NIHR | Public Health Intervention Responsive Studies Teams

Project summary

Study title	Green Health Prescription Evaluation (GRAPPEL) for Dundee, Highland, and North Ayrshire
Planned study period	1st October 2022 to 31st January 2024
Study design	Mixed Methods Evaluation
Research aim/s	To investigate whether green health prescriptions increase contact with nature, improve health and wellbeing, have an impact on health inequalities, and whether implementation differs between areas (Dundee, North Ayrshire, and Highland)
Chief Investigators	Professor Katherine Brown, University of Hertfordshire Professor Julia Jones, University of Hertfordshire
Co-Investigators	Dr Suzanne Bartington, University of Birmingham Dr Gavin Breslin, Ulster University Dr Neil Howlett, University of Hertfordshire (Project lead) Dr Katie Newby, University of Hertfordshire Mrs Amander Wellings, University of Hertfordshire Dr David Wellsted, University of Hertfordshire Dr Adam P Wagner, University of East Anglia
Funder	National Institute for Health and Care Research (NIHR) Award ID: NIHR131537 Project ID: NIHR135494
Protocol version number and date	V2.0 May 2023

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1 Title and additional identifiers

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Green Health Prescription Evaluation (GRAPPEL) for Dundee, Highland, and North Ayrshire

1.2 Short title of the study
GRAPPEL

1.3 Registry
[add reference and date once registered]

1.4 Funding
Funding is provided by the National Institute for Health and Care Research (NIHR) PHIRST initiative (Public Health Research funding stream).
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Project reference:

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1.6 Plain English Summary

Overview of the project being evaluated

Three Green Health Partnerships (GHP) are running in Scotland based in Dundee, North Ayrshire, and Highland as part of the Our Natural Health Service (ONHS) programme. The ONHS programme is being led by NatureScot, working with a range of national and local organisation partners. The aim of the ONHS is to use the extensive range of green spaces in the local environment to encourage healthy activities that incorporate nature. It is anticipated that doing this will have a positive impact on community health and wellbeing outcomes. GHPs co-ordinate a range of activities that directly or indirectly affect the public including: raising awareness of the benefits of green health to practitioners and ways to connect their service users to local opportunities; developing new green prescription referral pathways or adding green health options into existing health and social prescribing pathways; working with green health activity providers to deliver new or expand existing services to target specific locations/clinical groups; collating information about accessible green spaces/projects. This evaluation project is going to focus on the green health prescription pathways. The green health prescription pathways operate differently in the three areas of Dundee, North Ayrshire, and Highland. In some areas a new structured pathway has been established focusing only on green health activities, whereas in other areas the green health activities have been added to the range of activities that people can be prescribed based on their need and preference. There are a number of parts of the green health prescription pathway that are important to evaluate from the process of how the referral happens, to the link between referral and take up of an activity, all the way to exploring the potential benefits for the service user. The differences in setup and geography are expanded upon below.

Dundee is Scotland's fourth largest city and is situated on the north coast of the mouth of the Tay Estuary. The most recent estimate of Dundee's population is nearly 149,000. The Dundee City Council area covers 60 km^2 and is, geographically, the smallest local authority area in Scotland. There are 22 GP practices across Dundee City. Of the Dundee City population, 36.6% live in zones within the 20% most deprived in Scotland, with the proportion of children aged 0-15 even higher (43.8%). The GHP initiative, operating across Dundee, connects clinicians and other professional groups to directly prescribe green health related activity to patients/clients. Working in partnership with NHS Tayside, Dundee City Council and DVVA, local people are supported via person centred social prescribing approaches, to access and engage with over 60 outdoor local opportunities across the city. The Dundee GHP also works with other organisations to improve access to and engagement with nature for specific target groups, such as inpatients at NHS sites.

Highland Council area is one third of the land mass of Scotland and includes the most remote and sparsely populated parts of the United Kingdom, as well as several inhabited islands. The Highland population is ageing. There are significant variations in the population structures of the different areas within Highland. The most remote and rural communities in particular, have large cohorts in single occupancy households at older ages. Fuel poverty and access to services are challenges, and Highland has 17 data zones in the most deprived 15% in Scotland (SIMD 2012). There are 65 GP practices serving a population of 322,000 people (as of 2022). Of these, 29 GP practices have access to a Community Link Worker. It is through this social prescribing service that green health is promoted. Referrals also take place through the Active Health Project; a pan-Highland charity-led online social prescribing programme aimed at physical activity. The Cairngorms National Park straddles the Highland area and an initiative to develop green prescription pathways (similar to the Dundee model) is set to commence with the employment of a Green Health link worker (employed by the National Park Authority).

North Ayrshire is one of 32 Council areas in Scotland, situated on the West Coast it covers around 886

km^2 comprised of both mainland and island communities, and inhabited by approximately 134,000 people. North Ayrshire is a mix of both rural, island and urban spaces across six localities and has relatively high (40%) and increasing levels of deprivation. North Ayrshire deprivation is mainly concentrated on the employment, income and health domains. The North Ayrshire Green Health Partnership utilises two methods of green health pathways. Those are our formal referral pathway called Active North Ayrshire (ANA) which is coordinated by one of our main GHP Steering Group partner organisations KA Leisure. The other is social prescribing which includes multiple health and social care pathways e.g., Community Link Worker, GP, Medical Pharmacist, Physiotherapist.

Why this study is needed and what we are aiming to do

It is important to evaluate public health programmes to see how well they worked, who they worked for, what settings they worked best in, and how much they cost. The Green Health Prescription Evaluation (GRAPPEL) findings will provide lessons for future green health programmes. This will help with both recommendations for future service delivery and assess the impact the programme has had on local residents. This project is using a 'mixed-methods evaluation', which involves speaking to a range of people involved in organising and running the green health prescription service to get their ideas of how the programmes worked and the benefits that people in the community might have had as a result. The people interviewed will include referrers across a range of health professionals, link workers or project officers, the people delivering green health activities, community members who engaged with the green health prescription and if possible, community members who received a green health referral but did not take it up. The second part of this evaluation aims to get as many people as possible to complete surveys on their health and wellbeing before and after engaging in a green health prescription. By speaking to a range of people and looking at both physical and mental health outcomes, the evaluation aims to get a full picture of the ways in which the programme works, the good (or not) things that happened as a result, and how the organisations involved could try to make the service as successful as possible going forward.

Research questions

- Are green health prescriptions considered to be acceptable, practical, effective, affordable, beneficial to people or groups equally, and are there any negative side-effects?
- Does a green health prescription lead to improvements in mental and physical health and wellbeing, and physical activity, and reductions in the use of health services?
- Does a green health prescription increase contact with nature/green space?
- How does the delivery of the green health prescription across Dundee, North Ayrshire and Highland compare?

Evaluation timescales

Start of evaluation work: October 2022
Draft final report completed: December 2023
Key dissemination activities completed: January 2024

The value of the findings

The evaluation will provide value to a range of people and organisations. For the public health team and delivery organisations involved it will provide detailed findings about how these programmes worked, who benefitted and how much, and the best way to run them going forward. For the people being interviewed it will provide a way to have their voice heard based on their experience of running or receiving parts of the programmes. For public health leaders who might fund future programmes it will tell them how much the approach costs in each area and how they might best organise the services going forward. From a research perspective, there has been very little structured evaluation of the impact of green health prescriptions. The findings will be of interest to researchers and evaluators of

public health services because it can be difficult to explore the benefits and challenges of these programmes, as they are complicated with many people involved and many moving parts.

Research design
This is a mixed methods study. Research questions will be answered using routinely collected evaluation data (from Dundee), additional survey data (matching the Dundee data) from North Ayrshire and Highland, and additional qualitative data across all areas. The work will be organised across three workstreams as follows:

- Workstream 1: Interviews with those referred, service users, referrers, providers, and coordinators
- Workstream 2: Analysis of data on physical and mental health, physical activity, user of health services, and cost of programmes
- Workstream 3: Bringing the results together and telling people about what we found

1.7 Scientific abstract

There is an extensive literature base on the physical and mental health benefits of using green spaces such as parks and forests. Exposure to and use of green spaces has a positive effect on depression, anxiety, and mental wellbeing. Being physically active in green spaces can bring additional benefits over and above being active indoors. The availability of green spaces in an area can also be related to perceptions of loneliness and social support, and many social prescribing pathways already refer to outdoor activities with other local community members. Green Health Partnerships (GHP) have been set up in some areas in Scotland as part of the Our Natural Health Service programme. The activities of these GHPs include raising awareness of the benefits of green health to practitioners and developing green health prescription pathways or incorporating green health options into existing physical activity, mental health, or social prescribing pathways. This evaluation focuses on the green health prescription element of the wider GHP work within three areas; Dundee, North Ayrshire, and Highland. This proposed research aims to evaluate the green health prescription programmes using a mixed methods approach. Interviews with key stakeholder groups will evaluate the green health prescriptions on factors such as acceptability, affordability, and how practical they are to deliver and participate in. A quantitative survey will explore whether there are changes in physical and mental health, physical activity, and use of health services after participating in green health activities. Project dissemination will use traditional and creative methods to mobilise the knowledge from the evaluation and will provide insights about how to replicate desired effects of such programmes in future to the public and professional stakeholders and wider public health teams, third sector organisations, and researchers.

2 Background information

2.1 Overview of the interventions to be evaluated and contextual information
Three Green Health Partnerships (GHP) have been set up in Scotland based in Dundee, North Ayrshire and Highland as part of the Our Natural Health Service (ONHS, 2020) programme. The ONHS programme is being led by NatureScot, working in partnership with Scottish Forestry, NHS Health Scotland, and a range of other national and local organisations across the environment, transport, sport, education, and health sectors. The aim of the ONHS is to utilise the natural environment through a wealth of green spaces to encourage healthy activities that incorporate nature to positively impact community and population health and wellbeing outcomes (ONHS, 2020). The GHPs are led by local health boards and authorities and a range of cross-sector partners and are adopting a whole system approach to try and deliver key public health improvements across health and wellbeing. The GHPs are funded for up to £100k per annum for dedicated project staff and helps with management and coordination of referral to a range of green health prescriptions.

As per the ONHS (2020), GHPs staff co-ordinate a range of activities and multiple levels of the system, that cascade down to members of the public. These include:

- Raising awareness of the benefits of green health to practitioners from the health, social care and voluntary sectors and ways to connect their service users to local opportunities
- Developing green prescription referral pathways or incorporating green health options into existing physical activity, mental health, social prescribing and lifestyle pathways and programmes
- Working with partners and green health activity providers to deliver new or expand existing projects for the general public or to target specific locations/clinical groups
- Collating information about accessible green spaces and green health projects to be integrated into information sources used by the public and health practitioners
- Promoting the benefits of green health to the public through activities such as active travel, volunteering, community gardening and informal recreation through social media, leaflets, short, animated films shown in health and leisure settings and an annual Green Health Week

This project is going to primarily focus on the green health prescription pathways and how these are experienced by referrers and coordinators, and the associated experience and outcomes for members of the public offered a referral.

2.2 Review of existing evidence

2.2.1 Benefits of contact with nature and green space

There is an extensive literature on exploring the link between 'green space' areas in the local environment and a range of physical and mental health outcomes. These studies investigate both the effects of the mere presence of green spaces, and interventions that utilise green space. Green space interventions can be further divided into two main types, both designed to improve the wellbeing of local residents. The first aims to provide new green space areas or improve existing areas so that the local environment is better for residents. The second type are interventions that encourage greater use of these areas through changing behaviour such as physical activity in parks (Shanahan et al. 2019). Green space, defined as areas such as parks, forests, or community gardens, can have beneficial effects on the mental health of the general population such as stress, anxiety, and mood (Rugel, 2015), albeit the evidence was considered relatively weak overall. In addition to the potential mental health benefits, there are a range of physical health outcomes that can be impacted, many of which are related to long-terms conditions. Green space exposure is associated with decreased salivary cortisol, heart rate, blood pressure, HDL cholesterol, and decreased risk of preterm birth, small size for gestational age, type II diabetes, cardiovascular mortality, and all-cause mortality (Twohig-Bennett & Jones, 2018). For this review of physical health outcomes, green space was defined as both open, undeveloped land with natural vegetation, and urban green spaces such as parks (Twohig-Bennett & Jones, 2018).

There have been other studies looking exclusively at the impact of urban green spaces. Using 2001 census data, Mitchell and Popham (2007), found that more urban green space was associated with better health in the overall population, but that this relationship was reversed in some low-income areas. Therefore, it may be that the quality of urban green space areas is as important as quantity for achieving health benefits (Mitchell & Popham, 2007). A common theme in this area of research is the difficulty in evidencing a causal link between green space exposure and health outcomes, due to the complexity of the system in which people and communities reside, and the challenges associated with controlling for confounders or bias in studies with cross sectional designs (Lee & Maheswaran, 2010). It may be that simply changing small elements of the urban environment is insufficient to impact more pressing social and environmental determinants of health (Lee & Maheswaran, 2010). These difficulties

manifest themselves in the equivocal evidence of the impact of green spaces for mental health and wellbeing. In a systematic review, 13 out of 18 studies found some benefit of exposure to green space and mental health, but the evidence was considered to be limited (Gascon et al., 2015). Furthermore, the link between mental health and access to green spaces, quality of green spaces, and blue spaces was weak (Gascon et al., 2015). However, a later review found adequate evidence of associations between green space and life satisfaction but not wellbeing, and evidence on visits to greenspace, accessibility, and types of green space was limited (Houlden, Weich, Albuquerque, Jarvis, & Rees, 2018).

The health behaviour that may have the most synergistic effects with exposure to green spaces is physical activity. An experimental study tested the effects of fast walking or jogging on a treadmill in front of different types of nature scenes on a projector and found that the different scene type had positive effects directly after the activity (Pretty, Peacock, Sellens & Griffin, 2005). Specifically, blood pressure, self-esteem and mood improved after physical activity and when looking at the rural or urban 'pleasant' scenes, self-esteem was increased further (Pretty et al., 2005). Although these effects are very short term, it does suggest that the quality of urban or rural green spaces may be an important factor in use and the benefits derived from them. A further review has shown some evidence that interventions which change the built environment can increase use of urban green spaces including use for physical activity (Hunter, Christian, Veitchc, Astell-Burt, Hipp, & Schipperijn, 2015). The review identified stronger evidence that physical activity intervention programmes promoting the use of green space for physical activity, and these programmes combined with changes to the built environment, can increase use of, and physical activity in, urban green spaces (Hunter et al., 2015).

Physical activity is also one of mechanisms by which green spaces can affect health outcomes. Physical activity frequency is linked to both duration and frequency of green space visits (Shanahan et al., 2016). People who visit green spaces for greater duration may experience lower rates of depression and blood pressure, and those who visit more frequently can have greater social cohesion (Shanahan et al., 2016). Additionally, visits to green spaces of over 30 minutes per week can reduce the population prevalence of depression and high blood pressure by up to 7% and 9% respectively (Shanahan et al., 2016). Other potential mechanisms by which health is positively impacted by green space have been posited to be by reducing harm (e.g., exposure to air pollution), improving attention and physiological stress recovery, and through facilitating social cohesion (Markevych et al., 2017). Another study explored whether social contact was a potential mechanism responsible for the impact of green space on health, using a large dataset of Netherlands residents, including the percentage of green space within a 1-3km radius of their homes (Maas, van Dillenb, Verheija, & Groenewegen, 2009). Limited green space in the local environment was associated with feelings of loneliness and a lack of social support, and loneliness and low social support partly mediated the relationship between green space and health (Maas et al., 2009).

Overall, exposure to green space shows a range of health benefits, albeit the evidence for this is limited in places. Green space exposure is often beneficial when both quantity and quality is increased, and affects health through increased social contact, reducing environmental harms, and nature-based physical activity.

2.2.2 Green Health Partnerships (GHP) and green health prescriptions

The GHPs in Dundee, North Ayrshire, and Highland were set up in 2018 to promote the use of green space for health improvement. Monitoring and evaluation of the partnerships from June 2018 and September 2021 showed that at a strategic and system level these partnerships have achieved a range of key objectives including: facilitating or promoting 550 opportunities for green health activities; undertaking 440 awareness raising and capacity building activities; establishing or facilitating 63 referral pathways; coordinating and delivering 300 outreach and information activities; inclusion in 58

local policies and plans (Mitchell & Finton, 2022). This demonstrates evidence of how GHPs have been embedded into systems across these areas in Scotland. One of the major elements of GHPs is the drive to setup and run green health prescription pathways, where service users receive a prescription from a healthcare professional, community service, or self-refer. A Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was undertaken across NHS healthcare professionals, service-users, and nature-based intervention delivery partners, in Dundee (Marx & More, 2022). There was support from all three groups for the pathway. Threats and weaknesses that were identified included the need for sustainable funding, a centralised hub for all information and guidance related to the pathway, and that green health activities should be tailored to individual needs (Marx & More, 2022). To date, there is very little evidence that assesses the outcomes for service users engaging with a green health prescription.

2.3 The problem being addressed and why this research is needed now

Exposure to green space has positive benefits for physical and mental health, and therefore, referral pathways that prescribe tailored green health activities to individual service users could work for both health promotion and as low-intensity treatment for a range of conditions. With continuing pressure on public health budgets, interventions that utilise existing capacity and community assets (e.g., green spaces such as woodland and parks), have the potential to be an important preventative tool. Despite the potential of these green health prescriptions to achieve benefit, the barriers and facilitators to engagement for referrers, service providers, and service users remains relatively unknown. There is also very little evidence about whether structured green health referral pathways can promote similar benefits as people choosing to use green spaces in an informal manner. With the need to apply for sustainable funding for GHPs over the longer term, a detailed assessment of green health prescriptions is clearly needed.

2.4 Mixed Methods Evaluations

This evaluation will adopt a pragmatic mixed methods approach. Pragmatism attempts to identify ‘what works’, rather than seeking objective ‘truth’ or ‘reality’ (Weaver, 2018). Experimental designs such as randomized controlled trials (RCT) are often considered the optimal scientific method, particularly when assessing the efficacy of interventions. However, RCTs are routinely conducted with resources and within settings that cannot be replicated outside of a trial context (Saturni et al., 2014). Pragmatic evaluations draw upon quantitative, qualitative, and mixed methods approaches that are most suitable for the research question being investigated (Weaver, 2018). Pragmatic evaluations are consistent with a socio-ecological approach to public health research (Dahlgren & Whitehead, 1992) where the social, political, environmental, and cultural context of individuals or groups is considered crucial (Kaushik & Walsh, 2019). The aims of a pragmatic evaluation are to maximize the applicability of evaluation findings to real world service delivery (Patsopoulos, 2011), and to generate evidence that is contextually relevant, and therefore, of value to partners and wider stakeholders.

2.5 The current project

The current project is focused on evaluating the green health prescription element of the wider GHP initiative in Scotland, and will cover implementation of this in Dundee, North Ayrshire, and Highland. The evaluation approach will involve interviews with a range of stakeholders and analysis of data from existing datasets and additional data collection to supplement this. The overall findings will triangulate findings from both outcome and cost analysis, and process interviews to provide findings and key recommendations suitable for use by local authority and wider partners.

3 Study Information

3.1 Aim

3.2 Research questions

- Do a range of stakeholders perceive green health prescriptions to be acceptable, practicable, effective, affordable, and equitable, and are there any adverse side-effects?
- Does a green health prescription lead to measurable improvement in health and wellbeing, and physical activity, and reductions in the use of health services amongst service users?
- Does a green health prescription increase contact with nature/green space amongst service users?
- How does the different implementation of the green health prescription across Dundee, North Ayrshire and Highland compare?

4 Study design and methods

4.1 Study design overview

This is a mixed methods study. Research questions will be answered using routinely collected evaluation data (from Dundee), additional survey data (matching the Dundee data) from North Ayrshire and Highland, and additional qualitative data across all areas. The work will be organised across three workstreams as follows:

- Workstream 1: Qualitative evaluation with service users, referrers, providers, and coordinators
- Workstream 2: Quantitative outcome and health economic analysis
- Workstream 3: Data synthesis and dissemination

4.2.1 Workstream 1: Qualitative evaluation with service users, referrers, and coordinators

Design
Qualitative interviews

Interview Schedule
Ahead of their use, we will get feedback on the interview schedule for each group from nominated members of the PHIRST Connect Public Involvement in Research group (PIRg) and project-specific Public Voice contributors. The interview schedules will explore the acceptability, practicability, effectiveness, affordability, and equitable nature of the green health prescription, and whether there are any adverse side-effects (APEASE criteria; Michie, Atkins & West; 2014; West, Michie, Atkins, Chadwick & Lorencatto, 2019). For service users, there will also be questions on any out-of-pocket expenses incurred while participating.

Recruitment and sampling:

Service users
We will aim to recruit up to 15 service users. Maximum variation sampling will be used to achieve a sample which represents (within pragmatic and total sample size constraints) service users with a range of green health prescription experiences and engagement, across the three groups in Table 1, and across the three geographical areas.

Table 1. Characteristics of each of the three groups of service users

Service user group	**Engagement level**
Declined referral	Individuals who were offered a referral to a green health prescription and declined
Accepted but did not engage	Individuals who were offered a referral to a green health prescription and accepted, but did not engage with green health activities
Accepted and engaged	Individuals who were offered a referral to a green health prescription and accepted, and then engaged with green health activities

The Green health coordinators (e.g., link workers and project officers) will collect initial expressions of interest from service users and consent to share contact details with the research team. The research team will email potential participants with a link to our secure survey software REDCap (residing on the UH server). This process will continue until sampling quotas for our criteria are filled. If needed, the research team will additionally use the NIHRs 'People in Research' portal, or reach out via other forms of local media, to seek potential participants who were offered a referral to a green health prescription but declined to participate. REDCap will be used to present participant information, collect informed consent and basic demographic information, and to book participants on to available interview time slots.

Referrers, service provider, and co-ordinators

We will aim to recruit 5-10 representatives from each of these three groups. Maximum variation sampling will be used to achieve a sample which represents (within pragmatic and total sample size constraints) a range of green health activities and the three geographical areas.

The Green health coordinators will collect initial expressions of interest from link workers, referrers, and providers in managing the referral pathway/activities, and consent to share contact details with the research team. The research team will email potential participants with a link to our secure survey software REDCap (residing on the UH server). This process will continue until sampling quotas for our criteria are filled. REDCap will be used to present participant information, collect informed consent and basic demographic information, and to book participants on to available interview time slots.

Setting

All data will be collected remotely using each participant's preferred mode (i.e., telephone, or video conferencing software: Zoom or Microsoft Teams).

Procedure

Participants will be invited to take part in a semi-structured, in-depth interview undertaken by a member of the research team. All interviews will take place remotely. Participants will be able to choose to engage in the interviews online, using video conferencing software (Zoom or Microsoft Teams; audio only, or video plus audio), or by phone (mobile or landline). A safeguarding protocol is in place and will be enacted as/when required (see below, ethics). The interviews are expected to last between 45 and 75 minutes. Audio recordings will be fully transcribed prior to analysis.

Analysis

The interview transcripts will be analysed using the APEASE criteria (Michie, et al., 2014; West et al., 2019), which applies a deductive coding approach to provide pragmatic evaluation and recommendations about the acceptability, practicability, effectiveness, affordability, side-effects, and equity of a service or intervention. APEASE has been used to provide a detailed assessment of the

acceptability and feasibility of a range of interventions (e.g., Brierley et al., 2022). A brief explanation of each facet of APEASE is:

APEASE
Acceptability: How far is it acceptable to all key stakeholders?
Practicability: Can it be implemented as designed within the intended context, material and human resources?
Effectiveness: How effective and cost-effective is it in achieving desired objectives in the target population?
Affordability: How far can it be afforded when delivered at the scale intended?
Side-effects: How far does it lead to unintended adverse or beneficial outcomes?
Equity: How far does it increase or decrease differences between advantaged and disadvantaged sectors of society?

4.2.2 Workstream 2: Quantitative outcome and health economic analysis

Design
A longitudinal (baseline and 12-week) observational design will be employed.

Primary outcomes:
The primary outcomes for workstream 2 are health, psychological wellbeing, and physical activity measured as follows.

Perceptions of health will be measured using the EuroQol EQ-5D-5L (Herdman et al., 2011), which has five domains focusing on mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, with one question per domain. Each question has five options to choose from ranging from 1 “no problems” to 5 “inability to function,”. These will be used to calculate a standard index score, normally falling between 0 and 1. An additional EQ-VAS visual analog scale asks how good or bad service users perceive their health to be, ranging from 0 (the worst health you can imagine) to 10 (the best health you can imagine).

Psychological wellbeing will be measured using the short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS; Ng Fat, Scholes, Boniface, Mindell, & Stewart-Brown, 2016), a 7-item scale exploring thoughts and feelings over the previous 2 weeks. Programme users are presented with items such as “I’ve been feeling useful” and rate themselves on a scale from 1 “None of the time” to 5 “All of the time,” producing a total score between 7 and 35, with suggested cut-offs of <18 (probable clinical depression), 18-20 (possible mild depression), 21-27 (average mental wellbeing), and >28 (high mental wellbeing) (https://warwick.ac.uk/fac/sci/med/research/platform/wemwbs/using/howto/).

Physical activity will be measured using a single validated item which asks ‘‘In the past week, on how many days have you done a total of 30 min or more of physical activity, which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places but should not include housework or physical activity that may be part of your job.’ (Wanner, Probst-Hensch, Kriemler, Meier, Bauman, & Martin, 2014). Answers are given on a scale of 0-7.

Service use will be assessed by a single question asking how many times in the last 3 months any of the health services listed have been utilised. The focus of services is primarily on mental health services.

Recruitment and Sampling

We will aim to recruit as many service users as possible across a range of green health activities and the three geographical areas. In Dundee, evaluation is embedded within a structured green health referral pathway and will be routinely collected. In North Ayrshire and Highland, data collection cannot be accommodated within an existing system, therefore, a link to our secure survey software Qualtrics will be set up. Qualtrics will be used to present participant information, collect informed consent and basic demographic information, and for completion of the outcome measures listed above. Realistically, we are aiming for at least 50 participants per area to complete baseline and 12-week measures.

Setting

Routine monitoring and evaluation data collection will be used in Dundee, whereby service users complete the questionnaires (with the help of local staff input if needed) through a link to their data management system. In North Ayrshire and Highland, data will be collected online with our secure survey software Qualtrics.

Procedure

Survey

For Dundee, routinely collected monitoring and evaluation data will be used to answer the above research questions. A data sharing agreement (DSA) will not be needed with the data controllers (Dundee Volunteer and Voluntary Action) as only fully anonymised data will be transferred to the research team, with prior consent given from participants. All data will be stored on the University of Hertfordshire's secure R drive and only accessible to those within the PHIRST team who are performing either data management or analysis roles. Data in North Ayrshire and Highland will be collected online with our secure survey software Qualtrics, and participants will be fully informed of storage and access information prior to participation in the evaluation.

Costing

Data will be collected from service documents/records (e.g., budget allocations) and meetings with programme coordinators/managers from each referral pathway (or wider GHP if the pathway is not well established). It is planned that for each service there may be up to two meetings with managers: the first will provide general context, budget and general service information; if needed, the second will allow confirmation around information and assumptions, opportunity to sense check findings and collection of any final information. Answers on the EQ-5D-5L and health service use questions will provide additional information for outcomes in terms of health-related quality of life (HRQoL). Any change in service use will also be captured in quantitative measures and may be used in costings analysis.

Data analysis

Survey analysis

Summary statistics will be calculated using standard measures such as means, medians and proportions as appropriate. Relationships between primary outcomes at 12 weeks and explanatory variables will be investigated using univariate statistical tests.

For the EQ-5D-5L data, a standard index value will be calculated for each participant. Scores will be treated as continuous with values, normally between 0 and 1. For most populations, index values are highly skewed so nonparametric methods will be applied. Spearman's rank correlation coefficient will

be used with continuous explanatory variables; binary and categorical variables will be analysed with the Mann-Whitney U test and Kruskal-Wallis analysis of variance respectively. EQ-VAS data will be analysed either by methods that assume Normality (e.g., t-tests, analysis of variance) or the nonparametric methods given above, depending on the degree of skewness for the scores. SWEMWBS data will be analysed either by methods that assume Normality (e.g., t-tests, analysis of variance) or the nonparametric methods given above, depending on the degree of skewness for the scores.

Health economic data analysis
The primary health economic analysis will consider the costs to the service of delivering a Green Health Prescription referral and evidence outcomes in terms of health-related quality of life (HRQoL). We will work with appropriate service staff and other suitable stakeholders to understand the components and resources (such as staff time) required to deliver a referral. The costs of using these resources, such as staff time, will be costed using standard resources (e.g., Jones & Burns, 2021) and through consultation with service leads. We will use the latest cost year for which data is available. HRQoL will be estimated using utility values derived from the EuroQol EQ-5D-5L survey (valued as per latest NICE guidance, e.g., Devlin et al, 2016), collected at baseline and follow-up as part of the survey. Quality-adjusted life years (QALYs) will be calculated from these utilities using linear interpolation. We will explore whether there are other costs and resources involved in the delivery of the programme.

As secondary analysis, we will explore the use of other health services. The survey at baseline and follow-up asks about the use of health services in the previous 12 weeks. Adopting an NHS and personal social service costing perspective, we will cost the use of these services. Resource use and associated costs will be summarised using descriptive statistics. We will explore whether there is evidence of resource use changing, the associated cost changes, and how these compare to the costs of delivering the Green Health Prescription referral and programme.

4.2.3 Workstream 3: Data synthesis and dissemination

Objectives
- To generate recommendations for how the design of green health prescriptions in Scotland might be optimised in future
- To communicate the findings of the evaluation to a range of appropriate stakeholders, including service users and providers, commissioners and policymakers, and the wider public

Method
Approaches to integrating qualitative and quantitative research procedures and data can be implemented at 'design', methods', and 'interpretation and reporting' stages of research (Fetters, Curry, & Creswell, 2013). For this study, qualitative and quantitative data will primarily be integrated at the 'interpretation and reporting' level. Qualitative research data collected during Workstream 2, and quantitative data from Workstream 1, will be separately analysed as standalone workstreams before being brought together (Brannen, 2005).

Collection and analysis of data from both workstreams will be conducted concurrently. Data will be integrated using an 'integrating through narrative' approach (Fetters, Curry, & Creswell, 2013), where qualitative and quantitative findings are described in different sections of the same report. A mixed contiguous/weaving approach will be taken (Fetters & Freshwater, 2015), allowing the research team to integrate findings from the quantitative outcomes and health economic analyses with qualitative analysis of different stakeholder groups' experiences of the green health prescriptions. This will allow, for example, for the generation of explanations for patterns of outcomes and differences in costs and for scrutiny of inequalities in access to services.

Recommendations will be generated by the research team, through consultation with the Advisory Board, project-specific Advisory Group, and local public contributors. Recommendations will be further developed at a stakeholder workshop comprising key GHP stakeholders. This will help ensure that the recommendations for future optimisation of green health prescriptions generated by the evaluation are appropriate and feasible.

4.3 Co-production and Public Involvement

4.3.1 Co-production

Co-production is a central tenet of the PHIRST initiative and all PHIRST Connect evaluations. This evaluation will be co-produced by the PHIRST Connect team with local partners and stakeholders, all working together to plan, design, deliver, and disseminate the evaluation. We will routinely communicate and consult with these partner organisations and stakeholders, and in addition present proposals and updates to our Independent Core Advisory Board (composed of relevant stakeholders in the field of public health and evaluations, which includes academics, third sector, governmental and public expertise) and our Scotland GHP specific Advisory Group (similarly composed of key stakeholders but with membership more closely reflecting the subject and locality of the evaluation). The feedback they provide will shape key decisions within the research process including design, ethics and dissemination. Further details on our PHIRST advisory and consultative groups can be found in section 6.2 below.

4.3.2 Patient and public involvement and engagement (PPIE)

The University of Hertfordshire is committed to involving the public in all stages of its research and has an existing Public Involvement in Research group (PIRg) comprised of members of the public, service users and carers. PPIE (patient and public involvement and engagement) is key to the PHIRST Connect and will be integral at all stages. All PPIR activities will be co-ordinated by the lay co-investigator (Amander Wellings), the academic PPIE expert and Co-Chief Investigator Professor Julia Jones and members of the PHIRST team.

The PHIRST Connect Public Involvement in Research Group (PIRg) provide public, service user and carer perspectives to all the public health evaluation projects conducted by the team. The nine current members of the PIRg meet monthly to discuss key aspects of PHIRST Connect evaluation work (for example, research questions, methodology, literature review, research tools, and dissemination), and in between meetings, work closely with the PHIRST to co-produce our evaluations.

For this evaluation, PPIE will be embedded through both the PHIRST Connect PIRg's input and wider lay and public contributors recruited to the project specific advisory group. Two members of our PIRg have been supporting project development since the evaluability phase of our work, attending project meetings, and commenting on ideas and proposals. We are currently in the process of recruiting two to four people from existing local community groups through project partners to support the development, delivery, analysis, and knowledge mobilisation on the project.

4.4 Dissemination

Recommendations will be generated by the research team, through consultation with the project steering group, Scotland GHP Advisory Group, the PIRg, and Scotland GHP local lay people. Recommendations will be further developed with key stakeholders, including those who have accessed the programmes. This will help to ensure that the recommendations for future optimisation

of GHPs generated by the evaluation are appropriate and feasible, fit within wider transformation plans, and that a range of stakeholders are involved in their co-production.

In terms of dissemination, the research team will consider the value of findings to the wider public health system and its stakeholders and how outputs can be effectively communicated and mobilised to other regions and sectors. Dissemination will likely occur through several key routes, including the following options:

- Recorded presentation and accompanying set of PowerPoint slides or alternative format as agreed with the local authority and their partners
- Bitesize briefing that focuses on key findings and messages and recommendations
- PHIRST website, jointly managed by the six PHIRST teams
- Creative outputs such as video and interactive content, including a video lay summary
- Social media channels
- Traditional academic routes of conference presentations and peer-reviewed, open access journal articles
- Dissemination through professional networks of which our project-specific Advisory Group are members

All outputs will be informed by consultation with the PIRg, Scotland GHP public/lay contributors, and the project Advisory group.

5 Research governance and project management

5.1 PHIRST Connect governance and project management

Appendix B presents an organogram of the PHIRST Connect showing the team structure and roles.

Project Leads

The project is being led by the PHIRST co-investigator, Dr Neil Howlett, under the direction and supervision of the PHIRST Chief Investigator, Professor Katherine Brown.

Management Group

The PHIRST Connect Management Group meets on a fortnightly basis to provide oversight and guidance to the PHIRST Connect. The Management Group comprises the Chief Investigators and the seven PHIRST Co-applicants listed in section 1.5.

5.2 PHIRST advisory groups

PHIRST Connect Independent Advisory Board

An Independent Advisory Board (PHIRST Connect Independent Advisory Board) has been convened to provide independent, external and policy-orientated advice to the PHIRST Connect. The Board provides specific advice and support in relation to the strategic direction of the PHIRST Connect and its allocated projects. It comments on the ongoing work plan and progress in line with study protocols, acts as a sounding board for new ideas and developments and advises on opportunities for wider dissemination and for translating research into policy and practice. It is an advisory only body and does not make decisions, or report to any other group or committee.

The Board will meet up to three times per year and is comprised of experts in the fields of public health and evaluation from academic, third sector, governmental and public sector backgrounds. It is

comprised of the following members:

Name	Job title	Organisation
Mrs Helen King (Chair)	Former Deputy Director and Director of Public Health / currently Independent Public Health Consultant	Solihull Public Health Department
Dr Nicola Armstrong	Programme Manager, HSC & R&D Division	Northern Ireland Public Health Agency
Professor Katherine Brown	Professor of Behaviour Change in Health	University of Hertfordshire (non-independent)
Mr Geoff Brown	CEO	Healthwatch Hertfordshire
Professor Steve Cummins	Co-Director of the Population Health Innovation Lab	The London School of Hygiene and Tropical Medicine
Jane Ford	Public Health Intelligence Advisor	Public Health Scotland
Charlotte Grey	Public Health Evaluation Lead	Public Health Wales
Dr Sarah Hotham	Senior Research Fellow & NIHR RDS SE Research Adviser	University of Kent
Professor Margaret Maxwell	Director of MHANP Research Unit	University of Stirling
Mr John Jackson	PPI Expert by Experience on PHIRST Connect Public Involvement in Research Group (PIRg)	Independent Member
Professor Toby Prevost	Director, Nightingale-Saunders Clinical Trials & Epidemiology Unit at King's CTU	Kings College London
Mrs Genevieve Riley	Programme Manager	West of England Academic Health Science Network
Professor Sarah Stewart-Brown	Professor of Public Health	University of Warwick
Mrs Amander Wellings	PPI Expert by Experience; Chair of PHIRST Connect PIRg	University of Hertfordshire (non-independent)

PHIRST Connect Scotland GHP Evaluation Advisory Group

A project-specific Advisory Group has been convened to offer specific advice and support in relation to the Scotland GHP evaluation. The Advisory Group will meet up to six times per year for the duration of the Scotland GHP evaluation.

Name	Job title	Organisation
Dr Rebecca Wade	Senior Lecturer	Abertay University - Division of Engineering and Food Sciences

Dr Francis Harris	Senior Lecturer	University of Hertfordshire
Professor Rich Mitchell	Professor	University of Glasgow
Dr Andrew Radley	Public health consultant	NHS Tayside
Dr Munro Stewart	GP	NHS Tayside
Dr Sheona McHail	Research Fellow	Edinburgh Napier University
Dr Katie Walters	GP	Ullapool Medical Practice
Faib Riley	Public Involvement in Research group member	University of Hertfordshire
Sian Harding	Public Involvement in Research group member	University of Hertfordshire
Additional lay members TBC	TBC	TBC

6 Ethical considerations and approvals

Whilst an ethical framework guides the work of the PHIRST, ethical considerations for this project particularly relate to the survey data being collected and the interviews being conducted, and the following sections therefore largely relate to these elements of the study.

This project approaches ethics as an ongoing reflexive exercise relevant to all aspects of data collection, analysis and publication. While the below provides a description of the ethical issues identified, it is possible that unexpected ethical issues will arise in the course of the research. The research team will monitor and document ethical concerns arising during the research which will be captured in the study's issue log. When necessary, these will be discussed with partner organisations (in accordance with provisions of confidentiality). PPIE input will be sought in any discussion about ethical matters at all stages of research, both routinely, as and when different forms and data collection instruments are developed, as well as when particular issues arise.

6.1 Informed Consent and withdrawal

All participants will be aged 18 years or older. All potential participants will be provided with detailed Participant Information, which will convey comprehensive information about the project to allow them to provide informed consent. They will be requested to record this consent in an electronic format within REDCap (for interviews prior to the date) or Qualtrics (directly before completing the survey). Participants will be informed about their right to withdraw from the study at any time.

Participant information will be written in a style of language that is accessible to participants. To ensure this, we will seek input/review from our PIRg. A dedicated telephone number and email address (phirst@herts.ac.uk) has been set up for participants to contact the research team with queries.

6.2 Data protection

All data will be stored and processed in line with GDPR and our Data Protection Impact Assessment (DPIA). Data will be stored on our project-specific drive (on UH server) and only accessible to those within the research team who require this. The secure drive will be used to store, details of those interested in participating in interviews, audio recordings and transcripts of interviews. Also see section 8 below (data protection and management).

6.3 Confidentiality

This project will maintain full participant confidentiality (although see limits to confidentiality in next section). Participants' contributions to the research will not be shared with service providers or their organisations and will be anonymized in publications.

6.4 Risks, safeguarding and referrals

It is not expected that the nature of the project will give rise to safeguarding concerns beyond those of any other project. A PHIRST safeguarding protocol has been developed which will be used to guide decision-making/actions as and when necessary. A copy of the safeguarding protocol is available on request from the Chief Investigators. The team is also familiar with the University of Hertfordshire, School of Life and Medical Sciences safeguarding policy, which will be adhered to.

6.5 Potential benefits for study participants

This project focuses on evaluating three Green Health Partnerships in Scotland and will provide recommendations for how these approaches should be delivered in the future. It is possible that organisations modify their service delivery based on the findings of this project. Thus, this is a rare opportunity for participants to see the effects of their participation in action. Participants will be informed that a report and video summary will be produced and disseminated that will contain recommendations.

6.6 Approvals

Ethical approval for this project has been granted by the University of Hertfordshire Health, Science, Engineering & Technology ECDA (protocol number: tbc).

7 Data protection and management

The PHIRST is an NIHR funded initiative, and the University of Hertfordshire is leading a consortium involving Ulster University, the University of Birmingham and the University of East Anglia. Staff at the University of Hertfordshire will take full responsibility for organising data collection and the safe management and storage of data.

This study has been assessed using the University of Hertfordshire Data Protection Impact Assessment (DPIA) checklist. The checklist was discussed with the Data Protection Officer, and it has been agreed that this study does not require a full DPIA. Any changes to the methodology will require a reassessment of the project against the checklist and a re-notification of the Data Protection Officer. A copy of the current DPIA checklist assessment is available on request from the Chief Investigators.

8 Project timescales/GANTT chart

Activity	Oct 22	Nov 22	Dec 22	Jan 23	Feb 23	Mar 23	Apr 23	May 23	Jun 23	Jul 23	Aug 23	Sep 23	Oct 23	Nov 23	Dec 23	Jan 24
DPIA and DSA production if required																
Protocol production																
Ethics application																
Project meetings																
Advisory group meetings																
Workstream 1: Recruitment and semi-structured interviews with referrers, link/GHP workers, and public																
Workstream 2: Recruitment and completion of pre-post survey measures																
Workstream 1: Transcript coding and data analysis																
Workstream 2: Survey data analysis																
Synthesis of findings from both workstreams																
Reporting																
Dissemination																

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Appendix A: **PHIRST Connect team organogram**

NIHR | Public Health Intervention Responsive Studies Teams