire, Birmingham and Solihull, and South Yorkshire) have been selected for the study. They represent differing levels of engagement with decarbonisation. South Yorkshire is the first area in the UK to set up a Greener Practices regional group and is working on many initiatives (including promotion of the GIFH toolkit, working with PCNs, running webinars and creating actions within the RCGP). Birmingham and Solihull recently set up a Greener Practices regional group and have key health professionals starting to drive regional change. By contrast, Coventry and Warwickshire currently has a low level of activity. All three areas have expressed support for the study and are enthusiastic to participate, as demonstrated in the letters of support (see uploads).

3.3. Equality, diversity, inclusivity and geography

The three ICS areas cover a broad range of geographical locations and populations with diverse socioeconomic characteristics and ethnicity. They have varied general practice characteristics (patient list size, staffing and communities they serve) and communities (age, health needs, ethnicity, levels of deprivation, rural/urban location). This is important as WP2 includes purposive sampling of GP practices for socioeconomic and ethnic diversity, and purposive sampling of patient participants for diversity of age, gender, ethnicity, medical condition/disability and socioeconomic status. Participant information leaflets and surveys will be translated, and interviews will be conducted with interpreters, where required. Surveys will be undertaken at times which avoid cultural holidays.

3.4. Ethics / regulatory approvals

The University of Warwick is the Sponsor for this study. The study will follow NHS and University of Warwick ethical, governance and data management procedures.

The specific content of workshop (or guidance to content), topic guide for facilitated discussion, topic guide for staff interviews (will be similar/same as for facilitated discussion), online baseline survey and follow up survey, carbon calculator, budget impact model, survey for patients, topic guide for patients will be produced or updated once we have completed the systematic review (WP1) and involved the PPI panel and the Stakeholder Advisory Group (SAG) in refining the questions / topics. We anticipate returning to the REC with a major amendment in early 2024 with these documents.

4. WORK PACKAGES (WP)

4.1. WP1 – Systematic review and refinement of the initial programme theory *(Lead: RN; months 1-6)*

We will undertake a systematic review of the literature that addresses the overarching research question of our study: *How do institutional, organisational, professional, and patient factors influence the implementation and sustainability of actions to mitigate the greenhouse gas emissions associated with general practice?.*

We will explore institutional vs. organisational vs. behavioural vs. systems change models and literature. We will use the review findings to refine our programme theory, and in particular the mechanisms (behaviours, processes and activities) that support decarbonisation in general practice.

4.1.1. Inclusion and exclusion criteria

The inclusion criteria for the review will be: any study design; all types of evidence that examine institutional, organisational, professional, and patient factors that influence the implementation and sustainability of actions to mitigate the greenhouse gas emissions associated with general practice (or the equivalent in non-UK studies)

We will include both peer reviewed, and grey literature published in English from 2008 onwards up to May 2023 and will explore institutional vs. organisational vs. behavioural vs. systems change models and literature.

4.1.2. Search strategy

We will use the following databases: Medline, Embase, CINAHL, Global Health, Web of Science, the Cochrane Library, and NHS Evidence. We will also incorporate snowballing techniques to extend our learning to grey literature. We will also use the following databases to look for grey literature: Current Awareness Service for Health, OpenGrey, Grey Matters and EthOS. All searches will be restricted to 2007 onwards, and to English language publications.

The Stakeholder Advisory Committee (SAC) and PPI panel will act together as a reference group to critically comment on development of the systematic review and the emerging theory.

We will draw on the search strategies used in our previous scoping review and in the recent systematic reviews that are relevant to decarbonisation in general practice that we have been undertaking with medical students (covering the role of primary care estates, energy use and waste management; promoting sustainable patient choices; the role of digitalisation and application of technology in primary care). We will work closely with the Science and Medicine Academic Support Librarian and information specialist (Sam Johnson, University of Warwick) who provides support to systematic reviews. Additionally, we will work with Sam Johnson to set up database notifications to allow ongoing updating of the systematic review throughout the study. We will do this to ensure that the final programme theory and publications draw on the most up to date evidence. As a result, we will update the systematic review every 6 months which has been aligned to feed into the Knowledge Mobilisation factsheet drafting.

4.1.3. Screening and selection of studies

Titles and abstracts will be screened against these criteria and de-duplicated. Extracted references will be independently screened by a second reviewer and disagreements regarding inclusion resolved by internal discussion with a third member of the research team, so as to guide screening of the remainder. Full texts will then be assessed for eligibility.

4.1.4. Data extraction

We will extract study details (study type, outcomes, size, setting) and outcomes relating to the behaviours and mechanisms that support decarbonisation. A specifically designed form will be used by two reviewers independently, and any discrepancies will be discussed and resolved by a third reviewer, if necessary. The TDF will be used as a framework to support data extraction.

4.1.5. Quality assessment

For critical appraisal we will use the Mixed Methods Appraisal Tool. The Mixed Methods Appraisal Tool (MMAT) version 2018 will be used to assess quality of included studies. The MMAT is appropriate for use where included studies use a range of methodologies (Hong, Q. N., et al. (2018). "The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers." Education for Information 34: 285-291).

4.1.6. Data Analysis

We expect to find a heterogenous range of studies and will use a narrative synthesis approach to analysing the data from the included studies. The TDF will be used as a framework to support analysis as demonstrated by Rushforth and colleagues [45]. Perceived barriers and enablers to the TDF's 14 domains [44] will be coded against decarbonisation goals (such as reducing the use of asthma inhalers) and as primarily clinician, patient, or organisational related.

We will use the review findings to refine our programme theory, and in particular the mechanisms (behaviours, processes and activities) that support decarbonisation in general practice.

4.1.7. Data reporting and presentation

PRISMA guidelines will be followed.

4.2. WP2 – General practice level analysis of institutional, organisational and professional factors that influence the implementation and sustainability of decarbonisation actions

This work package comprises of two elements: a quantitative online survey for all general practices in the study settings to complete; and a longitudinal qualitative investigation to evaluate the implementation of decarbonisation activities in a sub-sample of 12 practices.

4.2.1. WP2.1 General practice survey (Lead 2.1: JD with HT; months 4-9)

4.2.1.1. Purpose

The survey will map the current levels of interest in decarbonisation in general practices across the three ICS areas; the type and extent of specific decarbonisation actions that are being undertaken (using questions adapted from the NOMAD survey); the awareness of decarbonisation resources available to general practice; the intentions/actions/ plans that are present in practices; and interest in taking part in the longitudinal study (WP 2.2).

4.2.1.2. Participants

All GP practices within the three participating ICS areas – approximately 500 in total – will be invited to participate in the survey; we anticipate a minimum response rate of 30% (ie >150 practices).

4.2.1.3. Recruitment

An email with a link to the online survey will be sent (via the ICS) to the practice manager and a lead GP at each practice, with a reminder 3-4 weeks later. To encourage participation and optimise response rates, we plan a range of measures that have been carefully considered with CRN GP research champions, GP networks and our Practice Manager co-app who works in a busy urban GP practice in Dudley:

- Engaging each ICS area's interest in the study through attending local GP meetings and events, submissions to newsletters, Primary Care Networks communications, and via CRN and local GP Research Champions.
- Providing a letter of support from the local ICS / Greener NHS / RCGP to encourage participation in the survey.
- Ensuring that the survey can be completed online within 5 minutes to minimise disruption and burden.
- Incentivising participation by planting a tree (through NHS Forest) for every practice that returns a completed survey; this could lead to over 200 trees being planted on NHS estates. (This will also serve to raise awareness of the NHS Forest and contribute to engaging practices' interest in the research)
- Including information in the invitation email from our PPI panel about how patients view this as an important area for research.
- Specifically engage local Greener Practice groups to promote completion of the survey to practices in these ICS areas.

4.2.1.4. Survey

We will draw on both sociological (NPT) and behavioural (TDF) theories to structure the data collection. This will allow systematic identification of the cognitive, affective and practice environmental determinants relevant to the planning and implementation of decarbonising activities within general practice and understanding of the dynamic social processes (facilitators and barriers) that are involved. This combined approach has recently been successfully used to explain the variable success of an adaptable implementation package promoting evidence-based practice in primary care [39].

Drawing on the NoMAD evaluation tool [42], together with findings from WP1, we will develop a survey to assess how actions to decarbonise general practice are currently occurring in general practice. NoMAD is an NPT-informed, 23-item instrument for measuring implementation processes from the perspective of professionals directly involved in the work of implementing complex interventions. A final question will seek expressions of interest in taking part in the longitudinal study in which they will be asked to implement a decarbonisation activity over the next year (WP 2.2).

The survey will be made available via an online platform and have multiple choice tick-box answers to enable quick completion and one free text question for additional comments. We will pilot the questionnaire with practices that are outside the recruitment areas to ensure its comprehensibility and that it can be completed within 5 minutes.

4.2.1.5. Data Analysis

We will summarise survey data using descriptive statistics to describe the extent to which practices are embedding (or considering) decarbonisation efforts. We will explore associations between practice characteristics (e.g., rural/urban; size) and levels of interest in and experience of decarbonisation activity.

We will draw on both sociological (NPT) and behavioural (TDF) theories to structure the qualitative and quantitative data analysis. This will allow systematic identification of the cognitive, affective and practice environmental determinants relevant to the planning and implementation of decarbonising activities within general practice and understanding of the dynamic social processes (facilitators and barriers) that are involved. This combined approach has recently been successfully used to explain the variable success of an

adaptable implementation package promoting evidence-based practice in primary care [39]. We will code qualitative data using Framework Analysis, with the coding framework drawing on the NPT and the TDF coding dictionaries with inductive and deductive elements guided by NPT and TDF constructs, following the method described by Glidewell et al [39]. This will allow us to explore the data from the perspective of the NPT and TDF and then integrate the findings. We will then develop a coding manual to do this.

Content analysis will be undertaken of the free text comments using NVivo.

4.2.2. WP2.2 Longitudinal investigation of practice teams' experience of engagement with and implementation of decarbonisation activities (Lead: HA with HT and RS; months 7-25)

From the general practices that expressed interest in the survey (WP2.1) in initiating new decarbonisation activity(ies) and participating in an evaluation over a 12 months' period, we will recruit 12 practices.

Sample: From the responses given in the WP2.1 survey, we will purposively recruit practices: four per ICS, aiming for a range of characteristics list size and number of GPs in the practice, level of deprivation, % of patients from an ethnic minority group, location (rural, semi-rural, urban), engagement with decarbonisation activities (low, medium, high) and varied geographical areas of England (ICS areas: (Coventry and Warwickshire, Birmingham and Solihull, and South Yorkshire).

Box 1. Maximum variability sampling within practices

- Index of multiple deprivation score at practice level.
- Location (rural, semi-rural, urban).
- List size / Number of GPs and staffing in the practice (small < 6000; large > 12000).
- % patients from an ethnic minority group.
- Current engagement with decarbonisation activities (low, medium, high).
- Geographical area / ICS area (Coventry and Warwickshire, Birmingham and Solihull, and South Yorkshire).

Following recruitment (months 4-9), an online Site Initiation Visit (SIV) will take place with the practice manager and practice staff to be involved in the study data collection. The SIV will last 30 minutes and involve a short presentation by the research team explaining what participation involves. It will be a prerecorded video presentation followed by a Q&A with the members of the research team. This will also include identifying patient participants for WP3, details on data collection requirements, identification of local stakeholders, timelines and significant dates. The SIV will establish the working relationship between the practice and the research team, including points of contact.

We will draw on both sociological (NPT) and behavioural (TDF) theories to structure the data collection and analysis. This will allow systematic identification of the cognitive, affective and practice environmental determinants relevant to the planning and implementation of decarbonising activities within general practice and understanding of the dynamic social processes (facilitators and barriers) that are involved. This combined approach has recently been successfully used to explain the variable success of an

adaptable implementation package promoting evidence-based practice in primary care [39].

4.2.2.1. WP2.2.1 Baseline practice workshop and interviews

A kick-off **workshop** will be held with each practice during which they will be introduced to the resources available to support decarbonisation (the **intervention**) followed by a recorded focus group about the decarbonisation actions to be undertaken.

The **intervention** that we are testing is a brief introduction at a practice meeting to the resources that are currently available to support general practice decarbonisation actions, with examples of how each can be used, together with funding to allow ring-fenced time for planning and implementing decarbonising activities. The presentation will be developed with input from members of our SAC, and will cover the availability, content and format of the different resources. Data will be collected from each practice team to evaluate their engagement with the resources, the actions(s) they implement, and their reflections on what has been achieved and the facilitators and barriers experienced.

At least one GP (preferably at least two, at different stages of their career as age / career stage may affect views), practice nurse, practice manager and receptionist will be invited to participate. We will explore their interest in using the available resources and elicit views and expectations of the drivers, barriers, costs, and benefits to implementing their chosen action(s) using a topic guide that draws on the domains of the NPT and TDF.

If available at the time of the workshop, we will provide the practice with a preliminary summary of the findings from their patient survey (see section 3.2 below) and elicit their views about their implications for the practice. (If the timing of the workshop means that it is not yet available, the summary will be provided to the practice during the first months following the workshop in a format that can be shared at a practice meeting).

Where this is insufficient time to fully explore a viewpoint that one or more participants have expressed, or where the practice participants identify another member of the team as having views that it is felt we should be aware of, we will invite such individuals to take part in a semi-structured online **interview**. We will interview where necessary.

Following the workshop, the practice team will be asked to confirm their decarbonisation plans and actions at a full practice meeting and complete the baseline carbon calculator which will be used to inform their decarbonisation planning. This should be done within the following two weeks. The baseline carbon calculator will be used again at the end of the year to evaluate progress. They will also be asked to provide data for the budget impact model (see WP4). While it is likely that the practice manager will be best placed to complete this, it will be at the discretion of each practice as to which individual(s) do so.

4.2.2.2. WP2.2.2 Three-monthly review meetings

These will be undertaken with each practice to monitor progress, with a particular focus on any organisational or individual drivers and barriers that have been encountered. These conversations will be audio recorded and take place with the practice manager or another designated member of the practice team via on-line meeting. In addition, at the fourth check-in (i.e. 12 months post-baseline), practices will be asked to repeat the carbon calculator to provide a measure of change.

4.2.2.3. WP2.2.3 Follow-up focus groups and interviews

12 months post-baseline we will hold an online **focus group** with each practice (where possible involving the same participants as at the baseline workshop) to discuss their experiences in relation to the actions they planned, implemented (or not), how they interacted as a team and how this affected the changes achieved, and their future plans. We will use the domains of the NPT to guide the focus group. As at the baseline workshop, where this is insufficient time to fully explore a viewpoint that a participant has expressed, or where the practice participants identify another member of the team as having views that we should be aware of, we will invite such individuals to take part in a semi-structured online **interview.** We will interview where necessary.

4.2.2.4. WP2.2.4 Data Analysis

Workshops, interviews, observation point data and focus groups will be audio recorded and transcribed verbatim. In order to maximise the potential impact of the findings for policy we will apply framework analysis [46]. Framework analysis is a systematic and flexible approach, suitable for multi-disciplinary health research, and it can be used by those who lack experience of qualitative research, enabling patient and public involvement alongside researchers' analysis (for validation purposes). It produces highly structured outputs of summarised data. It has five key stages: (1) Familiarisation; (2) Identifying a thematic framework; (3) Indexing; (4) Charting; (5) Mapping and interpretation. A matrix will be created, with 'cases' (e.g., individuals or practices) along one axis and 'codes' along the other. This will allow data to be organised systematically in order to compare differing experiences and perspectives on key areas from participants' accounts. NVivo software will be used to support this process [47]. We will apply these steps, working as a research team with PPI input throughout. There will be an ongoing process of team reflection and discussion, and close engagement with the PPI panel and SAG.

We will code qualitative data using Framework Analysis, with the coding framework drawing on the NPT and the TDF coding dictionaries with inductive and deductive elements guided by NPT and TDF constructs, following the method described by Glidewell et al [39]. This will allow us to explore the data from the perspective of the NPT and TDF and then integrate the findings. We will then develop a coding manual to do this. Content analysis will be undertaken of the free text comments using NVivo.

To optimise commitment to participation in the study and to cover the costs involved in data collection and implementation of the intervention, including commitment to have decarbonisation as a standing item at practice and partnership meetings across the study. we will pay each participating practice £2500: £1000 after the initial set-up; £500 after 6 months, and £1000 after the follow-up workshop.

4.3. WP3 – Patient level analysis and exploration of views about the implementation and sustainability of actions to decarbonise general practice (Lead: AE with RN; months 7-22)

WP3 focuses on understanding patients' views about the need for general practice to undertake actions that support decarbonisation and the potential consequences of such actions. It takes place in the same 12 practices that are subject to the research in WP2.2

and involves a quantitative survey and in-depth interviews with patients. This will allow us to consider the alignment between patients' views and those of their GP teams. Given the importance of understanding the views of patients that are underserved by research, we will also recruit through community and faith groups in the vicinity of the participating practices.

4.3.1. WP3.1 Patient Survey: *(months 7-13)*

A survey (delivered online or in hard copy, according to the participant's preference) will be designed drawing on the TDF domains to understand patients' awareness of and views on the role of general practice in carbon reduction efforts, specific actions already taken by their practice, and potential actions that may affect patient care. The survey will be piloted with our PPI panel for comprehensibility and acceptability. The last question will ask participants to indicate interest in being interviewed.

4.3.1.2. Sample

We aim for a response of 35 patients at each practice (i.e. at least **400 in total across the 12 case study sites**). We assume that the response rate will be around 20%; hence we will initially invite 150 patients to participate at each practice and will send out further invitations if necessary. To ensure that the sample includes a diverse range of participants, population, we will target recruitment on **under-served populations** resident in the vicinity of the participating practices, aiming to recruit a **further 100 participants.**

4.3.1.3. Recruitment

i) To recruit a representative sample of general practice users, each practice will send out postal invitations to participate (via Docmail) to a random sample of patients (or their carers) who have had contact with the practice in the five weekdays prior to the database search. This will include adult patients and parents of children. A GP will screen the list to ensure that patients who have opted out of taking part in research, are at the end of life, severely ill or suffering from cognitive decline or any other mental or physical condition which the GP deems to make them unsuitable to be invited to participate are not included. The invitation will explain that their practice is participating in the study, and that in addition to other benefits from participating in research this will lead to up to 10 trees being planted by NHS Forest (dependent on at least 30 patients completing the survey). We will discuss with GP practices as part of the SIV whether they feel it would be best to send the invitation letter with an online link to the survey which participants can copy into a web browser, a QR code for participants who would like to complete the survey directly on their phone, or whether everyone should be sent hard copy survey in order to avoid digital exclusion, and follow their preference.

ii) In addition, to **reach under-served populations**, and those whose first language may not be English, we will also contact local community and/or faith leaders (some of whom may be linked to the practice) and seek permission to invite their members who live in the vicinity of a participating practice (regardless of whether they are registered with it) to complete the survey. We will identify relevant community / faith groups with each GP practice and contact them by letter and phone. We will discuss with each how best to engage their members' interest in participating in the study, and if appropriate translate

materials. A hard copy of the participant information and survey, either in English or translated to another language will be made available for underserved populations.

4.3.1.4. Data collection

We will draw on both sociological (NPT) and behavioural (TDF) theories to structure the data collection. This will allow systematic identification of the cognitive, affective and practice environmental determinants relevant to the planning and implementation of decarbonising activities within general practice and understanding of the dynamic social processes (facilitators and barriers) that are involved. This combined approach has recently been successfully used to explain the variable success of an adaptable implementation package promoting evidence-based practice in primary care [39].

The survey will collect data on demographic backgrounds and include a maximum of 20 questions exploring views about climate change in general, actions that should be taken in general practice, and actions that they are aware their practice is already undertaking. For each question, participants will be asked to rank their agreement with statements, with the option of providing additional free text comments. A final question will ask participants to express their interest in taking part in an interview.

4.3.2. WP3.2 Patient interviews: *(months 11-22)*

Patients (or their carers) will be recruited from those who express interest in the patient survey to participating in an online or phone interview. The interview will be designed to gain in-depth understanding of how patients view and experience the ways in which their general practice is engaging with decarbonisation and will be conducted 6-9 months after their practice has entered the longitudinal study.

4.3.2.1. Sample

We will purposively sample 10-12 patients per ICS (n=30-35) to include a diverse sample across age, sex, ethnicity, socio-economic and health status, and practice, from within the group that respond to the survey. We will supplement the interviews with additional targeted invitations to participate through general practice should certain groups not be included amongst the survey respondents. To encourage participation, participants who take part in an interview will each be offered a £15 voucher; the type (e.g., Love2Shop or eco-friendly) will be discussed with our PPI panel. The interviews will take place 6 – 9 months after their practice has entered study. We have included in our budget costs for translation, should any participant require this.

Box 2. Maximum variability sampling of patients within practices

- Age.
- Gender.
- Health needs.
- Ethnicity
- Medical condition/disability
- Socioeconomic status.

4.3.2.2. Data collection

We will draw on both sociological (NPT) and behavioural (TDF) theories to structure the qualitative and quantitative data collection and analysis. This will allow systematic identification of the cognitive, affective and practice environmental determinants relevant to the planning and implementation of decarbonising activities within general practice and understanding of the dynamic social processes (facilitators and barriers) that are involved. This combined approach has recently been successfully used to explain the variable success of an adaptable implementation package promoting evidence-based practice in primary care [39].

We will use the domains of the TDF to structure the topic guide, and content will draw on the findings from the patient survey to gather more detailed evidence about patients' general views about the role general practice should play in sustainability and carbon reduction efforts, specific actions that the practice has initiated since the start of the study, and any concerns about how this might affect the delivery of patient care within their area. The interviews will last up to 30 minutes and be audio recorded.

4.3.3. WP3.3 Data analysis

The **patient survey** will be analysed using the statistical software package SPSS [48]. Descriptive statistics will be undertaken both at practice level and across the entire sample. We will explore association between patient characteristic (e.g., gender, age, ethnicity, registered practice) and views about general practice decarbonisation using chi-square tests. We will undertake multivariate modelling to test the associations between variables if the dataset is of sufficient size to allow this.

The **patient interviews** will be transcribed verbatim.

We will code qualitative data using Framework Analysis, with the coding framework drawing on the NPT and the TDF coding dictionaries with inductive and deductive elements guided by NPT and TDF constructs, following the method described by Glidewell et al [39]. This will allow us to explore the data from the perspective of the NPT and TDF and then integrate the findings. We will then develop a coding manual to do this. Content analysis will be undertaken of the free text comments using NVivo.

4.4. WP4 – Cost implications involved in adopting different approaches to decarbonisation using a primary care budget impact model *(Lead: SJ; months 5-7 & 20-22)*

Implementation of decarbonisation strategies has the potential to produce cost savings for primary care, but such cost savings must be balanced against the cost of implementing and delivering interventions. A detailed budget impact model (built in Microsoft Excel) will be designed during the first months of the study and will be used to establish baseline costs and resource usage (business as usual) under different categories of activity which contribute to carbon emissions (e.g., energy utilisation, asthma prescribing, travel, consumables). The categories will be determined from existing resources such as carbon calculators and toolkits, and responses to the WP2 survey. The model will then estimate the impact of decarbonisation strategies on cost inputs and outputs from a primary care perspective.

A practice-specific model will be produced for each of 12 WP2 participating practices, populated with their own baseline data for each activity category. Scenarios of different

potential interventions will be applied, and information provided to each practice on areas where changes can be made and the associated cost implications over a 12-month period. These will be made available to the practice within the first 3 months of the longitudinal study.

Data collected from each practice on any changes made will be inputted into the model to show how activity and associated costs have changed. Each practice will be asked to complete the non-clinical carbon calculator [12] at baseline and after 12 months in order to identify whether there has been any measurable change. Due to the current pressures on primary care, the process of data collection from practices will be light touch but comprehensive enough for the data and model outputs to be useful.

A user-friendly generic budget impact model will also be developed for widespread general practice use and to inform WP6. This budget impact model will enable extensive sensitivity analyses to explore a wide range of scenarios and assumptions, including the effect of variable levels of intervention uptake and different time horizons.

4.5. WP5 – Key stakeholder (local, regional and national policy, commissioning and primary care) level analysis and exploration of views about how to support the implementation and sustainability of actions to decarbonise general practice *(Lead: HT with RN and JD; months 15-27)*

WP5 is an interview study with key stakeholders. Working with our SAC, we will identify relevant stakeholders with a broad range of roles. The interviews will focus on how to reduce barriers to change and promote facilitators to GP practices undertaking actions to decarbonise, and identify actionable strategies, policies and plans that could be implemented at local, regional and national levels. The interview schedule will be informed by findings that have emerged from the general practice survey and baseline workshops with practices in WP2.

4.5.1. Sample

Up to 15 regional and national policy stakeholders, together with up to 20 local organisational stakeholders (from the vicinities of the participating practices). At a local and regional level, this will include, for example, net zero leads for each ICS area; primary care finance teams; primary care education coordinators; primary care sustainability teams, public health teams; and appropriate local authority leads (e.g., transport teams). At a national level, this will include, but not be limited to, NHS England, Greener NHS (Net Zero Delivery Leads), RCGP sustainability lead, directors of charitable organisations (e.g., Clean Air), SEE Sustainability, the Sustainable Healthcare Coalition.

4.5.2. Recruitment

We will purposively sample to recruit a broad range of individuals with different organisational affiliations, making initial contact via email and phone.

4.5.3. Data collection

We will draw on both sociological (NPT) and behavioural (TDF) theories to structure the data collection. This will allow systematic identification of the cognitive, affective and practice environmental determinants relevant to the planning and implementation of

decarbonising activities within general practice and understanding of the dynamic social processes (facilitators and barriers) that are involved. This combined approach has recently been successfully used to explain the variable success of an adaptable implementation package promoting evidence-based practice in primary care [39].

Interviews will take place via video meeting or telephone to gather views on how local, regional and national plans and strategies are aimed at decarbonising general practice and achieving NHS net zero goals, and experiences of facilitators and barriers that are affecting reach and adoption.

4.5.4. Data analysis

Interviews will be audio recorded and transcribed verbatim.

We will code qualitative data using Framework Analysis, with the coding framework drawing on the NPT and the TDF coding dictionaries with inductive and deductive elements guided by NPT and TDF constructs, following the method described by Glidewell et al [39]. This will allow us to explore the data from the perspective of the NPT and TDF and then integrate the findings. We will then develop a coding manual to do this. Content analysis will be undertaken of the free text comments using NVivo.

4.6. WP6 – Synthesise and integrate all findings into a programme theory, and engage with general practice, patients, and key stakeholders to develop implementation and sustainability recommendations *(Co-Leads: FD and RS and RN; months 10-28)*

4.6.1. WP6.1 Data synthesis

We will cumulatively synthesise and integrate findings from across all other WPs as they are ready. To achieve this, we will use triangulation and matrices to synthesise the data from across work packages [49]. Triangulation is a technique that involves cross verifying data from two or more sources that study the same thing, allowing validation of the findings. Mixed methods matrices offer a practical method of integrating data sources by enabling us to map out the findings and look for similarities and differences in the findings. These approaches work in a pragmatic context which fits with our use of theory.

We will draw on the findings from WPs 1-5 to evaluate how contextual factors (policies, people, structures, processes, and relationships) and mechanisms at practice organisational and workforce level affect the adoption and implementation of decarbonisation actions, and how these might be influenced. We will use the domains of the NPT and TDF to support this, matching the findings within each WP against each of domains. We will then integrate and summarise the findings that emerge against each domain, noting the strength of evidence and any gaps that require further investigation. This will be used to refine the programme theory developed in WP1, and hence define preliminary recommendations, including potential interventions, that are likely to drive adoption and maintenance of decarbonisation.

4.6.1.1. Identification of research gaps

Research gaps will be highlighted as they emerge throughout the study and will be further detailed as part of the data synthesis. They will also be highlighted in our dissemination

plans (WP7, below), through policy briefs, academic publications, conference presentations, knowledge mobilisation factsheets and recommendations to general practice.

4.6.2. WP6.2 Stakeholder consensus workshop

Working with our SAC, we will organise a consensus workshop to discuss the study's key findings and programme theory. Participants will be provided in advance with a pack of pre-reading that covers the key findings from each work package together with the programme theory. This will be an opportunity to directly engage a wider audience of key stakeholders in actively considering the study's implications for the overall contribution of general practice towards achieving NHS Net Zero.

We will aim for about 30 people to participate, including representatives and sustainability leads from GP teams, PCNs, ICBs, DHSC, NHS England, BMA, RCN, patient and public representatives. We will hold the meeting virtually using Teams in order to minimise travel time, environmental impact, costs and to enable wider participation.

The event will be designed to test the interpretation of the study's findings, their implications and gain agreement over prioritised recommendations for national policy and practice transformations in structures, processes, incentives and relationships to accelerate decarbonisation of general practice.

Consensus will be achieved using Nominal Group Technique [50] to enable views to be freely expressed, shared and prioritised. Participants will be divided into smaller groups, with each group facilitated by a member of the research team. They will consider the key issues raised by the findings, the completeness and face validity of the programme theory, and then prioritise recommendations using electronic voting.

4.7. WP7 – Targeted dissemination and impact *(Co-Leads: RN and JD; months 6-30)*

WP7 will involve all members of the research team together with the SAC, Healthwatch Warwickshire and PPI panel. At the start of the project, we will set in motion an active and multi-facetted dissemination and impact strategy focused on achieving awareness, adoption and accelerated uptake of measures to reduce the environmental impact associated with general practice. The strategy will cover the full range of outputs (from 6-monthly lay summaries, knowledge mobilisation factsheets and policy briefs to website materials, social media, press releases and academic presentations and publications) and it will be reviewed by the research management team every three months to ensure that outputs remain on track with key findings and recommendations being clearly articulated to regional and national audiences.

The key audiences for this study include commissioners and NHS managers (e.g., ICBs, NHS England), general practices and primary care networks; patients and the public; external statutory organisations (e.g., Dept. of Health and Social Care, Health Education England), external non-statutory bodies (e.g., RCGP, RCN, BMA), other groups (e.g., Greener Practices network), and academia, especially primary care academia via RCGP, conferences and Society of Academic Primary Care (SAPC).

Following the protocol paper, we anticipate a minimum of five open access papers submitted to high impact peer-reviewed journals (e.g. BMJ, BJGP) reporting on the various work packages, culminating in publication of the programme theory with

evidence-based recommendations for enhancing the take-up and use of decarbonisation resources in general practice. PRISMA guidelines will be followed. The focus of all outputs will be on providing evidence about what is required to implement, embed, and integrate (or normalise) actions in general practice to achieve decarbonisation.

4.7.1. Lay summaries

Public facing lay summaries associated with each of the work package will be made available via the study webpages. These will be co-developed with our Healthwatch collaborator and our PPI panel to ensure that they address the experiences and concerns of patients and are produced in a format that is meaningful to patients and the wider public. This may include the use of video and other media. Their availability will be publicised through Twitter and other social media, and via Healthwatch nationally.

4.7.2. Knowledge mobilisation factsheets and policy briefs

Actionable findings in the format of factsheets will be updated at six-monthly intervals, co-developed through half-day knowledge mobilisation meetings, consisting of members of the research team, PPI and SAG panels held via online video platform during months 6, 12, 18, 24 and 29. Central themes from the research will be considered at each workshop, and interpreted drawing on the experiences and priorities of patient, clinician, commissioner and policymaker participants. The factsheets will highlight the strength of evidence supporting recommendations, the diversity of findings, differences of interpretation, and potential implications for general practice. They will be adapted to maximise relevance to different audiences and will be made available as PDF documents available for download on the study webpage, with email and social media notifications and press releases.

4.7.3. Recommendations to enhance the resources available to general practice

Findings will be reported to those involved in developing and publishing resources to support decarbonisation in general practice (e.g. Green Impact for Health toolkit, the decarbonisation guide and non-clinical carbon calculator, and the asthma toolkit – all of whom will be represented on our SAC). Recommendations from the final work package will be summarised and collated into formats agreed with the associated resources, to ensure that these are described in actionable ways that will encourage more effective and widespread use in general practice.

4.7.4. Key findings and recommended actions for general practice

These will be shared with the Greener Practice network via their email bulletins and WhatsApp groups, in order that Greener Practice members can disseminate them within their local primary care networks. Findings with policy implications will be shared with RCGP faculty climate and sustainability champions so that they can disseminate them locally to their faculty boards and members and upwards within RCGP council structures. A focussed summary of any key policy suggestions resulting from the findings will also be sent directly to Dr Nick Watts, NHS Chief Sustainability officer.

4.7.5. Academic publications and presentations

- ***Protocol paper*** to raise awareness of the study (by month 6) - lead authors RN, JD.
- ***WP1: systematic review*** (by month 11) - lead author RN.
- ***WP2-5: 4 peer-reviewed publications*** reporting the main quantitative findings (by month 16 JD, RN), the general practice evaluation (month 25; HA, HT), the budget impact model (month 26; SJ), the qualitative studies of patient and stakeholder views (month 27; AE).
- ***WP6: 1 peer-reviewed publication*** reporting the stakeholder consensus process, programme theory and recommendations (month 30; lead authors – FD, RS).
- ***Full report within the NIHR HS&DR Journal:*** with details of the work undertaken, an executive summary with clearly identified policy, managerial and practice implications (month 30 - lead authors RN and JD, with all co-investigators contributing).
- ***Academic presentations*** at relevant conferences (e.g., Society for Academic Primary Care, Royal College of General Practitioners, British Journal of General Practice, Health Services Research UK, British Academy of Management).

4.7.6. Dissemination workshops

Two dissemination workshops will be held online (months 29-30), with one aimed at policy and practice stakeholders, and a second aimed at public/patient stakeholders, in partnership with HealthWatch and the Patients and Public Participation Groups (PPGs) Network. We will explore running the workshops in partnership with RCGP, NHS England, Greener NHS and either the King's Fund, Nuffield Trust or Health Foundation.

5. SUCCESS CRITERIA AND ANTICIPATED BARRIERS TO PROPOSED WORK

Key measures of success include achieving recruitment targets; timely completion of each work package; production and dissemination of outputs, in line with our dissemination plan, including publication of research papers in high impact peer-reviewed journals; and submission of final report on time and within budget. Potential risks will be logged at the outset, for each a risk management plan will be established, and this will be updated and reported to SMG meetings. Risks and planned mitigations include:

- *Difficulty recruiting appropriate practices.* We are working closely with partners in each area who are confident that recruitment targets are realistic. The team will make clear in all communications with CRNs, ICSs, PCNs and GP practices that we are keen to hear from all practices, whatever their level of engagement with the sustainability agenda. We will also engage early on with CRNs, ICSs, PCNs, presenting the study and engaging with practices (e.g., webinar). Additionally, survey and practices recruitment can be done in parallel if needed. We have worked with NIHR CRN GP research champions to minimise the demands involved in participating in the study, and have included incentives (e.g., tree planting), prize draw for the GP practice survey (£250) and financial resources (£2500 per practice to cover participation in WP2.2 and WP4). and if despite all our efforts the response rates are low we would be able to map responses and go back to CRNs, ICSs and PCNs where low or no practices have responded with a more personal approach (e.g. from a local greener practice champion).

- *Difficulty recruiting representative sample of patient participants.* Our approach to patient recruitment for the survey and interviews draws on those that we have used successfully in other recent NIHR-funded studies. We have included incentives through high street vouchers for the patient survey (£50 per practice for patients; £600). With PPI input we will refine participant facing documents to ensure they are attractive and relevant.
- *Personnel changes in the research team over the lifetime of the project.* We will ensure that we have clear processes in place to manage any unavoidable changes in the research team, with clear strategies to ensure that study progress is not significantly impaired.
- *Failure to disseminate robust evidence that will inform practice and policy, increase understanding of NHS Net Zero among patients and the public, and have impact.* Working closely with our stakeholder group and our PPI panel should ensure that we produce and disseminate outputs that have maximal relevance and impact.

6. DATA MANAGEMENT

6.1. General considerations

All investigators, research staff, PPI and steering group members will comply with the requirements of the Data Protection Act 2018 and General Data Protection Regulation (GDPR) 2016/679 with regards to the collection, storage, processing, and disclosure of data including any personal information. The Lead (Nunes) is the data custodian. University of Warwick is the data controller. At the end of the study (i.e., the date of the last visit of the last participant or the completion of any follow-up monitoring and data collection described in this protocol) data (including consent forms) will be stored for 10 years in accordance with University of Warwick policy and then destroyed. After the 10-year retention all research data (including consent forms) will be securely destroyed using the appropriate procedure advised at that time by the University of Warwick research data team.

Both the RF and RA will be conducting data collection and will be GCP trained.

All results and findings reported will be anonymised, to ensure no individuals can be identified in the study.

Data collected during the study will be handled and stored in accordance with GDPR, the 2018 Data Protection Act and WMS Standard Operating Procedures. The University of Warwick will act as Data Controller for the study.

6.2. Data collection and management

6.2.1. Quantitative Data

Each eligible participant will be entered into a database and given a unique identifier code. The data will be entered into the electronic study database it will be held in password protected secure files on the University server. A separate database will also be created to store survey responses. A final database will be created to register participants who have responded with contact details for interviews – it will not be possible to connect these participants with the data we hold or with the survey responses.

Participants who contact the research team and agree to take part in interviews will, with their agreement, have their name and contact details stored securely on the University server for the purposes of contacting them again for future studies.

6.2.2. Qualitative Data

Audio/video recordings of interviews will be transferred from site to the university securely using encryption either on the audio recorder, or by downloading the recording to an encrypted laptop. Video or audio recordings will be obtained using university approved secure systems. All recordings will be transferred to secure university servers for secure storage and copies on the audio recorder and / or laptop deleted. All interviews will be transcribed verbatim and anonymised with each participant being assigned a unique interview ID. Transcripts will be stored in a separate electronic folder to the database of names and contact details of participants. Transfer to any transcription services will be done via a secure system and a data sharing agreement. Any handwritten field notes will be kept in a locked filing cabinet in a locked room in the University. Field notes recorded electronically will be on an encrypted, password protected laptop while the researcher is at the site and then uploaded to secure university servers when they return to the office**.**

Audio recordings of interviews will be uploaded to NVivo software for data management together with any field notes. All transcripts and notes of conversations will be. Once analysis is complete the recordings will be erased from the study archive.

Workshop data comprise: audio/visual recordings of meetings, notes taken by the research team, emails sent by participants, written notes shared by participants. Data is non-confidential and does not relate to patients and is therefore treated in a similar manner to PPIE input material. It will be handled with due care in line with University of Warwick SOPs. The audio-recording of the workshop will be erased after analysis is agreed upon with all parties (anticipate 3 years after project close).

6.3. Data storage

All essential documentation and study records will be stored by WMS in conformance with the applicable regulatory requirements and access to stored information will be restricted to authorised personnel. Any paper data consent forms, field notes, meeting notes, or other documents will be stored in a lockable filing cabinet in a secure room, to which access is restricted to authorised personnel. Electronic data will be stored in a secure area of the computer with access restricted to staff working on the study.

6.4. Data access and quality assurance

All study participants will be identified using a unique study identifier. Their identities will not be recorded in field notes or interviews. Personal identifiable information required to contact participants, including information on potential participants who express an interest in participating in the study, will be stored at Warwick Medical School in a locked filing cabinet in a locked office, or electronically on a secure university server, until the end of the study. Once the study has been completed the records containing personal identifiable information will be destroyed according to Warwick standard operating procedures.

6.5. Archiving

Study documentation and data will be archived for at least ten years after completion of the study.

7. STUDY ORGANISATION AND OVERSIGHT

7.1. Sponsor and governance arrangements

The University of Warwick will act as the Sponsor for this study. Warwick standard operating procedures will be followed.

7.2. Ethical approval

All required ethical approval(s) for the study will be sought using the Integrated Research Application System (IRAS). The study will be conducted in accordance with all relevant regulations.

Before enrolling participants into the study, the research team will ensure that the local conduct of the study has the agreement of the relevant participating organisation as well as overarching HRA approval in place.

Substantial amendments to the protocol will be communicated to all relevant parties (i.e. investigators, sponsor, NIHR, REC, participating sites, local CRN).

Annual reports will be submitted to the REC within 30 days of the anniversary date on which the favourable opinion was given, and annually until the study is declared ended. The REC will be notified of the end of the study (whether at planned time or prematurely). The PI will submit a final report to the required authorities with the results, including any publications within one year of the end of the study.

7.3. Registration

The study will be eligible for inclusion on the CRN Portfolio.

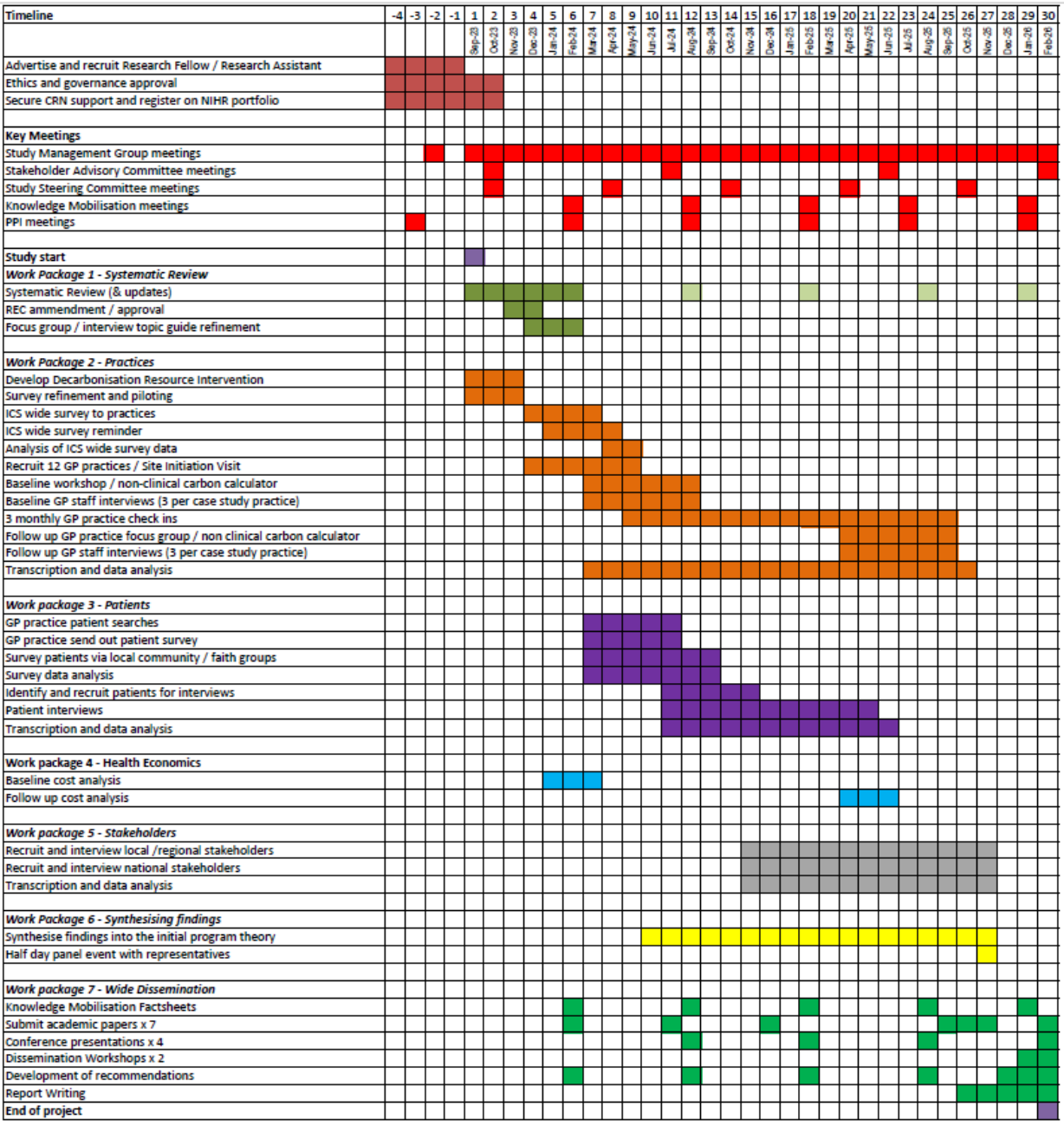
7.4. Indemnity

NHS indemnity covers NHS staff for any actions performed as part of the study. NHS bodies carry this risk themselves or spread it through the Clinical Negligence Scheme for Trusts, which provides unlimited cover for this risk. The University of Warwick provides indemnity for any harm caused to participants by the design of the research protocol or conduct of the research by its staff.

7.5. Project timetable and milestones

As shown in the Gantt chart (below), we will commence recruitment of the research fellow and research assistant and gaining ethics and governance approvals 3 months before the study commences. The leadership of the work packages will be distributed across the research team, overseen by RN and JD as described below, and will take place in parallel

with one another. This will allow the entire study to be delivered within a 30 months' timeframe.



7.6. Project management

The study will be sponsored and managed by the University of Warwick, with comprehensive project management systems. RN (50%FTE) and JD (15%FTE) will have responsibility for delivery of the project, overseeing and coordinating all work packages to timescale and budget. RN will be responsible for day-to-day project management, and with JD will co-chair the study management group (SMC; see below), with meetings held every one to two months. RN and JD will be responsible for the management of all contractual, financial and IP requirements.

Each WP will be led or co-led as follows: RN will lead WP1; JD will lead WP2.1 with HT; HA will lead WP2.2 with AE and RS; AE will lead WP3 with RN; SJ will lead WP4; HT will lead WP5 with RN and JD; FD, RS and RN will co-lead WP6; and RN and JD will co-lead

WP7. The WP leads will provide a progress report to each SMG meeting and will encourage all members of the research team to contribute to design of each WP, the analysis and interpretation of findings and the drafting of papers and other outputs. The study research fellow (FS; 100% FTE) and research assistant (OG: 100%FTE) will be fully involved in the conduct of each WP, under the line management of RN. RN will work with the WP leads to ensure that the researchers are optimally deployed. As well as leading WP3, AE (40%FTE) will lead the PPI activities and will be the point of liaison for our lay co-applicants MG and JE and the study's PPI panel (9 current members).

The **core operational team** (RN, JD, AE, FS, OG and administrator - HM) will meet on a weekly basis to manage day-to-day operational aspects of the study to ensure its progress, with rapid resolution of any problems identified. WP leads relevant to specific aspects of the study will join these meetings, where required. The team will be supported by the Unit of Academic Primary Care's research project administrator, and she will provide liaison with the appropriate finance and administrative departments at the University.

The **Study Management Group (SMG)** comprising the full research team will meet in person and/or by videoconference every one to two months. It will have overall strategic oversight and ensure the coordination and delivery of the protocol occurs efficiently. At each meeting the SMG will review progress against the study's Gantt chart, confirm data collection and analysis targets, and writing and dissemination actions. It will interpret data to contribute to theory development, and consider implications for policy, service delivery, decarbonisation resources, the refinement of the initial programme theory and consider actionable interim findings for their dissemination. All meetings are costed to allow meaningful PPI attendance and contribution. Co-chief investigators RN and JD will alternately chair the meetings.

The **Stakeholder Advisory Committee** (SAC) will support the delivery of the study, the interpretation and synthesis of findings, make suggestions about the implications and contribute to the dissemination activities in order to maximise impact. The following have already agreed to be members: Greener NHS (TBC), Larissa Lockwood (Director of Clean Air, Global Action Plan), Matt Sawyer (Director of SEE Sustainability), Dr Fiona Adshead (Director of Sustainable Healthcare Coalition), Keith Moore (Programme Co-ordinator, Sustainable Healthcare Coalition) and will be chaired by Dr Terry Kemple (former RCGP president). The SAG will meet three times over the course of the study - during the first 2 months to help us refine the WP2 recruitment, mid-way through WP2 to help us plan for the WP3 event, and in the last 2 months following the WP6 consensus workshop to advise on dissemination and impact activities. Between meetings, individuals will be contacted by email for advice, when required.

A study-specific **PPI panel** has been established, as described elsewhere in the application. In addition, Healthwatch Warwickshire, as a collaborator organisation will support drafting of lay summaries, their dissemination regionally and nationally, and attend SAG meetings.

An **Independent Study Steering Committee (SSC)** will be convened to meet at six monthly intervals throughout the project. It will oversee the running of the project, advise on methodological aspects and monitor outcomes and dissemination activity. It will have an independent chair, and will include scientific, PPI, provider and commissioner expertise.

7.6.1. Project / research expertise

Our team brings together individuals with a range of expertise: primary care research (JD, HA, RS, HT, AE); project management (all members of the team); methodological expertise (Mixed methods (JD, HA, AE, RN, HT, RS); survey design (JD, HA, RN, HT); qualitative methods (AE, RN, HA, HT, FD), health economics (SJ), sustainability in healthcare and small organisations (FD); environmental health practice, climate change and sustainable development (RN, HT); primary care intervention development (JD, RS); PPI (AE) and RK and MG (public co-apps); policy / service commissioning expertise (LN); clinical input as practising GPs (HT, RS); and primary care business / practice manager expertise (ET).

The research team has a strong track record for conducting and publishing service-related research, and our work has been used by key decision makers in health care (NHS, government, professional bodies). Several members of the team have worked together previously, delivering projects to time and budget. JD and RS have previously worked on studies involving organisational change in general practice, including the use of toolkits. RS developed the core content of the RCGP hosted patient safety Toolkit for general practice, a top 10 NIHR SPCR output of the decade. HT is a member of the South Yorkshire Greener Practice group (a primary care climate and sustainability network), co-leads a Student Selected Component of the MBChB course at the University of Sheffield that involves medical students supporting general practices to decarbonise, and is South Yorkshire North Trent RCGP faculty climate and sustainability lead. LN is the Chief Integration Officer at Coventry and Warwickshire ICB and is responsible for sustainability; her position and expertise will help ensure that our recommendations and communications are appropriately phrased, targeted, relevant and practical in the context of ICS and wider NHS priorities and developments.

7.7. Essential documentation

A Study Master File will be set up according to WMS standard operating procedures and held securely at the coordinating centre. The coordinating centre will provide investigator site files to all sites involved in the study.

7.8. Financial support

The GPNET-0 study has been funded as part of the Health and Social Care Delivery Research (HSDR) from the National Institute for Health and Care Research (NIHR).

8. MONITORING AND QUALITY ASSURANCE

All research staff involved in data collection will have had GCP training.

All data collection will be conducted by the RF and RA. Consent procedures, interview schedules and a process for recording field notes will be developed and reviewed by the study management group and the PPIE panel, ensuring a consistent, but flexible approach needed for this type of data collection.

Each site will receive a site initiation visit (SIV) where study training will be delivered by the research team. Training will be recorded on a log and stored in the study master file.

After the initial site visits to each practice, the research team will have regular contact with the sites to identify any problems with compliance with the protocol, training, data collection, or other barriers to progress, and to support sites with the day-to-day management of the study. As well as regular telephone and email contact, and the RF and RA visiting for data collection, a meetings may be arranged if there are particular issues.

9. PPIE INVOLVEMENT

In addition to our two lay co-applicants, a dedicated PPI panel has been established to provide input throughout the study. It has 9 members from across England with diverse backgrounds, with ethnicities including white British, South Asian, Chinese, and Hispanic. There is a broad age range from members in their 20s to others in their 60s. They experience a range of long-term health conditions, including asthma, disabilities, gastrointestinal, and neuro diversity. All members are very interested in this research area and many members have experience in carrying out PPI in previous projects.

We will run a series of 5 workshops with the PPI panel across the study duration via MS Teams. This will enable convenient access and is in line with the study's sustainability aims. The workshops will cover a background to the study; the development of public-facing documents; analysis and interpretation of the data; implications of the findings; and dissemination. We will also conduct pilot interviews with 3 panel members to refine the interview schedule. With the involvement of Healthwatch Warwickshire, our lay co-applicants and PPI panel will support the drafting and dissemination of lay summaries of the key findings which will be published on the public facing website.

PPI contributors will be reimbursed for their time at a rate of £25/hour in line with INVOLVE guidance. We have also included a budget to support carer costs where these are needed to enable involvement.

The team will inform and engage patients/service users, carers, NHS, social care organisations and the wider population about our work through the creation of public-facing study webpages on the University of Warwick’s website and social media accounts (e.g., Twitter) at the start of the study, and update these on a regular basis with links to all the research outputs. Participant information leaflets will include links to the study’s website and invite participants to follow the progress of the study by regularly visiting its pages. As described in WP7, we will produce clear, accessible, generalisable recommendations in Knowledge Mobilisation factsheets, lay summaries and policy briefs, and will work with SAC members to harness their contacts and professional networks, including key opinion leaders, to ensure they receive these outputs. Working with the SAC, we will seek endorsement of the study’s key recommendations from policymakers and stakeholders. We will promote public engagement with them through publishing in high profile open access journals, presenting findings at national and international academic conferences, and publicising key outputs via press releases (drawing on Warwick Medical School’s comms team), and via websites, blogs, Twitter etc. to maintain the study’s profile with public, professional and policy audiences.

10. DISSEMINATION AND PUBLICATION

The outputs of the GPNET-0 study will enter the health and care system or society through work with our SAC, ICB co-investigator and Healthwatch collaborator to focus our outputs and policy and practice recommendations on key national, regional and local bodies to ensure that they have maximal impact. We already have strong links with RCGP, SEE Sustainability, Greener NHS, Sustainable Healthcare Coalition and Global Action Plan and will directly communicate recommendations to our contacts within these organisations, several of whom have already agreed to be members of our SAC. We anticipate our outputs will influence the health care system in the following ways:

- Informing the development of ICS and national Net Zero strategies and policies, including incentives to support general practices' adoption and implementation of decarbonisation activities.
- Disseminating examples of innovative practice, through GP professional journals (e.g., Pulse) and networks (e.g., Greener Practice national and local groups and RCGP faculties' climate and sustainability leads).
- Influencing patients and the wider public through lay summaries etc. (as described above) to inform patients about ways that they can encourage and support general practice to adopt changes that improve health and wellbeing while also reducing the carbon emissions associated with general practice (e.g., where possible, walking or taking public transport).

11. CONFLICT OF INTEREST STATEMENT

12. ACKNOWLEDGEMENT AND DISCLAIMER

This project is funded by the National Institute for Health and Care Research (NIHR) Health and Social Care Delivery Research programme (NIHR153231). The views expressed in this protocol are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care.

13. REFERENCES

1. NHS (2020) Delivering a Net Zero National Health Service. delivering-a-net-zeronational-health-service.pdf (england.nhs.uk)

2. Naylor C and Appleby J. (2012). Sustainable health and social care. Connecting environmental and financial performance. London: The King's Fund.

3. Tennison I., Roschnik, S., Boyd R et al. (2021). Health care's response to climate change: a carbon footprint assessment of the NHS in England. Lancet Planetary Health, 5: e84-92 doi: 10.1016/S2542-5196(20)30271-0.

4. BMA (2021) Climate change and sustainability: The health service and net zero. bmaclimate-change-and-sustainability-paper-october-2020.pdf

5. Nunes AR, Lee K, O'Riordan T. (2016). The importance of an integrating framework for achieving the Sustainable Development Goals: the example of health and wellbeing. *BMJ Global Health*, 1(3), pp.1–12. DOI: 10.1136/bmjgh-2016-000068

6. UNFCCC (2015). Paris Agreement. https://unfccc.int/sites/default/files/english_paris_agreement.pdf

7. Atwoli L. et al. (2021) Call for emergency action to limit global temperatures, restore biodiversity, and protect health. *BMJ*; 374:n1734 DOI: 10.1136/bmj.n1734.

8. Gudde P, Oakes J, Cochrane P, Caldwell N, Bury N. (2021) The role of UK local government in delivering on net zero carbon commitments: You've declared a Climate Emergency, so what's the plan? *Energy Policy*, 154, 112245. DOI: 10.1016/j.enpol.2021.112245

9. Powell J. (2021) The rise of the green general practice. BMJ;372:m4827 doi: https://doi.org/10.1136/bmj.m4827

10. Wilkinson E. (2021) How to achieve a net zero carbon NHS during a pandemic. BMJ 2021;375:n2337 http://dx.doi.org/10.1136/bmj.n2337

11. Green Impact for Health Toolkit. *Green Impact for Health* (*https://greenimpact.nus.org.uk/green-impact-for-health/*

12. Non-clinical carbon calculator See Sustainability. General practice non-clinical carbon calculator. https://www.gpcarbon.org/ - /

13. SEE Sustainability. *Low Carbon Plan*. https://seesustainability.co.uk/low-carbon-plan

14. Greener Practice. *High Quality and Low Carbon Asthma Care.* https://www.greenerpractice.co.uk/high-quality-and-low-carbon-asthma-care/ [Accessed:

15. RCGP, 2022 *Sustainable development, climate change and green issues*. https://www.rcgp.org.uk/policy/rcgp-policy-areas/climate-change-sustainabledevelopment-and-health.aspx

16. BMA (2020) *Climate Change and Sustainability: The healthcare service and net zero*. bma-climate-change-and-sustainability-paper-october-2020.pdf

17. Greener Practice https://www.greenerpractice.co.uk/

18. Institute of Health Equity (2020) Sustainable Health Equity: Achieving a net-zero UK. main-report.pdf (instituteofhealthequity.org)

19. The Health Foundation (2021) https://www.health.org.uk/publications/public-perceptions-of-climate-change-and-health-september-2021

20. Harvey et al. (2021). *Talking to patients about the climate emergency.* https://blogs.bmj.com/bmj/2021/10/07/talking-to-patients-about-the-climateemergency/

21. Kotcher, J., Maibach, E., Miller, J. et al. (2021). Views of health professionals on climate change and health: a multinational survey study. *The Lancet Planetary Health*, *5*(5), pp.e316-e323.

22. Rimmer (2020) Five minutes with Aarti Bansal. *BMJ* 2020;369:m2483. doi: https://doi.org/10.1136/bmj.m2483

23. Iacobucci G. (2019) Planetary health: WONCA urges family doctors to commit to action. *BMJ*, 4; 364:1002. doi: https://doi.org/10.1136/bmj.l1002

24. Naylor C & Appleby J. (2013). Environmentally sustainable health and social care: scoping review and implications for the English NHS. *Journal of Health Services Research & Policy*, 18(2): 114-121. https://doi.org/10.1177/1355819613485672

25. WONCA, Planetary Health Alliance, Clinicians for Planetary Health. Declaration calling for family doctors of the world to act on planetary health. 2019.

26. Haines, A & Floss, M (2021). The inverse care law in the Anthropocene epoch. *Lancet*; 397: 773-774. doi:10.1016/S0140-6736(21)00304-4

27. Wabnitz K-J., Gabrysch S., Guinto R. et al., (2020). A pledge for planetary health to unite health professionals in the Anthropocene. DOI: 10.1016/S0140-6736(20)32039-0

28. Veidis, E., Myers S., Almada A et al., (2019). A call for clinicians to act on planetary health. *Lancet*, 393: 2021. DOI: https://doi.org/10.1016/S0140-6736(19)30846-3

29. Kemple T (2019) Planetary health and primary care – what's the emergency? BJGP, 69 (688): 536-537. DOI: https://doi.org/10.3399/bjgp19X706145

30. Xie E., Barros E. Abelsohn A. et al., (2018). Challenges and opportunities in planetary health for primary care providers. *The Lancet Planetary Health*, 2(5): e185- 187. doi:10.1016/S2542-5196(18)30055-X

31. Haines A, McMichael AJ, Smith KR, et al. (2009) Public health benefits of strategies to reduce greenhouse-gas emissions: overview and implications for policy makers. *Lancet*; 374: 2104–14. https://doi.org/10.1016/S0140-6736(09)61759-1

32. Dupraz J & Burnand B. (2021) Role of health professionals regarding the impact of climate change on health – an exploratory review. *Int. J. Environ. Res. Public Health*, 18, 3222. DOI: https://doi.org/10.3390/ijerph18063222

33. Watts et al. (2021) The 2020 report of the Lancet Countdown on health and climate change: responding to converging crises. *Lancet*, 397:129-70. DOI: 10.1016/S0140-6736(20)32290

34. Walker R, Hassall J, Chaplin S, et al. (2011) Health promotion interventions to address climate change using a primary care approach: a literature review. *Health Promotion Journal of Australia*; 22: S6-S12. DOI: 10.1071/he11406

35. Kemple T, Sowman G, Wilson A, Wynter Bee J. (2021) Primary care and the climate and ecological emergency. *BJGP*. doi: https://doi.org/10.3399/bjgp21X717077

36. Koleros A, Mulkerne S, Oldenbeuving M, Stein D. (2018) The Actor-Based Change Framework: A Pragmatic Approach to Developing Program Theory for Interventions in Complex Systems. *American Journal of Evaluation*, 1-20. DOI: 10.1177/1098214018786462

37. Skivington K, Matthews L, Simpson S et al. (2021) A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. *BMJ*;374: n2061 doi: 10.1136/bmj.n2061)

38. Currie, K., King, C., McAloney-Kocaman, K., Roberts, N. J., MacDonald, J., Dickson, A., Cairns, S., Khanna, N., Flowers, P., Reilly, J., & Price, L. (2019). Barriers and enablers to meticillin-resistant Staphylococcus aureus admission screening in hospitals: a mixed-methods study. *The Journal of hospital infection*, *101*(1), 100–108. https://doi.org/10.1016/j.jhin.2018.08.006

39. Glidewell, L., Hunter, C., Ward, V. et al. Explaining variable effects of an adaptable implementation package to promote evidence-based practice in primary care: a

longitudinal process evaluation. *Implementation Sci* **17**, 9 (2022). https://doi.org/10.1186/s13012-021-01166-4

40. Band R, Bradbury K, Morton K et al. Intervention planning for a digital intervention for selfmanagement of hypertension: a theory-, evidence- and person-based approach.

Implementation Science 2017; 12: 25.

41. Backman R, Weber P, Turner AM, Lee M, Litchfield I Assessing the extent of drug interactions among patients with multimorbidity in primary and secondary care in the West Midlands (UK): a study protocol for the Mixed Methods Multimorbidity Study (MiMMS). BMJ Open 2017

42.. Finch, T.L., Girling, M., May, C.R. et al. (2015). Nomad: Implementation measure based on Normalization Process Theory. [Measurement instrument]. Retrieved from http://www.normalizationprocess.org

43. Murray E, Treweek S, Pope C. et al. Normalisation process theory: A framework for developing, evaluating and implementing complex interventions. *BMC Medicine*. 2010 Oct 20;8. 63. https://doi.org/10.1186/1741-7015-8-63

44. Atkins, L., Francis, J., Islam, R. et al. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implementation Sci* **12**, 77 (2017). https://doi.org/10.1186/s13012-017-0605-9

45. Rushforth B, McCrorie C, Glidewell L et al. Barriers to effective management of type 2 diabetes in primary care: qualitative systematic review, *BJGP*, 2016;66 (643): e114e127. DOI: https://doi.org/10.3399/bjgp16X683509

46. Gale NK, Heath G, Cameron E. et al. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol*. 2013;13(1):117.

47. QSR International Pty Ltd. 2020. NVivo (released March 2020). URL: https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home

48. IBM Corp. Released 2020. SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp

49. O'Cathain A, Murphy E, Nicholl J. Three techniques for integrating data in mixed methods studies. Br Med J 2010;341 doi: ARTN c4587

50. Delbecq, A.L., Van de Ven, A.H., Gustafson, D.H. (1975) Group Techniques for Program Planning: A Guide to Nominal Group and Delphi Processes. Scott, Foresman Glenview.