

Green Prescribing: Communities of Boundary Practice in Transectoral Collaboration

An Actor-Oriented Approach to Environmental and Public Health Intervention

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Abstract

Green prescribing, the referral of patients to nature-based activities, has potential to bring co-benefits for psychological and physiological public health and for environmental health. Literature considers a major limitation to its effective implementation as a holistic, transectoral practice to be lack of a common language and tendency of actors involved to work within their respective paradigms, resulting in silo working and minimising realisation of potential co-benefits. Three research questions (RQs) were posed to explore how this barrier could be overcome. Qualitative analysis was undertaken to identify actors involved in practical application of green prescribing (RQ1) and information flows which exist between actors (RQ2). Interviews and grey literature formed the basis for analysis, themselves arising from two case studies situated in the United Kingdom. Data was fed into actor linkage matrices and determinants diagrams to allow its systematic analysis. Key actors originated from the health and social care sector; environmental sector; national and local governance; and the voluntary, community and social enterprise sector. User groups were additionally highlighted as key actors although were afforded little representation in extant schemes. Weak information flows typically arose between user groups and environmental and health and social care actors; between environmental actors and health and social care actors; and between local and national actors, although limited data was available on the latter. Silo working was thus apparent. A novel conceptual framework, Communities of Boundary Practice, was devised and its application to improve implementation of green prescribing considered (RQ3). Typified by flexibility, openness, inclusion of multi-level and multi-professional actors, shared knowledge generation, reflexive and iterative learning, and holistic responsiveness to feedback mechanisms, the concept provides a systems perspective on green prescribing via which relevant actors and information flows can be identified, transectoral working facilitated, organisational boundaries transgressed and effective implementation of green prescribing pursued as a common endeavour amongst actors.

Keywords: Green Prescribing, Transectoral, Communities of Boundary Practice, Boundaries, Co-Benefits.

Executive Summary

Degradation of the natural environment and of human physiological and psychological health is recognised globally. Whilst the interlinked nature of environmental and public health has been long proposed, particularly within academia, holistic approaches to improving both are increasingly sought by political and professional actors, particularly so in light of the SARS-CoV-2 (Covid-19) pandemic. One such approach is green prescribing (GRx), a public health intervention which sees members of the general public be referred nature-based activities to improve their mental and/or physical health. Engagement in GRx, whilst having potential to benefit the individuals' health, is also considered to increase pro-environmental behaviour and environmental stewardship of the individual. It additionally has implications for how we value, manage and use natural resources for social purposes, such that potential co-benefits can be best realised.

A relatively novel practice in its modern form, GRx is receiving a significant amount of academic and public attention. To date, several limitations to the practice have been observed, one of which is the tendency for actors involved to work within their extant paradigms, with lack of transdisciplinary language leading to silo working and undermining potential realisation of co-benefits. Literature on the practice, although limited, tends to consider two major GRx actors: the service prescriber, typically originating from primary healthcare, and the service provider, originating from the environmental sector, typically a nature-based organisation.

Drawing upon case studies situated in the United Kingdom where GRx has recently been introduced or is in the process of being introduced, this research focuses on whether actors involved in practical application of GRx resemble those considered to exist within the literature (research question one) and whether information flows between actors are indeed characterised by lack of an interdisciplinary language and tendency for silo working (research question two). A qualitative approach to data collection was undertaken, based on interviews with actors involved in GRx application and on grey material as further provided by actors involved. Data was analysed and fed into actor linkage matrices and determinant's diagrams, which provided a systematic means by which to identify actors and presence and strength of information flows between actors.

Results generated were subsequently used to explore whether conceptualisation of actors involved in GRx as a Community of Boundary Practice (CoBP) would facilitate transectoral communication, mutual learning and effective pursuit and implementation of GRx (research question three). CoBP itself a conceptual framework devised during the course of this research. It is based on pre-existing theories of communities of practice and boundary organisations, but considering the novel, complex and currently experimental nature of GRx, affords attributes which pre-existing theories do not offer in their singular form.

In alignment with the literature, actors involved in practical application of GRx were typically considered to comprise primary healthcare actors as service prescribers and nature-based organisations as service providers. Although variation existed between case studies, additional actors were typically considered to comprise national and local governance; the wider health and social care sector; the wider environmental sector; and the voluntary, community and social enterprise sector. Case studies also highlighted the importance of user groups, i.e. patients or members of the general public, being included as GRx actors. Information flows to and from this actor grouping were however weak across the case studies.

Information flows were also observed to be relatively weak between environmental actors and health and social care actors, indicating tendency for silo working and lack of transectoral communication; and amongst health and social care actors. Although limited data was available,

vertical information flows between local and national level actors were further considered relatively weak. In alignment with the literature, presence of silo working may undermine realisation of full environmental and public health co-benefits which have potential to be afforded through pursuit of GRx.

Results indicated that application of a CoBP perspective to GRx could provide a means by which comprehensive actor representation into a GRx scheme might be sought, and provide a basis on which to suggest practical implications for effective implementation of the practice. In combination with results generated from the first and second research questions, taking a CoBP perspective showed that:

- A working definition of GRx needs to be developed by those actors involved
- A systems approach needs to be taken to GRx
- Systematic identification of relevant actors should be undertaken for their inclusion into a CoBP. These should be multi-level and multi-professional
- User groups need to be considered active stakeholders
- Systematic identification of information flows between actors should be undertaken and strengthened as necessary
- Domain-specific knowledge should be shared, and common knowledge and resources generated
- Feedback loops will likely be complex. A holistic approach should be taken to interventions
- Iterative and reflexive learning should be undertaken by CoBP actors
- CoBPs should be viewed as a flexible and open system. Actors and information flows should be capable of reorganisation as new knowledge is produced via both practical GRx application and ongoing research in the field.

Finally, it is important to note that GRx is a novel and complex practice. Its effective implementation may look different across different jurisdictions as regards benefits sought, actors involved and information flows established. By taking a CoBP approach, however, relevant actors can be afforded comprehensive representation as the practice evolves spatially and temporally, with GRx therefore being tailorable to local contexts where potential co-benefits can be maximised as regards both environmental and human health.

Table of Contents

LIST OF FIGURES	II
LIST OF TABLES	IV
ABBREVIATIONS	IV
1 INTRODUCTION	1
1.1 PROBLEM DEFINITION	2
1.2 AIM AND RESEARCH QUESTIONS	3
1.3 SCOPE AND DELIMITATIONS	4
1.4 ETHICAL CONSIDERATIONS	5
1.4.1 Researcher Honesty and Personal Integrity	5
1.4.2 Ethical Responsibilities to the Subjects of Research	6
1.4.3 Outcomes of the Research	6
1.4.4 Handling of Data Records	6
1.5 AUDIENCE	6
1.6 DISPOSITION	6
2 LITERATURE REVIEW	8
2.1 TRADITIONAL, COMPLEMENTARY AND INTEGRATIVE MEDICINE AND THE ENVIRONMENT	8
2.2 PUBLIC HEALTH AND NON-COMMUNICABLE DISEASES	10
2.3 PUBLIC MENTAL HEALTH	12
2.4 NATURE-BASED SOLUTIONS	13
2.5 GREEN PRESCRIBING	15
2.6 SOCIAL PRESCRIBING	18
2.7 THEORIES, TENTATIVE EXPLANATIONS AND CONCEPTUAL FRAMEWORKS OF RELEVANCE	18
2.7.1 Complex Public Health Interventions	19
2.7.2 Institutional Learning and Change	19
2.7.3 Actor Oriented Approach	21
2.7.4 Communities of Practice	23
2.7.5 Boundary Organisations	24
2.8 CONCEPTUAL FRAMEWORK: COMMUNITIES OF BOUNDARY PRACTICE	25
3 RESEARCH DESIGN, MATERIALS AND METHODS	27
3.1 RESEARCH DESIGN	27
3.2 METHODS USED TO COLLECT AND PROCESS DATA	27
3.2.1 Data Collection	27
3.2.2 Data Processing	28
4 RESULTS AND ANALYSIS	29
4.1 ACTOR LINKAGE MATRICES	29
4.1.1 Scotland Nature Prescription Scheme	29
4.1.2 England Green Social Prescribing	33
4.2 DETERMINANTS' DIAGRAMS	53
4.2.1 Scotland Nature Prescription Scheme	53
4.2.2 England Green Social Prescribing	55
5 DISCUSSION	60
5.1 RESEARCH RESULTS IN LIGHT OF EXTANT DATA	60
5.1.1 GRx Actors	60
5.1.2 Extant Information Flows	61
5.1.3 Conceptualisation as a Community of Boundary Practice	64
5.2 REFLECTING ON THE RESULTS OF THIS STUDY	66
6 CONCLUSIONS	69
6.1 PRACTICAL IMPLICATIONS AND RECOMMENDATIONS FOR NON-ACADEMIC AUDIENCES	69
6.2 RECOMMENDATIONS FOR FUTURE RESEARCH	69
BIBLIOGRAPHY	71

APPENDIX A.....	83
APPENDIX B.....	84

List of Figures

Figure 1: Annual publication of articles on Google Scholar as returned using search terms "Nature-Based Solutions" and "Public Health". Entry for 2021 is correct as of May 2021.	14
Figure 2: Founding features of GRx which are considered to work in unison: access to the natural environment, a social setting and the opportunity to partake in meaningful activities.	17
Figure 3: Example of an Actor Linkage Matrix, as adapted from Biggs & Matsuert (1999). 'Flows' depicted in internal cells illustrate information flows established between actors or actor groupings, passing from horizontal to vertical actors. .	22
Figure 4: Example of a Determinants' Diagram, as adapted from Biggs & Matsuert (1999). An internal ALM cell acts as focal point around which strengthening and weakening factors and areas for intervention are depicted.	23
Figure 5: Communities of Boundary Practice conceptual framework, as devised by the author. Solid box borders depict closed systems whereas dashed borders depict open systems. Information flows are represented by arrows. Solid arrows depict strong flows whereas dotted arrows depict weak flows.	26
Figure 6: Actors identified and interviews conducted across each of the three geographic locations, Shetland, England and Edinburgh, respectively.	27
Figure 7: Example of a Determinants' Diagram as used within this research.	28
Figure 8: Actor Linkage Matrix: Shetland Nature Prescription Scheme. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.	29
Figure 9: Actor Linkage Matrix: TLS1 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.	37
Figure 10: Actor Linkage Matrix: TLS2 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.	40
Figure 11: Actor Linkage Matrix: TLS3 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.	43

Figure 12: Actor Linkage Matrix: TLS4 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.	45
Figure 13: Actor Linkage Matrix: TLS5 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.	49
Figure 14: Actor Linkage Matrix: TLS6 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.	52
Figure 15: Determinants' Diagram for bidirectional information flows between Shetland NBO and GPs. Strengthening and weakening factors are illustrated as are potential areas for intervention.	53
Figure 16: Determinants' Diagram for bidirectional information flows between Shetland NBO and User Groups. Strengthening and weakening factors are illustrated as are potential areas for intervention.	54
Figure 17: Determinants' Diagram for bidirectional information flows between Shetland GPs and User Groups. Strengthening and weakening factors are illustrated as are potential areas for intervention.	54
Figure 18: Determinants' Diagram for bidirectional information flows amongst Shetland GPs. Strengthening and weakening factors are illustrated as are potential areas for intervention.	55
Figure 19: Determinants' Diagram for bidirectional information flows between England National and Local Actor Groupings. Strengthening and weakening factors are illustrated as are potential areas for intervention.	56
Figure 20: Determinants' Diagram for bidirectional information flows between England Health and Social Care and Nature-Based Organisations Actor Groupings. Strengthening and weakening factors are illustrated as are potential areas for intervention.	57
Figure 21: Determinants' Diagram for bidirectional information flows between England Nature-Based Organisations and User Groups Actor Groupings. Strengthening and weakening factors are illustrated as are potential areas for intervention.	58
Figure 22: Determinants' Diagram for bidirectional information flows between England Health and Social Care and User Groups Actor Groupings. Strengthening and weakening factors are illustrated as are potential areas for intervention.	59
Figure 23: Evolutionary flowchart for typical complex public health interventions, as adapted from Ogilvie et al. (2011) and Nutbeam (1998).	83

List of Tables

Table 1: Actors contacted for interview including location, job role and the organisation/sector which they represent as well as the actor identifier assigned to them throughout the course of this research. 84

Abbreviations

ALM	Actor-linkage matrix
BAME	Black, Asian and minority ethnic
CCG	Clinical commissioning group
CoBP	Communities of boundary practice
CoP	Communities of practice
DD	Determinants' diagram
DEFRA	Department for Environment Food and Rural Affairs
DHSC	Department of Health and Social Care
ES	Ecosystem services
GP	General practitioner
GRx	Green prescribing/prescription
H&SC	Health and social care
H&SCP	Health and social care partnership
ICS	Integrated care system
NASP	National Academy for Social Prescribing
NBO	Nature-based organisation
NBS	Nature-based solutions
NCD	Non-communicable disease
NE	Natural England
NHS	National Health Service
NHSE	National Health Service England
NHSI	National Health Service Improvement
MHCLG	Ministry of Housing, Communities and Local Government
PCN	Primary care network
PHE	Public Health England
RSPB	Royal Society for the Protection of Birds
STP	Sustainability and transformation partnership
SPx	Social prescribing
TLS	Test and learn site
VSE	Voluntary, community and social enterprise

1 Introduction

Rapid unplanned urbanisation and globalisation of unhealthy lifestyles is leading to exacerbation of mental and physical health issues, with poor public health having potential to undermine progress towards the 2030 Agenda for Sustainable Development (Anguelovski et al., 2018; Cohen-Cline et al., 2015; WHO, 2018). Through conceptualisation of various ‘green concepts’, the interdependent relationship between nature and society has increasingly been recognised across various academic disciplines. Whilst exact causal mechanisms remain somewhat unclear, it is nonetheless largely accepted that time spent in natural or semi-natural environments can confer significant physiological and psychological health benefits to the individual (Cox et al., 2017; Robinson et al., 2020; Tester-Jones et al., 2020), hence Shanahan et al. (2016) consider that “nature within cities will have a central role in helping address key global public health challenges”. Perversely, increasing acceptance of nature-derived health benefits is mirrored by increasing awareness that modern human life has concurrently grown distant from nature, with the implications of this considered to be two-fold (Dasgupta, 2021; Frumkin et al., 2021). Firstly, it diminishes the potential for a wide range of health and wellbeing benefits to be garnered, which in itself is considered by Dasgupta (2021) to be “a cause for public concern”; secondly, it discourages positive emotional, attitudinal and behavioural connections to nature, leading towards a “cycle of disaffection” to the environment (Atchley et al., 2012; Collado et al., 2015; Dasgupta, 2021; Moeller et al., 2018; Soga & Gaston, 2016).

Recognising the interdependency between human wellbeing and the environment, therefore, integrative strategies for improved environmental and public health are increasingly being called upon (den Berg, 2017). Such strategies have potential to “reduce premature death and preventable...disability, and improve the quality of life and well-being of people and societies” (Nusrat et al., 2019; Shanahan et al., 2019; WHO, 2012) whilst simultaneously benefitting the environment through reconnecting people with nature, inducing environmental stewardship and pro-environmental behaviour (Collado et al., 2015; Robinson & Breed, 2019; Seymour et al., 2018; van den Bosch & Depledge, 2015; van den Bosch & Ode Sang, 2017). Whilst theories such as Ecosystem Health and Planetary Health saw human health and the environment as being inextricably linked as early as the 1970s, rising interest in integrative and complementary strategies across academia, policy and practice is incrementally supporting a move towards a symbiocene (Frumkin et al., 2021; Prescott & Logan, 2018; Robinson & Breed, 2019). Interdisciplinary working to achieve environmental, physical, mental and social wellbeing has further gained political traction since the turn of the millennium. For example, the 2008 political determination of nature-based solutions (NBS) as a green concept which draws upon nature to address societal challenges via fostering ecosystem processes to provide co-benefits for nature and people signalled a shift in how we understand and value our relationship with the environment (Albert et al., 2019; Hanson et al., 2020), and the One Health concept which combines ecosystem health and medicine to achieve improved health across all animal species has had adoption of its principles promoted by the United Nations and World Bank, with the European Union reaffirming commitment to its principles as of 2010 (Gibbs, 2014).

Green Prescribing (GRx) is an emergent, practical application of an NBS which typically sees healthcare practitioners prescribe their patients nature-based activities to address health issues. Such nature-based activities are considered to comprise therapeutic horticulture; biodiversity conservation; care farming (use of farming practices for health, socialising and education); green exercise (e.g. nature walks, biking, climbing); and wilderness arts and crafts, amongst others (Robinson et al., 2019; Jepson et al., 2010; Bragg et al., 2017). Whilst the evidence base for GRx is still building and empirical evidence for nature-based health interventions more generally is still lacking, it is nonetheless increasingly recognised that the practice might provide an integrative strategy to proactively and reactively address both mental and physical health issues

(Brown et al., 2018; Dasgupta, 2021; den Berg, 2017; Huynen et al., 2005; Robinson et al., 2020; Robinson & Breed, 2019; Tsunetsugu et al., 2010; Ye & Qiu, 2021). In particular, green prescriptions are cited as having potential to address the “combination of genetic, physiological, environmental and behaviour[al risk] factors” which are associated with the onset of non-communicable diseases (NCDs) such as chronic cardiovascular and respiratory diseases, cancer and diabetes (Robinson et al., 2020; Robinson & Breed, 2019; WHO, 2018). Equally, GRx administration has been associated with increasing individuals’ reported wellbeing, and lowering incidences of common mental health disorders within the wider population (Richardson et al., 2017; Tester-Jones et al., 2020), the latter of which is particularly pertinent given the observed and anticipated negative psychological impacts of the SARS-CoV-2 (Covid-19) pandemic (Cullen et al., 2020; Usher et al., 2020).

1.1 Problem Definition

Despite increasing recognition of the health benefits which might be conferred by an individual’s exposure to outdoor natural environments and the “excellent” economic and social benefits which might be inferred therein (Ministry of Health, 2016; Ulmer et al., 2016; WHO, 2018), the inclusion of GRx or similar integrative schemes into public health policies remains relatively limited. Having been coined by New Zealand health professionals in the late 1990s, a minority of countries have implemented GRx at the national level. Literature to date cites potential barriers to GRx to comprise lack of an interdisciplinary language and tendency for silo-working; lack of understanding of the causal mechanisms which explain how exposure to outdoor environments may affect an individual’s psychological and/or physiological health; and lack of understanding of the contexts in which GRx-derived benefits are most effective (Bloomfield, 2017; Robinson et al., 2020; Triguero-Mas et al., 2017). As concluded by Frumkin et al. (2021), therefore, although much evidence is already available on the range of human health benefits which nature may offer, much remains unknown, hence a “robust research effort, guided by a focus on key unanswered questions, has the potential to yield high-impact, consequential public health insights”.

Recognising that GRx remains a relatively novel practice and much research remains to be done in the field, therefore, this thesis will focus on the foremost of these cited barriers: lack of an interdisciplinary language and tendency of actors involved to work within their extant paradigms and networks. Given the intrinsically transdisciplinary nature of GRx, the practice cannot foreseeably be effectively implemented unless the tendency for silo-working ceases to exist. As highlighted by Blewett (2018), “silo thinking is probably the biggest threat to delivering the best outcomes” of GRx, and as further emphasised by Robinson et al. (2020), the “ability to speak multiple disciplinary ‘languages’ is...an essential asset” for the effective establishment of GRx. Tendency for actors to work within their own “scientific perspectives and information needs” is acutely illustrated by Frumkin et al.’s (2021) reluctance to rank topics based on perceived importance when proposing a research agenda for nature contact and human health, citing the highly interdisciplinary and context-dependent nature of the field. As further recognised by Johnston (2011), the relative success of an innovative practice or scheme is subject to myriad factors associated with those actors involved, as determined by individual views, interests and knowledge generation; communication amongst the network of actors involved and their establishment of relations; influence of, and relation to, systemic institutional logics (cultural and belief systems); and additionally governance mechanisms associated with the innovation.

Through use of case studies, this thesis explores what actors might be involved in GRx and how these actors, originating from disparate disciplines, might collaborate and communicate in order for GRx to be effectively implemented and benefits therein had on both environmental and public health. An actor-oriented approach to analysis is applied. Communities of practice (CoP) and boundary organisations theory are drawn upon and development of a novel conceptual

framework, communities of boundary practice (CoBP), presented to explore whether creation of a multi-level, transectoral community, characterised by flexibility, sharing of resources and mutual knowledge generation might facilitate transgression of knowledge across disciplinary boundaries and enable holistic responses to be sought through reflexive learning (O'Mahony & Bechky, 2008; Star & Griesemer, 1989; Wenger, 2011). Given that this research is conducted under the auspices of an environmental sciences, policy and management programme, the role and management of natural elements is undeniably a central area of interest. However, given the inextricable link between the health and status of natural elements, societal health and therein the healthcare system, an interdisciplinary approach to research is undertaken, mirroring that as required for effective implementation of GRx. Effort has been made to ensure that this research itself does not fall foul of working within its own environmentally grounded conceptual boundaries and existing paradigms, as evidenced by the range of disciplines from which both the literature review and methods employed for analysis draw.

By furthering understanding of actors involved in GRx and how they might effectively communicate with one another, this thesis hopes to provide insight on how one of the major limitations to GRx might be overcome and the practice be most effectively implemented. By achieving this, in tandem with other research being undertaken in the field to address further limitations to the practice, it is hoped that an increasingly solid base for GRx can be built on which future research can target the nuances and more practical tasks associated with GRx implementation. Research generated should enable effective management of environmental and public health, operationalised through practical application of NBS. It should additionally encourage pro-environmental stewardship by professional actors originating from the environmental and healthcare sectors, alternate disciplines such as urban planning, and, of course, by the patients and user groups which GRx is intended to target.

Two case studies are drawn upon to inform analysis, both of which are situated in the United Kingdom, where a recent and oddly disparate interest in GRx has occurred in Scotland and in England. As of 2017, a GRx project, Nature Prescriptions, commenced in Shetland as a partnership project between NHS Shetland and Royal Society for the Protection of Birds (RSPB) Scotland. The scheme was rolled out across the ten general practitioner (GP) surgeries which serve the islands and is currently in the process of being expanded to Edinburgh to see how it might fare in an urban environment. The Shetland scheme informs the first case study. Unfortunately, inadequate data was available to inform analysis of the Edinburgh expansion, hence this jurisdiction has received only brief mention during the course of this thesis.

Spurred on by the Covid-19 pandemic and further increasing recognition of the inextricable link between human and environmental health (Stieger et al., 2021), a trial GRx scheme introduced in England as of 2021 comprises the second case study. A cross-governmental project, the scheme is intended to 'test' how GRx might improve mental health outcomes; reduce health inequalities, reduce demand on the health and social care (H&SC) system; and catalyse best practice development in increasing resiliency and accessibility of green social activities throughout communities (NHS, 2020). Seven test and learn sites (TLSs) allocated across England will undertake project delivery from April 2021 through April 2023 with the purpose of understanding the barriers to scaling up the practice nationwide. The TLSs will implement GRx at the regional level to explore potential system barriers; actions and behaviours required of different stakeholders; and how local plans can be developed via collaboration of the environmental and health sectors, and in conjunction with the other TLSs (DEFRA et al., 2021).

1.2 Aim and Research Questions

Based on the assumption that the performance of an intervention "is dependent on how actors...within an innovation system interact with one another and within the wider system"

(OECD, 1999), this thesis explores the actors involved in GRx and the networks which they might create. The literature cites main actors involved in GRx to comprise healthcare practitioners and actors from the environmental sector, typically originating from nature-based organisations (NBOs). It cites that lack of a common lexicon and tendency for actors to work within the boundaries of their own disciplines, based on existing theoretical paradigms, training, beliefs, values and interests is a major barrier to effective implementation of the practice (Blewett, 2018; van den Bosch & Depledge, 2015; van den Bosch & Ode Sang, 2017).

This research therefore seeks to explore whether actors involved in GRx in practice resemble those considered to exist within the literature, and produce knowledge on whether information flows between actors originating from disparate disciplines are characterised by lack of an interdisciplinary language and tendency for silo working as cited within the literature. Ultimately, it intends to inform an understanding of whether inclusion of actors in arenas of collaboration might facilitate transgression of occupational boundaries. By doing so, it is hoped that improved transectoral communication, mutual learning and effective pursuit of GRx as a common endeavour would occur.

Research questions posed are therefore as follows:

1. What actors are involved in the implementation of GRx?
2. What are current examples of communication pathways between these actors?
3. How might conceptualisation of actors involved in GRx as a Community of Boundary Practice work to improve practice implementation?

Data generated in response to the first and second research questions was fed into actor linkage matrices and determinants' diagrams, areas for intervention highlighted and potential for establishment of a CoBP to overcome silo working therein explored. By asking these questions, it is hoped that this research might aid the scaling up and permanent implementation of GRx as a nature-based healthcare intervention both in the United Kingdom and in wider jurisdictions, supporting recognition of the mutual benefits which can be gained from GRx with implications had on how we value, manage and use natural resources for social purposes.

Whilst alternate research in the field focuses on mechanistic pathways and contexts in which GRx is most beneficial for the user, this research seeks to provide an understanding of the various actors involved in the practice and the networks which they might establish in order to address silo thinking and smooth the transition from evidence to policy to practice, aiding institutionalisation of the practice. As the evidence base for GRx continues to increase, it is hoped that this research might in tandem provide a basis of understanding on which GRx can be recognised as a viable route to ameliorate the increasing degradation of the natural environment and prevalence of public physiological and psychological health issues.

1.3 Scope and Delimitations

It is recognised that there is a need for empirical evidence regarding the potential benefits of nature-based health interventions to be identified. However, experimental studies are increasingly being undertaken which seek to understand the causal mechanisms by which nature-derived benefits might be conferred. These are increasingly longitudinal in nature. Additionally, several comprehensive reviews have recently sought to synthesise data available to date, for example, van den Bosch & Ode Sang (2017b) and Kondo et al., (2020). Together, these efforts seek to consolidate the evidence base for GRx practice as regards the potential benefits it may provide public health. A review of the evidence for nature-based health interventions and generation of further relevant empirical data is therefore excluded from the scope of this thesis. This thesis instead intends to understand the contexts in which a GRx scheme might be

successfully implemented, focusing on both the meso and macro level, such that silo-thinking at the practice-policy-academia interface might be overcome.

Considering the pioneering nature of GRx as a practice, academic literature on the topic is somewhat scarce. In some instances, it has therefore been necessary to draw upon related literature such as that pertaining to NBS and also nature-based health interventions more generally. This novelty and subsequent potential for lack of data is further mirrored in the case studies drawn upon. In England especially, the GRx scheme was within project set-up stage only as interviews were conducted (January – March 2021), with project delivery having commenced only as of April 2021. Accordingly, it is important to consider that a high proportion of interview data was speculative and based on perceived/anticipated involvement of stakeholders; requirements of stakeholders; and perceived methods for increasing intersectoral collaboration. These perceptions may therefore be largely based on interviewees' personal understanding and an expectation for the project to adhere to *modus operandi*.

In undertaking a comparative analysis on GRx practice across disparate geographic areas, it is important to note that motivations for the implementation of GRx and outcomes observed or anticipated will be somewhat context-dependent and will differ as a result. Whilst unable at present to predict how project outcomes may differ, the point can be illustrated by differing motivation alone. The new test sites in England, for example, have primarily been announced as a means to address general wellbeing of the population, with an emphasis on mental health issues. Conversely, GRx has been introduced by RSPB Shetland with the primary purpose of increasing the community's connectedness to nature and use of mindfulness, whereas Shetland GPs' motivation for using the practice reportedly differs based on individual understanding and interest, with an interview respondent citing that GRx was approached primarily as a means by which to promote physical activity within the community. Similarly, discrepancies are seen within the literature, with one body of papers focusing solely on potential physiological benefits of nature-based health interventions, a second on potential psychological benefits, and a third on the combination of the two. Recognising that purposes for implementing GRx differ, I argue that the premise is nonetheless comparable in that each scheme wants to support GRx implementation as a means to improve health and social cohesion through increased access to blue-green space. Besides, the complexity of human health suggests that regardless of motivational factor, potential benefits had on psychological or physiological health cannot reasonably be extricated. As summarised by Patel et al. (2011), "a number of studies that have employed a physical activity intervention with clinically depressed adults have found an association between physical activity engagement and a reduction in depressive symptomatology, or an increase in positive mood". Nonetheless, in seeking broader institutionalisation of the practice, quantification of potential nature-derived benefits and the forms which they take may be necessary. Whilst outside the scope of this research and currently being addressed elsewhere in academia as discussed above, it is noteworthy that insufficient evidence on potential impacts has proved a barrier to mainstreaming of NBS more generally.

1.4 Ethical Considerations

This research has been reviewed against the criteria for research requiring an ethics board review at Lund University and has been found to not require a statement from the ethics committee.

1.4.1 Researcher Honesty and Personal Integrity

This research has in no way been funded by an external organisation, nor has an external individual or organisation influenced the analysis and subsequent conclusions drawn. Whilst personal contacts were mobilised to obtain initial contact with a selection of interviewees associated with the Shetland GRx scheme, I do not believe that this has influenced the nature or the outcomes of this research.

1.4.2 Ethical Responsibilities to the Subjects of Research

It is not envisioned that respondents will suffer any damage or disadvantage as a result of their partaking in this research project, be this emotional, economic, reputational or other. Nonetheless, names of individuals are not disclosed at any point in the project and prior to interview, each respondent was reminded of their right to privacy and to withdraw from the process at any given point. This was considered of particular importance given the remaining potential for identification of individuals, particularly due to the relatively small population of Shetland and the interconnectedness of its resident communities, and the relatively small pool for interview selection from the English GRx scheme.

1.4.3 Outcomes of the Research

Despite redaction of names, it is recognised that individuals may nonetheless be identifiable through a combination of their job role and location. To overcome this, locations of individuals have not been made explicit. Rather, interview respondents have been referred to throughout by an anonymised identifier pertaining to the organisation or sector which they represent. For example, general practitioners interviewed are identified throughout as GP1, GP2 etc. and TLS respondents are referred to as TLS1, TLS2 etc. Effort has been made to ensure that other identifying features which were given mention during the course of the interview, for example, specifics of local bodies or facilities, have been omitted from the data reported within this thesis.

1.4.4 Handling of Data Records

All foreseeable measures have been taken to ensure the privacy of individuals involved in this research. Aside personal correspondence with interviewees, redaction of name and exclusion of location of all interview participants has been ensured throughout the process. Empirical data has been assigned an arbitrary identifier as described above. Empirical data has throughout been stored on a password protected personal computer and backed up on an external hard-drive.

1.5 Audience

This thesis will likely have implications for two categories of audience. The first, and most temporally immediate, will comprise those actors contacted for interview who have recently implemented GRx or are in the process of doing so. In Scotland, findings generated will likely have biggest impact on the NBO which has instigated the scheme as may provide a means of informal evaluation of the Shetland project to date and highlight potential areas for intervention. In England, the findings are likely most applicable to the local leads responsible for project delivery at each TLS. Should the results generated in this research influence project implementation at site level, implications ought, in theory, be fed back to national cross-governmental actors during project progression and may provide guidance for future rollout of GRx across England should the trial project be deemed a success. Similarly, results generated are intended to guide development of GRx in alternate jurisdictions prior to practice implementation. Actors involved would comprise the second category of audience, and themselves might originate from a range of disciplines, including the health and environmental sector, as is typically associated with GRx in the literature, or from less immediately impacted sectors, for example, urban planning through to public policy, due to related implications on how society might take a more holistic approach to long-term management of both environmental and public health in tandem.

1.6 Disposition

Chapter one of this thesis presents an introduction to the research undertaken, including a background of the topic, identification of a problem drawn from the literature and rationale for this problem being the focal point of the research. It sets out research questions to be answered, the audience for which results generated might be of use, scope and delimitations of the research

and ethical considerations undertaken during the process of devising and conducting the research.

Chapter two presents a literature review. Given the interdisciplinary and novel nature of GRx, literature drawn upon originates from a variety of fields. It builds on the background presented within the introduction and provides a more thorough analysis of how the disparate sectors of environmental and public health have traditionally operated alongside one another and explores existing areas of overlap. It explores literature on public health with an emphasis on NCDs and mental health; considers current knowledge on NBS including how the concept has developed in both political and scientific spheres, and introduces the tendency for silo-working to occur when disparate sectors draw on a common concept situated at the boundary between disciplines. It provides background on the current status of GRx, highlights potential benefits which may be brought about by the practice and key limitations to implementation of the practice. A further public health intervention, social prescribing (SPx) is introduced as provides the basis on which the trial England GRx scheme is based. Theoretical frameworks of relevance are subsequently presented. Again, given the novelty of this field, several disciplines and their respective facets of literature are drawn upon, that relevant to: complex public health interventions; institutional learning and change, which provides rationale for undertaking an actor-oriented approach to analysis of projects or public health interventions and provides analytical tools employed by this research, namely, actor-linkage matrices and determinants' diagrams; communities of practice; and boundary organisations, focusing on their potential to mediate effects of silo working. Chapter two concludes with presentation of a novel conceptual framework, Communities of Boundary Practice. Devised by the author, CoBP draws together findings from the above presented disparate disciplines, particularly that related to limitations imposed by silo-working as recorded within the literature on integrative medicine, NBS and GRx.

Chapter three details the research design, methods and materials employed by this research. It details methods used to collect and process data; outlines actors identified and contacted for interview and provides an example of a determinants' diagram as modified for use within this research.

Chapter four presents the results of the research. Results are presented in sequential order: first by actor linkage matrix per case study including explanatory text as drawn from interviews and grey literature analysed, and second, by determinants' diagram. Results are presented first for the Scotland Nature Prescription Scheme and second for the England Green Social Prescribing Scheme. Whereas actor linkage matrices are presented one per site in the case of the England GRx scheme, the determinants' diagrams condense results from across these sites.

Chapter five presents discussion on the research conducted and results observed, as split into two sub-sections: implications of results observed in relation to extant data presented in the literature; and an objective reflection on results of the research, the theoretical and methodological methods employed and the legitimacy and generalisability of results observed. Within the former, each of the research questions are sequentially addressed and discussion presented in relation to results generated through this research. Implications are considered, including the extent to which conceptualisation of actors involved in GRx as a CoBP might lend itself to improving efficacy of practice implementation.

Chapter 6 concludes the main body of the thesis. It presents conclusions drawn from the research undertaken and results garnered, presents practical implications of these results and provides recommendations for non-academic audiences. Finally, recommendations for future research are highlighted.

2 Literature Review

As outlined within Disposition, the following literature review draws upon a variety of academic disciplines when considering current knowledge related to the interchange between environmental and public health. Whilst background literature pertinent to the topic of green prescribing is explored within the chapter, attention has been paid to underline the tendency for silo working to occur within both academic and practical settings as appropriate. Uncertainties which remain to be resolved in the field, in part attributable to lack of transdisciplinary working, are further highlighted.

Section 2.7 introduces conceptual theories and therein analytical methods as relevant to this research, again drawing from disparate disciplines. The chapter concludes with presentation of a novel conceptual framework as informed by the literature review and devised by the author.

2.1 Traditional, Complementary and Integrative Medicine and the Environment

The importance of the physical environment on public health has been recognised for thousands of years, with the use of nature as a therapeutic and medicinal resource having “ancient foundations” (Florey et al., 2007; Franco et al., 2017; Maver et al., 2015). Use of nature as a health resource has manifested itself in numerous ways, from inclusion of gardens into monasteries in the 1200s to facilitate recovery of the sick, through to inhalation of phytoncides during the Japanese practice of Shinrin-Yoku, or forest bathing, and provision of herbal and phytomedicines in both indigenous and pharmaceutical settings (Bielinis et al., 2018; Franco et al., 2017; Hansen et al., 2017; Li, 2010; Maver et al., 2015; Montford, 2017; Tsunetsugu et al., 2010; WHO, 2019). This relationship is complex, and certainly not linear. In the present day, for example, traditional and complementary medicines, i.e. those which exist outside a country’s dominant healthcare system and are informed by theories, beliefs and experiences indigenous to different cultures, continue to be relied upon by millions of individuals (Dasgupta, 2021; WHO, 2019), yet the WHO class alternative medicinal approaches as an underestimated health resource, interest in which is only recently undergoing a revival due to the “unique health challenges of the 21st century” and their being well positioned to aid prevention and management of NCDs (WHO, 2019).

In Western societies, a holistic approach to health which draws upon the immersion of oneself in nature to alleviate health qualms has been incorporated into individuals’ lives since the 19th century, one of the most notable examples being Kneipp therapy (Locher & Pforr, 2014; Tsunetsugu et al., 2010). The connection between nature and wellbeing has similarly “long been emphasise[d] in the academic literature”, spanning multiple disciplines (Anguelovski et al., 2018). The Biophilia hypothesis, for example, as defined as humans’ “innate tendency to focus on life and lifelike processes”, considers that humans are “hardwired to experience a deep connection with nature” and we thus experience an evolutionary need for nature connectedness (Dasgupta, 2021; Franco et al., 2017; Nusrat et al., 2019; Wilson, 1984). Psychological theories such as attention-restoration theory and stress-reduction theory similarly provide insight on why contact with, and connectedness to, nature might “heighten [one’s] sense of well-being” (Dasgupta, 2021). Despite this longstanding recognition, however, mainstream Western healthcare practices have nonetheless tended towards more ‘orthodox’ treatment methods, such as prescription of medication, with Hartig et al. (2014) stating that “the public health field views the natural environment with ambivalence”. In combination with increasing urbanisation and the increasingly technology-intense environments in which we reside, the proportion of the global population accessing nature has declined, with its use as a health resource mirroring this trend (Atchley et al., 2012; Dasgupta, 2021).

Following a similar trend to that of traditional and complementary medicines, however, academic, political and public interest in nature's benefits on human health have recently undergone a resurgence. Whilst emergent literature is relatively young, the central ideas "have ancient provenance in the public health field", and similarly in seminal literature (Hartig et al., 2014). Hansen et al. (2017) summarise that this trend is "indicative of a time in history when researchers and practitioners are willing to look at how humans [have] evolved over the past 6- to 7-million years", and Hartig et al. (2014) consider that this resurgence may provide opportunity for a "more nuanced theoretical and practical consideration of nature-health relations". The latter point is particularly pertinent as both academic theories regarding, and practice of, nature-derived health benefits to date have largely been based on observational knowledge - empirical evidence remains weak (Brown et al., 2018; Dasgupta, 2021; Huynen et al., 2005; Tsunetsugu et al., 2010; Ye & Qiu, 2021). Human-nature connectedness, the health benefits which might therein be conferred and limitations to our understanding are discussed more extensively within Section 2.5: Green Prescribing.

Recent advancements in research as regards the relationship between public health and the environment appear to have taken several major routes forward. Firstly, there is increasing interest within academic disciplines to increase the level of evidence for this phenomenon. Despite the wealth of anecdotal support for derivation of health benefits from the natural environment, this "dose of nature" approach is oft considered reductionist (Robinson and Breed, 2019). Increasing experimental studies have therefore sought to quantify the health benefits brought about by humans' exposure to natural environments such that we can begin to establish causality and understand the mechanisms behind nature-based interventions (Hartig et al., 2014; Triguero-Mas et al., 2017). By doing so, it is envisaged that specific health benefits conferred by different aspects of nature can be better leveraged, enabling targeted health benefits for the individual and pursuit of maximal public benefit to counteract the stressors of modern day life (Bielinis et al., 2018; Hansen et al., 2017; Vlachokostas et al., 2014). Both laboratory and in-situ studies are being undertaken to try and determine this. Whilst the former appears to focus largely on the establishment of specific causal links (see Franco et al., 2017), the latter appears to focus on understanding the contexts in which nature-derived benefits can be harnessed, tending towards systematic meta-analyses which involve large sample numbers and a cross-section of the population; long-term benefits; and overcoming of subjectiveness and compounding factors such as an individuals' diet or pre-existing psycho-physiological state (Bloomfield, 2017; Franco et al., 2017; Hartig et al., 2014; Nusrat et al., 2019; Robinson et al., 2020; Triguero-Mas et al., 2017).

Secondly, a more integrative and comprehensive population approach to healthcare is increasingly being sought (Patrick, 2000; Reddy, 2002). As we begin to circle back around to more 'traditional' approaches to healthcare which diverge from a clinically oriented perspective and instead draw increasingly upon the natural environment, the interdependent relationship between human health and environmental health is ever-more emphasised. This has spurred on increasing calls from academia and practitioners for complementary strategies which have potential to address deterioration of both public health and the environment (Nusrat et al., 2019). As of the late 1970s, early publications linked ecosystem health and assessment to medical diagnostics, with Rapport et al. (1979) commenting that "there are more than merely heuristic analogies between these two disciplines, and that useful transfer of approaches might occur once it is more clearly established that both are variants of a common theme". The concept of planetary health further popularised the idea that the natural environment and human health are inextricably linked, as did determination of the One Health transdisciplinary approach to health and wellbeing, which integrates ecosystem health and medicine to achieve improved health across all animal species (Gibbs, 2014; Myers, 2017). Increasing recognition of the implications of ecological imbalance on global health has seen facets of academia move away from the current understanding of a "unidirectional and exploitative relationship" between humans and

nature as is characteristic of the Anthropocene (Prescott & Logan, 2018; Rapport & Maffi, 2011; Robinson & Breed, 2019), with transition towards a ‘symbiocene’ being proposed, characterised by a holistic and mutualistic medical system which is socially just and ecologically, culturally and ethically sustainable (Gill & Benatar, 2020; Prescott & Logan, 2017; Rapport & Maffi, 2011; Robinson & Breed, 2019). Similarly, an integrative medicine approach encourages an ideological transition from “thinking of ourselves as separate passive recipients of reductive health care strategies” to instead considering ourselves “active participants in an interconnected biopsychosocial global ecological system” (Nusrat et al., 2019). Interestingly, public and political interest in an integrative approach which cares for both our health as well as that of the environment appears to have been spurred on by the Covid-19 pandemic as a result of: realisation that tipping points may have been breached; exposure and aggravation of social inequalities and inequities; and acknowledgement of mental and physical health benefits brought by access to nature and blue-green space during lockdown (Douglas, 2021; Mell & Whitten, 2021; Mocatta & Hawley, 2020; Pouso et al., 2021; Robinson et al., 2021; Stieger et al., 2021; Venter et al., 2020).

Thirdly, both of the above advancements have highlighted the need for transdisciplinarity (Anguelovski et al., 2018; Gehlert et al., 2010; Pérez-Soba et al., 2018). As summarised by Gehlert et al. (2010), transdisciplinarity research forms its own intellectual ‘outerspace’, occurring beyond and outside all disciplines and endeavouring to pursue an understanding of the “world in its complexity, rather than just a part of it”. Conversely, research to date on the relationship between human health and the environment has typically taken a multidisciplinary approach with related disciplines and their respective actors having operated largely within their own silos, be these: healthcare practitioners of alternative medicines versus those of more ‘orthodox’ westernised medicines; researchers focusing on human health and specific, different aspects of the environment (physicochemical factors such as air quality and the urban heat effect, microbiological factors and impacts on the microbiome, obesogenicity of the environment); researchers focusing on the environment and specific, different aspects of human health (cognitive development, chronic stress and depression, psychosocial health, development of allergies); and finally those actors involved in the implementation of public policies, themselves spanning a breadth of specific topics from public health through to urban planning and their historically limited recognition of the value and importance of nature in providing ecosystem services (ES), specifically health benefits, with the 1990s being the “starting point for formal urban sustainability programs in many cities around the world” (Anguelovski et al., 2018). Several academic reviews now published seek to bring together disparate information, particularly that pertinent to establishing causality (see for example Hansen et al., 2017). Having recognised the need for transdisciplinarity to broach the “pragmatic complex problems” associated with bridging medicine, behavioural and environmental health, conceptual models are increasingly being devised and presented within the literature, and the need for a common lexicon has been reiterated throughout (Gehlert et al., 2010; Nusrat et al., 2019; Robinson et al., 2020).

2.2 Public Health and Non-Communicable Diseases

As of 2017, non-communicable diseases were considered to dominate the global disease burden, being cited as the primary driver for premature deaths globally and accounting for 70% of total deaths (van den Bosch & Ode Sang, 2017a; WHO, 2020). The manifestation of “a combination of genetic, physiological, environmental and behaviour[al] factors”, NCDs comprise chronic cardiovascular and respiratory diseases, cancer and diabetes (WHO, 2018). Of interest, the World Health Organisation (WHO) also encompassed common mental health disorders in their most recent report on NCDs (WHO, 2020). The literature attributes a global increase in the prevalence of NCDs to a myriad of phenomena, comprised of a complex web of interactions ranging from the individual level through to the community, national and supra-national levels

(Florey et al., 2007). Whilst NCD cases increase worldwide, their mirroring inequalities in the distribution of risk factors sees low and middle socioeconomic communities and countries be disproportionately impacted, exacerbating both inter- and intra-national health inequalities (Beaglehole & Yach, 2003; Gill & Benatar, 2020; Mackenbach et al., 2000; Raymond et al., 2006; van den Bosch & Ode Sang, 2017a).

Whilst the global community, WHO and United Nations have begun to make concerted efforts to address the proliferation of NCDs, Beaglehole and Yach (2003) consider that the WHO and governments alone cannot adequately address NCD prevention and control. Progress to date against internationally set benchmarks has been classed as “insufficient and highly uneven” (United Nations General Assembly, 2012). As summarised by Yang et al. (2018), slow progress has been attributed to: insufficiencies regarding funding, political prioritisation, public understanding, civil society engagement and management of industrial stakeholders (enabling industry interference); weak health systems; inappropriate framing of NCDs and legitimacy challenges; and the aforementioned complexity of NCDs.

Critics of prominent action taken to date further emphasise how the onus has largely been placed on the individual as the “locus of change”, with initial interventions having typically focused on eliciting change in individuals’ behaviours and lifestyle choices rather than calling for structural change at the meso- or macro-levels (Florey et al., 2007; Vos et al., 2016; Yang et al., 2018). National policy interests to date have largely targeted individuals’ physical inactivity, harmful use of alcohol, tobacco use and unhealthy diets, which are together assigned approximately 82% of NCD-related deaths globally (WHO, 2013; Yang et al., 2018). However, macrosocial determinants of population health are increasingly privy to epidemiological and academic attention. Under the guise of globalisation, rapid unplanned urbanisation, industrialisation and also digitalisation, modern and increasingly westernised lifestyles have converged to together exacerbate risk-factors which are known to lead to onset of NCDs (Florey et al., 2007; Kumanyika, 2000; Okumiya et al., 2011; Patrick, 2000; Raymond et al., 2006; Vos et al., 2016; WHO, 2018). Access to global markets and communities has increasingly seen cultural homogenisation, increased uptake of salubrious and deleterious products (alcohol, tobacco and diets with high proportions of salt, sugars and saturated fats), increasingly sedentary lifestyles and a concurrent disconnect with nature (Atchley et al., 2012; Beaglehole & Yach, 2003; Florey et al., 2007; Frank & Engelke, 2001; Hartig et al., 2014; Huynen et al., 2005; Kumanyika, 2000; Okumiya et al., 2011). Whilst these modifiable, behavioural risk factors do indeed impact public health at the individual level, the pervasivity and normativity of these trends has resulted in academia and international bodies highlighting the need for societal-level structural changes which might address distal underlying causes (Florey et al., 2007; Kumanyika, 2000; WHO, 2020). The WHO (2018) therefore calls for a comprehensive and collaborative approach to reduce risk factors associated with the onset of NCDs, leveraging the idea that these diseases are best prevented through societal and environmental interventions, with prevention, early detection and timely treatment being shown to confer “excellent” economic and social benefits (van den Bosch & Ode Sang, 2017b; WHO, 2012).

Despite the wealth of literature attributing the advance of NCDs to macrosocial trends of urbanisation in both developed and developing economies, it must nonetheless be noted that the need for longitudinal cohort studies has been asserted (Duboz et al., 2019; Hartig et al., 2014; Holmes et al., 2010). For example, prevalence of hypertension amongst African rural populations has been observed to be comparable to that of urban areas, despite the less Westernised and obesogenic lifestyle choices and environments which might immediately be found in the former (Duboz et al., 2019; Holmes et al., 2010; B. Swinburn et al., 1999). Indeed, within the urban environment itself, population diversity and variability are cited as challenges when attempting to comprehensively evaluate the impact of the physical environment on human health (Ye & Qiu, 2021). As highlighted in Section 2.5: Green Prescribing, the

complexity of public health and potential beneficial connections with the environment is a recurring theme for which evidence is sought generally, but especially in relation to the implementation of GRx.

2.3 Public Mental Health

Mental health disorders constitute a substantial independent contribution to the burden of disease globally, with neuropsychiatric conditions accounting for approximately a quarter of all disability-adjusted life-years and neurological disorders accounting for a smaller, but still significant contribution (Prince et al., 2007). When compiled within the realm of NCDs, as per the aforementioned approach of the WHO, neuropsychiatric conditions contribute to the majority of global disease burden, surpassing the contributions made by both cardiovascular disease or cancer (Mathers & Loncar, 2006; Prince et al., 2007; WHO, 2020). Despite this, mental health receives relatively little attention and funding in public health initiatives, with developing countries favouring an approach which tackles the control and eradication of infectious disease, and reproductive, maternal and child health, and developed countries prioritising those NCDs associated with premature death rather than those which typically manifest as years lived-with-disability (Patel et al., 2011; Prince et al., 2007).

Whilst acknowledged that mental and physical health have historically been viewed and treated as distinct phenomena, each operating within their respective health domains, there is increasing recognition that the two are interlinked. The onset of one has potential to manifest itself as symptoms of the other - mortality included - and similarly, treatment for one might be afforded by a health intervention which specifically focuses on the other (Atroszko et al., 2020; A. Patel et al., 2011; Prince et al., 2007). Not only are these phenomena considered complex in their own right, therefore, but the link between the two is further considered extensive and complex. Whilst each may benefit from respective treatments, many put forward the case for integrated primary healthcare strategies, community based programmes and holistic care models which might afford effective delivery of both mental and physical health benefits in tandem (Kakuma et al., 2011).

The need to better understand the mechanistic pathways between mental and physical health was recently brought to the fore due to the advance of the Covid-19 pandemic and its associated social restriction measures which led to unprecedented alterations in individuals' lifestyles and an increase in mental health disorders therein (Cullen et al., 2020; Kumar & Nayar, 2020; Prince et al., 2007; Rajkumar, 2020; Robinson et al., 2021). Urban mobility and social interactions curtailed, individuals altered their patterns of accessing natural environments during the pandemic with health and wellbeing benefits being cited as a prominent motivator (Lennon, 2020; Robinson et al., 2021). An increase in individuals' reliance on public greenspace to help them cope with the pandemic was noticed across the board, with reported increases in both frequency and duration of individuals' visits to nature as a means to benefit mental health underlined (Dzhambov et al., 2020; Robinson et al., 2021; Slater et al., 2020; Soga et al., 2021). In the United Kingdom specifically, an increase in individuals accessing outdoor environments for physical exercise as a result of the pandemic was coupled with a surge in "people's interest in nature", with 41% of respondents to Natural England's (NE) People and Nature Survey reporting that visiting green and natural spaces has become more important for their wellbeing compared prior to the pandemic (Natural England, 2021; Office for National Statistics, 2021). Indeed, realisation of the mental health benefits which might be conferred by an individual's accessing natural or semi natural environments forms a major reason for the pursuit of GRx and establishment of the seven TSLs across England, with the government of the United Kingdom having identified public greenspace as critical infrastructure which was to be kept open throughout the pandemic as far as was reasonably permissible in light of local 'lockdowns' and social distancing measures (DEFRA et al., 2021; Public Health England, 2020).

Recognising the mental and physical health benefits which might be conferred by access to greenspace, it is of paramount importance to consider the equitable distribution of public and private greenspace accessibility, particularly within urban areas. Although variable and contradictory results exist (see Macintyre, 2007; Shen et al., 2017; Timperio et al., 2007), it is often accepted that a lesser quantity and quality of urban greenspace is correlated with neighbourhoods of lower socioeconomic status (Astell-Burt et al., 2014; Jennings et al., 2017; Mitchell et al., 2011; Schüle et al., 2019). As summarised by Sharifi et al. (2021), urban planning has typically not succeeded in countering urban inequality trends, whereby economically disadvantaged communities who are known to experience a heightened burden of health issues have lower access to greenspace, ultimately “leading to intergenerational well-being problems”. Specifically in light of the Covid-19 pandemic, Robinson et al. (2021) highlight how across England, socioeconomic factors including deprivation are interrelated with presence of greenspace and relative greenness, with greater land-cover greenness within accessible distance of the individuals’ home being correlated with higher levels of mental wellbeing. In combination with the disproportionate physical and mental health impacts of Covid-19 observed amongst specific demographic groups, inequitable access to greenspace and the exposure and exacerbation of social and health inequalities has further been underscored (Bhatia, 2020). Whilst this pattern of environmental injustice has been brought into sharp relief by the Covid-19 pandemic, it is a pattern consistent with existing literature on preventable lifestyle-related health conditions and NCDs, where those who have the most to gain from access to high quality greenspace have the poorest access, further aggravating health disparities or inequalities (Astell-Burt et al., 2014; Jennings et al., 2017). Recognised that urban nature has “great potential” to be used as a nature-based solution for improved public health, the literature emphasises that it is of paramount importance that affirmative action is taken in redressing the socioeconomic inequity of access to public greenspace as an important public health resource (Astell-Burt et al., 2014; A. Patel et al., 2011; Slater et al., 2020; Soga et al., 2021).

2.4 Nature-Based Solutions

Having emerged in the policy context in 2008, the NBS concept has relatively recently entered the scientific sphere (Hanson et al., 2020), yet the vast array of disciplines which have drawn upon the concept has led to publication of circa three million peer-reviewed articles to date (Albert et al., 2019). Within this, however, NBS have been subject to different definition. Two notable definitions originate from the EU Commission and the International Union for Conservation of Nature (IUCN). The former targets “ambitious social and economic innovation goals with NBS”, whereas the latter interprets NBS within the context of five developmental areas, including that of public health (Albert et al., 2019). Hanson et al. (2020) further highlight that the IUCN “clearly refer[s] to large-scale ecosystem solutions”, whereas the scale of solution is less well defined by the EU Commission. Despite such differences being highlighted within the literature, common ground is typically reconciled as both definitions share the notion that NBS are actions based in nature which should meet societal challenges by using ecosystem processes to provide co-benefits for nature and people (Albert et al., 2019; Hanson et al., 2020).

Proliferation of NBS into academia has seen “conceptual advances...[be] made regarding a synthesis of interdisciplinary perspectives on NBS”, yet these have largely been undertaken by the natural sciences community rather than social sciences, and have typically focused on relationships between NBS and “older green concepts” (Albert et al., 2019; Hanson et al., 2020). A review of literature by van den Bosch and Ode Sang (2017) pertaining to NBS and public health returned only 27 articles, the majority of which were conceptual and covered three discourses: NBS in relation to green infrastructure; NBS for climate change adaptation and or mitigation; and NBS in relation to ES. Only three papers reviewed explicitly considered the

relationship between NBS and human health and wellbeing, and all were conceptual, catalysing van den Bosch and Ode Sang's (2017) summation that “the intimate relation between environmental conditions and human health is insufficiently explored within the NBS-context”. Both academic focus on, and practical application of, the link between NBS and public health has however continued to increase, with a literature search on Google Scholar as of May 2021 returning circa 800 articles to date (Figure 1) and the Urban Nature Atlas featuring 28 cases of NBS implementation associated with public health at the time of project culmination in November 2020 (NATURVATION, 2020).

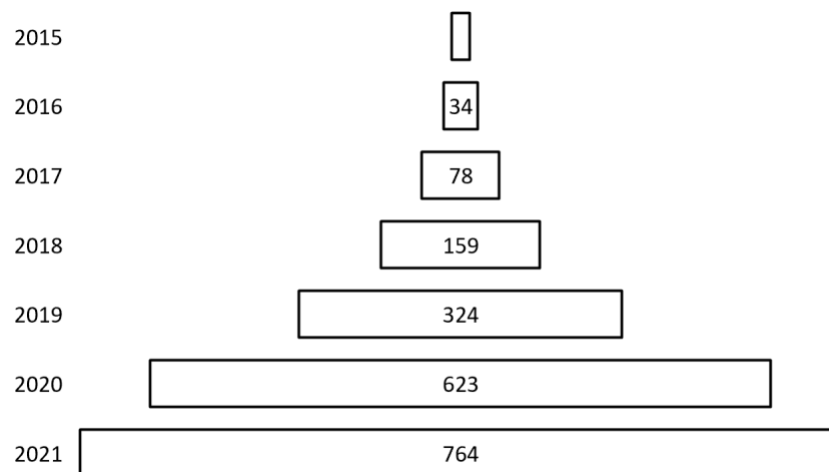


Figure 1: Annual publication of articles on Google Scholar as returned using search terms "Nature-Based Solutions" and "Public Health". Entry for 2021 is correct as of May 2021.

Nonetheless, an apparent skewed research focus on green concepts within NBS literature precipitated Hanson et al.'s (2019) caution of ‘stickiness’, whereby differing research communities and disciplines draw upon their respective, pre-existing theories when considering the implications of NBS. Bias thus exists, with the vast majority of literature on NBS retaining a focus on derivation of potential environmental benefits, rather than a suite of potential co-benefits, public health included, as is integral to the definition of NBS. Similarly, practical application of NBS appears subject to the same phenomenon, with Bloomfield (2017) asserting that environmental actors “might see...work in terms of potential ecological gain”, whereas “health professionals are liable to see...work largely or wholly in terms of health benefit to patients and reduced health costs”.

In endeavouring to understand the factions which may exist amongst the multidisciplinary lines of enquiry regarding NBS and socioecological systems more broadly, two concepts are often drawn upon in the literature: boundary and landscape theory. Boundary theory deals primarily with the boundaries which may exist between the political and scientific spheres, and amongst differing scientific communities (see Hanson et al. 2020). The need to strengthen the science-policy interface for ES, natural capital and NBS for “long-term human well-being and sustainable development” has been emphasised by both academia and bodies such as The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Pérez-Soba et al., 2018). The landscape approach seeks to integrate the natural and social sciences by encompassing derivation of both environmental and societal benefits from the biophysical landscape in a socioecological system, rather than focusing on environmental benefits alone (Angelstam et al., 2013; Westerink et al., 2017). Nonetheless, Potschin-Young et al. (2018) emphasise the wide uptake of the ES concept by researchers working at the interface of science and policy, particularly in cases where a real-world, problem-solving context is

required. The ES concept is considered a means by which NBS can have their benefits asserted and ‘mainstreamed’ in decision making, facilitating their potential to resolve societal issues (Potschin-Young et al., 2018). However, in light of the need for transdisciplinarity when implementing NBS, the tendency for silo working by actors originating from health, environmental, public planning and urban planning sectors and lack of capacity to overcome these factions, the establishment of transectoral arenas may be further required to support practical application of NBS, as discussed under Sections 2.7.4 - 2.8 in relation to GRx.

Finally, whilst the majority of literature focuses on potential NBS-derivable benefits and how these might be realised, criticisms exist that NBS as a concept, as per natural capital, may lead to “overemphasisa[tion of] a utilitarian perspective of nature which might promote [its] exploitation and commodification” (Albert et al., 2019; Nesshöver et al., 2017; Schröter et al., 2014).

2.5 Green Prescribing

Although nature-based therapies have existed for centuries, ‘green prescribing’ is an emergent concept, with the term having undergone popularisation in the literature relatively recently (see Robinson et al. 2019). GRx was first introduced as a public health intervention in New Zealand in the late 1990s, designed as a primary care scripting programme specifically aimed at increasing physical activity amongst sedentary patients and the general population (Gribben et al., 2000; Patel et al., 2011). During consultation, GP and patient would verbally discuss and set an action plan for increasing the patient’s physical activity, based on concrete targets specifying the frequency and duration of exercise to be taken (Gribben et al., 2000). A paper-based GRx was presented to the patient as a tool to “formalise and document mutually agreed exercise goals”, based on the expectation that a written reminder would elicit more effective exercise participation than verbal advice alone (Swinburn et al., 1997). The GRx further included a free-phone number by which the patient could contact a local Regional Sports Trust to discuss the exercise plan and seek support (Gribben et al., 2000). Whilst the scheme nowadays retains a predominant focus on increasing patient physical activity through programme assignment, it additionally focuses on dietary changes and considers potential mental benefits which can be garnered in addition to physical benefits alone (Manatū Hauora, 2020).

Elsewhere, GRx is considered a more holistic healthcare intervention with practitioners prescribing a range of nature-based activities to their patients, comprising therapeutic horticulture; biodiversity conservation; care farming (use of farming practices for health, socialising and education); green exercise (e.g. nature walks, biking, climbing); and wilderness arts and crafts (Robinson et al., 2019; Jepson et al., 2010; Bragg et al., 2017). Although postulated that GRx could be used as a treatment in itself due to its having potential to both proactively and reactively contribute to health care whilst “bringing important co-benefits”, the practice to date has largely been considered supplementary to conventional healthcare, with GRx typically being prescribed alongside more orthodox treatments (Blewett, 2018; Bragg & Leck, 2017; Robinson et al., 2020; Robinson & Breed, 2019). Indeed, Robinson et al. (2020) highlight that holistic medical interventions rarely focus on a singular aspect such as increasing an individuals’ access to nature, but rather on prescribing general changes in an individuals’ diet and exercise in order to minimise the attributable burden of relevant risk factors.

Green prescriptions, the forms they can take, the environments in which they can be applied and the people and health complaints to whom and which they can be applied make the system as a whole rather complex, and specific benefits difficult to decipher. This complexity and uncertainty of directly attributable evidence is a recurring theme within the literature and is cited as a major barrier to the uptake of GRx in practice (Bloomfield, 2017; Cohen-Cline et al., 2015; Robinson et al., 2020; Triguero-Mas et al., 2017). Specifically, major barriers are considered to

comprise: lack of understanding of the contexts in which GRx-derived benefits are most effective, lack of understanding behind the exact mechanisms which explain how exposure to outdoor environments may affect an individual's psychological and/or physiological health and lack of an interdisciplinary language, as is consistent with the aforementioned limitations of NBS more generally (Bloomfield, 2017; Robinson et al., 2020; Triguero-Mas et al., 2017).

A whole suite of potential health benefits are thought to be offered by nature-based health interventions, affecting both physical and mental health. However, lack of understanding of specific health benefits, the causal mechanisms behind each of these benefits and how each of these mechanisms may differ between individuals together all hamper understanding of the contexts in which GRx may be most beneficial and ought therefore be focused. As stated by Shanahan et al. (2019), “there is almost no guidance on how much or how frequently people need to engage with nature, and what types or characteristics of nature need to be incorporated...for the best health outcomes”. Nonetheless, examples of specific epidemiological health benefits which may be had on the individual include: elicitation of biophysical changes associated with lowered stress levels; improved immune functioning; increased activity of natural killer cells associated with combatting tumours and virally infected cells; improved cardiovascular functioning and reduced incidence of hypertension and coronary artery disease; improved functioning of the respiratory system and increased resilience to both respiratory diseases and allergies; decreased obesity and incidence of diabetes; reduced psychological manifestations of the modern-day “stress state” and “technostress”; increased mental relaxation, restoration and engagement of the “default mode” networks of the brain, which emerging literature considers may be important for peak psychosocial health; decreased incidence of depression and anxiety; and improved creative reasoning and cognitive functioning (Alcock et al., 2017; Astell-Burt et al., 2014; Atchley et al., 2012; Bielinis et al., 2018, 2021; Chun et al., 2017; Elsadek et al., 2019; Flies et al., 2020; Halonen et al., 2014; Hansen et al., 2017; Immordino-Yang et al., 2012; Kardan et al., 2015; Kim et al., 2015; Li et al., 2007, 2008; Li, 2010; Morita et al., 2007; Ochiai et al., 2015; Pretty et al., 2007; Song et al., 2015; Takayama et al., 2019; White et al., 2019). A large body of self-reported and anecdotal evidence which supports the pursuit of nature-based health interventions also exists amongst both academic and grey literature. Reported benefits include increased personal energy, good overall health, happier state of mind, increased mindfulness, improved cognition, more sense of meaningful purpose in life, and stimulation of feelings of “awe”, resulting in displays of gratitude and selflessness (de Bell et al., 2020; Douglas, 2021; Hansen et al., 2017; Sifferlin, 2016; White et al., 2019; Williams, 2016). Of note, whilst the majority of literature presented above pertains to health benefits associated with individuals' access to greenspace, similar potential public health and wellbeing benefits are acknowledged as being derivable from individual's access to large water bodies such as the coast, lakes and rivers (blue-space), despite this relationship being yet further, and disproportionately, underexplored (Grellier et al., 2017; Pasanen et al., 2019; Völker & Kistemann, 2011; Wheeler et al., 2012).

Reasons behind these observed and perceived benefits are similarly varied and also largely interlinked. As summarised by Atchley et al. (2012), a limitation of much research on nature-derived health benefits is that there are “multiple candidates” for the potential mechanisms which underly observed effects of nature-exposure on health, and whilst it may prove theoretically important to disentangle these reasons to “understand the unique influences of nature”, from a pragmatic perspective, these factors “are often so strongly interrelated that they may be considered to be different sides of the same coin”. Whilst lack of determination of precise impact pathways by which GRx might confer health and wellbeing benefits may increase difficulty in validating the practice, as discussed below, Robinson et al. (2019) further consider how within the realm of public health, social, biological and psychological determinants interact with one another to form a “complex bio-eco-psycho-social network”, hence any GRx-related activity is typically understood to have three founding features which work in unison: access to

the natural environment, a social context and opportunity for individuals to partake in meaningful activities (Figure 2).

Whilst some dispute the practical need to establish causality, a large proportion of the literature on GRx and nature-based health interventions more broadly nonetheless advocates for more empirical evidence which might aid in disentangling the relationship between nature-derived benefits and the mechanisms by which these are achieved. A number of comprehensive reviews have recently been undertaken which seek to synthesise extant data in order to consolidate the evidence base, such that this can feed into future research on, or practical application of, nature-based health interventions (see Flies et al., 2020; Franco et al., 2017; Frumkin et al., 2021; Hansen et al., 2017). Additionally, increasing experimental studies are being undertaken, exploring which specific benefits might be derived by who and in what contexts. These studies differ from previous work as generally place an emphasis on being longitudinal, comprised of larger cohorts and selecting for specific group health disparities. As summarised by Gehlert et al. (2010), the latter considers how race, sex, socioeconomic status, sexual orientation, and other group differences act as determinants of group health from the molecular to societal levels. Recent studies additionally take into account confounding factors such as how benefits may differ in landscapes with varying levels of vegetation complexity; in snow-covered environments; in institutional and organisational settings where people reside full-time for care or rehabilitation purposes; in urban areas in the Global South versus the Global North; in public versus private greenspace; and how ‘restraining factors’, such as a view of urban buildings in forest landscape matrices or the use of technological devices might impact derived benefits (Atchley et al., 2012; Bielinis et al., 2021; de Bell et al., 2020; Franco et al., 2017; Hauru et al., 2012; Labib et al., 2020; Moeller et al., 2018; Shanahan et al., 2016). Franco et al. (2017) further note a bias in studies to date, asserting that the majority focus on an individuals’ connection to nature as achieved via visual pathways, with the multi-sensory nature of potential benefits remaining largely underexplored.

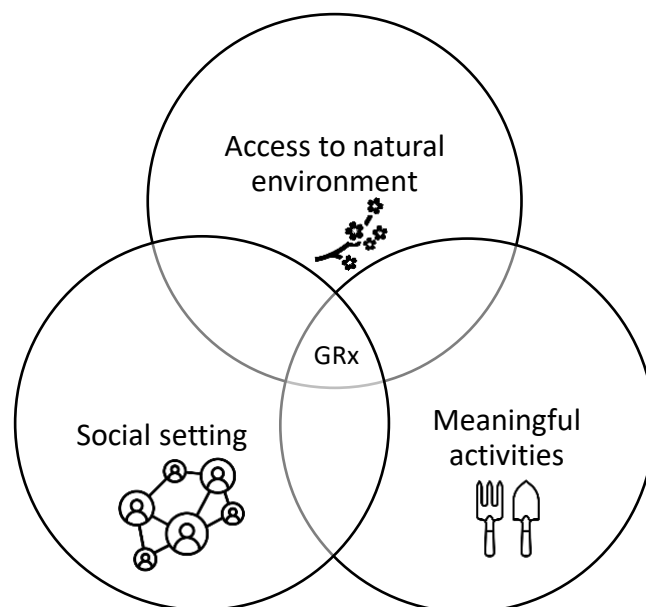


Figure 2: Founding features of GRx which are considered to work in unison: access to the natural environment, a social setting and the opportunity to partake in meaningful activities.

Finally, when considering how increasing academic and epidemiological evidence for nature-derived benefits might be used in practice, lack of collaboration between disciplines and actors is listed as a recurring constraint within the literature. Whilst the “urgent need” to promote future transectoral and transdisciplinary research is called upon in order to integrate the “critical

field” of environmental research and public health studies (van den Bosch et al., 2015; van den Bosch et al., 2017), lack of a common lexicon between actors involved is considered a major hindrance in both academic and practical settings. Robinson et al. (2020) conclude that the “ability to speak multiple disciplinary ‘languages’ is...an essential asset” for the effective establishment of GRx schemes, with Blewett (2018) further emphasising that “silo thinking is probably the biggest threat to delivering the best outcomes” of GRx. As discussed under section 2.8, conceptualisation of the practice as a CoBP’s common pursuit by may therefore have a role to play in integrating actors from disparate sectors in order to mitigate tendency for silo working.

2.6 Social Prescribing

Particularly relevant to the England GRx case study presented within this research, SPx is an example of a holistic public health intervention currently being practiced and advocated for by NHSE. Itself still a relatively novel concept, SPx is considered a key component of a move towards Universal Personalised Care and, when effectively implemented, sees referral of members of public to sources of practical and emotional support within the community via community groups and statutory services (Bickerdike et al., 2017; NHS England, n.d.). SPx is intended to support a wide breadth of people, including those: with long-term health conditions; who require support with their mental health; who are lonely or isolated; or who have complex social needs which affect their wellbeing (NHS England, n.d.). SPx and Universal Personalised Care are grounded on increasing recognition that individuals’ opportunity to actively shape the care and support which they receive has potential to lead to better health outcomes and experience, reduce health inequalities and lead to a reduction in reliance on NHS services (NHS England, n.d.; Personalised Care Group, 2019). Given the opportunity to improve patient health and wellbeing and reduce reliance on NHS services, a relatively large proportion of referrals originate from primary healthcare as SPx “provides GPs with a non-medical referral option that can operate alongside existing treatments” (Bickerdike et al., 2017). Referrals can however originate from a range of local actors across primary and secondary healthcare, social care, emergency services, housing associations, job centres, voluntary, community and social enterprise organisations (VCSE) and via self-referral.

Referrals are supported by SPx link workers, who communicate directly with the individual being referred on the basis of understanding “what matters to [the individual]” (NHS England, n.d.). In line with the NHS Long Term Plan, SPx link workers are “becoming an integral part of the multi-disciplinary teams” constituting Primary Care Networks (PCNs), are included in the Network Direct Enhanced Service Contract for 2020/21, and comprise additional roles in the five year framework for GP contract reform, hence NHSE committed to having “1,000 new [SPx link workers] in place by 2020/21” (British Medical Association, 2019; NHS England, n.d.; Primary Care Strategy & Group, 2020).

SPx link workers are further touted as supporting community groups’ accessibility and sustainability, facilitating the initiation of new community groups and working collaboratively with local partners involved in provision of SPx services (NHS England, n.d.). SPx is considered to legitimise community-based activities and support alongside medical treatment and, whilst the need for increasingly robust and systematic evidence is highlighted as per GRx, has received emergent evidence that it can provide a “range of positive health and wellbeing outcomes” for individuals, including improved quality of life and emotional wellbeing (Bickerdike et al., 2017; Centre for Regional Economic and Social Research, 2014; NHS England, n.d.).

2.7 Theories, Tentative Explanations and Conceptual Frameworks of Relevance

When considering realisation of the multiple benefits which have potential to be brought about by GRx, it is foreseeable that the necessity to consider efficacy of GRx implementation will

come to the fore, with efforts to date having been largely hampered by quality and quantity of available data (Labib et al., 2020). The literature below considers how the complexity and novelty of GRx may have reduced suitability of evaluation of the practice to date and further explores how, in combination with the acknowledgement that silo working and lack of a transdisciplinary language is considered a major hindrance to the effective implementation of GRx, the importance of understanding actors involved in the practice and how they engage and communicate with one another is a key building block which will in turn affect future efficacy of the practice and its implementation.

2.7.1 Complex Public Health Interventions

Typically accompanied by weak evidence to support their development and implementation, public health interventions are characteristically complex due to their targeting changes in population behaviour and health via implementation of “multiple interacting activities in a variety of settings” (Craig et al., 2008; Ogilvie et al., 2011). Ogilvie et al. (2011) therefore summarise repeated calls for improved evaluative quantity and quality of complex health interventions in order to facilitate their implementation from initial concept to dissemination of full-scale intervention packages applicable across a population. They further highlight that the evaluative process is itself complex and non-linear, with the evolutionary flowchart for typical complex public health interventions (see Appendix A), illustrating that both “in principle” and “in practice” evaluations are typically sought when considering the efficacy of public health interventions (Ogilvie et al., 2011; Nutbeam, 1998).

However, Bradford Hill (1965) and Nutbeam (1998) caution against undertaking an evaluative checklist, especially when an intervention remains in its relative infancy. In combination with Ogilvie et al. (2011), they highlight that premature evaluation may yield disappointing, unhelpful or misleading results, particularly if evaluative processes do not allow adequate time to pass for benefits to be realised and captured by the evaluation process. Instead, they highlight that evaluative opportunities evolve alongside the evolution of an intervention. Patton (1997) additionally indicates that learning opportunities occur during the evaluative process itself, with Horton & Mackay (2003) concluding that active participation of stakeholders in the process can have important and enduring impacts on actors’ knowledge, attitudes, skills and subsequent decisions and actions. Rather than approaching a public health intervention through the lens of an evaluative study based on checklists and the presumption of a linear process, therefore, evaluation can instead be used as a basis by which to ask questions and support the notion of an “iterative, bidirectional circuitry of scientific discovery” (Bradford Hill, 1965; Ogilvie et al., 2011). Horton & Mackay (2003) further highlight an increasing awareness that appropriately designed and executed evaluations which go beyond traditional evaluative methods such as economic impact assessment can “contribute substantially to institutional learning and performance improvement”. Although Horton & Mackay (2003) discuss the evaluative process relative to agricultural innovation, they nonetheless conclude that holistic evaluative approaches provide a potential means by which to foster organisational learning and change such that an understanding can be garnered of how policies and programmes may function and contribute to innovation.

2.7.2 Institutional Learning and Change

Institutional Learning and Change (ILAC) is founded on the premise that learning occurs amongst individuals within an organisation, and that to improve performance and move towards a common goal, a process of “deliberate and critical self-awareness...and an open culture of reflective learning” are required (Horton & Mackay, 2003; Watts et al., 2007). By engaging in evaluative enquiry and emphasising the need for reflective learning, ILAC provides an understanding of how organisations and their programmes interact with one another, what limitations may exist, and how programmes might be improved (Horton & Mackay, 2003).

Converse to 'checklist' evaluative methods, ILAC specifically advocates for examination of opportunities for change which can "direct changes in objectives, strategies and methods" (Watts et al., 2007). It is "fundamentally concerned with seeking out knowledge on what has...and what has not worked", to be achieved mainly through the detection and correction of errors and relying on "collective and collaborative reflection on experience" (Horton & Mackay, 2003). Consistent with the notion that evaluative processes of complex public health interventions ought not be linear but rather iterative, ILAC proponents consider that evaluation should be undertaken for learning purposes rather than being reserved for the point when conclusions and recommendations are reported on reaching project completion (Weiss, 1998).

As summarised by Watts et al. (2007), ILAC is based on input from a variety of disciplines, including sociology, institutional economics, action research, management science, education, systems research, innovation policy, capacity development, and participatory evaluation. Whilst many theoretical studies on organisational change undertaken during the turn of the millennium focused on the micro-perspective of "what went wrong" based on the perspective of internal actors, the majority failed to adequately take into account the macro-perspective which may explain what might be fundamentally flawed (Dayton, 2018). Furthermore, both a rational systems view and a natural systems view of organisations are explored within the literature, yet both consider the organisation to be a closed system, neither approach taking into account the impact of external factors. Thompson (1967) highlights how external factors are capable of heavily influencing the internal operations of an organisation hence calls for internal organisational structures to be created which are capable of deflecting deleterious external forces or leveraging beneficial external influences.

Whilst organisational change theory during the industrial era was grounded in the rationalist-positivist ontological paradigms of engineering, Dayton (2018) calls on the need for an ontological shift which is instead more appropriate for the knowledge era, characterised by the social exchange between humans. He proposes transition to a social-constructionist ontological perspective, which focuses on social organisation, knowledge and information exchange. This is consistent with Mendel & Scott's (2010) definition of a healthcare 'organisation', in which a multi-level approach to organisational change is adopted, encompassing field actors, institutional logics and governance mechanisms. Field actors are classed as individuals, for example, doctors and health administrators, but also as organisational models such as community acute-care hospitals, medical groups and health insurance groups. Institutional logics are considered to comprise the cultural frames and belief systems which create and shape the role of these actors and provide "routines and rationales" for the methods by which work is conducted. Governance mechanisms are recognised to support "regulari[s]ed control, whether by mutual agreement, legitimate authority, or coercive power, or some subset of actors by others" (Mendel & Scott, 2010). Through this approach, individual knowledge and communication between field actors enables analysis of mesocapabilities and networks whereas an appreciation of institutional logics and governance mechanisms promotes understanding of macro institutional arrangements (Swan et al., 2007), with resultant, relatively impermeable, professional and organisational boundaries being recognised as having potential to impede effective change, particularly in healthcare settings (Currie, 2006; Kislov et al., 2012).

Recognised that many purposes exist for conducting evaluations, Horton and Mackay (2003) consider two main motives to stand out: the first seeks to account for resources used and results achieved; the second seeks to generate knowledge which can be leveraged to improve decisions about policies, programmes and organisations. For the latter to be achieved, stakeholder interests and intentions require assessment (Horton & Mackay, 2003). Due to the complexity of public health interventions, and when considering complex adaptive systems as a whole, it is difficult to attribute impacts observed to specific research investments (Kuziemy, 2016; Pype et al., 2018). Indeed, Kuziemy (2016) considers a primary cause of healthcare intervention

failures to be attributable to failure to acknowledge the larger system within which ‘the task at hand’ operates, whilst Ekboir (2003) warns that it is “impossible to assign causality to just one variable” within a complex adaptive system, as outcomes are dependent on how actors and processes interact through multiple channels and feedback loops, both with intention and by chance. Dayton (2018) further highlights that within the field of organisational improvement, identical conditions which allow duplication of results are rarely, if ever, found from one organisation to the next, hence attempts to establish causation can be further complicated across different cases of intervention, as is the case for GRx across the United Kingdom, and efforts ought to therefore be focused on “establish[ment of] plausible links” rather than proving causation (Horton & Mackay, 2003).

Hall et al. (2003) further argue that the typically linear input-output assumptions of evaluative assessment have poor diagnostic power, particularly as this approach fails to provide critical institutional lessons. Instead, Hall et al. (2003) propose that an innovations systems perspective should be achieved through introduction of an analytical framework which “recognises systems of reflexive, learning interactions and their location in, and relationship with, their institutional context”. Whilst differing applications exist, innovation is broadly summarised by Ekboir (2003) as a new entity brought into an economic or social process. Lämsä et al. (2006) consider innovation to comprise three essential components: novelty; an application component; and an intended benefit, all of which are typically apparent within a healthcare intervention. As previously highlighted, the performance of an innovation, or intervention, is dependent on how actors within an innovation system interact with one another and within the wider system (OECD, 1999), with Contu (2013) further asserting that semantic, interpretative and epistemic differences amongst actors may affect knowledge creation and sharing in innovative practice.

Whilst the literature reviewed here largely advocates that explicit inclusion of institutional learning within a systems perspective approach offers a holistic approach to evaluation, Hall et al. (2003) nonetheless concede that a major challenge remains the requirement to contend with dominant evaluative paradigms which focus on measuring specific impact, typically economic.

2.7.3 Actor Oriented Approach

Although the above presented literature on ILAC and evaluation of complex public health interventions considers the benefits of pursuing a non-linear evaluative approach which focuses on reflexive learning of both individuals and organisations within an institutional context through ‘asking questions’ (Bradford Hill, 1965; Hall et al., 2003; Horton & Mackay, 2003; Ogilvie et al., 2011; Watts et al., 2007), Biggs and Matsuert (1999) consider that of five major areas of concern associated with planning, monitoring and evaluation approaches, one comprises the lack of systematic and usable methods for qualitative assessment. In order to ascertain the ‘research capability’ of an intervention, i.e. the reflection of skills, resources and network development which are integral to the long-term success of a programme (Biggs et al., 2001), Biggs and Matsuert (1999) developed an ‘actor oriented approach’ to intervention evaluation, a holistic approach which facilitates identification and structural understanding of major actors within an innovation system. Specifically, the actor oriented approach is concerned with the “productive collaboration and flows of information” between key actors (Biggs & Matsuert, 1999). As discussed previously, lack of a transdisciplinary language is cited as a major barrier for GRx, with Tsasis et al. (2013) summarising the importance of knowledge being shared across disciplinary boundaries when “bringing together professionals with conflicting paradigms rooted in differing subject or technical knowledge and professional experiences”. Lack of a systematic yet holistic evaluative approach to knowledge transfer within and across complex organisational settings is addressed by Biggs and Matsuert’s (1999) development of two analytical tools as presented in Figure 3 and Figure 4: an Actor Linkage Matrix (ALM) and Determinants’ Diagram (DD), respectively.

Due to the complex organisational settings of healthcare institutions, an actor-oriented approach has previously been drawn upon by academia to understand how actor networks might affect outcomes of innovative programmes (Papadopoulos et al., 2011). In taking an actor-oriented approach to public health innovations, both Mantzana & Themistocleous (2004) and Ratnapalan & Uleryk (2014) classify actors in categories. Mantzana & Themistocleous (2004) further classify these actors into two sub-sets, or dimensions: human actors and organisational actors. It should be noted that whilst Biggs and Matsaert (1999) propose that an ALM comprises actors listed down the rows and across the columns of the matrix, Mantzana & Themistocleous (2004) instead list the actors only across the columns and rather use the rows to consider benefits that the healthcare innovation (technological) may bring. As this research focuses on communicative capacity of actors involved in the GRx innovation, however, an approach is taken consistent with that of Biggs and Matsaert (1999).

2.7.3.1 Actor Linkage Matrix

The ALM provides a visual illustration of key actors involved within an innovation system, the flow of information between these actors and the “control and use of this information by different actors” (Biggs & Matsaert, 1999). By mapping out the current state of an innovation or intervention and allowing identification of key actor linkages and partnerships within a system, ALM increases transparency of “the assumptions and assertions that are often implicit in projects” and further provides a basis on which key areas for intervention can be identified (Biggs & Matsaert, 1999). Such an area for intervention which might be visualised through use of an ALM could be a weak information flow between certain actors which replanning of a project might endeavour to address, thus the matrix facilitates learning alongside project progression.

Actors or actor groupings are listed both down the rows (A, B, C etc.) and across the columns (1, 2, 3 etc.) of an ALM (Figure 3). Internal cells (A1, A2, A3 etc.) represent the flow of information which passes from the actor or actor grouping listed in the rows to those listed in the columns. The strength of information flows between actors is commonly represented by use of asterisks, with the higher the number of asterisks representing the higher the intensity of information flow. Areas of uncertainty are commonly illustrated with a question mark and a blank cell indicates that no communication pathway is considered to have been established from the horizontal to the vertical actor.

Actors	Actor 1	Actor 2	Actor 3
Actor A	Flow A1	Flow A2	Flow A3
Actor B	Flow B1	Flow B2	Flow B3
Actor C	Flow C1	Flow C2	Flow C3

Figure 3: Example of an Actor Linkage Matrix, as adapted from Biggs & Matsaert (1999). ‘Flows’ depicted in internal cells illustrate information flows established between actors or actor groupings, passing from horizontal to vertical actors.

2.7.3.2 Determinants’ Diagram

The DD builds upon the ALM. It provides a reproduction of information flows which occur between actors detailed within the ALM and guides the systemic analysis of why these flows occur (Biggs & Matsaert, 1999). Weak information flows identified during ALM development typically provide the focal point of a DD, such that reasons behind this observation can be more thoroughly considered. As depicted in Figure 4, an internal cell of the ALM features centrally within a DD and major influences on information flows which exist – or do not exist - between actors are illustrated, categorised as either weakening or strengthening factors. Areas for intervention can subsequently be determined.

Within the context of GRx, use of an ALM and DD in tandem provides a systematic means by which to explore actors involved in the practice and the sectors from which they originate;

intensity of information flows which exist between actors and their respective occupational communities; and potential areas for intervention which might facilitate enhanced implementation of the practice.

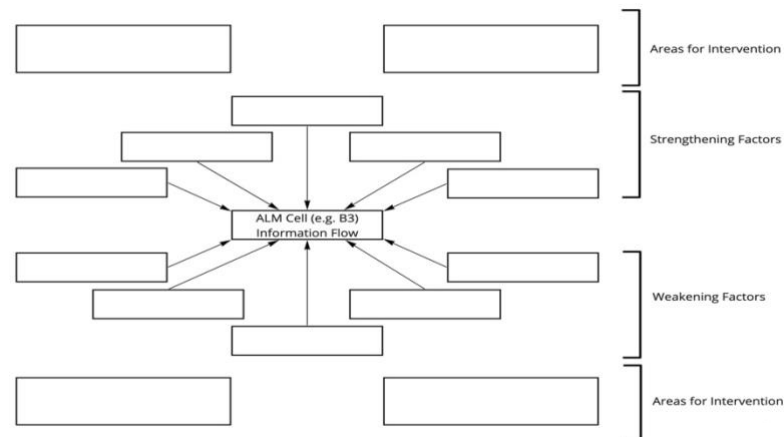


Figure 4: Example of a Determinants' Diagram, as adapted from Biggs & Matsuert (1999). An internal ALM cell acts as focal point around which strengthening and weakening factors and areas for intervention are depicted.

2.7.4 Communities of Practice

Blackmore (2010) introduces the theory of social learning when considering how multi-level and multi-stakeholder processes of interaction may “lead to concerted action for change and improvement of situations”, as is sought by both healthcare and environmental practitioners in the practical application of GRx. Whilst recognised that social learning may occur at different levels, from the individual to group, organisational to institutional and local to global, in attempting to understand how it might be systematically explored in complex systems, Snyder & Wenger (2010) propose Communities of Practice (CoPs) as an appropriate theoretical lens. CoPs are formed by actors who “engage in a process of collective learning in a shared domain of human endeavor” (Wenger, 2011). CoPs may arise either intentionally or unintentionally, with learning being the primary cause of a CoP coming together or rather an “incidental outcome of [its] member[s] interactions”, with Wenger (2011) further noting that whereas some CoPs are formally recognised and often supported with a budget, others exist on an informal basis, and some go unnoticed. Nonetheless, three aspects need to be met in order for a CoP to be called as such: a shared domain of interest which provides an identity for those actors involved; a community, in which actors build relationships, engage in joint activities and discussions, help each other and share information; and a practice (Wenger, 2011). As regards the last aspect, Wenger (2011) considers CoP members to be practitioners who, through sustained interaction over time, come to develop a shared repertoire of resources.

Sharing of practice, knowledge and identity are considered to create boundaries between CoPs, differentiating each community from the next, with opportunity to interlock with other CoPs resulting in formation of “complex social landscapes of practice” (Kislov et al., 2012). CoP boundaries are not typically considered to coincide with organisational boundaries, however “are often seen as a reproduction of professional boundaries” (Kislov et al., 2012). In a review of CoPs in the NHS, Ferlie et al. (2005) concluded that healthcare CoPs were typically uni-professional, highly institutionalised and sealed off to adjacent CoPs. Conversely, Kislov et al. (2012) found that in spite of epistemic and status differences, intra-organisational multi-professional CoPs successfully bridged professional boundaries within primary healthcare. Both however, conceded that ‘stickiness’ of knowledge across boundaries hindered innovation

spread, due to boundaries remaining relatively impermeable and knowledge sharing, collaboration and learning not transgressing equally to other actor groups.

Whilst epistemic communities surrounding GRx are yet to be realised, practitioners involved have potential to fulfil the definitional aspects of a CoP through sustained interaction and collective pursuit of a shared domain of human endeavour (Brown & Duguid, 1991; Ferlie et al., 2005; Kislov et al., 2012; Wenger, 1999). As such, CoP lends itself as a theoretical lens by which to explore GRx. However, inter-organisational stickiness has potential to allow perpetuation of silo working, undermining opportunities for knowledge sharing and therein effective implementation of GRx as an innovation.

2.7.5 Boundary Organisations

Given the transectoral nature of GRx, it is imperative that inter-organisational barriers to transdisciplinary knowledge sharing are overcome such that intrasectoral communities can be built and tendency for silo working be overcome. Each sector entails its own complexity, for example as per complex public health interventions addressed above, and each comprises its own lexicon and motivations, hence tendency of actors to operate within their respective disciplines and extant paradigms having potential to persist despite establishment of CoPs. It is therefore useful to draw upon Guston's (2001) concept of boundary organisations. Boundary theory was first devised to conceptualise the blurring of demarcations between science and non-science, particularly regarding environmental science and policy, hence lends itself to GRx based on the recognition that NBS and GRx work on the boundaries between different scientific and professional disciplines and sit at the intersection between these sectors and policy.

Whilst the above reviewed literature suggests that actors or networks associated with healthcare, political and environmental sectors, and public and urban planning are at present unequipped to deal with the complexity of GRx, inclusion of actors originating from each sector into a boundary organisation has potential to act as a bridging strategy, fulfilling the role necessary to facilitate implementation and operationalisation of the practice. Guston (2001) stipulates that boundary organisations are characterised by three criteria which allows their redressing of problems which may arise from working at the interface between different sectors: i) they involve participation of actors originating from each relevant sector in addition to actors who serve a mediating role; ii) they provide opportunity and sometimes incentive for the creation and use of boundary objects and standardised packages; and iii) they are situated “at the frontier of...two relatively different social worlds...but have distinct lines of accountability to each”. In respect to point two, Guston (2001) summarises the work of Star and Griesemer (1989) in stating that boundary objects “sit between two different social worlds...and can be used by individuals within each for specific purposes without losing their own identity”, and highlights that in some cases, organisations themselves may represent a boundary object. Standardised packages are considered more robust in that they are liable to change practice on either side of the boundary, for example, through incentivising cooperative research which benefits all actors involved regardless of which side of the boundary they lie (Fujimura, 1992; Guston, 2001).

By pursuing co-optation whereby representatives from “both sides” of the boundary are brought into the decision-making structure, boundary organisations are able to perform tasks and disseminate information useful to actors situated external to the boundary organisation, thereby forging links with each respective side of the boundary (Guston, 2001). Furthermore, as argued by Rip (1994), the multi-sectoral composition of a boundary organisation affords a level of independence which can be exploited entrepreneurially. When considering the novelty of GRx as a public health intervention, formation of a bridging organisation might increase capacity of relevant actors to work innovatively despite conserving links with their respective sectors. This is particularly pertinent to actors originating from public health systems which are characteristically highly regulated and institutionalised (Walshe, 2002). Despite promoting

innovation external to the traditional confines of each sector, the inclusion and collaboration of representatives from disparate sectors into a boundary organisation has potential to stabilise the system by successfully embodying and internalising external values which may originate from each sector (Guston, 2001). By facilitating collaboration and encouraging generation of boundary objects and standardised packages, boundary organisations provide an arena for co-production of inter-sectoral knowledge and social order (Guston, 2001; Jasanoff, 1996).

However, organisational theorists consider that effective collaboration can be difficult to achieve due to differing interests, goals and practices of those actors involved (O'Mahony & Bechky, 2008). It has been observed that divergent interests often influence the outcomes of collaboration at the intersection between science and medicine in particular (Fujimura, 1988; O'Mahony & Bechky, 2008; Star & Griesemer, 1989), as is consistent with the aforementioned tendencies of environmental actors to pursue ecological gains and healthcare actors to pursue health gains when considering both academic research into, and practical application of, NBS. Even in cases where all sides stand to benefit from the pursuit of collaborative practices, therefore, O'Mahony and Bechky (2008) highlight the importance of managing boundaries if all actors involved are to "preserve their disparate interests". Conversely, other boundary theorists consider that through creation of common standards, methods and objects, boundary organisations can be used to provide a "common structure [which] remain[s] flexible in interpretation", hence can be used intersectorally to produce common knowledge across differing occupational communities, regardless of intrinsically differing interests and respective embodied values (Guston, 2001; O'Mahony & Bechky, 2008; Star & Griesemer, 1989).

In alignment with O'Mahony and Bechky (2008), however, Wenger et al. (2002) consider that even when designed with flexibility and responsiveness to the environment in mind, organisational design remains somewhat prescriptive, not typically allowing "organic growth and aliveness", but rather focus on "creating structures, systems, and roles that achieve relatively fixed organizational goals and fit well with other structural elements of the organization". Amin & Roberts (2008) further emphasise the "frequently idiosyncratic and always performative nature of learning", including the context, process, social interaction, material practices, ambiguity and disagreement of learning arenas, and the importance of their not "being lost to formulaic distillations...and instrumentalist applications".

2.8 Conceptual Framework: Communities of Boundary Practice

Given the novelty and complexity of GRx as a practice, the uncertainty of how the Scottish and English GRx schemes might develop temporally, and the context specificity and intuitiveness of the learning process (Amin & Roberts, 2008; Hall et al., 2003), I argue that flexibility and opportunity for organic growth of, and by, those actors involved provides a key attribute for its effective and sustained implementation. Likewise, however, these actors must be able to effectively communicate across disciplinary boundaries to overcome tendency for silo working and increase capacity for establishing a common lexicon and shared resources. As such, neither CoP nor boundary organisations theory lend themselves wholly to the practice. I thus propose synthesis of a novel framework which includes key attributes of both CoP and boundary organisation theory, allowing knowledge transgression of inter-sectoral boundaries in addition to affording flexibility as the learning process progresses. Herein referred to as Communities of Boundary Practice (CoBP), a conceptual diagram is presented in Figure 5.

Incapacity of GRx actors to share knowledge transectorally despite formation of an early-stage CoP has potential to allow silo working to persist, as depicted in Figure 5 by closed borders for environmental and healthcare actors and respective outcomes, and the occurrence of 'weak information flows' between the two. Potential therefore exists for continued undermining of opportunities for learning and creation of shared resources, minimising realisation of mutual

health and environmental benefits. Establishment of boundary organisations may facilitate transectoral communication and collaboration, yet are typified by lack of flexibility, inadequately allowing for the idiosyncratic and highly context dependent nature of learning. Given the complexity, innovative status and the various lines of research which are currently being undertaken in the field of GRx, I argue that its ability to retain flexibility in practical application will comprise a key asset to its effective implementation and success. Requirement for flexibility is illustrated in the case studies drawn upon by this research, whereby both the Edinburgh expansion of the Scottish Nature Prescription Scheme and the seven TLSs which comprise the English GRx are characterised by their experimental status and intention to undertake learning in practice.

Actors' involvement in GRx and the information flows which they establish should thus be considered an open, complex system (as depicted by open borders for CoBP actors and GRx practice in Figure 5), which allows for accommodation of changes as reflexive and iterative learning is undertaken by those actors involved, including through development of institutional logics, shared knowledge and shared resources both inter- and intra-sectorally. Openness would further allow for integration of new knowledge originating from academic research in the field and from data produced as a result of the case studies considered in this research. It would allow for adaptation of the system as required, including transition of actors situated at the core of the system with those situated at the periphery (consistent with CoP (Wenger, 2011)), each bringing their respective knowledge and institutional logics, and also the responsive emergence of information flows between actors in their joint pursuit of a shared endeavour.

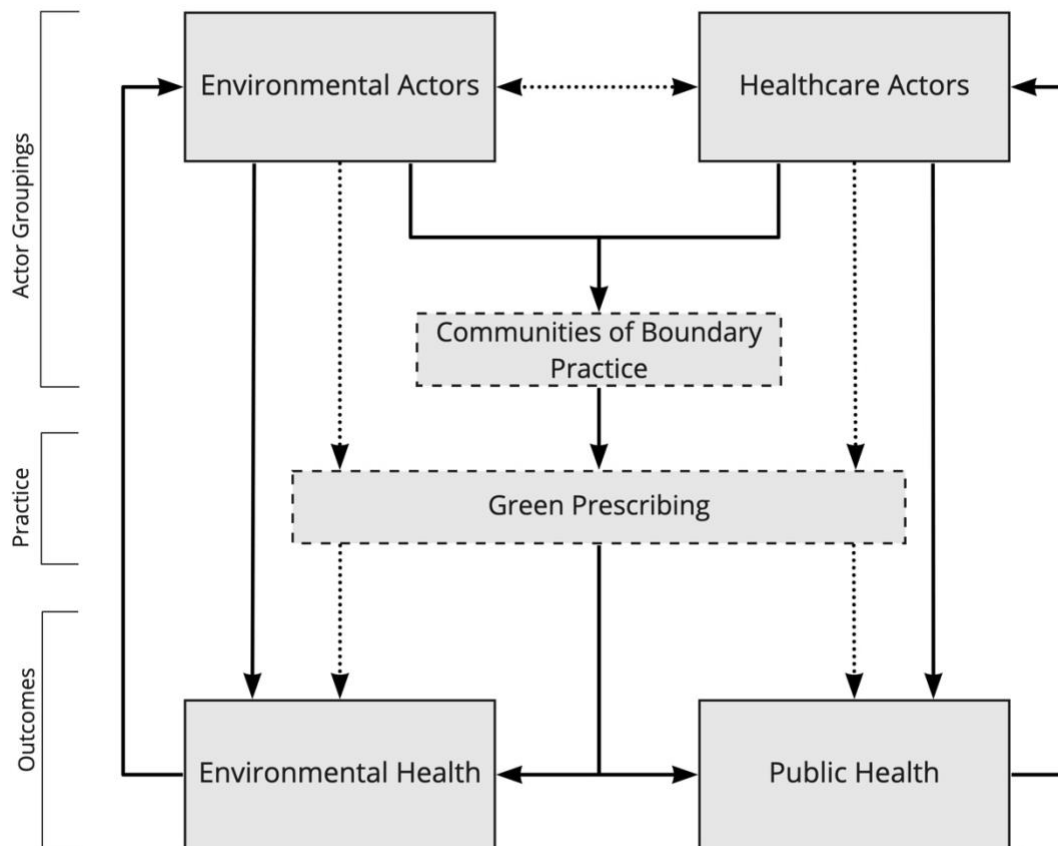


Figure 5: *Communities of Boundary Practice* conceptual framework, as devised by the author. Solid box borders depict closed systems whereas dashed borders depict open systems. Information flows are represented by arrows. Solid arrows depict strong flows whereas dotted arrows depict weak flows.

3 Research Design, Materials and Methods

3.1 Research Design

An interpretative, qualitative approach has been taken to this research. Semi-structured interviews form the basis for analysis as supplemented by review of grey literature as required. Methods used for data collection and processing are detailed below.

3.2 Methods Used to Collect and Process Data

3.2.1 Data Collection

Field actors contacted for interview were identified via snowball referencing, online search and, in the case of Shetland, personal contacts. A diagram of recruitment is provided in Figure 6 and further detail on the actors contacted including job role and organisation or sector which actors represent are detailed in Table 1 (Appendix B). Actors were contacted via email in the first instance and follow-up emails sent to prompt those from whom a response was not initially elicited. For GPs in Edinburgh, email addresses could not be obtained hence webforms were instead relied upon for three of five surgeries. The remaining two surgeries were deemed uncontactable. Due to privacy constraints, no potential users of GRx (patients/general public) were contacted during the course of this research. Data gathered relevant to this actor grouping was instead informed by that collected from actors presented in Figure 6.

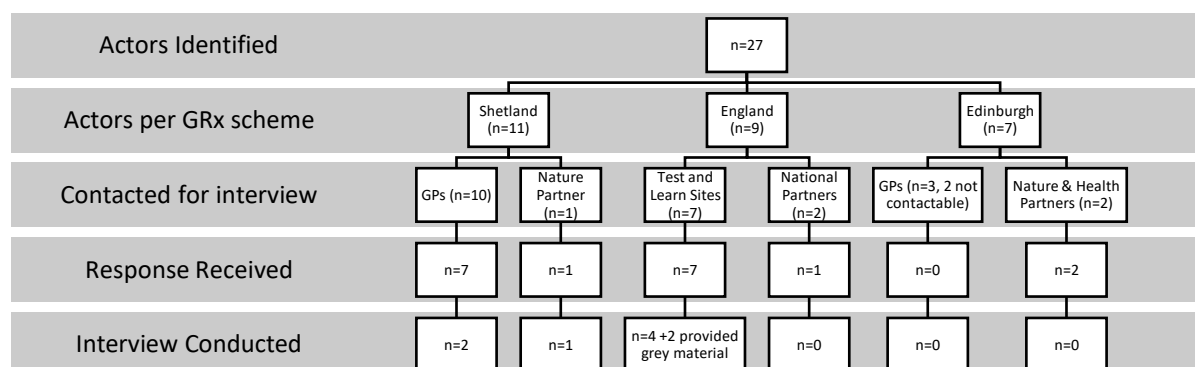


Figure 6: Actors identified and interviews conducted across each of the three geographic locations, Shetland, England and Edinburgh, respectively.

Of the Shetland GPs which accepted the invitation to interview, one was approached by the NBO during scheme set up; the other began their employment post scheme introduction, hence was not involved in its initial rollout. Of those Shetland GPs which did not accept the invitation to interview, actors cited lack of awareness of the Nature Prescription scheme and/or lack of a permanent GP at the surgery. One GP cited lack of time for interview. No actors from Edinburgh responded favourably to the invitation to interview nor was adequately detailed grey literature available. Data pertinent to the Edinburgh expansion of Scottish GRx as presented in Results and Analysis is therefore limited, and informed only by the Shetland NBO interviewee.

Of 62 bids put forward by English Integrated Care Systems (ICSs), Health and Social Care Partnerships (H&SCPs) or Sustainability and Transformation Partnerships (STPs) in response to the cross-governmental call for expressions of interest (EOIs), 14 were shortlisted and seven were successfully appointed as TLSs, covering the following geographic regions: Humber Coast and Vale; South Yorkshire and Bassetlaw; Nottinghamshire; Derbyshire; Greater Manchester; Surrey; and Bristol, North Somerset and South Gloucestershire. A representative from each TLS was contacted for interview, of which four TLSs accepted and a further two provided grey material in lieu of interview. Supplementary grey material was further provided by three of four

actors interviewed. Grey material comprised EOIs and 'TLS' internal documents, for example material developed for stakeholders. National partners appointed to oversee the scheme were also contacted for interview, however declined. These actors were NE, a non-departmental public body, and an NHS Green SPx team instated alongside trial rollout.

A semi-structured approach was taken to interviews. All interviews were conducted online via Zoom API Version 5.3.1 (Zoom Video Communications), recorded using the software's inbuilt recording feature and an audiofile per interview extracted for subsequent processing.

3.2.2 Data Processing

Each audiofile was processed via an online transcription service, Otter.ai. Resultant text was manually checked against the audiofile, amendments made as necessary and keywords extracted. Interview transcripts and grey material were imported into NVivo (Release 1.4). Following familiarisation, data was coded and subsequently grouped into themes. Deductive analysis was drawn upon, as informed by the research questions. Pre-determined themes focused on i) actors involved in each scheme (research question one) and ii) the information pathways considered to exist between actors (research question two). A semantic approach to analysis was taken.

Post coding and analysis, data was fed into ALMs as devised by Biggs and Matsuert (1999). One ALM was developed for the Shetland case study and a further one per TLS. Existence and intensity of information flows between actors as illustrated within the ALMs were informed by interview responses and grey material reviewed. Weak information flows were identified and subsequently provided areas of focus when developing DDs. Potential strengthening and weakening factors were fed into DDs, and areas for intervention highlighted. Whereas Biggs and Matsuert (1999) illustrate one internal ALM cell as the focal point of a DD, given the number of actors involved and commonality observed across the English TLSs, actor groupings between which information flows have potential to be improved were instead illustrated centrally to the DDs developed during this research, with indication provided of whether flows are uni- or bi-directional. Example is provided in Figure 7. Results generated provided basis by which to explore whether conceptualisation of GRx actors as a CoBP may work to overcome silo working (research question three), as presented in Discussion.

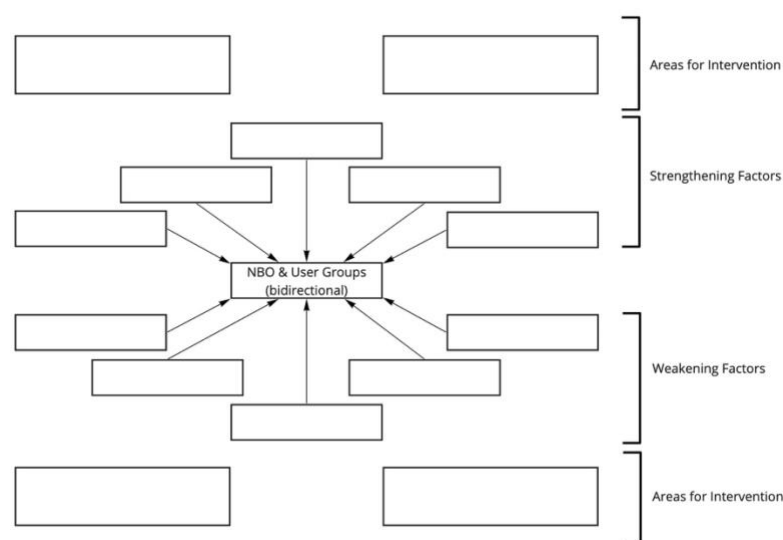


Figure 7: Example of a Determinants' Diagram as used within this research. Actor groupings involved in information flow being analysed provide the focal point, central to the DD, as accompanied by an indication of whether these flows are uni- or bi-directional. Adapted from Biggs & Matsuert (1999).

4 Results and Analysis

4.1 Actor Linkage Matrices

Sections 4.1.1 and 4.1.2 present information flows which are considered to exist amongst the actors involved in the Scottish Nature Prescription Scheme and the English Green Social Prescribing project, respectively. Each ALM presents the flow of information which is considered to exist from one actor or group of actors to another. Flows are not to be perceived as bidirectional, but rather should be considered unidirectional, flowing from the actors listed in the rows (A, B, C etc.) to those actors listed in the columns (1, 2, 3 etc.).

Information flows which are considered to exist are illustrated with asterisks. The intensity of flow is distinguished within the internal cells (A1, A2, A3 etc.), with a singular asterisk representing a weak flow and up to three asterisks representing stronger flows. A blank internal cell indicates that no communication pathway is considered to have been established from the horizontal actor to the vertical actor. Areas of uncertainty are illustrated with a question mark.

Beneath each ALM, supplementary text provides an explanation of the context in which these information flows are considered to exist and therein provides the rationale by which these flows have been identified as weak, strong and/or uncertain.

4.1.1 Scotland Nature Prescription Scheme

4.1.1.1 Shetland

Information flows which were identified to occur within the Shetland Nature Prescription Scheme are detailed in Figure 8. The three main actors involved in the Shetland Nature Prescription Scheme are the NBO, the general practitioners and the patients.

Identifier		1	2	3
	Actor	Nature-Based Organisation	General Practitioner	Patient
A	Nature-Based Organisation	***	**	**
B	General Practitioner	**?	**	**
C	Patient		*	*

*Figure 8: Actor Linkage Matrix: Shetland Nature Prescription Scheme. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.*

Having initiated the GRx scheme, internal communication within the NBO is relatively strong on Shetland (cell A1), with the individual who devised the scheme and their line manager working in close collaboration with one another. The representative of the nature-based organisation (NBO1) acknowledged that strength of flow is in part necessitated by the geographically isolated location of Shetland, with being “out in a limb in Shetland” having potential to discourage information flows between themselves and the main body of the NBO based on the Scottish mainland. This disconnect between Shetland and mainland Scotland was further evidenced as regards expansion of the scheme to Edinburgh, with NBO1 inputting “creative help...but apart from that, nothing to be honest”.

Information flows from NBO1 to GPs (cell A2) on Shetland were considered somewhat mixed by the different respondents and appear to have evolved temporally as the project has progressed. Due to the small geographical setting of Shetland, NBO1 was able to introduce the concept at a general educational meeting which occurred between NHS staff from general practice and the Shetland hospital and was further able to visit each GP sequentially at project initiation. However, it was noted that issues arose around making initial contact with all GPs in

the first instance and NBO1 found various receptions to the information. Initial understanding of the motivation behind the project differed between GPs who received information at project commencement. Some considered exercise to be the main health benefit to be derived from the project whereas others considered a connection to nature and mindfulness to be key components. Different interpretations of information exchanged during this flow were allowed by the NBO which took the notion that the primary importance was for GPs to engage with the project and that differing opinions might be reconciled “further down the line”.

Following initial project set up in which leaflets were disseminated to GP surgeries, information flows from the NBO to GPs have been relatively weak. A web-based ‘calendar of ideas’ which accompanies the leaflet is regularly updated with localised, temporally appropriate nature-based activity suggestions, but patients rather than GPs are target recipients of this information flow, as discussed below in relation to cell A3. Weak communication between the NBO and GPs has led to varied GP use of GRx, as evidenced by three of ten individuals contacted for interview citing that they had limited knowledge of the scheme, if any, and had not used GRx. Lack of internal communication amongst GPs and lack of consistency of individuals which exist within this actor grouping has further exacerbated limited knowledge of GRx, as explained further in relation to cell B2.

Information flows between the NBO and patients (cell A3) are primarily indirect. Through provision of leaflets to GPs, the NBO has set up an indirect communication flow between themselves and patients. However, this is dependent on GPs disseminating written material amongst the patient group, which has its own limitations as discussed in relation to cell B3. The information flow from the NBO to patients as afforded by the online calendar of ideas is again dependent on signposting via the leaflet and is similarly dependent on GPs facilitating this communication and also on the patient actively engaging with the project. As considered by GP1, dependency on the leaflet to facilitate this information flow acts as a barrier. Instead, it was proposed that a technological information flow might better facilitate communication between the NBO and the patient group as “everything is on people’s [mobile] phones now, their life is on their phone”. GP1 considered that the ability to text online resources directly to the patient would reinforce the information flow, whereas requiring the patient to actively search for relevant online material has potential to act as a barrier, “if you say to people ‘Go away and Google this...’, I don’t know how inclined people are to do these things”.

Little communication from GPs to the NBO was observed (cell B1). Those communication pathways recorded were dependent on initiation by the NBO. A qualitative review of the project was undertaken by the NBO at one of the GP surgeries following its implementation, but it was unclear whether the primary purpose of this review was to ascertain indirect feedback from the patient group rather than the GPs themselves. Nonetheless, information was received by the NBO from the GPs regarding personal preferences for disseminating GRx information to patients, with some GPs reportedly stating, “No, I just don’t like having leaflets in my room”, or conversely, “Ye[s], I’ll have that leaflet on my desk, no problem”. Other GPs reportedly expressed a preference for digitised communication flows, as is consistent with GP1’s account, above. Additionally, the NBO sought quantitative data on the progress of the project following its implementation by tracking total number of leaflets distributed through the same GP surgery from which the qualitative data was obtained. However, this data collection has now ceased and no other communication pathways from GP to NBO appear to be present.

There was evidence of some information flow amongst GPs (cell B2). However, several limitations appear to exist, particularly regarding lack of consistency of individual actors within this group. Whilst the whole spectrum of reasons behind this remain unclear, evidence suggests that a relatively high prevalence of locum GPs combined with the temporal nature of the information flow from NBO to GP has led to incomplete knowledge of the project amongst

the GP actor grouping, with three of ten GP surgeries contacted for interview citing lack of a regular GP having prevented implementation of the programme. Whilst not explicitly due to the presence of locums, a fourth surgery stated that they were “not aware of [their] GPs ever prescribing this programme”. Indeed, having not been party to the initial contact between NBO and GPs when the project first commenced, GP2 explained that they were “aware of [the project] through...news and social media” as opposed to through communication amongst colleagues. This disruption in communication flow amongst the GP grouping has further been exacerbated by Covid-19. As explained by GP2, “I think maybe with Covid[-19] we haven’t been....as in touch with other practices. We haven’t been meeting up in the same way that we used to so [are] maybe not getting the opportunity to discuss that kind of thing very much”.

Information flows from GPs to patients appear to be mixed (cell B3). GPs interviewed did not use GRx consistently with all patients but rather used it selectively as limitations allowed and as they perceived would be best received. Limitations noted were first and foremost, time, “consultation time is very precious”, and also the scheme’s reliance on GPs having to physically pass GRx-relevant information to patients. GP1 considered that patients typically were not receptive to receipt of a physical leaflet, expressing preference for an online resource, “I don’t really hand out leaflets on anything really...I would be much more inclined to text people a link [and] I recommend apps quite a lot to patients”. However, it was conceded that Shetland does not “have the IT capability...to do that”. GP2, conversely, perceived the leaflets favourably, “it is a nice thing to give to somebody as well as their prescription pack”. However, issues arose when GP2 considered accessibility to the leaflets within the surgery, “I remember having to look for them...when I was trying to prescribe this...and not finding them and having to get more ordered”. Reliance on physical dissemination of GRx information has further impacted frequency of patient referral to GRx as Covid-19 has resulted in “all...GP consultations [being] phone first and phone only”, hindering establishment of the information flow. GP1 considered that this limitation “makes it quite likely that [GRx referral] isn’t happening anymore”.

When selecting which patients to refer to the scheme, both GP1 and GP2 tailored use of the project to those patients who were being treated for low-level mental health issues such as anxiety or depression, asserting that they would “definitely put more emphasis on the outdoor benefits when...treating something to do with mental health”, whereas “if I am talking to somebody who is a bit overweight and who has high blood pressure or cardiovascular risk factors, I would tend to just say about exercise in general...I don’t really mind how they do it, [they can] go to the gym if that is what suits them”. Whilst GP2 explained that GRx was “a good addendum” to traditional prescriptions, neither GP had used GRx as a standalone prescription but rather introduced it “as part of a multimodal approach”. In the majority of cases, GPs appear to draw upon the project “when the opportunity presents”, noting that “it feels more natural to include [GRx] in just a general lifestyles measures conversation”. Nonetheless, GP2 asserted that for some patients, it appeared useful to have a structured, specific course of action to follow, as is included in the leaflet. This variation in receptiveness between patients was noted by both GPs 1 and 2, as emphasised by their being selective in which patients they initiated the information flow with. On first making use of the project, GP2 revised their use of the scheme, noting that some patients were not receptive to receipt of a GRx, hence individual learning was undergone and future information flows from GP to patient influenced. This is further considered in relation to cell C2.

Correspondence with those GPs or GP surgeries which did not make use of the GRx scheme suggested that their respective patients were not introduced to the scheme. One potential reason cited was that “there was this idea that [the scheme was] trying to replace conventional medicine”. There was a further suggestion that the number of GPs who did “test...the water with [GRx] in clinical practice” at the project’s inception “fizzled out quite quickly”, and that the scheme is “not something that is often or commonly used anymore”, hence information

flows from GP to patient have evolved temporally, reducing the scheme's potential for consistent use. A select sub-group of patients were therefore privy to GRx, with information flows being dependent on their respective GPs' inclination to make use of GRx, which in turn was dictated by GPs' own belief systems or perceptions of the patients' belief systems and their suitability or openness to being prescribed a holistic, nature-based approach to health improvement. As summarised by GP1, amongst other factors, provision of GRx is therefore determined by "perceived relevance to the patient...but that is all about doctor perception".

No formal information flow exists from the patient group to GPs (cell C2). As discussed above, some information flow regarding individual patients' receptiveness to GRx prompted GPs to be more selective when making use of the scheme in the future, however, it was noted that the opportunity for feedback to be given from patient to GP is scarce and that "people are just very polite with doctors so it is difficult to know what they're really thinking". NBO1 provided anecdotal evidence that some patients were aware of the scheme and themselves had approached their respective GP to ask for a GRx, "I hoped [my] GP would prescribe me nature". Whilst GP2 explained that GPs are "often not getting feedback from patients about specific things that we've been trying", GP1 did suggest that more qualitative evidence from the patient "would be helpful" in encouraging buy-in of both healthcare colleagues and government.

Data that fed into cell C3, pertinent to information flows amongst the patient group, is based on perceptions of the NBO and GPs. NBO described anecdotal evidence of patients discussing GRx amongst themselves, "that's how small Shetland is...we heard of people going along to the surgery hoping that they were going to be prescribed nature". Whilst media outlets have not been considered an actor in their own right in this analysis due to their not being integral to the project, NBO1 considered media coverage at the inception of the scheme to be paramount in establishing this information pathway amongst the patient group. NBO1 further discussed anecdotal implications of this, "media attention and the world's attention and everybody sort of having heard of it means it's easier for [GPs] to actually prescribe [GRx]".

Anecdotal evidence aside, an information flow is missing between the patient group and NBO. NBO1 acknowledged that "it is really hard to get...patient feedback", and recognised the need to complete a review of the project. However, the advance of Covid-19 has provided a limitation to this, "we were also going to put in an evaluation process in Shetland but nobody's going to their doctor's surgery at the moment, so there was no point in putting out anything in a waiting room for people to look at", as has patient confidentiality, "I just didn't want to go near it, you know? So [the NBO is] really just getting feedback from doctors".

4.1.1.2 Edinburgh

As highlighted within Data Collection, no interviews were conducted with actors involved in the expansion of the Scottish Nature Prescription Scheme from Shetland to Edinburgh. Grey literature available provided inadequate data on the actors involved and information pathways which have potential to exist. Lack of data is further illustrated by NBO1 stating that the Edinburgh expansion "is still at the pilot stage, so we can't release those materials or talk to doctors or things like that until that's fully reviewed and properly evaluated really".

Whilst it may be presumed that actors involved in the Edinburgh expansion might resemble those in Shetland due to the scheme being introduced by the same NBO, it is not possible to make inferences on information flows which might have potential to exist. Nonetheless, NBO1 was able to confirm involvement of an additional NHS trust in the implementation of the scheme in Edinburgh, consistent with those actors identified and contacted for interview during the course of this research (Table 1). Additionally, NBO1 confirmed that the Edinburgh expansion would follow a similar route to that of Shetland, with NBO1 providing "design and

develop[ment of] the materials and help[ing the scheme] run”, “but...the doctors are delivering it really”.

Despite information provided by NBO1, an Edinburgh ALM is excluded from this research due to overall data limitations. Any information flows which might otherwise be presented would be purely speculative on the part of the author.

4.1.2 England Green Social Prescribing

Information flows anticipated to occur within each of the six TLSs for which data was gathered are detailed in Figure 9 - Figure 14. Of note, common actors exist amongst each of the TLSs. Common actors and common information pathways which are therefore anticipated to exist across the TLSs are herein presented whereas those pathways which are specific to each TLS are discussed alongside their respective matrices.

Common actors across each of the TLSs comprise the eight actors responsible for cross-governmental project delivery at the national level; local actors responsible for site-level project delivery; and additionally user groups for whom GRx is intended to improve health, as identified by local leads. TLS user groups can be considered akin to the patient group within the Shetland GRx scheme.

Those eight actors who together constitute the project national leads, Department for Environment Food and Rural Affairs (DEFRA), National Health Service England and Improvement (NHSE), Public Health England (PHE), Department of Health and Social Care (DHSC), National Health Service Improvement (NHSI), Ministry of Housing, Communities and Local Government (MHCLG), National Academy for Social Prescribing (NASP) and NE are represented as a common grouping in row A in each of the following matrices.

Across each TSL, the local leads were comprised of an ICS, H&SCP or an STP, each of which amount to a partnership of H&SC organisations which exist across 'TLSs' respective regions. Although each TLS was led by one of each partnership type as required by the call for EOIs for the project, actors directly involved in bid development and submission varied between sites. At TLS2 in particular, an additional actor with charitable status was appointed to oversee bid development and implementation of the project at the regional level. Those actors which comprise local leads for each of the TLSs are represented in row B in the following matrices, and further information as pertinent to each TLS presented alongside their respective matrices.

Whilst it may be presumed that relatively strong internal information flows have potential to exist between and amongst national actors as will be necessary in facilitating collaboration and therein oversight of the programme, data to validate these information flows was not available, hence cell A1 is marked as uncertain across each of the following matrices. Dissemination of national-level information to local leads will further be required during implementation of the programme, however, data on this information flow was again not accessible from national leads. Data garnered from the TSLs, however, suggests that this information flow, although existent, might be considered relatively weak. Information regarding the evaluative process which is to be used for the duration of the project at the national level, for example, was yet to be communicated to TLSs as they transitioned from project set-up to project delivery. TLSs were therefore reluctant to finalise plans for evaluation at the local level.

It is not envisaged that national leads will communicate directly with other actors involved in the scheme, with dissemination of national level information instead being dependent on local leads and high-level communication channels such as online governmental press releases. Conversely, each 'TLS' local lead will feed information to national actors, with these information

flows being comparable across each of the TLSs and largely revolving around reporting and evaluation.

4.1.2.1 Test and Learn Site 1

Information flows for TLS1 are detailed in Figure 9. Targeted user groups are considered by TLS1 to comprise those recognised to experience health inequalities including minority ethnic groups, those recognised as living in deprivation and those identified as having additional needs.

Note that primary healthcare providers such as GPs are not listed within this matrix as a key, independent actor group. Rather, they are encompassed within a grouping which relates to professional referral of user groups to GRx more widely (row D). When considering the role of the H&SC sector within the GRx scheme, TLS1 particularly focuses efforts on leveraging existing networks rather than initiating new ones, with health, care and community actors as a whole being considered well posited to deliver GRx to the various user groups. SPx link workers are considered a key actor in the professional referral process, although TLS1 consider self-referral an important component of the scheme, such that individuals can access GRx directly, bypassing professional referral channels.

In response to the cross-governmental call for EOI, TLS1 sought input on bid development from circa 90 – 100 actors. Whilst some actors were specifically approached by the local lead, others put themselves forward as interested parties. Together, these actors spanned the H&SC sector, the environmental sector, community organisations, volunteer organisations, local governmental organisations and interested individuals from within the community. Actor involvement partially drew on existing local networks related to greenspace, however TLS1 recognised that previous discussions had rarely considered the connection between greenspace and health specifically and had therefore not resulted in cross-sectoral communication. TLS1 acknowledged that the prevalence of SPx within the region provided “a bit more of a framework” onto which GRx “can be added”, and whilst conceded that there was still “a lot of work” to be done, emphasised that use of pre-existing connections would facilitate GRx rollout. Through a series of workshops, the above outlined actors identified barriers to GRx which they anticipated may exist at the regional level. Of five main barriers identified, potential for a lack of systemic connection between the environmental and healthcare sectors was considered, originating from a lack of awareness, engagement and communication.

Recognising the need for an inter-sectoral, system wide approach to GRx, TLS1 have established a Green Health and Wellbeing Network into which actors can report, providing a means by which disparate information can be combined into a common information flow. Seven working groups have been established with the intention of reporting into the Green Health and Wellbeing Network. Each working group has a specific focus; is headed by a representative from each the environmental and H&SC sectors; and seeks to “encourage wide engagement from sector partners”, hence is comprised of a variety of actors. Similarly to those involved in bid development, the actors which constitute the working groups are comprised of over 100 representatives spanning the H&SC sector; district and borough level governance; environmental sector organisations; voluntary, community and faith representatives and individuals from the wider community. Focus areas of the seven working groups are: awareness and connection; self-referral and self-care; targeted and supported nature-based opportunities; training; community engagement, co-design and capacity building; and evaluation. Whilst recognised that a number of specific actor groups have been identified by local leads at TLS1 and that these will be responsible for instigating their own respective information flows (rows A and B; rows J – R), it is important to take into account the added complexity of information flows which will occur across the actor groupings through their inclusion into various working groups. For this reason, whilst actor-group specific information flows have been included in the below ALM, these have been preceded by the inclusion of the seven working groups to allow

identification of those cross-cutting information flows which have specifically been established to facilitate sharing of information amongst and between actor groups (rows C – I). Each working group is expected to feed back to the local lead, hence relatively strong information flows have potential to exist between these actor groupings (cells C2 through I2).

The ‘Awareness and Connection’ working group is specifically concerned with “bring[ing] the system together”, hence will work on “creat[ing] and strengthen[ing] connections between health, care and the green sector” and will have potential to establish strong information flows between governance, H&SC and environmental actors at the regional level (cells C2 – C14). The working group will be responsible for further developing the Green Health and Wellbeing Network and for overseeing development of an asset map of greenspace and GRx opportunities which currently exist across the region. The asset map takes the form of an online database, Commonplace, and is intended to act as a common resource into which other actors can feed and draw upon. By compiling information of existing opportunities, the map is intended to allow development of a baseline of existing opportunities, in turn allowing identification of GRx opportunities which develop as a result of the project and also providing an accessible platform by which GRx referrals – either via professional channels or via self-referral – can be made aware of what opportunities currently exist. By facilitating such system wide connection, TLS1 “hope that...communication, engagement and awareness [might] tak[e] place across the network”. TLS1 did however acknowledge that some uncertainty remains on how “we can develop a dialogue and collaboration between the SPx commissioners and policy makers, and also green commissions and policy makers” (J10 and 13; M10 and 13).

The second working group, ‘Self-Referral and Self-Care Opportunities’ will target user groups of GRx with the aim of increasing participation in pre-existing green SPx opportunities so that “residents are able to facilitate improvements in their own health and wellbeing [without] need[ing] to rely on formalised services”. This is to be achieved through developing exposure of both the project and of existing GRx opportunities through prompting and organising opportunities which originate from the environmental sector. Whilst the exact methods for communication remain unclear at present, it is envisaged that strong information flows will therefore exist from the actors involved within this working group to the various user groups (in particular, cells D17 and D18). NBOs and charities will in turn feed back into this working group via the Commonplace database, creating an indirect information flow from themselves through to user groups, particularly those of target groups and the general population (N17 and N18, respectively) .

Working group three, ‘Targeted and Supported Opportunities’, will further place emphasis on strengthening information flows to target user groups concerning GRx opportunities which are available (cell E17). To achieve this, the working group will develop specialised environmental sector opportunities which can be accessed by invitation only hence will rely on facilitating collaboration between those health, care and community actors which may refer an individual to a GRx opportunity (K15 – K18), NBOs which may offer these opportunities (N15 – N18), and individuals within user groups which might access these opportunities (rows O – R). Regarding the latter actor grouping, the working group will work to improve awareness and co-ordination of GRx opportunities, including that of green volunteering opportunities (O14 – R14). Due to the invitation-only nature of GRx opportunities considered by this working group, it is unclear whether these opportunities will be publicly listed on Commonplace, hence flows to the Awareness and Connection working group are listed as uncertain in the ALM.

Training and support will be offered to “green sector organisations and staff” by the fourth working group to facilitate NBOs’ “delivery of the broad range of green opportunities...to support health and wellbeing outcomes” (cells F13 and F14). A “kite mark” for GRx opportunities will further be developed by this working group such that an instantaneous

information flow can be observed by GRx prescribers via quality assurance of the specific opportunity (F11 and F12; N11 and N12). The Training working group will additionally develop recruitment, training and support models to enable potential volunteers to work across multiple nature-sites, hence a strong information flow will be established from this working group to the ‘whole population’ user group (F18) and in turn an information flow, albeit potentially weaker, will be established from the ‘whole population’ user group to NBOs (R14).

Bidirectional information flows will be sought by the ‘Community Engagement, Co-Design and Capacity Building’ working group, with a focus on the “development of user voice”. To facilitate the exchange of information between GRx service providers and user group actors, the working group will engage target communities through establishment of ‘friends groups’ and community nature hubs; pursue empowerment of community champions; and facilitate community co-design of both GRx activities and community toolkits. The working group will work to enable “community-led initiatives to meet community needs”, hence will strengthen information flows from the user groups to the H&SC and environmental sectors (rows O – R). Through prioritising community participation and ownership, GRx opportunities have potential to be better embedded into the community, aiding long-term sustainability of the project and continuation of GRx beyond the two year timeline of the project, hence will support work of the sixth working group (G6; O6 - R6). The sixth working group, ‘Sustainability’, will focus on drawing links between GRx, Natural Capital and Social Capital approaches. Particularly strong information flows are therein anticipated to be observed from this working group to the national leads, the Evaluation working group and environmental commissioners and policy makers (cells H2, H9 and H13, respectively; M2 and M7).

The seventh working group, ‘Evaluation’, will focus on capturing baseline engagement in, and uptake of, GRx with a particular focus on target communities, hence will rely on establishment of information flows from these actor groups (cells O9 – R9). The wider impact of greenspace and natural environments on health and wellbeing, “especially of those who experience [health] inequality, mental ill health and adverse impacts from Covid-19” will further be evaluated, and data obtained shared with regional and national networks (cells I1 and I2). Learning will be solidified into a “toolkit of resources”, such that future information flows can aid roll out and/or scaling up of GRx to other sectors and authorities. Evaluation will be used as a basis on which to seek additional funding following culmination of the trial period, hence will provide a key resource for the Sustainability working group (cell I8). Whilst exact methods of data collection and evaluation remain unclear at present, in part due to the aforementioned weak information flow from national to local leads, this process is anticipated to require input from the H&SC sector, environmental sector and user groups (cells J9 – R9).

Finally, particular note was given to the role that SPx link workers currently provide in SPx settings which will now extend to GRx. TLS1 recognised that SPx actors play a pivotal role in initiating and maintaining information flows between various actors. Link workers seek to understand what matters to the individual who has been referred to the scheme “through shared decision making, or personalised care and support planning”, hence provide a link from user groups to SPx providers, referrers and SPx commissioners, now to be extended to environmental commissioners and NBOs. SPx link workers further connect individuals within user groups “to community groups and agencies for practical and emotional support”, strengthening information flows within the user groups themselves, and they further “collaborate with local partners to support community groups to be accessible and sustainable and help people to start new groups”. Lack of clarity was available on who these community groups comprise.

Identifier		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Sector	Governance		Working Groups							Health and Social Care			Environment		User Groups			
	Actor	National Leads	Local Lead	1 Awareness and Connection	2 Self-referral & Self-care Opportunities	3 Targeted and Supported Opportunities	4 Training	5 Community Engagement, Co-design and Capacity Building	6 Sustainability	7 Evaluation	SPx Commissioners & Policy Makers	Health, Care & Community Actors (Referral)	SPx Providers	Green Commissioners & Policy Makers	Nature-Based Organisations	Existing SPx Clients	Existing Greenspace Users	Targeted Groups	Whole Population
A	Governance	National Leads	***?	**							*	*	*	*	*	*	*	*	*
B		Local Lead	**	***							**	**	**	**	**	*?	*?	*	*?
C	Working Groups	1 Awareness and Connection		***	***	**	**	**	**	**	**	***	**	**	***				
D		2 Self-referral and Self-care Opportunities		***	*	***	*	*	*	*	*	***	***	*	*	*	*	***	**
E		3 Targeted and Supported Opportunities		***	*?	*	***	*	*	**	***	***	***	*	***			***	*
F		4 Training		***	*	*	*	***	***	*	**	**	*	*	***			*	**
G		5 Community Engagement, Co-design and Capacity Building		***	**	**	*	***	**	*	*	*	*	*	**	**	**	**	***
H		6 Sustainability		***	*				***	***				**	*				
I		7 Evaluation	***	***	*				**	***	**	*	*	**	*				
J	Health and Social Care	SPx Commissioners & Policy Makers		**						***	*	*	*			*			
K		Health, Care & Community Actors (Referral)				**				**	**	*				**	**	**	*
L		SPx Providers			**	*	**			**	*	**				**	**	**	**
M	Env.	Green Commissioners & Policy Makers		**						***				**	*	*			
N		Nature-Based Organisations			***	**	**			**		**	**	**	**	**	**	**	**
O	User Groups	Existing SPx Clients						**	*	**	*	**	**	*	*	***	*	*	*
P		Existing Greenspace Users						**	*	**	*	**	*	*	*	*	*	*	*
Q		Targeted Groups						**	*	***	*	**	**	*	**	*	*	*	*
R		Whole Population						*	*	**	*	*	*	*	*	*	*	*	*

Figure 9: Actor Linkage Matrix: TLS1 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.

4.1.2.2 Test and Learn Site 2

Information flows for TLS2 are detailed in Figure 10. As per TLS1, TLS2 brought together a range of organisations when developing the bid in response to the cross-governmental call for EOIs. Circa 40 organisations were involved in bid development, including representatives from local councils; various tiers of the NHS and the wider H&SC network; voluntary sector organisations - including those associated with infrastructure services provision and those previously involved in SPx provision; and NBOs, including those previously involved with provision of green and blue SPx as well as ‘natural partners’ which operate at the local through to national level. At the time of interview, a total 140 organisations had contacted the TLS to provide input as the site progressed from project development to project implementation.

Converse to TLS1, the local lead overseeing bid development and project implementation has a charitable status. When developing the bid, an emphasis was put on TLS2 having a lead which originated from the voluntary sector rather than from the NHS. The majority of actors were cautious of the project appearing as a top-down NHS approach for fear of minimising the fact that green and blue SPx had operated within the region prior to implementation of this project. As summarised by the interviewee, “within green SPx and SPx as a whole, if we don’t get the resource and relationship right within communities and neighbourhoods, it doesn’t work”, hence this selection of lead actor at the regional level was considered paramount. In practice, the local lead (row B) will play a central role in aiding project delivery, particularly through establishing and facilitating strong information flows amongst the various local actors involved, “we believe in partnership and collaboration, so there’s a whole host of organisations that are involved”, hence “our small central team [will be] maximising all the resources that are there to us, in a collaborative way...we’re just oiling the wheels, making things work”.

Following bid submission, the local lead has maintained strong information flows with interested organisations, for example, via hosting update sessions. The lead has further focused on “building resources in the background”. A programme manager has been appointed and a steering group created which embodies a number of the actors above outlined (rows C and E, respectively). The steering group itself is led by a clinical lead (row D), a senior individual who has worked within the two mental health trusts which operate across the region. Although the programme manager will oversee operationalisation and implementation of the project and facilitate information flows therein, the clinical lead was specifically appointed due to their having extant communication pathways with mental health providers within the region (row G) as well as their being “hugely passionate about social prescribing”. Gaining the trust of mental health providers was identified as one of the potential main challenges to the project, hence the appointment of this particular individual to the role was considered key in strengthening communication flows, “we’ve got somebody who was trusted by those [mental health] partners and has worked with a number of the partners in the past” (cell D7). In addition to the clinical lead of the steering group, the inclusion of a representative from each of the six localities which are geographically encompassed within TLS2’s region has also been ensured, each of which are responsible for a lead SPx service in their respective localities (row M). These six representatives will also be tasked with entering and maintaining an online map of green and blue organisations present in their respective localities such that opportunities for GRx referral can be reliably accessed by prescribers. Information flows between extant SPx services which exist across the region should therefore be strengthened through inclusion of these relatively high-level actors, facilitating horizontal information flows (cell E13). Additionally, links will be strengthened between those services (M14), the healthcare actors responsible for referrals (cells G13, I13 and L13) and the NBOs which operate within these localities (rows M; O– R).

When considering the NBOs which operate within the region, these have been categorised such that resources can be directed to each service and expansion of respective capacities supported

accordingly. As can be seen in the ALM, these categorisations are ‘seed organisations’, ‘nurture organisations’, ‘blossom organisations’ and ‘pollinators’ (rows O – R). It is anticipated that information flows between these organisations and those actors overseeing implementation of GRx at TLS2 will vary both temporally and directionally. ‘Seed organisations’, for example, are considered those that are at an early stage of development, are not yet ready to accept referrals and require a relatively substantial amount of support (cells E15, K15, M15, O15, Q15 and R15). Information flows from TLS2’s leads would therefore likely be relatively strong at project rollout but diminish as the project commences and the NBO increases its operative capacity. ‘Nurture organisations’ are anticipated to require support and investment as regards administrative and safeguarding procedures (in particular, E16 and K16); ‘blossom organisations’ are anticipated to require less support (K17); and ‘pollinators’ are considered able to disseminate information regarding best practice amongst other organisations within the region (R5, R12, R13 and R21), particularly with less developed organisations which fall into the other categories (R15 – R17).

The charitable lead, programme manager and steering group will in combination determine a target group from within the population whom they will direct GRx efforts towards (row S). They plan to identify two target sub-groups, or “cohorts”, which will sequentially progress through the project during the first and second years of the project’s operation. By identifying two specific cohorts, it is envisaged that bidirectional information flows can be established, and cohorts can feed back into the system throughout their “journey” of green social prescribing. Areas of focus for information flows will consider where the individuals within the cohorts originate (understood as their state of health prior to embarking on the programme); what specific needs the individuals might have; how these needs might be delivered on the ground; and what benefits might be had by both those individuals who constitute the cohorts, and by those from the voluntary sector who are involved in operationalisation of the project (S3 –S5 and S21). In addition to identification and support of the two specific cohorts, the lead, programme manager and steering group will direct resources towards communities within the region such that additional capacity will exist for community-based referrals and referrals from the existing PCN (E20, G20 and H20).

In anticipation of evaluating the potential benefits of the project, actors overseeing GRx implementation in TLS2 have built communication pathways with several partners. Firstly, two local universities have been brought into the process with the intention of researching the mental health and wellbeing benefits which have potential to be conferred via green and blue SPx (row U). The potential benefits reaped by volunteers will be considered in addition to those observed by the “cohort” participants in the programme. In addition to garnering information, these academic partners also intend to provide additional learning locally, securing a bi-directional information flow (U2, U3, U5 and U13). Secondly, it is intended that a technological approach to evaluation of potential benefits will also be undertaken. The interviewee considered that a “number of different valuation tools” might be drawn upon, some of which are currently used from an SPx perspective. However, as per TLS1, evaluative methods for TLS2 are yet to be finalised as the site is awaiting input from national leads, “we are wanting to ensure that we connect into the national [approach] – we don’t want to do things twice...as soon as we know...what the learning partner is, and the evaluator, then we’ll be able to connect into it”. As per TLS1, therefore, information flows from national partners to regional partners appears relatively weak despite national partners holding meetings for attendance by the TLSs in combination (A2). As a result, evaluative information flows from TLS2 to the national partners is for the time being lacking solidification and some opportunities for cross-board collaboration potentially being missed (U1 and B1).

Identifier	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
	Sector	Actor	Governance						Health and Social Care				Voluntary		Environment						User Groups		Acade mia
			National Leads	Local Lead - Charity	Programme Manager	Clinical Lead	Steering Group	Local Councils	Mental Health Providers & Trusts	Primary Healthcare Providers	Acute Healthcare Providers	Clinical Commissioning Groups	Infrastructure	SPx Prescribers	SPx Providers (Green & Blue)	Natural Partners	Seed Organisations	Nurture Organisations	Blossom Organisations	Pollinators	Targeted Groups	Communities & Neighbourhoods	Local Universities
A	Governance	National Leads	***?	**																			
B		Local Lead - Charity	**	***	***	**	**	*	**	*	*	*	**	*	*	*	*	*	*	*	*	*	**
C		Programme Manager	*	***	***	***	***	**	**	**	*	*	**	**	**	*	*	*	*	*	*	*	**
D		Clinical Lead		**	***	***	***	*	***	**	**	**	*	***	**	*	*	*	*	*	*	*	*
E		Steering Group		***	***	***	***	**	***	**	*	*	*	***	***	**	***	***	**	*	**	**	**
F		Local Councils		*	**		**	***	**	*	*	*		*	*	*						*	
G	Health and Social Care	Mental Health Providers & Trusts			*	**	**		***	*	*	*		**						**	**		
H		Primary Healthcare Providers				*	*			**										**	*		
I		Acute Healthcare Providers				*	*																
J		Clinical Commissioning Groups				*	*	*	*	*	*												
K	Voluntary	Infrastructure		*	*		*						*		*		**	**	*				
L		SPx Prescribers					*		*	*	*		**	*						**	**		
M	Env.	SPx Providers (Green & Blue)			*		**	*					**	*	***	**	**	**	**	**	***	**	**
N		Natural Partners					*						*		*?							*	
O		Seed Organisations		*	*		**						*	*	**		***	**			*	*	*
P		Nurture Organisations		*	*		*						*	*	**		*	***			**	**	*
Q		Blossom Organisations		*	*		*						*	**	**		**	**	**		**	**	*
R		Pollinators		*	*		**	*					*	**	**	*	**	**	**	***	**	***	**
S	User Groups	Targeted Groups			*	*	*															**	
T		Communities & Neighbourhoods					*?															*	
U	Academia	Local Universities	*?	**	**	*	**	*							**	*	*	*	*			**	

Figure 10: Actor Linkage Matrix: TLS2 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.

4.1.2.3 Test and Learn Site 3

Information flows for TLS3 are detailed in Figure 11. The local lead for TLS3 is a regional H&SCP which represents a total 37 organisations, comprising H&SC organisations and ten local authorities which operate within the region. In addition to the H&SCP, circa 40 further organisations were involved in co-production of bid development, each lending their signatories to bid submission. Key actors included representatives from the public and mental health sectors; voluntary organisations and existing networks, including those associated with provision of infrastructure services and provision of nature-based activities; private sector organisations; and academic partners. Several actors spanning H&SC and the environmental sector were previously involved in a regional Natural Capital Task and Finish Group (row Q), providing “really good infrastructure...that [TLS3] could build on”. Additional to these key partners, TLS3 highlighted extant strong local partnerships, “both within individual localities and also across [the region] as a whole”, particularly so with the voluntary sector.

The TLS3 local lead will oversee project implementation at the regional level and facilitate information flows from regional to national partners (cell B1). Their work will be heavily supplemented by a steering group (row C) which is largely based on an existing group network which, in its previous capacity prior to bid development, was specifically concerned with regional SPx. It entailed active participation from relevant SPx actors in addition to representatives originating from each of the ten localities (rows D- I). The extant “mature and thriving social prescribing system” which covers the city region will provide the groundwork on which GRx will be leveraged. The interviewee considered the region to be the first city region across England to have a ubiquitous SPx structure which is integrated into primary healthcare through use of a digital SPx platform (row T) for ease of use by healthcare actors (row F). Scaling up of GRx across the region aligns with local plans, policies and programmes in that it is considered “an essential element” in linking the strong SPx network, reducing health inequalities and addressing the region’s acknowledged climate and ecological emergency by drawing upon the region’s “vibrant VCSE sector [which delivers] diverse, localised and inclusive nature-based activit[ies]”. In seeking a “whole system approach” to GRx, TLS3 intend that all publicly funded services across the region will use an SPx approach to connect individuals with support in their community.

Two major components will run simultaneously throughout project duration. The first will concern support and evaluation of region-wide initiatives as facilitated through creation of a central team comprising actors from the H&SCP including the SPx regional facilitator (row B), the regional learning coordinator (row G), a project manager (included in row C), a personalised care GP clinical champion (row F) and representatives from both the population health and mental wellbeing teams (rows J and K, respectively). Together, these actors will supplement the aforementioned, pre-existing SPx Steering Group and will be chaired by the SPx regional facilitator. Both the SPx regional facilitator and learning coordinator are integrated within the regional and national SPx network (rows H and I) and “are therefore ideally placed to share learning and outcomes from...[TLS3]...nationally”. Although outside the direct scope of this research, integration of TLS3 SPx actors into national SPx networks would likely strengthen information flows from regional to national level. Presence of the bolstered Steering Group will facilitate information flows at the regional level between actors directly comprising the Steering Group in addition to peers in each of their respective sectors (cells C2 – I11). The central team will further draw upon information flows provided by the second major project component, as detailed below. In combination with input of these information flows, the Steering Group will “pick up the wider things...like training, resources [and] linking stakeholders”. The second major component concerns appointment, support and evaluation of five extant, voluntary nature-based projects in the region (row R), which are themselves expected to act as TLSs from which cross-regional learning can be garnered. They have a majority focus on piloting activities

such as food growing schemes with deprived communities and schemes to support provision of education and activity kits to promote exercise in natural environments. They seek to identify and fill gaps in existing schemes by trialling what types of nature-based activity might engage disinterested and/or excluded social groups. Representatives from each site will together comprise a Programme Oversight Group which will supplement the Steering Group, facilitating information flows from user groups and themselves (cell U18) to the central team (in combination, cells U3 and R3, respectively). By feeding information from the Programme Oversight Group to the region-wide Steering Group, it is intended that a community perspective can be afforded to the scheme, “it’s not something you can centralise...[the region] is so diverse...it has to be done in the community if you’re going to get to people”.

It is unclear exactly who will comprise the user groups targeted by GRx within the region (row U) and how these groups will be targeted, however, the bid indicated that the scheme intends to engage cohort groups which experience high levels of health inequality and social deprivation; Black, Asian and minority ethnic (BAME) communities; communities disproportionately impacted by Covid-19; individuals living with disabilities; and those embedded within mental health prevention and recovery (the latter of which is particularly pertinent to row K). Whilst important to recognise that information flows which may exist between user groups and other actors represented in the ALM may vary at a more granular level in practice, high-level information flows between relevant actors can nonetheless be fairly assuredly ascertained. Whilst the interviewee considered GP referral to GRx, it was also discussed that the scheme intends to support referral capacity of alternate actors, “referrals come from a variety of sources, most come from GPs, or somebody in a practice, but... anybody [i]s free to refer... any other professional can refer. And a lot of our schemes also accept self-referrals if people want to refer themselves on in that way”. Further detail on self-referral was not clarified, hence information flows between user groups and NBOs are marked as uncertain (cell U18). Regarding GP referrals, the scheme will leverage existing digital infrastructure in place across the region, whereby a digital SPx referral system is integrated into GP surgeries’ computer systems. Existence of this mechanism as afforded by the private sector (row T) has potential to facilitate information flows from user groups, through GPs (cell U6) and to SPx link workers (row I) who are able to initiate direct information flows with the user (cell I21) and also establish indirect flows between the user and service provider (cell U18).

Recognising that “the vast majority of...schemes [already in place across the region] relied on community input...[and] were actually run by community...grassroots organisations”, the interviewee placed an emphasis on community engagement, with the bid mirroring that TLS3 actors “were very, very keen to make sure that the voluntary sector was...represented at a high level”. Of four key project aims, one was to promote volunteering, social action and increased capacity of the wider VCSE sector, hence would strengthen information flows amongst and between actors represented in rows L - O. Again, whilst unclear how information will be disseminated amongst these actors and the wider GRx scheme (particularly the Steering Group, hence cells L3 – O3 are marked as uncertain), it is important to note that flows will draw upon relatively strong existing networks. The regional VCSE sector, for example, already has an appointed Leadership Group, and the BAME VCSE Network is comprised of circa 1,300 sub-groups. TLS3 intends to strengthen partnerships with the private sector by engaging landowners in increasing greenspace availability for GRx (cell C19), and also with academia (cell C21). Of two universities to be engaged with the project (row V), one has a pre-established SPx hub, data from which feeds into a GRx sub-group which was established in 2013 under a Local Nature Partnership (row P), comprised of the H&SCP, private sector, academia and environmental sector representatives, hence information flows amongst these actors are considered relatively strong. Following successful allocation of TLS3 as a national test site, it is intended that the partnership will feed into the Steering Group, ensuring that “representatives of key partners, as well as local pilot sites...are included in the governance and supervision of the project”.

Identifier			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
	Sector		Governance				Health and Social Care								Voluntary				Environment			Private		Users	Acade mia
		Actor	National Leads	Local Lead	Steering Group & Project Manager	Local Authorities	Primary Care Networks	Primary Care Providers	SPx Commissioners	SPx Providers	SPx Link Workers	Population Health Programme Board	Mental Health Programme	VCSE Leadership Group	Infrastructure	Natural Environment Activity Providers	BAME VCSE Network & Leaders Group	Local Nature Partnership	Natural Capital Group	Nature-Based Organisations	Landowners	Digital SPx Partner	User Groups	Local Universities	
A	Governance	National Leads	***?	**	*																				
B		Local Lead	**	***	***	**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
C		Steering Group & Project Manager	*	***	***	**	**	**	**	**	**	**	**	***?	*	**	***?	**	*	**	**	*		*	
D		Local Authorities		**	***	**	**	*	**	**	*	**	**	*	*	*			*	*	*				
E	Health and Social Care	Primary Care Networks		*	*		**	**	*	*	*	*									*				
F		Primary Care Providers		*	*		*	**		*	*	*							*		**	**			
G		SPx Commissioners		**	***	**	**	*	***	***	**	**													
H		SPx Providers		**	***	**	**	**	***	***	***	**	**	*	*	*	*	*		*		*			
I		SPx Link Workers		*	**	*	**	**	**	***	***	**	**	*	*	*	*	*		*		*	*		
J		Population Health Programme Board			*		*	*	*	*		**	*												
K		Mental Health Programme			*		*	*	*	*		*	**												
L	Voluntary	VCSE Leadership Group			***?				*	*			**	*	*	**			**			*			
M		Infrastructure			*?					*			*	*	*	*			*	*					
N		Natural Environment Activity Providers			***?					**			*	*	*	*	**	*	*			*	*		
O		BAME VCSE Network & Leaders Group			***?					*			**	*	*	*	**			*			*		
P	Env.	Local Nature Partnership		*	**						*	*	*		*	*	**	*	*	*	*	*			
Q		Natural Capital Group		*	**	*	*		*	*		*	*	*	*	*	**	**	*						
R		Nature-Based Organisations (Programme Oversight Group)		**	***				*	**	*	*	**	*	**	**	**	*	*	***			***		
S	Private	Landowners		*	*	*							*	*	*	*	*		*	*			*		
T		Digital SPx Partner		*	*		*	*	**	**	*	*	*		*		**	*	*		**		*		
U	Users	User Groups						**		**			*		*	*			***?			*			
V	Academia	Local Universities		*	***			*	*		*	*			*		**		*		*		**		

Figure 11: Actor Linkage Matrix: TLS3 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.

4.1.2.4 Test and Learn Site 4

Neither an interview nor the bid submitted to the cross-governmental call for EOIs were made available by TLS4 upon request. In lieu of these materials, an information sheet was presented by the site representative. From this, the data presented in the following text and ALM (Figure 12) is drawn. Due to the brevity of information available for analysis, a cautionary approach is taken in interpreting the information presented below.

The regional STP (row B) delegated bid development and submission to a “well established” SPx Advisory Group (row E) which was present in the region prior to the call for EOIs. Leveraging this pre-existing network, the SPx Advisory Group co-ordinated input of disparate regional actors into bid development. A cross-sectoral bid was submitted, comprising actors from local authority; the public H&SC sector; and nature-based charities and organisations (rows D and F – J). As illustrated in the ALM, whilst specific actors involved in bid development and submission are clearly identified in the material provided, full representation of the breadth of actors is not provided, in that the material alludes to input originating from “...other Health & Social Care commissioning organisations” (row I).

Following successful allocation as a TLS, a local lead, evaluation lead and communications lead have been appointed at site-level. Each of these individuals originate from those actor groupings involved in bid development. Together, these individuals span the health and the environmental sectors, as are based in the region’s Clinical Commissioning Group (CCG) and a “nature for wellbeing hub” Community Interest Company which operates within the region (hence are represented in rows F and J, respectively). A project manager was further recruited, considered to be “key to the success of the project” (row C).

At the time of receipt of the material provided by TLS4 for this research, TLS4 was uncertain what further actors might be involved in the project as it progresses from project development to delivery, “over the set up period we will bring in additional organisations and partners....and then get involved in delivery”. TLS4 highlighted that they were to “receiv[e] support from the national organisations involved in the programme” as the project transitions to its delivery phase (cell A2), and through the publicly facing information sheet, encouraged actors to register their interest should they wish to be “update[d]/engage[d]...as the project develops”. It is unclear exactly what actor grouping this sentiment targets, for example individuals within the community or NBOs, nor is it clear whether the information flow which might subsequently be established would be bidirectional or rather would constitute dissemination of top-down information. User groups to be targeted by GRx across the region are further not detailed, nor the routes by which they might be referred to the project or by which their participation in, and benefits garnered from, the project might be evaluated, hence these information flows are marked as uncertain (cells B1, G11, H11, J11, K2, K10).

Identifier		1	2	3	4	5	6	7	8	9	10	11
	Sector	Governance				Health and Social Care					Env.	Users
	Actor	National Leads	Local Lead	Project Manager	Local Authority	SPx Advisory Group	Clinical Commissioning Group	Regional NHS Foundation Trust	Regional Community Health Services	Other Commissioning Organisations	Nature-Based Organisations	User Groups
A	Governance	***?	**									
B		***?	***	**	*	**	*	*	*	*	*	
C			**	***	*	**	**	*	*	*	**	
D			*	*	**	*	*				*	
E	Health and Social Care		**	***	**	***	**	**	**	*	**	
F			**	**	*	**	***	**	**	**	*	
G			*	*	*	*	**	**	*	*		?
H			*	*	*	*	**	*	**	*		?
I			*	*	*	*?	**	*	*	*		
J	Env.		*	**		*?					*	?
K	Users		?								?	

Figure 12: Actor Linkage Matrix: TLS4 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.

4.1.2.5 Test and Learn Site 5

Actors and information flows for TLS5 are detailed in Figure 13. The local lead for TLS5 is an ICS. The interviewee considers their ICS “quite NHS driven at the moment”, as it comprises CCGs from each of five localities across the region, including acute and mental health trusts and also “broader partners...who all support health and care”, including local authorities and the voluntary and community sector.

As explained by the interviewee, the TLS5 region has a “really strong track record of SPx” and “really great SPx services, and whilst [actors] were already doing what you would recognise as green and blue prescribing, [they] weren't calling it that and weren't having explicit conversations about green and blue, it was just all SPx, you know, with a range of diverse offers”. The trial GRx scheme is therefore seen as “a huge opportunity to build on the strengths of what [the region] already had in place”, with “huge ambition and huge interest and lots of excitement about it”. TLS5 has an established SPx stakeholder steering group (row J) which “has been meeting for a few years”. Whilst recognised by the interviewee that the SPx steering group has gaps as regards the actors represented, they nonetheless considered that the steering group encompasses key partners including SPx commissioners and voluntary sector organisations (rows K and N, respectively). Of note, the interviewee highlighted how prior to national investment which arose following publication of the NHS Long Term Plan (2019), different SPx commissioning services were present across the region, “all [of which] look[ed] a little bit different”. A CCG or local authority (rows E and F) would tend to commission an SPx service which would subsequently be led by the voluntary sector (row N; cells E14 and F14) which was therein largely responsible for leading on SPx developments and for “tend[ing] to employ the link workers who drive referrals” of individuals to SPx (cells N13 and M19). This would likely require information flows to be established from link workers and user groups to primary healthcare actors and vice versa, but as was not explicitly stated as such by the interviewee, the relevant cells (M8, R8, H13 and H19) have been marked as uncertain. As regards GRx specifically, the interviewee emphasised the need to “make connections across what is quite a complex system” and gave particular mention to the need to involve PCNs into the scheme. Whilst a general practitioner who acts as clinical director in one of the region's PCNs and was branded a “real national advocate of SPx” sits within the SPx steering group, the interviewee considered that “a comprehensive representation of primary care networks in...steering group meetings” is still lacking, hence relatively weak information flows are considered to exist between these actors (cells G10, H10, J7 and J8). A total 30 PCNs exist across the region, hence the interviewee considered an increase in their engagement with the scheme warranted “a big consideration to think about”. The interviewee conceded that “clearly, GP referrals will be a big feature of [GRx], but...how broad we can go is the bit that we haven't defined”.

During bid development, the local lead was approached by actors from the health sector and from both green and blue environmental charities. Whilst some had previously been involved in SPx “in some way”, the interviewee highlighted that these actors had typically not been privy to “more central conversations about” SPx to date or were entirely external to existing SPx provision. Of those environmental charities which came forward during bid development, some offered the input of existing services which they offer and others enquired how they could adapt their current practices and services to support GRx provision. At the time of interview, the local lead was “working through what all of the partner connections might be”, hence it is important to note that the specifics of those actors included within the ALM might be subject to change, as might the strength and direction of anticipated information flows.

Following allocation as a TLS, TLS5 developed a GRx-specific Task Group (row C) which brought together actors from the SPx steering group in addition to additional actors “who were interested in supporting the ambitions” of TLS5. Whilst noted that the GRx Task Group

membership shares “a lot of commonality with the steering group”, the local lead put emphasis on “think[ing] about what is specific and unique about the GRx programme and who [they] need to involve in that”. The GRx Task Group is tasked with keeping oversight of the programme, considering strategic direction and identifying strategic links between actor groupings. To date, the group encompasses actors from public health (cells F3 – H3), but with an emphasis on recruiting actors from mental health trusts (cell I3) to support the scheme’s mandate to “make a direct connection between mental health and wellbeing...[and the] environment”; a prominent regional H&SC actor; SPx lead providers and employers of SPx link workers; housing federations and PCNs from across the region; one local authority representative; and representatives from the environmental sector and academia. A pre-existing ‘neighbourhood-based model’ in one of the region’s five localities sees representation of circa 15 neighbourhood leads by an umbrella body which additionally sits amongst the GRx Task Group. As regards engagement of local authority (row E), the local lead cited engagement of only one representative to date “who is a very strong leader in this space”, but highlighted TLS5’s intention of establishing further connections with relevant authority representatives (cells E3 and C5). Mention was given to representation from the environmental sector, yet only one major actor was specifically cited (row Q). This actor is considered a “key partner” as they “...are going to be doing a lot of the programme delivery and...really influencing all of [TLS5s] thinking on all of [the scheme]”. Similarly to TLSs 3 and 4, a local university will aid regional evaluation of the scheme and feed into national evaluation work (cells T1 – T3). Academic evaluation of the scheme is to be developmental and take a systems perspective “alongside the national evaluation”, however, as per the other TLSs, TLS5 was not yet informed of the national-level evaluation framework to be used, hence information flows from national actors to the local lead and academic partner are considered somewhat weak (cells A2 and A20). TLS5 nonetheless expected to “aim to influence” national evaluation development, which would strengthen links from the regional to national levels (cells B1 and T1). Converse to the other TLSs, TLS5 has additionally engaged a physical activity strategic lead (row P), “because of the connect with just being more active in outdoor space”. Underpinning the work of the Task Group, a project team comprised of actors from public health, mental health, the environmental sector and SPx will further provide support.

Whilst the GRx Task Group as a whole is concerned with establishing strategic links between actors, the local lead has specifically brought in an individual who has capacity to “help...navigate where there [are] some connections”, specifically as regards identification of investment and political opportunities which exist in the region and are pertinent to the scheme. By means of example, the interviewee was aware of an active travel programme and a woodlands creation programme which, if leveraged, might provide opportunity for mutual benefit creation across the region. Additionally, the interviewee emphasised the need to introduce actors who have “lived experienced” of nature-derived health and/or wellbeing benefits into the scheme (row R), such that user experience could inform project development, stating “...to me, it's really important that we have that perspective, and that that influences what we do. But it's important to get it right”. Due to the emphasis placed on “get[ting] it right”, the local lead at the time of interview remained in the process of i) identifying an individual, or individuals, suitable for this role, “...not to just simply invite someone to come to a meeting that doesn't, you know, isn't a great experience”, and ii) exploring how these user perspectives might most effectively be embedded into the project, “...so I don't know what that will look like yet. It might be that we hear those experiences and those perspectives through the co-design work, or it might mean that we want to do something much more formal and invite people to the meetings”. Due to lack of clarity surrounding the role of the individual(s) who might provide input here and how this input might be formulated, relevant information flows have been marked as uncertain (in particular, cells R2 – R4; R14, R15, R17, C18 and D18). Regardless of the route taken as regards both of these points, however, the interviewee highlighted that “...that, again, is something that we want to co-design”.

TLS5 have identified user groups to which regional GRx provision will be tailored. Firstly, TLS5 will leverage the capacity of existing environmental charities where “the connection [pathway just] needs to be made” in order to provide universal access to GRx across communities within the region. Secondly, four cohort groups of specific socio-demographic characteristic have been identified based on perceived needs, particularly those which have occurred as a result of, or been exacerbated by, Covid-19. These four cohorts will comprise: BAME communities, young people, clinically extremely vulnerable individuals and deprived communities. Recognising the large geographical area of the region relative to the “size of the programme”, the latter user group is to be targeted via identification of “pockets of neighbourhood deprivation” and matched with GRx projects which exist at a similar level. Exact mechanisms by which target groups might be engaged with GRx were neither discussed by the interviewee nor included in supplementary grey material, hence clarity is missing on how information flows might be established between GRx users, prescribers and providers (universal offering) and also on how information flows might differ between prescribers and providers and specific user groups. Due to lack of clarity and distinction in information flows to specific user groups, these actors are portrayed as one actor grouping within the ALM (row S) and information flows with relevant actors are marked as uncertain (in particular, cells N3, O3, N19, O19 and H19).

Despite lack of clarity on how user groups might be engaged in practice, two important information flows were nonetheless highlighted by the interviewee. Firstly, the interviewee detailed data collection which had occurred external to the scheme but fed into its development. Resultant information flows concerned the ‘BAME communities’, ‘young people’ and ‘clinically extremely vulnerable’ target groups specifically, as identification of these actors having potential to benefit from GRx were informed by i) a separate body of work pertinent to regional BAME communities’ relatively low participation in SPx generally as compared other sociodemographic groups (cells S10 and J3); ii) data collected by the regional authority regarding “high youth benefit claimants, big impacts around employment and...that there’s...a growing mental health issue for younger people” as a result of Covid-19 (cells S5 and E3); and iii) anecdotal evidence that clinically extremely vulnerable individuals have “been deconditioned through the pandemic [and] are less used to going out and being around people”, with “some people...reporting at Covid[-19] vaccination sites that they just haven't been leaving the home at all” (cells G3 and H3). Secondly, the interviewee highlighted TLS5’s intention to support voluntary sector provision across the region, primarily via allocation of microgrants and establishment of a Green Network (row D) which will “be an opportunity for all stakeholders who want to support the ambitions of the programme to come together, develop relationships, share learning, maybe do a bit of a deeper dive into topics of interest”. At the time of interview, it was unclear what actors would be involved in the Green Network and in what capacity, “we don’t know yet, we want to co-design that with those people”, hence no information flows to or from the Green Network have at present been recorded in the ALM aside with actor(s) with lived experience, which are indicated as uncertain (cell D18 and R4). Regardless, the interviewee explained that launch of the network would be a “a way to start the conversation”.

The aforementioned nature-based charity is to co-design a training programme for SPx link workers, facilitating information flows between these actors (cells Q13 and M17). However, it is unclear what other actors will be involved in programme co-design, hence further potentially relevant information flows have not been illustrated in the ALM. The “wider workforce across H&SC” will subsequently be targeted, “to help people understand what GRx is; to be able to advocate and champion that with the people who [they] come into contact with; [and] maybe apply it to themselves as well...[through] maybe think[ing] about the benefits for...their personal health and wellbeing”. Information flows would therefore be strengthened between the NBO and the wider H&SC network (cells Q6 – Q12 and F17 – M17) and also amongst actors within the H&SC network as individual learning has potential to occur.

Identifier		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Sector	Governance					Health and Social Care								Voluntary			Env.	Users		Academia
	Actor	National Leads	Local Lead	GRx Task Group	Green Network	Local Authorities	Clinical Commissioning Group	Primary Care Networks	Primary Care Providers	Mental Health Trusts	SPx Steering Group	SPx Commissioners	SPx Providers	SPx Link Workers	Voluntary offering SPx	Voluntary not offering SPx	Regional Sports Foundation	Nature-Based Organisations	Lived Experience	User Groups	Local University
A	Governance	National Leads	***?	**																	*
B		Local Lead	**	***	**		**	**	*			***	*	*	*		*	**			*
C		GRx Task Group		**	***		**	*	**	*	***	**	**	*	**	*	**	**	*?	*	*
D		Green Network																	*?		
E		Local Authorities		*	*		**	*			*	*		*						*	
F	Health and Social Care	Clinical Commissioning Group			**		*	***	**	**	**	*	*	**	**			*			
G		Primary Care Networks		*	*		**	***	**	**	*	*	*	*				*			
H		Primary Care Providers		*	*		*	**	**	*	*	*	*	*?				*	*	*?	
I		Mental Health Trusts		*	**		*	*	*	***	*	*	*	*				*	*	*	
J		SPx Steering Group		***	**		*	**	*		***	***	***	***	**			**			
K		SPx Commissioners			*		*	*	*	*	**	***	**	***	**			*			
L		SPx Providers			**		*				*	**	**	**	**			*	*	*	
M		SPx Link Workers			**		*	*	*?	?	*	*	**	**	**			**	**	**	
N	Voluntary	Voluntary offering SPx			**		*	**	*			**	**	**	**				*	**	
O		Voluntary not offering SPx			*											*		*		*	
P		Regional Sports Foundation		*	**		*										**	?	*	*	
Q	Env.	Nature-Based Organisations		*	***		*	**	**	**	**	*	**	**	*?	*?		**	*?	*?	
R	Users	Lived Experience		*?	**?	*?									*?	*?		*?	*		
S		User Groups			*				*?	*?	*		*	*	?	?	?	?		*	*?
T	Academia	Local University	**	*	**															?	**

Figure 13: Actor Linkage Matrix: TLS5 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.

4.1.2.6 Test and Learn Site 6

Information flows relevant to TLS6 are illustrated in Figure 14. Data presented is drawn solely from TLS6's bid submitted to the cross-governmental call for EOIs, hence may lack some granularity as opposed to had an interview also been conducted. Whilst SPx is considered "well established" across each of the region's 18 PCNs (row G) and a strong SPx network is considered to exist within the region (row L), TLS6 considers their current offer of GRx to be "in its infancy,...inconsistent,...and not focussed into those areas of greatest need". However, the multi-faceted benefits of GRx are recognised within the region, with the bid stating that the practice provides a "key element of...offer for communities"; "support[s TLS6's] efforts to improve mental wellbeing"; "aid[s TLS6's] response to climate change"; and is capable of helping "frontline professionals and...community partners to understand the local resources [TLS6 has] and how to access and benefit from them". Successful allocation as a TLS is therefore hoped to "firmly establish health and nature as a golden thread across [TLS6's] health and care offer", as offers the required impetus and capacity for a systematic approach to scaling up the practice across the region. Development of a comprehensive governance structure, as outlined below, has facilitated collaboration of H&SC actors with environmental actors as a means by which to "fully embed" GRx across the regional health and care system.

Although the regional STP (row B) submitted TLS6's bid, a CCG (row F) will lead coordination and implementation of the project and will have accountability for reporting to national partners in addition to a Mental Health and Wellbeing Programme Board which is overseen by an STP Steering Group (cells F1, F2, F8 and I2). The CCG will co-chair a GRx-specific body, Thriving with Nature Project Board (row C), alongside an extant regional Nature Partnership (row 15) and an SPx Lead, strengthening information flows between these actor groupings (cells F3, F11, F15, C5, C11, C15, L3, L5 and L15). The Nature Partnership itself is cross-sectoral, encompassing actors from local and regional authorities, utility companies, primary healthcare, academia and environmental non-governmental organisations, charities and organisations which operate at the local through to national level, with bidirectional information flows existing amongst these actors. Both a Nature and Health Strategy Group and a Health Practitioners Network Community Interest Company further sit under the Nature Partnership, the latter of which has been established to "support the development of a regional approach to green SPx through linking practitioners and projects, funders and commissioners, and health and environmental professionals...[and to] support smaller providers to develop and deliver professional, locally valued and sustainable services beyond the end of the 'test and learn' pilot, facilitating grassroots development of service provision". For ease of interpretation, these two entities and the information flows which they are considered to generate are included under the umbrella Nature Partnership in the ALM. To date, the Nature Partnership has provided tools such as asset mapping to social prescribers and link workers such that blue and green activities which are available within the region can be easily identified (cells P11 and P12). The Nature Partnership is therefore considered by TLS6 to be integral in providing a direct and essential link between the health and "the wider environmental sector".

A Prevention and Health Inequalities Working Group (row K) will facilitate information flows from the Thriving with Nature Project Board to the Mental Health and Wellbeing Programme Board (cells C8 and K8) and therein the circa 60 partners of which the Programme Board is comprised, including actors from public H&SC, SPx, the voluntary sector, academia, equality leads, lived experience leads and representatives from a regional SPx Working Group and a Building Healthier Communities Board. The STP Steering Group, into which the Programme Board will report (cell K2), is co-chaired by a senior representative of each the regional Mental Health Partnership Trust (cell K9) and the local authority (K4), and itself reports to the STP Executive Board on which Chief Executive Officers of the regional H&SC organisations sit (cells B5, B6 and B8).

As regards community partners, the VCSE sector (row N) is detailed as “offer[ing] extensive green health support”, and considered a key project partner. The VCSE and environmental sectors having previously “established effective green health programmes” (cells N16, N19, Q16 and Q19), the STP is engaged in developing a “one team” approach, particularly as regards community mental health, which is to draw together actors from H&SC, pharmacies, social prescribers, the VCSE and also peer support. Resultant mainstreaming of green support and its delivery through community-led approaches is intended to “encourage and support people to take up green offers”, strengthening information flows from service prescribers and providers to users. In addition to increasing universal access to GRx (row T), the local lead intends to target socio-demographic groups which are considered to have highest potential benefits to be garnered from GRx. User groups will in particular comprise BAME communities (row U), communities living in deprivation and the “older population” (both encompassed within row T, as explained below). Sub-groups are to be created which will focus on each of these user groups, bringing together community, health and environmental partners in addition to individuals with lived experience. BAME communities will be engaged in co-designing plans with an extant BAME Network of “pan-STP reach” (in particular, cells O19, O20 and U14), such that existing projects can be built upon and “culturally appropriate support” be provided, further linking into a system race equality partnership which is chaired by the region’s Deputy Mayor (cells O4 and U4). Of note, the bid acknowledges “senior level support” for the project, “including from...political leaders” (facilitating flows from cells E2 and E3 to B4 and C4, in particular). The exact mechanism by which individuals within areas of deprivation and the older population demographic will be engaged with GRx remains unclear, hence these user groups have been compiled into one actor grouping and relevant information flows are marked as uncertain; these uncertainties feature some overlap with those identified for BAME communities where specific detail is not present. The older population demographic is nonetheless touted as entailing “working with community partners” such that issues of loneliness and isolation as identified by “community-led research and engagement” can be ameliorated (cells V12 and V13). Whilst exact referral pathways pertinent to GRx remain unclear, TLS6, as per TLS3, has recently engaged a digital SPx platform (row R) which will inform information flows between primary healthcare and SPx opportunities more broadly. The platform provides the ability for primary healthcare providers (GPs) to make SPx referrals (cells H11 and H12; H16, L16, M16); record information pertinent to SPx in patients’ digital notes (cell T7); and access an online service directory as upkept by local authority (cells Q11, L4, E7).

Together, a close connection between community, health and environmental partners is intended to “strengthen integration between different sectors and enable opportunities to spread GRx to be noticed and acted upon”. Reflexive learning is to be undertaken as the project progresses. An emphasis is to be placed on action research and bringing various stakeholders “together in relation” such that learning can be gained “through every phase of this project”. A common outcomes framework which had previously been rooted in the region’s SPx scheme will be utilised and learning will further be enhanced through collaboration with local academic partners (row X). The STP will continue their pre-existing “strong research and evaluation focus” through forging partnerships with two local universities (cell B22). The data generated will in turn be fed to both local and national partners (the former of which is detailed further below, the latter of which is illustrated in cell X1), such that “high levels of awareness of the impact of this work, and commitment to progress further” can be ensured. In particular, academic learning will be communicated with the aforementioned Thriving with Nature Project Board (cell X3), regional Mental Health Programme Board which takes a systems perspective on “how inputs in one part may affect outcomes in another” (cell X8), and with partners comprising the Nature Partnership and local green practitioners’ network (cell X15).

Identifier			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	Sector		Governance				Health and Social Care								Voluntary		Env.		Private	Users				Academia
		Actor	National Leads	Local Lead & STP Steering Group	GRx Thriving with Nature Board	Local Authorities	Clinical Commissioning Group	Primary Care Networks	Primary Care Providers	Mental Health Programme Board	Mental Health Trusts	Prevention & Health Inequalities Working Group	SPx Network	SPx Link Workers	VCSE Actors	BAME Network	Regional Nature Partnership	Nature-Based Organisations	Digital SPx Partner	Lived Experience	Whole Population	BAME Communities	Areas of Deprivation & Older Population	Local Universities
A	Governance	National Leads	***?	**																				
B		Local Lead & STP Steering Group	**	**	**	**	**	**	*	**	**	*	**	**	**		**	*	*	*	*	?	?	**
C		GRx Thriving with Nature Board	*	**	***	**	***	**	*	***	**	***	**	*	**	*	***	**		*		*	*?	**
E		Local Authorities		**	**	**		*	*								**					?	?	
F	Health and Social Care	Clinical Commissioning Group	**	***	***	*	***	**	*	***	**	*	**	*			***	**	*					
G		Primary Care Networks		*		*	**	***	**	*	*	*	*	*	*	*	*		*	*	*			
H		Primary Care Providers					*	**	**	*	*	*	**	**	*		*	*		*	*	?	?	
I		Mental Health Programme Board		**	*		**	*	*	***	**	*	*	*			*							
J		Mental Health Trusts					**	**	*	***	***	**	*	*	*		*			*	*	*?	*?	
K		Prevention & Health Inequalities Working Group		***	**	***	***	**	*	***	***	***	***	**	**	*	*			**				**
L		SPx Network			**	*	***	*	*	**	**	**	***	***	*		**	*	*	*	*	*	*?	
M		SPx Link Workers			*		*	*	*	*	*	*	**	**	*	*?	*	**	*?	*	*	**	**?	
N	Voluntary	VCSE Actors			**	*	*		*	*	*	**	**	***	***	**	**		*	**	**	**?		
O		BAME Network			*	**								**	***	*	*?			**	***			
P	Env.	Regional Nature Partnership		*	***	**	**	*	*	*	*	*	**	**	**		***	***	?			*	*?	**
Q		Nature-Based Organisations			**	*	**	*		*	*	*	*		*		***	***	?		**	**	**?	
R	Private	Digital SPx Partner				**	*	*	**	*	*		*	**	?		?		***					
S	Users	Lived Experience			**		**		*											**		?	?	
T		Whole Population			?		?		*		?		?	*	*?				*		*			
U		BAME Communities		?	*	*	*	?	*?		?	*	*	**	**	***	*	*				*		
V		Areas of Deprivation & Older Population		?	?	?	?	?	*?		?	*?		**	**		*?	*?					*	
X	Academia	Local Universities	**	*	**	*	*			**							**	*						**

Figure 14: Actor Linkage Matrix: TLS6 Green Social Prescribing, England. Information flows passing from horizontal actors (ABC) to vertical actors (123) are represented by *, with a higher number of asterisks reflecting a higher intensity of flow. Key areas for intervention are shaded, and areas of uncertainty are marked with ?.

4.2 Determinants' Diagrams

4.2.1 Scotland Nature Prescription Scheme

Seven key areas for intervention have been highlighted through ALM analysis of the Scotland Nature Prescription Scheme (see Figure 8). Although anticipated to be somewhat comparable between the Shetland and Edinburgh cases, lack of data on the latter is a limitation, hence areas for intervention are drawn only from the Shetland specific data analysis.

As the majority of those areas identified for intervention are characterised by bidirectional information flows (i.e. NBO to GP and conversely GP to NBO), the following DDs combine related weakening and strengthening and therein areas for intervention. DDs are herein presented for information flows pertinent to the Shetland NBO and GPs (Figure 15); NBO and user group (Figure 16); GPs and user group (Figure 17); and internally amongst GPs (Figure 18).

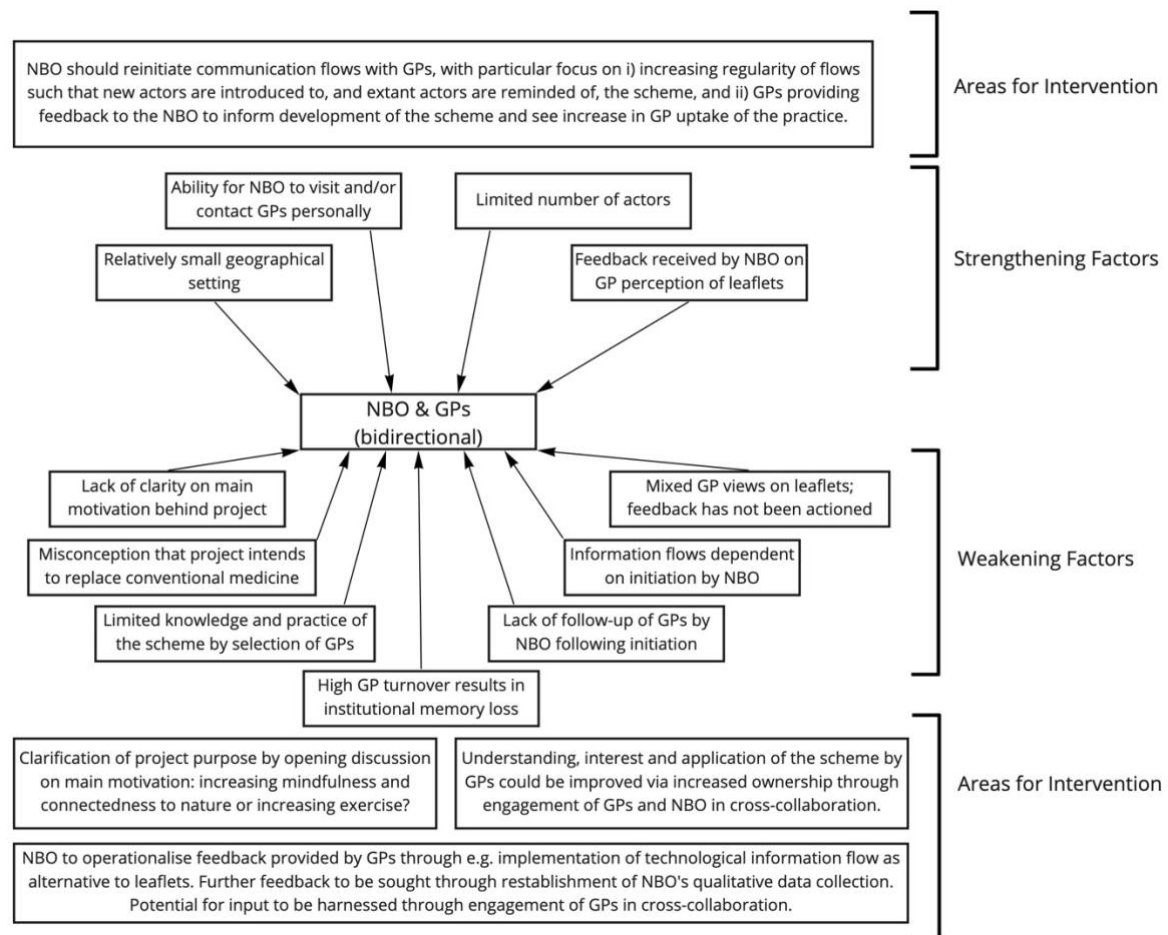


Figure 15: Determinants' Diagram for bidirectional information flows between Shetland NBO and GPs. Strengthening and weakening factors are illustrated as are potential areas for intervention.

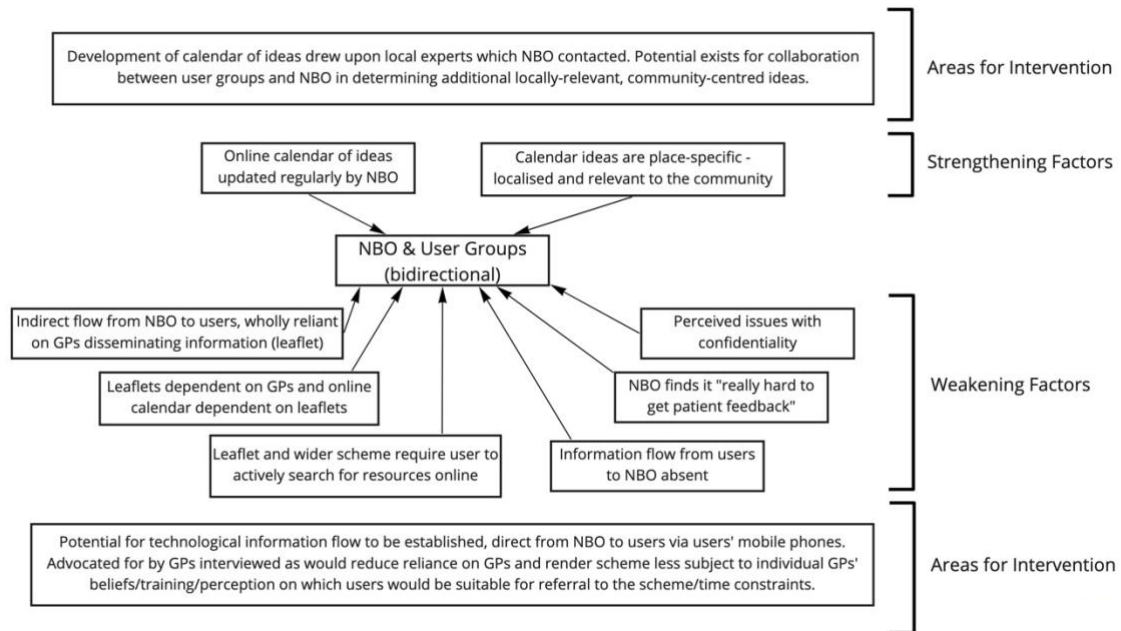


Figure 16: Determinants' Diagram for bidirectional information flows between Shetland NBO and User Groups. Strengthening and weakening factors are illustrated as are potential areas for intervention.

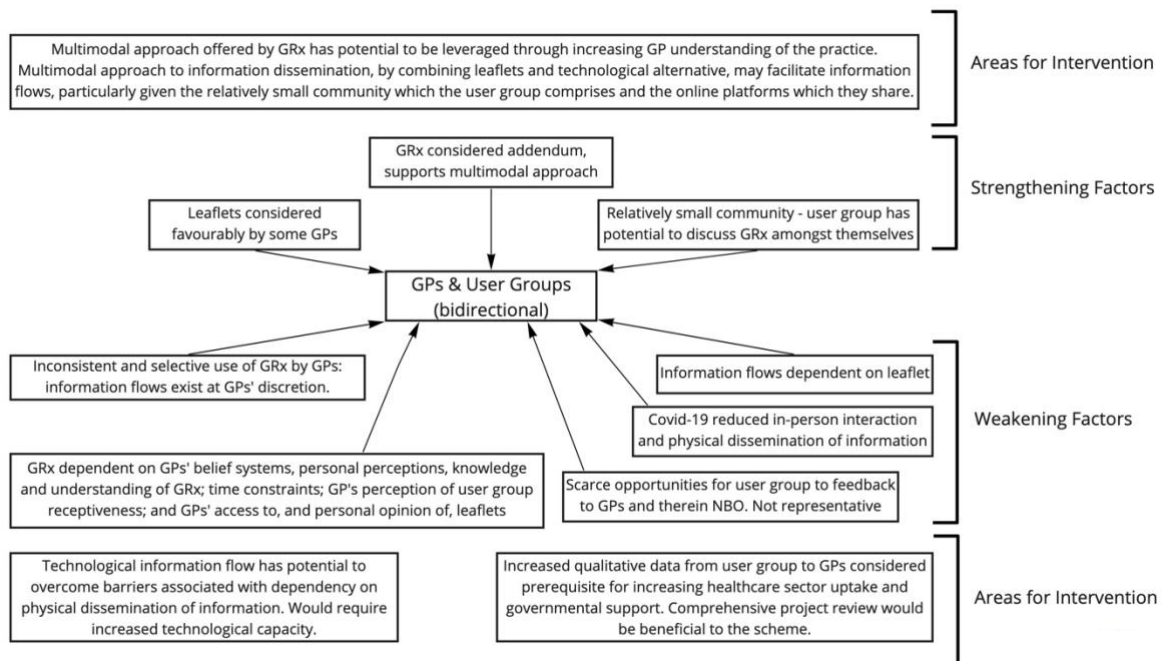


Figure 17: Determinants' Diagram for bidirectional information flows between Shetland GPs and User Groups. Strengthening and weakening factors are illustrated as are potential areas for intervention.

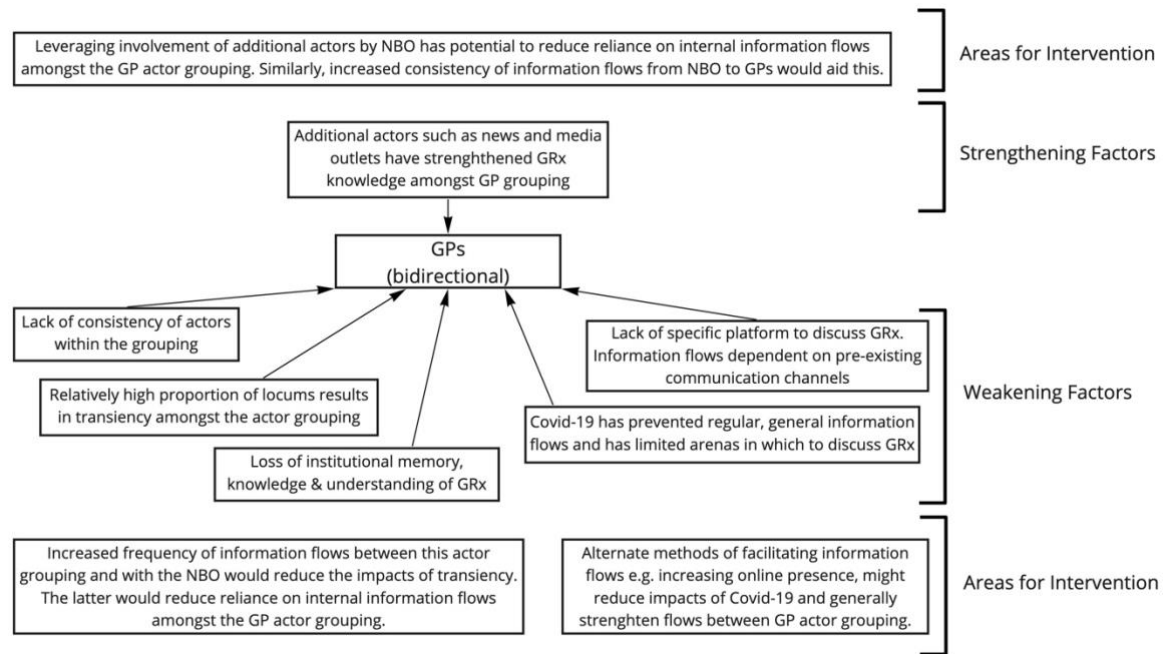


Figure 18: Determinants' Diagram for bidirectional information flows amongst Shetland GPs. Strengthening and weakening factors are illustrated as are potential areas for intervention.

4.2.2 England Green Social Prescribing

Strengthening and weakening factors and areas for potential intervention specific to the English GRx scheme are presented in Figure 19 - Figure 22. For ease of understanding and to provide a comprehensive review of factors involved, these figures combine data pertinent to each of the TLSs analysed with commonalities in actors involved and themes pursued having been identified across the sites. However, where inter-site differences do exist, these have been highlighted within the figures.

As per the Shetland case study above, the majority of areas identified for intervention as regards the England GRx scheme are characterised by bidirectional information flows (i.e. national to local actors and conversely local to national actors), hence the following DDs combine related weakening and strengthening and therein areas for intervention. Note that information flows amongst national actors would be worthy of further consideration, however have not been considered within the DDs due to lack of data.

DDs are herein presented for information flows pertinent to national and local actors (Figure 19); H&SC and NBO actors (Figure 20); NBO actors and user groups (Figure 21); and H&SC actors and user groups (Figure 22). Networks which exist amongst the TLSs, including those specifically established for the purpose of the GRx scheme such as the seven working groups within TLS1, or those existing networks which will be leveraged during progression of the GRx scheme such as the BAME VCSE Network in TLS3, have not been presented in their own DDs, but rather are illustrated as strengthening (or weakening) factors in the below DDs, highlighting the role that these networks play in facilitating information flows between those actors which are featured centrally within each DD.

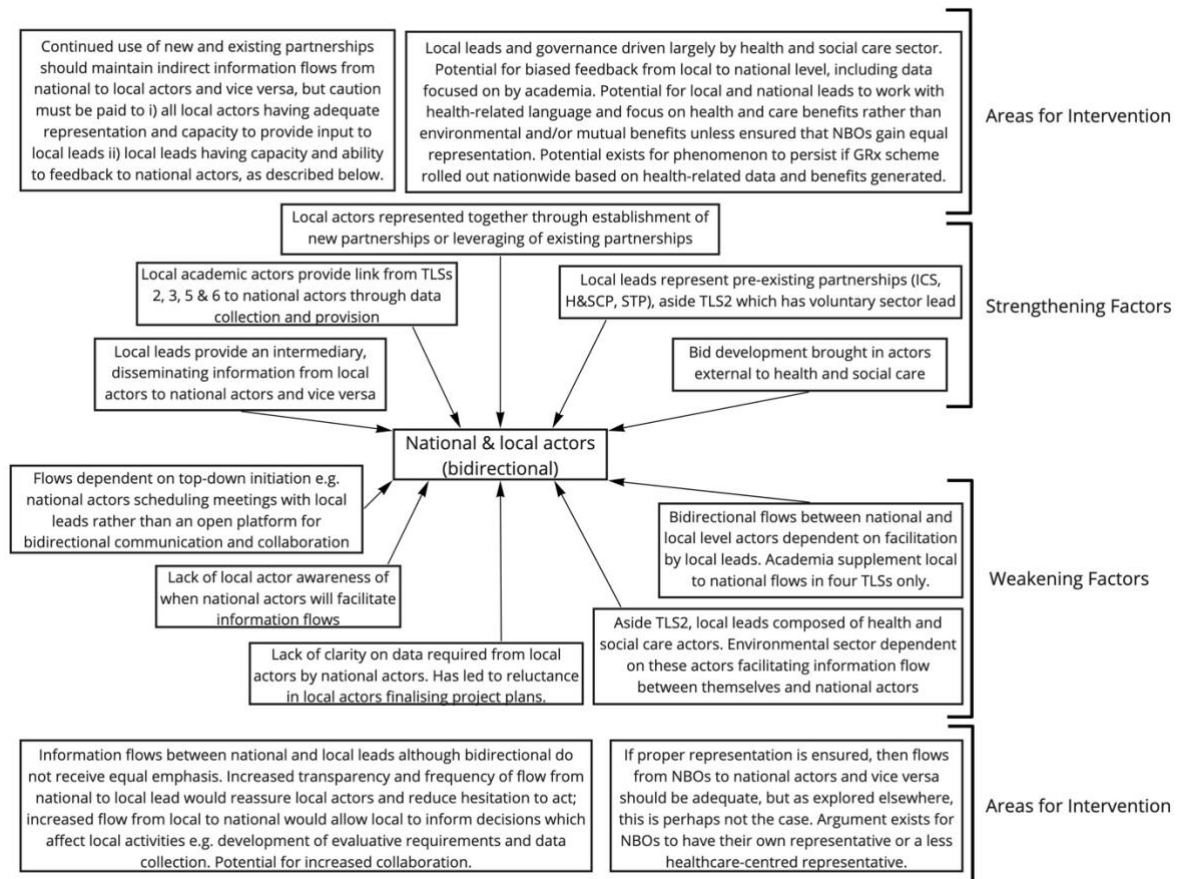


Figure 19: Determinants' Diagram for bidirectional information flows between England National and Local Actor Groupings. Strengthening and weakening factors are illustrated as are potential areas for intervention.

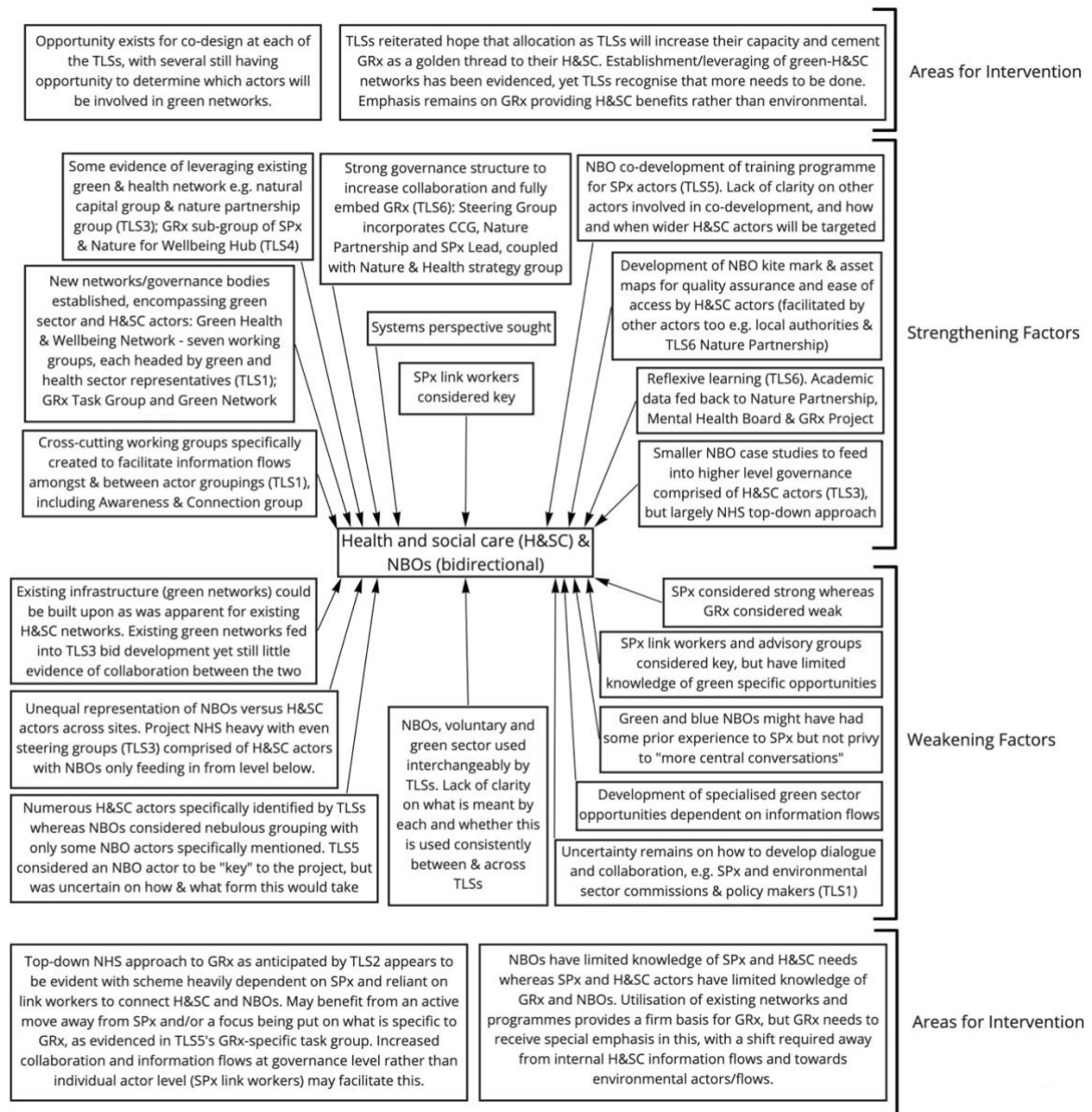


Figure 20: Determinants' Diagram for bidirectional information flows between England Health and Social Care and Nature-Based Organisations Actor Groupings. Strengthening and weakening factors are illustrated as are potential areas for intervention.

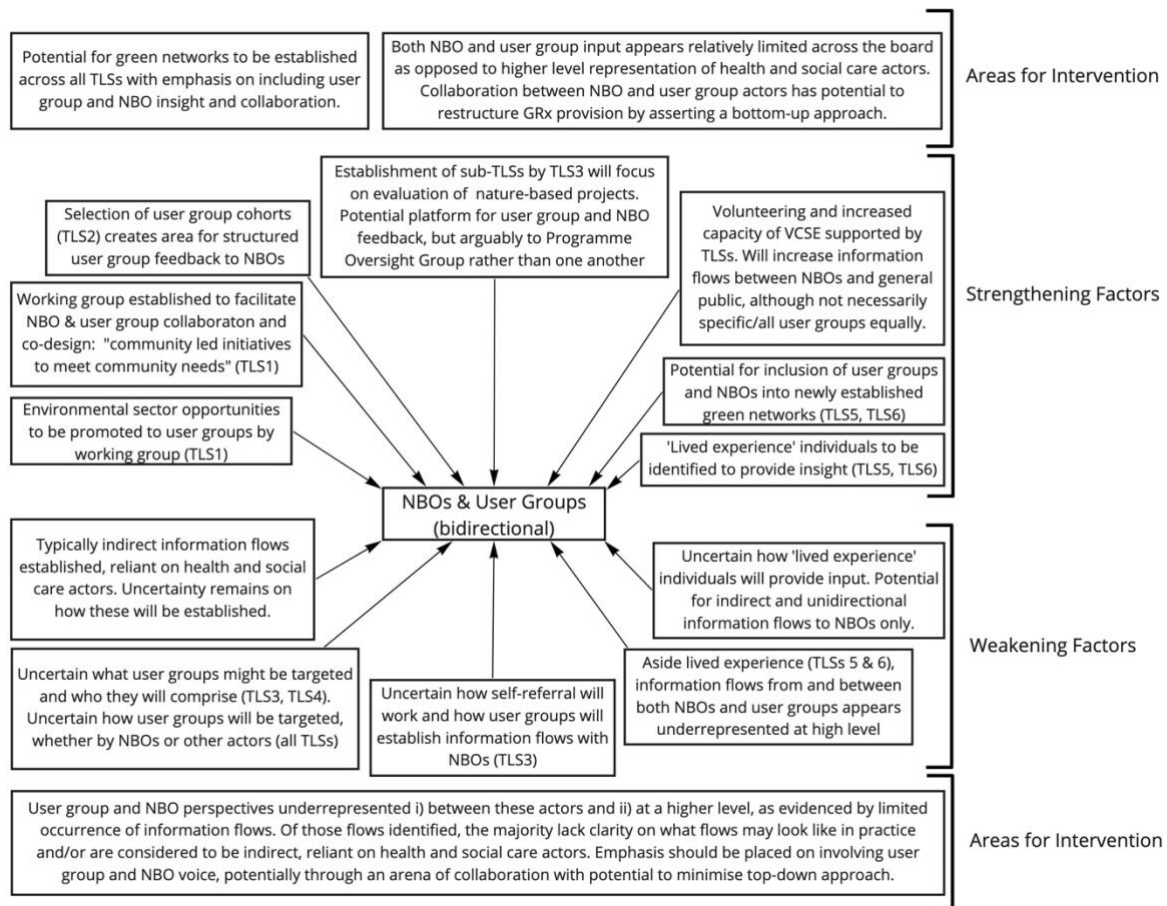


Figure 21: Determinants' Diagram for bidirectional information flows between England Nature-Based Organisations and User Groups Actor Groupings. Strengthening and weakening factors are illustrated as are potential areas for intervention.

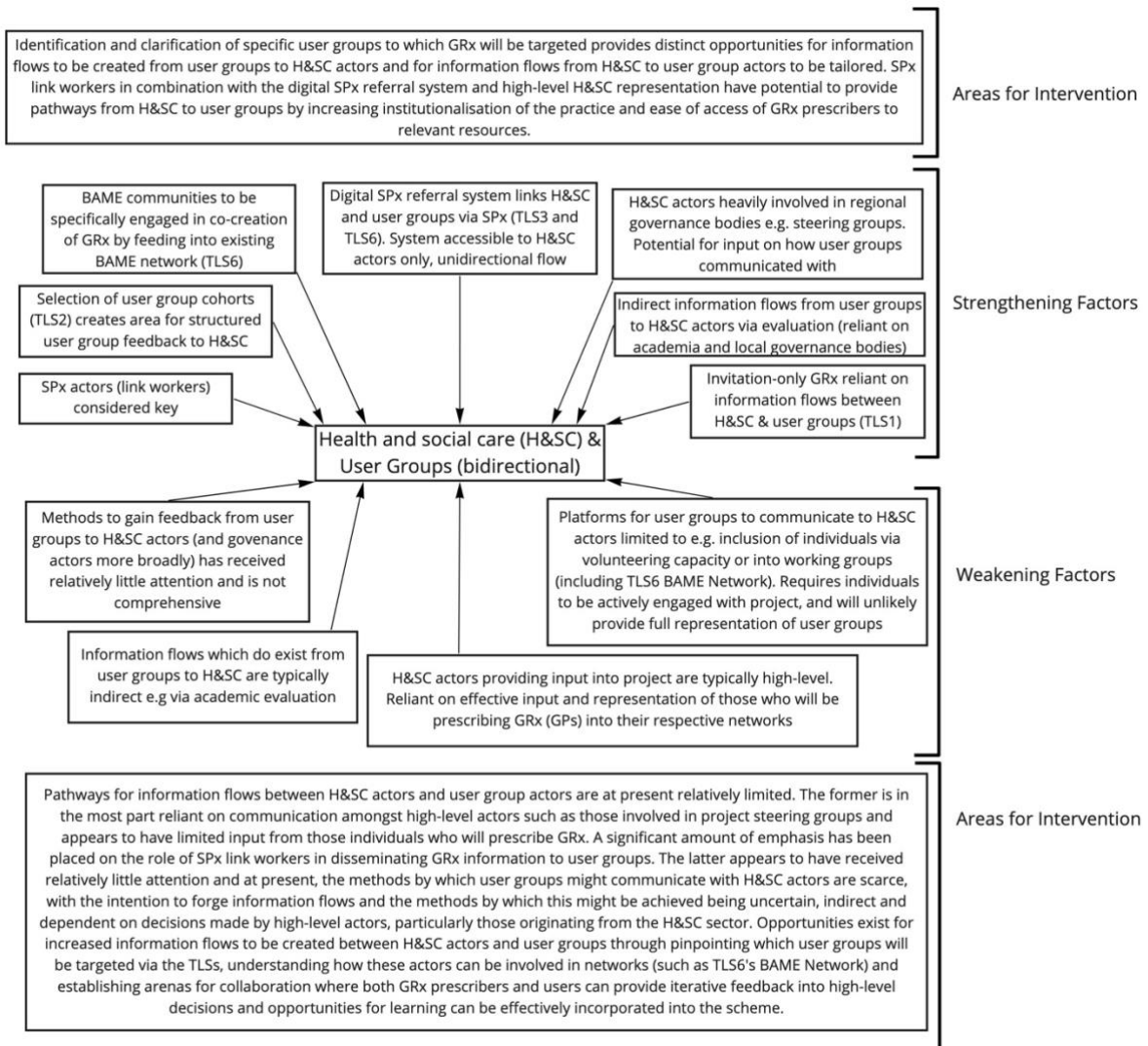


Figure 22: Determinants' Diagram for bidirectional information flows between England Health and Social Care and User Groups Actor Groupings. Strengthening and weakening factors are illustrated as are potential areas for intervention.

5 Discussion

5.1 Research results in light of extant data

5.1.1 GRx Actors

In relation to research question one, ‘what actors are involved in the implementation of GRx?’, the Shetland Nature Prescription Scheme has three major actors involved in the practice: GPs as the service prescriber; an NBO as the service provider; and patients as the user group. Actors associated with the Edinburgh expansion of GRx are similarly considered to comprise the NBO, local GPs and GRx users, however, neither potential additional actors nor information flows which may exist can be ascertained due to lack of data so are not discussed further here. As regards the Shetland case, the former two actor groupings are consistent with those presented within literature whereas the inclusion of users targeted by GRx as a third grouping interestingly differs from the literature. Rather, the literature appears to consider these individuals passive recipients of the practice rather than as stakeholders within their own right. When considering user groups targeted by the practice, Robinson et al. (2020) consider that GRx are “typically administered to patients with a defined need”, whereas den Berg (2017) consider GRx to also be applicable to projects for the general population. Results of this research indicate that GP1 and GP2 both practiced selective administration of GRx, targeting patients being treated for low-level mental health issues, as is consistent with Robinson et al. (2020). Selection of patients was however undertaken at the discretion of the GP whereas the NBO considered the scheme applicable to the general population, consistent with den Berg (2017). GP2 additionally conceded that patient referral to GRx was further based on GP perception of patients’ potential receptiveness to the practice, with GRx not being applied ubiquitously across the demographic of patient initially identified by the GP but rather having potential to be referred to those individuals already more ‘connected’ to nature or sensitive to environmental causes. Selective referral emphasises the importance of user groups being incorporated into collaborative design of GRx to increase suitability of nature-based opportunities to the user and therein increase ownership, uptake, derivation of health and wellbeing benefits and, according to the literature, increased pro-environmental behaviours more generally. Similarly, healthcare actors prescribing GRx was not equal across the board, as indicated by those who did not accept the invitation to interview citing that they did not use the practice. Whilst discussed further in relation to research question two, below, lack of comprehensive use of the practice by service prescribers was in part attributable to mixed understanding of mechanistic pathways behind GRx and lack of resource suitability and time, consistent with the literature (Handcock & Jenkins, 2003; Robinson et al., 2020; Robinson & Breed, 2019), indicating the value in increasing service prescriber-provider collaboration to increase understanding, guide resource development and increase prescriber buy-in.

In England, numerous actors are involved with trial implementation of GRx, spanning the national to local level with the former comprising cross-governmental actors, DEFRA, NHSE, PHE, DHSC, NHSI, MHCLG, NASP and NE, and each TSL being further governed by a local lead, comprised of an ICS, H&SCP or STP, with the exception of TLS2’s appointment of a voluntary lead to oversee site-level project implementation. Each TLS placed an emphasis on involving multiple site-level actors in scheme development and rollout. Whilst specific actors vary between sites, overall actor groupings are largely comparable, encompassing local governance, with all bar one site including local authorities; the wider H&SC sector; the environmental sector; the VCSE sector at all bar two TLSs; and user groups. User groups varied between sites and had yet to be clearly defined by some TLSs. Actors from the wider H&SC sector have received particularly high representation across each TLS. In contrast to both Shetland and the literature, service prescribers themselves appear to have received relatively little representation, with emphasis and high-level decision making instead being placed on H&SC

actors such as commissioners, CCGs and PCNs. Additionally, SPx actors have received an unanticipated level of representation amongst the TLSs as compared both Shetland and the literature, likely attributable to GRx in England being viewed as an expansion of the existing SPx scheme, with TLSs acknowledging that SPx has provided a solid actor-base and foundation of networks on which GRx can be built.

The environmental sector has received comparatively little representation across the TLSs. The majority of TLSs presented the sector as a nebulous actor grouping, indicating a lack of consideration as to which specific actors this grouping might actually comprise. Clarity appeared absent on a fundamental note: what GRx might entail in practice and therefore which actors ought to be involved in project development and implementation. TLSs in several cases appeared to conflate the environmental sector with the VCSE sector and only two TLSs made the distinction between NBOs offering blue nature-based activities as opposed to those offering green activities. Underrepresentation of benefits which might be brought by exposure to blue activities is consistent with the literature (Grellier et al., 2017; Völker & Kistemann, 2011; Wheeler et al., 2012), and is in itself indicative of lack of a holistic approach to GRx, manifesting as unequal representation of blue NBOs as compared their green counterparts. Blurred delimitation between environmental and VCSE actors as illustrated by TLSs' synonymising these groupings suggests that GRx may be being approached as SPx more generally, without TLSs necessarily exercising adequate consideration of "what is specific and unique about the GRx programme and who need[s] to [be] involve[d] in that", as per TLS5.

Additionally, four TLSs have sought academic partner collaboration for evaluative purposes, which whilst outside the direct scope of this thesis, may serve to mitigate lack of understanding of the causal mechanisms behind GRx-derived benefits and the contexts in which they are most effective (Bloomfield, 2017; Robinson et al., 2020; Triguero-Mas et al., 2017). In turn, development of a repository of localised, benefit-specific GRx opportunities may be enabled. Two TLSs will include a private sector actor through leveraging this actor's prior digital involvement in regional SPx. Finally, also converse to both Shetland and the literature, is the presence of networks reported across the TLSs. Each TLS has sought to leverage existing networks or establish new networks in light of project development and rollout. Actors involved in these networks differ, with some seeking representation of H&SC and environmental actors, others maintaining a H&SC skew and one in particular (TLS3) supporting a green network. It appears that a systems perspective is nonetheless being pursued, as further exemplified by establishment of seven working groups by TLS1, particularly so that concerned with Awareness and Connection.

5.1.2 Extant Information Flows

In relation to research question two, 'what are current examples of communication pathways between these actors?', silo working is evident in both Shetland and England. Although the latter has established some networks to overcome this, these are typically NHS-heavy and have not provided comprehensive representation of all actor groupings involved, particularly so for the environmental sector and user groups. Whereas silo working in Shetland is attributable to lack of horizontal information flows intersectorally and, in the case of GPs, intrasectorally, silo working in England is evident across both horizontal and vertical information pathways. Whereas a limitation to effective GRx implementation through exclusion of multi-level stakeholders is evident in the latter, I argue that absence of multi-level stakeholders in the former is not proof of such a limitation being absent, but rather highlights the need for broader identification of multi-level actors in Shetland for future inclusion into GRx. Although discussed further below, necessity of comprehensive multi-level actor representation through both their participatory inclusion and strengthening of vertical and horizontal information flows can for now have comparisons drawn with Lämsä et al. (2006), whose systematic review found that

“almost all large-scale [healthcare] innovations possess features which cross the levels of analysis among individuals, work groups, and organizations”.

Whilst strengthening and weakening factors are more specifically discussed within the DD’s presented above, efficacy of the Shetland Nature Prescription Scheme is largely dependent on physical dissemination of GRx-related information as provided by the NBO from GPs to users via leaflet. Information dissemination is therefore a two-step process, with several points for disruption existing en route. Firstly, dissemination has been hindered by inconsistent information flows from the NBO to GPs and also amongst GPs. It has further been exacerbated by loss of institutional memory as a result of GP turnover, consistent with Horton and Mackay (2003), and additionally Covid-19 having reduced regularity of interaction between these actors. Secondly, receipt of information by GPs does not automatically translate into their uptake of the practice, but is further dictated by prescribers’ understanding of the purpose of GRx and the benefits it may provide; the notion that GRx and more orthodox medical treatments are mutually exclusive; and perceived relevance of the practice to the patient. Of those GPs who were inclined to prescribe GRx, lack of time, lack of access to appropriate resources and GPs’ perception of usability of resources (leaflet) which they could access were further cited as constraints, as was perceived receptiveness of the patient to GRx again also taken into account. As such, application of the practice appears “sporadic and limited”, with prescribers’ adoption of GRx being dependent, at least in part, on institutional logics including tendency of an individual to work within the realms of their pre-existing perspectives, knowledge and training, as is consistent with the literature on ILAC, GRx and NBS more broadly (Albert et al., 2019; Blewett, 2018; Hanson et al., 2020; Robinson et al., 2020). Recognising that evaluation of Shetland GRx is yet to be undertaken by the NBO – or indeed the healthcare sector – and that evaluation at this stage may yield negative results due to its relative infancy (Bradford Hill, 1965; Nutbeam, 1998; Ogilvie et al., 2011), this research indicates a lack of networks between actors, as evidenced by information flows being weak or, in the case of users to the NBO, non-existent.

Whereas Shetland GRx is driven by the NBO, England GRx is driven by cross-governmental institutions at the national level and H&SC partnerships at site level. A lack of data was available from national actors to explore how cross-governmental project oversight might overcome silo working at the national level. Correspondence with TLSs however indicates that bidirectional national-local information flows are relatively weak, reducing efficacy of vertical information dissemination. However, high-level support of GRx should see increased institutionalisation of the practice as has resulted in increased link worker employment (NHS England, n.d.) and seen provision of funding such that TLSs can strengthen their capacity to provide GRx. Funding received is considered to especially aid the voluntary environmental sector two-fold, by ensuring their economic sustainability which has been particularly undermined as a result of the Covid-19 pandemic and by increasing their capacity to provide GRx services. At site-level, inclusion of multiple actors into bid development, leveraging of existing actor networks and establishment of new networks and working groups has potential to improve actor representation, strengthen horizontal information flows and promote ownership, minimising potential for silo working. Establishment of new networks which span disciplinary lines, in particular as per TLS1’s establishment of interdisciplinary working groups, is indicative of site-level boundary organisations having been created. Nonetheless, silo working remains somewhat evident, with emphasis having been placed on the scheme being largely NHS-driven and high-level decisions typically arising from H&SC actor groupings across the sites. Whether this has been pursued intentionally or has rather occurred by virtue of the scheme being based on pre-existing practice, and therein networks, of SPx is unclear, yet is evidenced by H&SC partnerships constituting site leads with the exception of TLS2 which intentionally appointed a voluntary sector lead due to local actors’ hesitation in instilling a top-down NHS approach to the project.

Within the apparent top-down NHS approach to England GRx as afforded by comprehensive representation of high-level H&SC actors at all sites bar TLS2, several links with additional actor groupings appear underexplored and information flows between these actors weak or absent as a result. Similarly to Shetland, a link appears missing from healthcare actors to user groups, and to an even greater extent, vice versa. Although inclusion of SPx actors, link workers in particular and SPx networks more generally, provides a relatively strong base on which GRx can be supplemented, information flows between SPx actors and GRx prescribers nonetheless appear weak in the majority of TLSs. Although NHS England (n.d.) consider that user group SPx referral may occur via a range of actors not limited to GPs, Bickerdike et al. (2017) consider that in practice, the majority of SPx referrals typically arise from GPs. Given the SPx base on which England's GRx is built, therefore, and in the absence of contrary information presented by TLSs aside mention of supporting self-referral, it would appear that GRx field actors (prescribers) would likely also constitute GPs, i.e. those actors which have received relatively little representation via involvement in networks established as a result of project rollout. Although GP representation is afforded via engagement of PCNs across some TLSs, this again offers relatively high-level representation of individual actors and relies on active engagement of the individual with their respective network or the project more generally. As per Shetland, GP uptake of GRx is again therefore dependent on individuals' inclination to participate in development and promotion of the practice based on institutional logics and capacity to take a holistic approach to treatment options, working outside of existing paradigms.

Lack of clarity exists on exactly what user groups will be targeted across TLSs and who these might entail. This is particularly the case at some TLSs more so than others. Users nonetheless appear considered a key actor in England GRx which is again converse to the literature. However, as per Shetland, limited communicative pathways exist from user groups to H&SC actors as indicated by weak or absent explanation of i) whether TLSs intend to establish information flows from user groups, and ii) how this might be achieved. Of those TLSs which have considered user input more effectively, this has tended to take the form of user group representation afforded by a select individual or individuals with lived experience, or by indirect information flows as facilitated via academic partners, user groups' active engagement in the project through personal volunteering capacity as per TLS3's BAME VCSE Network, or individuals' active engagement through personal inclusion into working groups. Whilst SPx link workers have potential to bridge the gap between user and H&SC actor groupings, receipt of user input via this route would again depend on the user being connected to GRx via professional or self-referral channels and likely also their inclination to participate in future development of the project, thus equally may not offer comprehensive representation of all user group actors as opposed to opening up the system for inclusion of all user stakeholders' input. Although user group representation remains relatively weak, both Shetland GPs and TLS local leads emphasised the need to focus on "getting [GRx] right" at the community level. The importance of a social setting is further emphasised as a cornerstone of GRx in the literature, hence, despite user groups not being considered a key actor in the literature (Robinson et al., 2020), it appears that user group inclusion in collaborative development of targeted GRx opportunities which are embedded in community-based activities is an essential link, requiring a significant amount more emphasis than it currently receives across both Shetland and England.

A relatively weak link exists between H&SC and environmental actors in England, again mirroring GRx literature and the findings of Shetland. Extant information flows are typified by skewed overrepresentation of high-level H&SC actors and reliance on existing SPx actors and institutional structures. Again, it is unclear whether underrepresentation of environmental actors has largely occurred by virtue of England GRx being based upon SPx and headed by H&SC actors and partnerships. However, TLSs' minimal inclusion of pre-existing environmental networks as opposed to H&SC networks is potentially indicative of systemic differences between the two sectors, with the former often comprising voluntary networks which lack

institutional support, structure and capacity as opposed to the latter, which can draw upon pre-existing institutional structures, common frameworks and national support to align their various operations. In light of this, it is important to note that despite inclusion of NE in the cross-governmental partnership, a potential disjunct may be particularly present in vertical information flows amongst environmental actors, in addition to horizontal, as compared H&SC.

5.1.3 Conceptualisation as a Community of Boundary Practice

Discussion is hereon presented in regard to research question three, 'how might conceptualisation of actors involved in GRx as a Community of Boundary Practice work to improve practice implementation?'. Silo working appears to persist in both Shetland and England, despite leveraging of existing and new networks in the latter. It appears GRx implementation might be improved through inclusion of additional actors and strengthening of information flows amongst existing actors, which I propose conceptualisation of GRx as a common endeavour around which a CoBP might be built would have potential to aid.

Firstly, in pursuit of GRx as a common endeavour, as per CoP, actors currently involved in its implementation would be required to define what GRx entails in practice and therefore what community members should be built around it. To undertake this task appears necessary and therefore beneficial in the case of both Shetland and England. In Shetland, clarification of what GRx entails in practice would work to ameliorate conflicting views held by the NBO and by GPs as regards the purpose of the practice, the nature-based activities which might be encompassed by the practice, the types of nature-derived benefits which have potential to be realised, and therefore the users to which the practice is applicable. In England, the process of defining the practice would provide clarity on what GRx entails as compared SPx; ameliorate differences observed in approach taken as regards green versus blue nature-based activities; provide clarity on which actors are able to provide these activities, specifically whether green or blue NBOs or the VCSE sector; and further provide a more nuanced understanding of which user groups these activities can and should be best targeted.

Having developed a working definition of the practice, relevant actors can be systematically identified for their inclusion into a community built around the practice. In both Shetland and England, this would likely see realisation of the importance of gaining user group input into the practice as a means by which to tailor GRx provision, increase ownership and therein uptake of the practice as is recognised by Farrington et al. (2015) in relation to behavioural risk factor reduction of NCDs more widely (S. Biggs & Matsuert, 1999; Lachapelle, 2008). User group inclusion into a CoBP would further create an increasingly balanced learning environment in which the practice could progress as, recognised that an over-emphasis on knowledge and skill tends to dominate in healthcare organisations, inclusion of community voices could cultivate habits of intra-personal interactions, feedback, reflection, self-directed learning and systems thinking (Tsasis et al., 2013). The process of developing a working definition of GRx which aligns a CoBP would further provide a means by which to systematically identify information flows of particular importance and, as per this research, identify weak information flows at which corrective action ought to be targeted. In addition to identification of actors directly relevant to the practice, development of a core community could be supplemented by peripheral actors who are currently considered external to GRx, such as urban planners, such that community boundaries as opposed to occupational boundaries can be drawn and an increasingly holistic approach to the practice afforded (Wenger, 2011). Equally, a CoBP built around GRx would have potential to interlock with relevant neighbouring CoPs, contributing to formation of a complex, multi-professional social landscape through which derivation of mutual benefits can be laterally sought, for example via reorientation of planners' thinking towards realisation of health-promotive environments (Frank & Engelke, 2001; Kislov et al., 2012).

Secondly, transgression of occupational boundaries, as offered by the ‘boundary’ aspect of a CoBP would work to counteract silo working amongst both existing and newly identified actors. Whilst evident that a systems perspective has been sought by some TLSs, occupational boundaries nonetheless appear to persist, particularly between environmental and H&SC actors. Conceptualisation of all actors into a CoBP would provide a common platform via which resources and knowledge could be shared. Although lack of a transdisciplinary language may have potential to persist, multi-level and intersectoral actors’ inclusion into a CoBP would strengthen both intra- and inter-sectoral information flows and create an arena in which extant institutional logics and governance mechanisms, particularly those relevant to the H&SC sector, can be more effectively explored (Johnston, 2011). By means of example, given the heavy dependency of the England GRx scheme on SPx, the ability to draw on existing institutional structures and support may provide a solid base on which GRx can successfully be implemented, with SPx link workers considered to play a key role in bridging the gap between H&SC, environmental actors and user groups. However, if facilitation of transsectoral information flows is to be viewed as the responsibility of link workers, it is integral that a platform is available by which they can communicate with each relatively disparate actor grouping, particularly so that link workers themselves can understand what GRx opportunities can be provided by NBOs and therefore what nature-based opportunities exist within the region to which user group individuals can be referred. Furthermore, it is integral that service prescribers are aware of GRx opportunities available and how each can be drawn upon to support the individual user. It is recognised that the former has been somewhat broached by leveraging of existing networks and creation of new networks across the TLSs and via inclusion of suggested localised nature-based activities in the Shetland GRx leaflet. The latter has been supported across some TLSs through inclusion of the pre-existing digital SPx partner and creation of asset maps, and will in turn be supported across both jurisdictions by ongoing research into the potential benefits of GRx.

Inclusion of disparate actors into a GRx CoBP would enable transformation of domain-specific knowledge such that it can be used towards a shared goal, for example by increasing service prescribers’ awareness and understanding of the practice and by increasing capacity of NBOs to tailor their service provision and support increased GRx participation by users (O’Mahony & Bechky, 2008). By acknowledging the wider system in which GRx operates and focusing on both meso- and macro-capabilities of actors involved (Kuziemy, 2016), therefore, questions arising from CoBP members can be brought to the fore, and common resources developed and deployed by and within the community with the specific intention of facilitating transgression of disciplinary, sectoral and organisational boundaries. Inclusion of disparate actors into a CoBP would instead signal development of a new, common paradigm such that differences identified to exist between various extant paradigms might be minimised. Converse to much literature on boundary organisations (Guston, 2001; O’Mahony & Bechky, 2008), inclusion of GRx actors into a CoBP would not require actors to concede on inherently divergent interests, but would rather allow pursuit of a common endeavour, as co-benefits which have potential to be realised as a result of effective GRx implementation are not mutually exclusive, hence convergent interests of achieving both environmental and public health benefits can be pursued by actors performing tasks which are useful to both sides of the boundary whilst being able to retain links with their respective sectors, organisational and governance structures and networks therein.

Multi-professional and multi-level actor inclusion into a CoBP and transgression of paradigmatic boundaries therein afforded would allow comprehensive stakeholder representation and input. In pursuit of a common endeavour, reflexive and iterative learning could subsequently be undertaken (Farrington et al., 2015; Johnston, 2011; Tsasis et al., 2013). Active participation of stakeholders in a collaborative learning environment would enable evaluation of actor interests and intentions and have potential to impact actors’ knowledge, attitudes, skills and subsequent decisions made and actions taken (Horton & Mackay, 2003). Given the complexity of GRx as a public health intervention, the context specificity of learning

and the “great diversity of approaches, partnerships and strategies” which might arise therein (Hall et al., 2003), in tandem with the increasingly numerous goals and strains put upon public health systems, multiple channels and feedback loops established would likely be complex and interact with one another, as is typical of health interventions and complex adaptive systems more generally (Ekboir, 2003; Rouse, 2008). However, inclusion of actors into a CoBP would enable a systems view to be taken, and holistic responses be developed. By conceptualising GRx actors as a CoBP as opposed to a boundary organisation, design of a pre-determined organisational boundary with associated prescribed information flows, actors and organisational roles would be foregone, and increased flexibility and openness of the system afforded.

As reflexive learning is undertaken and new knowledge generated, actors involved in a CoBP and information flows established could be revised as appropriate (Wenger, 2011), which, given the novel nature of GRx, the early-stage of Shetland implementation, the early-stage and experimental nature of English implementation and the “idiosyncratic and performative nature of learning” (Amin & Roberts, 2008), will foreseeably be a key asset to effective GRx implementation both within these cases and wider jurisdictions. By means of example, flexibility in Shetland would enable responsiveness in tailoring of nature-based activities as user input is obtained. In England, flexibility would enable intra- and inter-site responsiveness as required during project progression as a result of stakeholder input (user groups included); as data is obtained and fed back into the system from local academic and national evaluation partners; and as potential national roll-out of GRx following project culmination requires. The necessity for flexibility and ability to adapt is further underscored in light of the wider academic research being undertaken in relation to GRx and derivation of nature-health benefits. Recognising that external factors can “heavily influenc[e] the internal operations of an organisation”, therefore, flexibility and reorganisation as afforded by a CoBP would increase capacity to deflect deleterious external forces or leverage beneficial external forces (Thompson, 1967)

Akin to the words of Gehlert et al. (2010) when discussing the importance of transdisciplinary collaboration in addressing health disparities, “the broad, inclusive picture that transdisciplinary approaches provide is essential for the development of interventions”, and to effectively intervene “requires consideration of the multiple interactions that occur between determinants at different levels, from the social to the molecular”, hence it is integral to gain comprehensive representation and active participation of multi-level, multi-professional, transdisciplinary and transectoral actors which have potential to be involved in GRx, including user groups. However, this is no small feat. To prescribe a one-size-fits-all approach to effective implementation of the practice is simply not feasible, particularly when taking into account the context specificity of the social, institutional, political and physical environments in which its application might be pursued. However, I hope that by application of a CoBP perspective to development and implementation of the practice, an appreciation can be garnered of the need for stakeholder inclusion into, and effective information flows within, an open, innovations system perspective to the practice which allows for reflection, flexibility and shared knowledge generation. Whilst complexity of the practice remains an inevitable feature, a CoBP perspective advocates for high-level support of a community-based, socially responsive and holistic approach to GRx as a common endeavour such that mutual environmental and public health co-benefits can in turn be realised, the two of which are so inextricably linked.

5.2 Reflecting on the results of this study

Due to the relative novelty of GRx, limitations to research naturally exist. Whilst recognised that various uncertainties surrounding the practice remain in the literature, I will here discuss the limitations specific to this research.

Firstly, this research has taken an exploratory approach to ascertain what actors are involved in GRx. Data obtained for analysis has had a natural boundary imposed, determined by which actors accepted the invitation to interview and availability of pertinent grey literature. In particular, had additional Shetland GPs, actors from Edinburgh or national actors within the England scheme provided interviews, variation in results obtained may well have been observed. Representation of national actors from England would have provided additional data specifically on information flows which are anticipated to exist between themselves and local actors and also amongst national actors. Although the former has been partially informed by site-level interviews, data obtained cannot be considered comprehensive hence results may be subject to bias. Data on the latter is missing entirely. Furthermore, again given the novelty of GRx and its implementation in the United Kingdom, project evaluations are absent from all cases drawn upon for this research. In Shetland, qualitative and anecdotal data obtained indicates that practice of GRx is sporadic and limited, yet quantitative data is absent. In England, TLSs remain in the early stages of project delivery and at time of interview, some actors were yet to progress beyond project design stage hence data obtained was, at least in part, somewhat speculative. Data analysed and conclusions drawn must therefore be treated with caution.

Analysis presented further begs the question of how one might effectively evaluate the success of GRx implementation, and whether the implications of no evaluation might impede strengthening and evolution of the practice. As above, whilst practical application of Shetland GRx appears limited and this research has highlighted absent or weak information flows existing between actors or actor groupings in both Shetland and across each TLS, chance exists that if those areas highlighted for intervention, if actioned, may not result in improved delivery of GRx in practice. If each scheme were to be evaluated further down the line, it may be that actors involved would consider the scheme a success; equally, it may highlight further, alternate areas for intervention. Again, however, this highlights the benefits of actors undertaking an iterative, stakeholder-representative approach to evaluation as per the literature presented in Section 2.7.

Given the NHS-heavy nature of GRx in England, this research has itself disproportionately reflected the H&SC sector as opposed to the environmental. Whilst specifics which lend themselves to silo working - such as benefits sought from GRx - have not been a focal point of this research, and effort has been made to provide an objective, comprehensive overview of the actors involved in the scheme, it is nonetheless important to note that had environmental actors been interviewed at the TLSs as opposed to H&SC actors (with the exception of TLS2), a different perspective may have been afforded. However, this has again occurred as a result of the scheme itself being heavily seated within the institutional structures of the NHS and building upon the pre-existing practice of SPx with the various actors and networks which this entails.

When considering the generalisability of this research, several points must be addressed which are pertinent to Dayton's (2018) summation that identical conditions which allow duplication of results are rarely, if ever, found from one organisation to the next, and that attempts to establish causation across different cases of intervention can further complicate findings when attempting to pursue improvement. Firstly, two different approaches have been taken to GRx within the United Kingdom, with one scheme having been initiated and driven by an NBO at the local level and the other having been initiated at the national level by a cross-governmental partnership and delivered, for now, across disparate regions of the country by local leads, themselves of an NHS-origin with the exception of TLS2. Generalisations which seek to establish causal links are therefore not only impracticable to draw from the case studies included in this research, but also when applying findings to alternate jurisdictions. However, as per literature on GRx, it might be reasonably presumed that environmental and healthcare actors will remain central to the delivery of GRx elsewhere, with the addition of user groups as per the case studies considered here. As such, generalisation of plausible links by which these key actors might communicate can reasonably be sought and applied across alternate jurisdictions, yet it is important to consider how institutions and relevant networks within which these actors operate

will likely differ across jurisdictions. Take, for example, the highly institutionalised and complex nature of the NHS and the implications that this has had on the variety and skewed representation of actors involved in the England GRx scheme, in addition to external limiting factors that this has imposed on Shetland GPs, such as cited time constraints, which have impacted prescriber uptake of the practice. Results which might be observed through implementation of GRx in jurisdictions which operate with a private healthcare system might therefore be contrary to those observed within the boundaries of this research. Such a limit to generalisability of the results generated here is further exemplified by considering how integral a part SPx has played within the England GRx scheme as compared the Shetland GRx scheme and the differences which have been observed therein.

Finally, I suggest that application of the CoBP conceptual framework to the research has provided a means by which to reduce limitations to the practice in research and in practice. By affording attributes which neither boundary theory nor CoP theory offer in their singular form, CoBP allows conceptualisation of the communities and networks which might be built around GRx and highlights key aspects which I consider would aid successful implementation of the practice. Granted the novelty of the framework, like the practice, I nevertheless suggest that further work on the framework would naturally be beneficial. In particular, it would be important to consider how a GRx CoBP might be managed or led, for example, whether it would be viewed as a flat arena, somewhat akin to the Shetland scheme, or rather have a hierarchical structure, more akin to the TLSs; whether a CoBP would require a common institutional structure, albeit potentially loose to allow for adaptation to be undergone; and finally, whether mutual incentives would be required for actors involved.

6 Conclusions

Silo working and lack of a transdisciplinary language is considered a major barrier to the effective implementation of GRx and therefore has potential to minimise environmental and public health co-benefits which might be afforded by the practice. This research therefore sought to understand i) what actors are involved in implementation of GRx, ii) what current examples of communication pathways between these actors are, and iii) how conceptualisation of actors involved in GRx as a Community of Boundary Practice might improve its implementation.

6.1 Practical Implications and Recommendations for Non-Academic Audiences

Case studies analysed differed from the literature as regards the actors involved in GRx. Whereas service prescribers (primary healthcare actors) and service providers (environmental actors) were considered in the literature, these actor groupings were further supplemented by additional actor groupings in practical application of GRx. Additional actors included user groups of GRx (patients, targeted groups and/or the general public); the wider H&SC sector; local and national governance actors; the VCSE sector; the private sector and academia.

Aligned with the literature, silo working was evident across case studies drawn upon. Although silo working varied on a case-by-case basis, weak information flows were typically observed to exist between environmental and healthcare actors; between these actors and user groups; between healthcare actors; and between national and local actors, although limited data was available on the latter. Presence of silo working suggests environmental and public health co-benefits may not be realised to their full extent, and so effort should be focused on minimising this limitation through use of a systems approach which offers comprehensive representation and input of all actors involved. In particular, input should be sought from user groups so that GRx can be locally tailored and its uptake amongst users and healthcare actors increased.

Application of a CoBP perspective to GRx highlights the benefits of producing a working definition of GRx amongst actors involved, therein enabling systematic identification of additional actors who ought to be brought into the community and identification of particularly important information flows on which strengthening efforts should be focused if necessary. Inclusion of multi-level, multi-professional actors into a CoBP would enable sharing of domain-specific knowledge and resources, facilitating intersectoral working and generation of common knowledge. It would further allow iterative learning to be undertaken and a holistic response be applied to the complex and multiple interacting feedback loops which are likely to exist in relation to GRx. Finally, a CoBP perspective would allow flexibility of both actors involved in GRx and potential information pathways which might be established between these actors. In practice, generation of new knowledge relevant to GRx is likely, arising via practical application and experimentation of GRx and via further academic research being undertaken in the field. The flexibility offered by an open CoBP perspective would allow integration of new knowledge and reorganisation of actors and information pathways as necessary, facilitating responsive implementation of the practice. In turn, this would enable contextually appropriate implementation of GRx, maximising the potential for realisation of co-benefits which can be offered by the practice.

6.2 Recommendations for Future Research

This research has contributed to extant GRx literature in several ways. It has provided an exploratory insight into actors currently involved in GRx and highlighted where this differs from existing literature, providing a much more complex picture of multi-level and multi-disciplinary stakeholders whose input needs to be effectively and comprehensively managed. In particular, it has highlighted the need for comprehensive user group representation such that GRx can be

socially and culturally tailored to local contexts, therein increasing user participation, opportunity for realisation of co-benefits and strengthening of environmental stewardship. The research has emphasised the importance of leveraging existing and new networks to facilitate information flows between GRx actors, yet asserts that silo working nonetheless has potential to persist. Therefore, it suggests application of a novel theoretical concept, Communities of Boundary Practice, which considers how both actors and information flows associated with GRx should remain flexible, multi-professional and multi-level in order to iteratively, reflexively and holistically respond to i) multiple channel feedback loops arising from practical application of GRx and generation of common knowledge amongst GRx actors, and ii) external forces arising as ongoing academic research into the field generates new knowledge and potential for institutionalisation of GRx increases.

Recognised that much research is currently being undertaken as regards various aspects of GRx and nature-health benefits more generally, the following recommendations for future research are specifically concerned with how the performance of GRx is dependent on actors involved in implementation of the practice and how they interact with one another and the wider system.

A limitation to this research has been lack of data pertinent to national actors and user groups associated with GRx. Future research should seek to fill this knowledge gap. National actors involved in GRx implementation may themselves span a range of sectors, each with their own respective agendas, governance mechanisms and institutional structures. Future research should focus on how information flows might be facilitated between these actors and consider whether application of a CoBP perspective might aid GRx implementation. Whilst current research focuses on potential nature-derived health benefits, the contexts in which these are maximised and to whom they are most applicable, future research into user perspectives ought to also focus on understanding how user input into GRx implementation can be best achieved, and how this can in turn inform green infrastructure planning and implementation of NBS.

Due to the relatively small scale of the Shetland Nature Prescription Scheme and the NHS-heavy nature of the England GRx scheme, environmental actors have received relatively little representation within this research. As a key actor in the practice, future research ought to target the environmental sector to understand how these actors might be best represented in GRx. Distinction should be made between green and blue environmental actors, the latter of which has received further underrepresentation still. In addition, future research should bring into consideration actors typically considered external to the practice, such as urban planners and secondary healthcare actors, so that understanding can be sought on how collaboration of actors in a CoBP might inform practical realisation of co-benefits, such as through transectoral, multi-level support of NBS. It should further consider whether introduction of bridging concepts such as ecosystem goods and services into a CoBP might facilitate transectoral working and knowledge production.

Finally, three additional theoretical concepts might serve well as a focal point for future research which, on a different level to CoBP, seeks to explore actors involved in GRx and the information flows which they might establish. The first comprises epistemic communities, which typically focuses on the production of policy-relevant knowledge by interdisciplinary professional groupings, often pertinent to complex technical issues (Dunlop, 2012). The second comprises complex adaptive systems, which would provide a means by which to conceptualise the complexity of GRx and the multiple interacting feedback loops which exist, providing implications for its design and management (Rouse, 2008). The third comprises health system analysis, which could be drawn upon to consider efficacy of GRx implementation, and later guide its evaluation through understanding inputs, process and outputs of the practice and the collective results of these aspects working in combination (Berman & Bitran, 2011).

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Appendix A

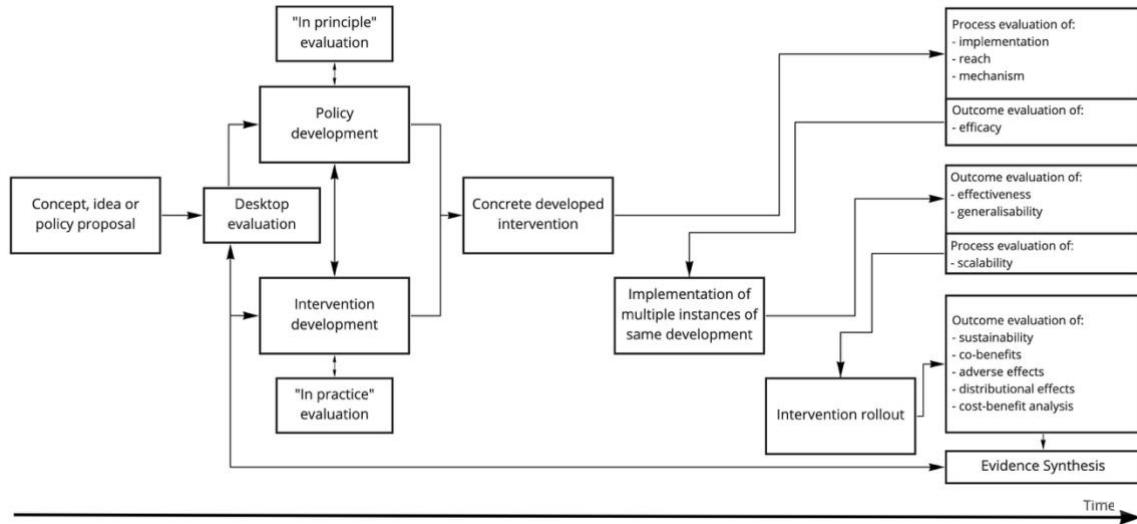


Figure 23: Evolutionary flowchart for typical complex public health interventions, as adapted from Ogilvie et al. (2011) and Nutbeam (1998).

Appendix B

Table 1: Actors contacted for interview including location, job role and the organisation/sector which they represent as well as the actor identifier assigned to them throughout the course of this research.

Those actors who accepted the invitation to interview are indicated (Y), as are those which provided grey material relevant to their case (Y). Those who did not accept the invitation to interview or did not provide grey material are similarly indicated (N).

Actor Identifier	Job Role	Organisation/Sector	Interview Provided	Grey Material Provided
Shetland Nature Prescription Scheme				
GP1	General Practitioner	NHS Primary Healthcare	Y	N
GP2			Y	N
GP3			N	N
GP4			N	N
GP5			N	N
GP6			N	N
GP7			N	N
GP8			N	N
GP9			N	N
GP10			N	N
NBO1	Community Engagement Officer	Royal Society for the Protection of Birds. Environmental sector	Y	N
Edinburgh Nature Prescription Scheme Trial				
GP11	General Practitioner	NHS Primary Healthcare	N	N
GP12			N	N
GP13			N	N
GP14			N	N
GP15			N	N
NBO2	Project Development Executive	Royal Society for the Protection of Birds. Environmental sector	N	N
NHS1	Green Health Programme Manager	NHS Healthcare Trust	N	N
England Green Social Prescribing Scheme				
TLS1A	Partnership Commissioning Manager	Regional Council; Health & Care Partnership; Clinical Commissioning Group. Government and NHS	Y	Y
TLS1B	Council Representative	Regional Council; Clinical Commissioning Group. Government and NHS	Y	Y
TLS2	Chief Executive	Charitable Foundation and Volunteering Hub	Y	N
TLS3	Senior Analyst	Person and Community Centred Approach; Health and Social Care Partnership. NHS	Y	Y
TLS4	Integrated Community Place Officer	Clinical Commissioning Group. NHS	N	Y
TLS5	Prevention Programme Manager	Integrated Care System. NHS	Y	Y
TLS6	Project Officer	Mental Health and Learning Disabilities Transformation Directorate; Clinical Commissioning Group. NHS	N	Y
TLS7	Chief Executive	Regional Community and Voluntary Service	N	N
NBO3	Natural England	Non-Departmental Public Body	N	N
NHS2	Green Social Prescribing National Team	Green Social Prescribing National Team. NHS	N	N