BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (http://bmjopen.bmj.com).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open: first published as 10.1136/bmjopen-2024-088573 on 29 April 2025. Downloaded from http://bmjopen.bmj.com/ on June 10, 2025 at Agence Bibliographique de l Enseignement Superieur (ABES) .
Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

BMJ Open

Quantifying, Understanding and Enhancing Relational Continuity of Care (QUERCC) A mixed methods protocol.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2024-088573
Article Type:	Protocol
Date Submitted by the Author:	09-May-2024
Complete List of Authors:	Marshall, Tom; University of Birmingham - Edgbaston Campus, Public Health and Epidemiology Williams, Iestyn; University of Birmingham College of Social Sciences, Social Policy Nirantharakumar, Krishnarajah; University of Birmingham - Edgbaston Campus, Institute of Applied Health Research Willis, Brian; University of Birmingham College of Medical and Dental Sciences, Institute of Applied Health Research Kasteridis, Panagiotis; University of York, Economics Sterniczuk, Kamil; University of Birmingham - Edgbaston Campus, Institute of Applied Health Research Scheibl, Fiona; University of Birmingham, Chen, Jinyang; University of York, Economics Anteneh , Zecharias; University of York, Center for Health Economics Greenfield, Sheila; University of Birmingham - Edgbaston Campus, Institute of Applied Health Research
Keywords:	Patient Care Management, Person-Centered Care, HEALTH ECONOMICS

09/05/24 vs 1.5

Title page

Quantifying, Understanding and Enhancing Relational Continuity of Care (QUERCC) - A mixed methods protocol.

Authors:
Tom Marshall,
t.p.marshall@bham.ac.uk

Iestyn Williams,
i.p.williams@bham.ac.uk

Krishnarajah Nirantharakumar,
k.nirantharan@bham.ac.uk

Brian Willis,
b.h.willis@bham.ac.uk

Panagiotis Kasteridis,
panos.kasteridis@york.ac.uk

Kamil Sterniczuk,
k.sterniczuk@bham.ac.uk

Fiona Scheibl,
f.scheibl@bham.ac.uk

Jinyang Chen,
jinyang.chen@york.ac.uk

Zecharias Anteneh,
zecharias.anteneh@york.ac.uk

Sheila Greenfield,
s.m.greenfield@bham.ac.uk

Corresponding author
Tom Marshall
t.p.marshall@bham.ac.uk

Word count 7860 (manuscript excluding abstract, title page, references and figures)

Key Words: Continuity, Primary care, Measurement, Improvement

09/05/24 vs 1.5

Abstract

Introduction

Relational continuity of care is where patients see the same clinicians over time. Evidence suggests relational continuity of care is valued by patients and clinicians and results in better health. While current NHS policy aims to maintain relational continuity of care it has been declining in recent years which may be linked to the growth in practice size, increased staff turnover, part time working, and the focus on patient access. Our research aims to develop resources to help clinicians measure, manage and improve relational continuity of care.

Methods and Analysis: A mixed methods approach in UK primary care commencing with two workshops drawing patients, clinicians, and researchers together to establish an agreed approach on the measurement of continuity of care. Second, analysis of national data will provide insight into how staff turnover, part-time working, practice size and funding per patient affects continuity. Third, case studies in a sample of high performing practices will document the barriers and facilitators to the establishment and maintenance of continuity of care. Forth, an economic analysis of resource costs and health outcomes using linked primary and secondary care data will show whether costs influence continuity for different patient groups (by age, sex, deprivation status and chronic disease status). Fifth, we will develop practical guidance for clinicians to improve continuity of care, based on the findings from each stage of the research.

Ethics and dissemination.

This study has approval from the HRA and Health and Care Research Wales (HCRW) Research Ethics Committee [23/SW/0101]. We will share research findings across a range of academic publications, networks and conferences. For a lay audience, we will commission a short animation of our final report. We will initiate a social media campaign to garner interest and encourage feedback via blogs and personal stories of continuity of care.

09/05/24 vs 1.5

Article summary

QUERCC is a mixed methods study drawing on data collected in workshops, case studies and national data sets to develop understanding of the measurement and improvement of relational continuity of care in general practice. The project is working in collaboration with the Royal College of General Practitioners and other stakeholder partners. The research has five work packages and aims to work towards the development of tools that will help general practitioners measure and improve continuity of care. The project has a wide body of patient and public involvement members who are engaged in the project process and development of the study website. Dissemination will engage with a range of stakeholders and use innovative pod casts and animation to ensure the study findings are communicated to the public and practitioners. The online supplement **Figure 1** presents the components and methods used in each work package. This paper describes the protocol and methods to be used to deliver the research aim. The study commenced in May 2023 and will conclude in April 2026.

Strengths and Limitations of this study

- Engaging patients and clinicians' views on measurement of relational continuity of care
- In-depth case studies of within-practice organisational context and drivers of relational continuity of care
- Economic analysis of the effects of relational continuity of care
- A potential weakness is that the economic analysis assumes continuity is causally related to costs and health outcomes
- A further weakness is that participating practices may be self-selected and unrepresentative

Funding Statement

This work was supported by NIHR HSDR. Reference: NIHR152277 Quantifying, Understanding and Enhancing Relational Continuity of Care (QUERCC). HSDR Funding call: 22/16 HSDR May 2022.

09/05/24 vs 1.5

Data Statement

Technical Appendix including topic guides and qualitive data set will be made available at OSF | Quantifying, Understanding and Enhancing Relational Continuity of Care (QUERCC). Quantitative data set and models available from the authors.

Introduction

Background

Continuity of care includes informational continuity, sharing information between clinicians and organisations; management continuity, following the same management plan across different clinicians and organisations; and relational continuity, an ongoing between clinician and patient. (1) Relational continuity of care (RCC) enables and underpins informational and management continuity and is important in primary care for two main reasons: it is valued by patients and GPs, and it is associated with better health care delivery, and better health outcomes.(2). Doctors and patients value RCC as facilitating the conditions required for person-centred care (3-6) and view its absence as increasing the risk of harm and loss of trust (2, 7-9). Longstanding evidence shows RCC is associated with reduced emergency consultations, unplanned admissions and even mortality (5, 10-17) across a range of acute and long-term conditions(18-23). Disruption of continuity is associated with increased use of specialty, urgent, and emergency care in older patients (24, 25). Furthermore, RCC is often particularly important in the delivery of primary care to diverse populations (6, 26) and can result in better care navigation and engagement among young people.(27).

However, continuity is declining. Lower continuity is associated with more clinicians working part-time, use of locums, the growth in practice size with greater numbers of clinicians in practices and patient turnover(28, 29). There is also an increased focus on patient access, rather than continuity. We currently do not know the extent to which practice-level characteristics undermine continuity or the extent to which continuity might be maintained or enhanced by within-practice policies. There are potentially many ways to optimise continuity. As no two general practices are the same, the most successful approach is likely to depend on the practice context. The Royal College of General Practitioners (RCGP) emphasises the need to measure relational continuity as a first step in its management (30).

Very few general practices monitor the impact of their within-practice policies on continuity of care and conceptions of how to measure it differ. There is a long-recognised need for consistent measures of RCC (5, 31, 32). However, choosing an appropriate measure is complex (33). Subjective measures based on patients' experience of continuity using questionnaires is impractical for monitoring (34-37). Measurement of the frequency of consultation with the same clinician is feasible using electronic health records (EHR) and correlates with subjective measures (38). But different objective measures capture different conceptions of RCC (31). Continuity may be with the GP or with any clinician; it may be in all patients or in specific patient groups (e.g. ≥65 years); it may be measured quarterly, monthly, or weekly. There are different RCC indices. Some measure density: the Usual Provider of Care index (UPC) % of consultations with most frequently seen GP, or the St Leonard's Index of Continuity of Care (SLICC) % of consultations with a named GP (39). Others measure dispersion, taking account of the number of different clinicians consulted, using the Bice-Boxerman (BB) or Herfindahl (HI) indices. There is also a measure of Sequential Continuity (SECON). **(TABLE 1)**

Table 1: Main indices of relational continuity of care (RCC)

Name	What is measured	Formula
Usual Provider of Care (UPC^{Patient})	Concentration with usual provider	$max\left(\frac{n_i}{n}\right)$
St Leonards Continuity of Care (SLICC or UPC$^{GP}_{level}$)	Concentration with named provider	$named\ clinician\left(\frac{n_i}{n}\right)$
Herfindahl Index (HI)	Concentration taking into account all providers	$\sum_{i=1}^{p}\left(\frac{n_i}{n}\right)^2$
Bice-Boxerman (BB)	Concentration accounting for the number of consultations	$\frac{\left(\sum_{i=1}^{p} n_i^2\right)-n}{n(n-1)}$
Sequential (SECON)	Sequential aspect of continuity	$\frac{\left(\sum_{j=1}^{n-1} c_j\right)}{(n-1)}$
Modified-Modified Continuity Index (MMCI)	Dispersion (lack of concentration)	$\frac{1-\frac{p}{n+0.1}}{1-\frac{1}{n+0.1}}$

p = total number of providers (clinicians); n = total number of visits during episode; n_i *= number of visits to provider i;*
c_j *= indicator of sequential visits to same providers, equal to 1 if visits j and j+1 are to the same provider, 0 otherwise*

Research has explored effects of regularity and minimum frequency of contact on patients with chronic conditions.(40, 41). For patients who consult infrequently, measured continuity is arithmetically high, therefore measured continuity declines with consultation frequency.. Some RCC measures (e.g. the Bice-Boxerman) account for this. In practice, BB, HI, UPC and SECON are often highly correlated (42). SLICC is easy to calculate at the practice level and does not require patients to have a minimum number of consultations, but it may differ from the UPC if the patient's usual GP and named GPs differ (43). A realistic strategy to improve continuity would also need to consider for which patient group it needs to be prioritised as the optimum balance between access and continuity may vary across different patient groups.

Given the complexity of the issues at stake the QUERCC study aims to develop a menu of approaches to measuring RCC, and empirically informed practical guidance to help general practices optimise it. QUERCC uses a mixed methods design across five work-packages with defined objectives **(TABLE 2)** leading toward project outputs and dissemination. To ensure QUERCC outputs are impactful the team will work closely with the RCGP and international colleagues leading research addressing the same issues in different contexts (44).

Table 2: Objectives of QUERCC study

Objectives	Work package	Outcome
Develop guidance for general practices on quantitative measurement of RCC.	WP1	A menu of approaches to measuring RCC for monitoring in primary care.
Quantify the practice-level determinants of RCC: including staff and patient turnover, part-time working, practice size and practice funding. Identify practices showing unusual variation (positive deviants) in RCC.	WP2	A model of the contribution of patient and general practice-level characteristics to trends and variations in RCC. An observed to predicted ratio of RCC in Clinical Practice Research Datalink (CPRD) practices. A list of general practices in the top decile for RCC will be abstracted and sites selected for inclusion as potential case studies.
Conduct in-depth case-studies to understand how practices achieve high RCC.	WP3	The primary output is an understanding of the practice characteristics which contribute to RCC and understanding of barriers and facilitators to RCC and the mechanisms by which RCC influences health.
Undertake economic analysis of the likely causal effects of changing RCC on resource costs and health outcomes across different segments of the registered practice population.	WP4	A model assessing the impact of changes in RCC on healthcare resources and health outcomes. The model will describe the effects of changing RCC on different population groups.
Develop empirically informed practical guidance to help general practices optimise RCC.	WP5,	Develop guidance deriving from existing research will and stakeholder input to produce in-depth empirical data on the strategies for increasing and/or maintaining RCC in primary care settings. We will document the full range of these strategies and interventions and provide a summary of evidence on their efficacy and implementation in different settings. These outputs will be a key part of our dissemination and knowledge exchange activities and will therefore inform practice in the immediate term. We will also identify areas where there might be a need for intervention *adaptation* or de novo.

METHODS AND ANALYSIS

Research design

A mixed methods approach is used to capture the complexities of continuity of care as a measurable event with associated outcomes and subjective experience and an organisational process and value. Our approach is designed to develop empirically informed strategies for improving and maintaining RCC in primary care settings (see FIGURE 1). Work packages (WPs) 1–3, will draw together insights from consensus workshops (WP1), case studies (WP3) and CPRD data (WP2) to identify factors that explain the practice level drivers of continuity of care. These findings will be integrated with the economic evaluation (WP4) leading to the development of a menu of approaches to measuring RCC, and empirically informed practical guidance to help general practices optimise it (WP5).

Figure 2 HERE

Data collection across the five work packages addresses the possible determinants of RCC (patient characteristics, patient and staff turnover, part-time and full time working, practice size and within-practice policies) and its effects, including both positive effects (on hospitalisations, consultation rates, prescribing, patient experience and mortality) and negative effects (lack of a second opinion, clinician burden). Consideration is also given the interplay between RCC and access to primary care.

Patient and public involvement and engagement

During the conception and development of this proposal we consulted with 8 patients in two workshops. Participants had lived experience of RCC becoming more difficult to maintain and something that they valued in health care. They identified more doctors working part-time, larger practices and automated booking systems and receptionists as potential barriers to continuity. These issues are also reported in the literature and informed our decision to conduct a mixed methods programme of research. We established a Patient Advisory Group PAG group (five members) in October 2023 and recruited three Patient and Public Involvement (PPI) representatives in January 2024. The study PPI lead /co-applicant (KS) came through to work on the project from the original cohort consulted in 2019. The PAG and PPI have contributed to patient facing documents developed for WP1 and WP3 and worked together to shape the content of the study website. PAG and PPI will contribute to data review across all five work packages, working with the team to maximise knowledge sharing. The PPI lead will attend monthly management meetings and three PPI members will have optional attendance to contribute to management of the project.

Theoretical framework

Synthesis and interpretation of data collected across the five work-packages will be guided by the recently updated Consolidated Framework for Implementation Research (CFIR) (45). CFIR is one of the most widely used frameworks to organise and interpret data on factors that shape implementation of change within health care settings (45, 46). It provides a framework of 39 implementation constructs which facilitates the organisation and interpretation of data across five core domains: outer setting (e.g., the economic, political, and social context), inner setting (e.g., the structural, political and cultural context where the implementation takes place, such as an organization), characteristics of individuals (e.g., attitudes, values and believes of the individuals involved) and process (e.g., components that impact the implementation process). Working in this way the analysis will aim to unpack the key components of a workable intervention.

Work package 1: Identifying areas of divergence and consensus in the measurement of RCC in two qualitative consensus workshops

Using coproduction and consensus methods across two workshops this WP aims to determine how clinicians, patients and researchers define continuity and which RCC measures they recognise as offering the best intuitive approach to its measurement. This WP opens a stakeholder debate around the development of guidance for practices and the choice of RCC index to adopt and in which populations to measure RCC which will feed into all five work packages.

Selection of workshop participants: Clinicians, patients and researchers will be recruited using purposive sampling methods. We aim to recruit through local patient networks to sample a range of patients by age, gender, ethnicity, education level and where possible chronic disease status. Professionals will be identified and recruited through national and regional professional networks who will be selected to represent a diversity of age, gender, ethnicity. Working in this way we aim to recruit a minimum of 15 – and a maximum of 30 participants with equal numbers in across the patient and professional categories.

Data collection

Data is collected face to face in two workshops convened in central Birmingham and professionally facilitated. All participants will be consented to take part and reimbursed for their time at appropriate NHS locum rates (clinicians) or INVOLVE payment guideline recommendations (lay participants).

Approach

In workshop 1 participants will be invited to contribute three key ideas on what RCC means to them and given time ahead of the workshop to write these ideas down. Once in the workshop a professional facilitator skilled in coproduction approaches and the theme lead will work with participants in three break- out groups to select a key idea to bring to a wider group discission. During the group discussion the theme lead will explain the breadth of issues in RCC measurement and participants will be asked to individually reflect on the key components of RCC (e.g. "Is continuity primarily with one GP, more than one GP or all clinicians?" "What aspects of care are most important in providing continuity?". The discussion and break out group ideas will be charted visually, and key ideas generated in the debate summarised under thematic headings. Participants will be invited to vote on key themes and the facilitator will work towards a consensual perspective using co-production methods.   Coproduction approaches will enable us to bridge any discursive gap between lay and medical understandings of RCC.

At the second workshop, which will be held approximately 2 months later, we will work with the same participants (or substitutes if some cannot attend) and professional facilitator to examine the issue of RCC measurement. The team lead will generate a series of visual scenarios and outline the pros and cons (see **TABLE 3)** of currently used indices (BB, HI, UPC$^{\text{Patient}}$ or UPC$^{\text{GP level}}$)(47, 48). We will record the discussion to aid analysis and thematic summary.

Table 3: Illustration of pros & cons of different measures of relational continuity of care

Clinician group	Patient group	Criterion	Continuity index				
			SLICC	UPC	BB	HI	Secon
Consultations with GPs only	All ages	Understandable	Good	Good	Fair	Fair	Fair
		Unaffected by consultation rate	Poor	Poor	Good	Good	Fair
		Patient conception	Fair	Fair	Good	Good	Poor
		Clinician conception	Fair	Fair	Fair	Fair	Fair
	Aged 65+ only	Understandable					
		Unaffected by consultation rate					
		Patient conception					
		Clinician conception					
Consultation with all clinical staff	All ages	Understandable					
		Unaffected by consultation rate					
		Patient conception					
		Clinician conception					
	Aged 65+ only	Understandable					
		Unaffected by consultation rate					
		Patient conception					
		Clinician conception					

Facilitated group discussion will work towards an understanding of which measure best captures continuity as understood by the stakeholder group (patients, clinicians and researchers). It is anticipated that facilitation will be supported by an online voting tool (Interactive presentation software - Mentimeter) to gauge support for different measures presented.

Data analysis

A manifest content analysis approach will be used to examine the overlap and divergence of views on the definition of continuity of care obtained in workshop 1. Summary analysis will identify the points of convergence and difference across the participant groups (clinicians, researchers, and patients). Transcripts and voting results from workshop 2 will be summarised in an Excell spreadsheet and further content analysis will summarise the range of perspectives on measurement and the value of a range of RCC indexes.

Output

We do not anticipate that the workshop data will generate a complete consensus on a single way to measure RCC but expect these stakeholder conversations to inform and sensitise analysis and modelling in WP2 and subsequent work packages.

WP2 Investigation of determinants of relational continuity of care (RCC) & identification of outliers

The aim of this work package is to investigate practice-level determinants of measured RCC in general practices and to identify practices showing unusually high continuity given their characteristics for inclusion as case studies in work package 3. We will examine how RCC is related to the practice population's characteristics (age, sex, ethnicity, chronic disease status, deprivation) and practice characteristics (practice size, patient turnover, clinician turnover, workload, part-time working, funding levels).

Data and Methods:

We will investigate the determinants of RCC using Clinical Practice Research Datalink (CPRD) data; a large primary care database linked to data on practice funding. CPRD collects fully coded and de-identified patient electronic health records from a network of GP practices using the Vision® (CPRD GOLD) or EMIS® (CPRD Aurum) software systems. CPRD data are broadly representative of the English general population (49). We will use data from the CPRD GOLD database for the period 1st January 2005 until the most recent data upload linked to the General and Personal Medical Services database (NHS Digital) from which we will obtain data on average funding per registered patient. Modelling will enable us to calculate a predicted monthly RCC for each participating general practice from this we can calculate an observed to predicted ratio of RCC. Unusual variation in a process is more likely to have an assignable cause (50). Therefore it is likely to be productive to investigate outlier practices as case studies. To shortlist potential case studies, for the most recent quartile of RCC data, we will identify the top decile of general practices by their observed to predicted ratio of RCC.

Output: A model of the contribution of patient and general practice characteristics to trends and variations in RCC. An observed to expected ratio of RCC in CPRD practices. Identification of general practices in the top decile for RCC for inclusion as potential case studies in WP3.

WP3 Qualitative case study research into determinants of continuity of care

In WP3 we will use an exploratory multiple case study design sampling deviant cases which will enable exploration and rich description of the relevant everyday processes and interactions in practices (51). Previous research suggests that selecting case studies from outliers (deviant cases) is a valid way to find out about causal pathways and causes of heterogeneity (52). For example, a similar method has been used to investigate wards providing safe hospital care (52, 53).

Sample selection

Deviant 'outlier' sites for WP3 case study will be identified during analysis of CPRD data completed in WP2. We will identify a quartile (180) with the highest continuity of care (CoC) and a quartile (180) with average CoC. Within these quartiles we will also consider the size of practices with high and low CoC and whether the populations they serve are more, or less, deprived. We aim to sample eight 'deviant' sites: six general practices from the quartile with the highest continuity of care (from the top 10%) and two general practices from those with average continuity of care (the lowest 10%).

Site recruitment

CPRD data is anonymised which means it is not possible to identify organisations prior to obtaining their agreeing to take part as case studies. To facilitate recruitment, we will enlist the CPRD agency to send invites to practices that meet the inclusion criteria on behalf of the QUERCC study. We will supply CPRD with a template letter to send out. Recruitment will be ongoing until 8 sites agree to take part. To maximise recruitment rates, we will facilitate participation by offering flexible times and either hybrid or in person options for data collection.

Participant recruitment at case study sites

We will recruit 15-30 participants at each of the eight case study sites to take part in two focus groups,: one with a range of clinical and non-clinical staff; and one with practice patient participation groups. Focus groups will be supplemented with semi-structured interviews with up to three key informants per practice (identified during the focus groups). This size and number of focus group is optimal for data collection in a case study context (54, 55).

We will aim to recruit a diversity of clinicians and patients by age, gender, ethnicity. We will also aim to select a range of patients by education level and chronic disease status and use an equality and diversity form to collect participants details anonymously. An interpreter will be made available to any potential participant whose first language is not English and wants to take part, we will translate the PIS/ E&D/ ICF documents on their behalf to enable them to fully consult the terms of the study and consider the implications of participation. We will use topic guides to structure the focus group discussion and interviews. Recruitment will exclude patients who lack capacity to consent and a lower age limit of >20 and an upper age limit of <95 years. The number of participants recruited and consented to take part will be in the region of n =72-216 (two focus groups (6-12 people) + three interviews x 8 sites).

Data analysis and synthesis

Thematic and framework approaches (56) will be used to work with qualitative data and integrate these with the findings of the quantitative data collected in WP2. Themes will be compared within and across practices, and across data collection method focus group, interview and documentary data (57). A summary of overall themes from their discussion will be sent to participants for comment. PPI representatives and members of the multi-disciplinary research team (SG, Sociologist, TM, Public Health Clinician, IW, Health Service Policy analyst) will read a selection of transcripts and documents, then discuss and agree on emerging themes to develop the data coding framework. To ensure robustness and quality our research and analysis will also be guided by the COREQ checklist for reporting qualitative research (58) and data will be 'triangulated' across the work packages data sources across the study. Comparing and synthesising data in this way will provide additional insights and enhance understandings. Overall findings will then be brought together and considered by the whole research team (59, 60).

Output: The primary output of WP3 is an understanding of the practice characteristics which contribute to RCC and understanding of barriers and facilitators to RCC and the mechanisms by which RCC influences health. A secondary output will be identifying individuals as potential advocates for general practices which have maintaining high levels of continuity. These may be research participants or individuals identified as champions within individual general practices.

WP4 Economic analysis of the effects of RCC

In this work package we will analyse the potential effects on resource use and health outcomes of changes in practice-level RCC using patient-level data. We will analyse the effects across different segments of the registered practice population.

Data and Methods

We will use primary care data from the CPRD database from 1st January 2005 until the most recent upload, with standard linkages to: i) Hospital Episode Statistics data (including inpatient admissions, outpatient appointments and A&E attendances), ii) Office for National Statistics (ONS) mortality data, and iii) area level deprivation. We will also use one non-standard linkage to funding per patient. CPRD Gold includes about 9 million patients eligible for linkage, in around 400 general practices and CPRD Aurum 38 million eligible patients in around 1400 general practices (Clinical Practice Research Datalink | CPRD.)

We will analyse the effects of RCC on i) two types of primary care use: consultations and prescribing; ii) three types of hospital use: unplanned admissions, A&E presentations, outpatient appointments; iii) costs, and iv) mortality. We will identify primary care activity from the CPRD records of consultations, clinical events, and prescription records and secondary care activity from HES inpatient, outpatient and A&E records. We will cost primary and secondary care activities using methodology that we have previously used (61).

We will undertake a patient-level analysis with the explanatory variable of interest (RCC) measured at practice level. We will undertake preliminary analyses to explore the relationship between RCC and unplanned admissions (the main driver of costs) over time. If the relationship was altered during the pandemic years we will consider whether to consider pre-pandemic and post-pandemic years separately. We will also undertake preliminary analyses to explore whether the relationship between RCC and unplanned admissions varies by chronic disease status (using chronic diseases included in the Quality and Outcomes Framework) to determine whether analysis should be segmented by chronic disease status.

The study population will consist of patients who were registered with a GP practice any time during the period from 1 January 2006 to 31 March 2021 (currently most linked data are available up to 2021). We will observe these patients until outcome or censoring, where censoring is due to the patient changing GP practice, death, or the end of the study period (date of last upload). The observation period for each patient will be divided into periods of 3 months and outcomes will be binary variables indicating whether or not the particular event occurred in each 3-month period (except from costs which are a continuous variable). For instance, a patient who was first observed on 1st January 2017 and experienced an inpatient hospitalisation in March 2018 will contribute to the data five quarters: four quarters in 2017 where the outcome takes values of zero and one quarter in 2018 where the outcome takes a value of one. The resulting dataset will be an unbalanced panel as individuals contribute to the sample different number of quarters depending on when they experience an outcome. RCC will be measured at practice level over the 12 months prior to the outcome period using the indices from WP1 (e.g. in the above example the RCC associated with patient's first observation will be measured over the period 1st January 2016 – 31st December 2016). We will include a mix of patient level confounders such as age, gender, deprivation, ethnicity, morbidity profile, prior healthcare utilisation and practice level characteristics such as practice size, practice funding, staff turnover and part-time working.

We will employ discrete time survival analysis to evaluate the association between risk of each outcome in a particular 3-month period and RCC in the prior twelve months. Specifically, we will estimate complementary log-log (cloglog) models (the discrete-time analogue of the continuous-time proportional hazards models) which are appropriate when the occurrence of an outcome is rare.

Output: A model assessing the impact of changes in RCC on healthcare resources and health outcomes. The model will help us understand the effects of changing RCC on different population segments.

09/05/24 vs 1.5

WP5 Empirically-informed practical guidance to help to improve RCC in primary care

This final phase of this research is to collate and integrate findings from different work-packages, generate and disseminate learning, and create impact. It involves co-designing principles and methodologies to develop guidance on how to improve and enhance RCC. We will develop empirically-informed practical guidance to help general practices optimise RCC using a behaviour change framework relevant to primary care interventions (62, 63) and disseminate findings to stakeholders.

Method: Co-design and dissemination

We will undertake a rapid review of evidence on within-practice interventions (64-66) making use of ongoing reviews on this topic (67). We will follow good practice and consider or 'triangulate' findings from the evidence review and this study's work packages. We will follow good practice and consider or 'triangulate' findings from the evidence review and from our own study's work packages: 0 (determinants of RCC), **Error! Reference source not found.** (detailed case-studies) and preliminary results from 0 (economic analysis). Each separate WP will have individual and stand-alone findings analysed separately using techniques appropriate to their methods, but we will additionally look at all of the different sets of findings together, to identify what each contributes to the overall picture. Comparing and contrasting individual WP findings is likely to provide additional insights and enhance overall understanding. Overall findings will then be brought together and considered by the whole research team. We will convene two 3-hour deliberative workshops (either face-to-face or online) to integrate these findings and develop practical guidance on how best to improve RCC. This process will be informed by existing research on how to ensure the needs of diverse groups are taken into consideration (68) using coproduction methods (69) to ensure that recommendations are acceptable to patients and clinicians and are deliverable (70).

As with WP1 participants will include a purposive sample of clinical and non-clinical professionals and patient representatives. Participants who attended workshops in WP1 will be given the opportunity to take part and if needed we will invite additional attendees, drawing on networks and groups identified over the life course of the study.

The first workshop will be carried out with the patients only (n = approx. 15), in order to determine their views. In this workshop we will investigate what role patients and the public might have in facilitating RCC in different settings. We will explain the background to the project and share preliminary findings from our case-studies on the characteristics of general practices associated with high RCC and the perspectives of staff and patients in these practices. Before the workshop we will summarise the findings in plain language form, for participants to read and will briefly present the findings at the start of the workshop. We will ask participants to reflect on the evidence in relation to their own experience, to identify which characteristics might form the basis of practice policies which are acceptable to patients. We will also ask them to identify any knowledge gaps. To facilitate discussion participants will be broken up into smaller groups (6 or less). The headline conclusions of the workshop will be summarised at the end of the workshop to ensure these have been captured accurately. Notes and minutes of the workshop will be collated and summarised by the research team and circulated to workshop participants for their final approval.

In the second workshop both patients and practice staff (n= approx. 30) will meet together for joint discussion. We will again provide the findings from in written form for participants to read before the workshop and briefly present findings at the start of the workshop, including key messages from the first workshop. We will ask participants to identify practice characteristics which might form the basis of acceptable and feasible practice policies on RCC. We will ask participants to achieve satisfactory agreement on the information content and medium of delivery of a final set of recommendations on optimising RCC. We will also ask participants to identify any knowledge gaps. To facilitate discussion participants will be broken up into smaller groups (6 or less). Workshops will be facilitated by a professional facilitator supported by the study team and audio-recorded, audios will be deleted following verification of anonymised transcript. Transcripts will be analysed using the principles of framework analysis with the specific purpose of informing the development of good practice principles to support RCC (71). The research team will then draft a written document with recommendations and circulate this to participants for final comment.

Output and dissemination

A key benefit of our work is involvement of patients in the wider debate around the measurement and definition of RCC. A key output will include findings on the causes of declining RCC, its effects and solutions to the problem. For a lay audience, we will create a project website and commission a short animation version of our final report to communicate findings in an accessible way. A project website will make available regular publicly accessible bulletins of interest to the general public. We will initiate a social media campaign to garner interest in and share information about the project and will share research progress and encourage feedback via blogs and personal stories of continuity of care. Through our digital profile we will engage with patient groups and 3rd sector organisations as intermediaries and knowledge brokers to help us develop an effective implementation and dissemination strategy and to ensure we engage heterogeneous groups of stakeholders. We will engage with software manufacturers to share findings on measurement of RCC in primary care to stimulate work on development of tools to measure RCC. To directly reach primary-care clinicians we will develop a podcast or short video with the Personalised Care Institute to disseminate to clinicians and have fully costed development of two webinars and a package of marketing and communications with the RCGP. The University of Birmingham's Centre for Primary Care Improvement will create a postgraduate module for primary care professionals on managing continuity of care.

Declaration of Helsinki

This study complies with the Declaration of Helsinki, adopted by the 18th World Medical Association (WMA) General Assembly, Helsinki, Finland, June 1964 and last revised by the 64th WMA General Assembly, Fortaleza, Brazil, October (2013).

Acknowledgements

The study team thank the participants of the workshops held during the development of the project and our PAG group and PPI members who have contributed to the development of the research.

Author Contributions

Tom Marshall: Conception and design, acquisition, and analysis of data, drafting, writing, and approving content for publication.
Iestyn Williams: Conception and design, acquisition, and analysis of data, drafting, writing, and approving content for publication.
Krishnarajah Nirantharakumar: Conception and design, acquisition, and analysis of data, and approving content for publication.
Brian Willis, Conception and design, acquisition, and analysis of data, and approving content for publication.
Panagiotis Kasteridis: Conception and design, acquisition, and analysis of data, drafting, writing, and approving content for publication.
Kamil Sterniczuk: Design, PPI coordination reviewing and approving content for publication.
Fiona Scheibl, Acquisition, and analysis of data, drafting writing and approving content for publication.
Jinyang Chen: Acquisition and analysis of data, commenting and reviewing manuscript approving content for publication.
Zecharias Anteneh: Acquisition and analysis of data, commenting and reviewing manuscript approving content for publication.
Sheila Greenfield: Conception and design, acquisition, and analysis of data, drafting, writing and approving content for publication.

conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND

Drafting the work or reviewing it critically for important intellectual content; AND

Final approval of the version to be published; AND

Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Conflicting interests

None

REFERENCES

1. Haggerty JL, Reid RJ, Freeman GK, Starfield BH, Adair CE, McKendry R. Continuity of care: a multidisciplinary review. Bmj. 2003;327(7425):1219-21.
2. Nowak DA, Sheikhan NY, Naidu SC, Kuluski K, Upshur REG. Why does continuity of care with family doctors matter? Review and qualitative synthesis of patient and physician perspectives. Can Fam Physician. 2021;67(9):679-88.
3. Murphy M, Salisbury C. Relational continuity and patients' perception of GP trust and respect: a qualitative study. Br J Gen Pract. 2020;70(698):e676-e83.
4. Rolfe A, Cash-Gibson L, Car J, Sheikh A, McKinstry B. Interventions for improving patients' trust in doctors and groups of doctors. Cochrane Database Syst Rev. 2014;2014(3):Cd004134.
5. Saultz JW, Lochner J. Interpersonal continuity of care and care outcomes: a critical review. Ann Fam Med. 2005;3(2):159-66.
6. Tarrant C, Dixon-Woods M, Colman AM, Stokes T. Continuity and trust in primary care: a qualitative study informed by game theory. Ann Fam Med. 2010;8(5):440-6.
7. Waibel S, Henao D, Aller MB, Vargas I, Vázquez ML. What do we know about patients' perceptions of continuity of care? A meta-synthesis of qualitative studies. Int J Qual Health Care. 2012;24(1):39-48.
8. Fernholm R, Holzmann MJ, Malm-Willadsen K, Härenstam KP, Carlsson AC, Nilsson GH, et al. Patient and provider perspectives on reducing risk of harm in primary health care: a qualitative questionnaire study in Sweden. Scand J Prim Health Care. 2020;38(1):66-74.
9. Morris RL, Stocks SJ, Alam R, Taylor S, Rolfe C, Glover SW, et al. Identifying primary care patient safety research priorities in the UK: a James Lind Alliance Priority Setting Partnership. BMJ Open. 2018;8(2):e020870.
10. Cheng SH, Chen CC, Hou YF. A longitudinal examination of continuity of care and avoidable hospitalization: evidence from a universal coverage health care system. Arch Intern Med. 2010;170(18):1671-7.
11. Cunningham C, Patil T, Shahid R, Patel AB, Oddie S. Patient-Physician Relational Continuity and Health System Utilization among Patients in Alberta. Healthc Q. 2020;22(4):13-21.
12. Tammes P, Purdy S, Salisbury C, MacKichan F, Lasserson D, Morris RW. Continuity of Primary Care and Emergency Hospital Admissions Among Older Patients in England. Ann Fam Med. 2017;15(6):515-22.
13. Barker I, Steventon A, Deeny SR. Association between continuity of care in general practice and hospital admissions for ambulatory care sensitive conditions: cross sectional study of routinely collected, person level data. Bmj. 2017;356:j84.
14. Raivio R, Holmberg-Marttila D, Mattila KJ. Patients' assessments of the continuity of primary care in Finland: a 15-year follow-up questionnaire survey. Br J Gen Pract. 2014;64(627):e657-63.
15. Sandvik H, Hetlevik Ø, Blinkenberg J, Hunskaar S. Continuity in general practice as predictor of mortality, acute hospitalisation, and use of out-of-hours care: a registry-based observational study in Norway. Br J Gen Pract. 2022;72(715):e84-e90.
16. Cho KH, Kim YS, Nam CM, Kim TH, Kim SJ, Han KT, et al. The Association between Continuity of Care and All-Cause Mortality in Patients with Newly Diagnosed Obstructive Pulmonary Disease: A Population-Based Retrospective Cohort Study, 2005-2012. PLoS One. 2015;10(11):e0141465.
17. Wasson JH, Sauvigne AE, Mogielnicki RP, Frey WG, Sox CH, Gaudette C, et al. Continuity of outpatient medical care in elderly men. A randomized trial. Jama. 1984;252(17):2413-7.
18. Kao YH, Wu SC. STROBE-compliant article: Is continuity of care associated with avoidable hospitalization among older asthmatic patients? Medicine (Baltimore). 2016;95(38):e4948.
19. Ride J, Kasteridis P, Gutacker N, Doran T, Rice N, Gravelle H, et al. Impact of family practice continuity of care on unplanned hospital use for people with serious mental illness. Health Serv Res. 2019;54(6):1316-25.

20. Kim W, Jang SY, Lee TH, Lee JE, Park EC. Association between continuity of care and subsequent hospitalization and mortality in patients with mood disorders: Results from the Korea National Health Insurance cohort. PLoS One. 2018;13(11):e0207740.

21. Chan KS, Wan EY, Chin WY, Cheng WH, Ho MK, Yu EY, et al. Effects of continuity of care on health outcomes among patients with diabetes mellitus and/or hypertension: a systematic review. BMC Fam Pract. 2021;22(1):145.

22. Delgado J, Evans PH, Gray DP, Sidaway-Lee K, Allan L, Clare L, et al. Continuity of GP care for patients with dementia: impact on prescribing and the health of patients. Br J Gen Pract. 2022;72(715):e91-e8.

23. Sabety AH, Jena AB, Barnett ML. Changes in Health Care Use and Outcomes After Turnover in Primary Care. JAMA Intern Med. 2021;181(2):186-94.

24. Skarshaug LJ, Kaspersen SL, Bjørngaard JH, Pape K. How does general practitioner discontinuity affect healthcare utilisation? An observational cohort study of 2.4 million Norwegians 2007-2017. BMJ Open. 2021;11(2):e042391.

25. Pereira Gray DJ, Sidaway-Lee K, White E, Thorne A, Evans PH. Continuity of care with doctors-a matter of life and death? A systematic review of continuity of care and mortality. BMJ Open. 2018;8(6):e021161.

26. Lautamatti E, Sumanen M, Raivio R, Mattila KJ. Continuity of care is associated with satisfaction with local health care services. BMC Fam Pract. 2020;21(1):181.

27. van Walraven C, Oake N, Jennings A, Forster AJ. The association between continuity of care and outcomes: a systematic and critical review. J Eval Clin Pract. 2010;16(5):947-56.

28. Winkel MTT, Slottje P, de Kruif AJ, Lissenberg-Witte BI, van Marum RJ, Schers HJ, et al. General practice and patient characteristics associated with personal continuity: a mixed-methods study. Br J Gen Pract. 2022;72(724):e780-e9.

29. Kajaria-Montag HaF. Explaining the Erosion of Relational Care Continuity: An Empirical Analysis of Primary Care in England In: INSEAD, editor. 2020.

30. RCGP. Continuity of care resources RCGP; 2022 [Available from: https://elearning.rcgp.org.uk/mod/book/tool/print/index.php?id=12895.

31. Salisbury C, Sampson F, Ridd M, Montgomery AA. How should continuity of care in primary health care be assessed? Br J Gen Pract. 2009;59(561):e134-41.

32. Freeman G HJ. Continuity of care and the patient experience. An inquiry into the quality of general practice in England. . The King's Fund; 2010.

33. Jackson C, Ball L. Continuity of care: Vital, but how do we measure and promote it? Aust J Gen Pract. 2018;47(10):662-4.

34. Ball LE, Barnes KA, Crossland L, Nicholson C, Jackson C. Questionnaires that measure the quality of relationships between patients and primary care providers: a systematic review. BMC Health Serv Res. 2018;18(1):866.

35. Dolovich LR, Nair KM, Ciliska DK, Lee HN, Birch S, Gafni A, et al. The Diabetes Continuity of Care Scale: the development and initial evaluation of a questionnaire that measures continuity of care from the patient perspective. Health Soc Care Community. 2004;12(6):475-87.

36. Uijen AA, Schers HJ, Schellevis FG, Mokkink HG, van Weel C, van den Bosch WJ. Measuring continuity of care: psychometric properties of the Nijmegen Continuity Questionnaire. Br J Gen Pract. 2012;62(600):e949-57.

37. Hill KM, Twiddy M, Hewison J, House AO. Measuring patient-perceived continuity of care for patients with long-term conditions in primary care. BMC Fam Pract. 2014;15:191.

38. Tousignant P, Diop M, Fournier M, Roy Y, Haggerty J, Hogg W, et al. Validation of 2 new measures of continuity of care based on year-to-year follow-up with known providers of health care. Ann Fam Med. 2014;12(6):559-67.

39. Sidaway-Lee K, Gray DP, Evans P. A method for measuring continuity of care in day-to-day general practice: a quantitative analysis of appointment data. Br J Gen Pract. 2019;69(682):e356-e62.

40. Ha NT, Harris M, Preen D, Moorin R. Time protective effect of contact with a general practitioner and its association with diabetes-related hospitalisations: a cohort study using the 45 and Up Study data in Australia. BMJ Open. 2020;10(4):e032790.

41. Einarsdóttir K, Preen DB, Emery JD, Holman CD. Regular primary care plays a significant role in secondary prevention of ischemic heart disease in a Western Australian cohort. J Gen Intern Med. 2011;26(10):1092-7.

42. Pollack CE, Hussey PS, Rudin RS, Fox DS, Lai J, Schneider EC. Measuring Care Continuity: A Comparison of Claims-based Methods. Med Care. 2016;54(5):e30-4.

43. Swanepoel R, editor Poster presentation BJGP 2020.

44. Te Winkel MT, Damoiseaux-Volman BA, Abu-Hanna A, Lissenberg-Witte BI, van Marum RJ, Schers HJ, et al. Personal Continuity and Appropriate Prescribing in Primary Care. Ann Fam Med. 2023;21(4):305-12.

45. Damschroder LJ, Reardon CM, Widerquist MAO, Lowery J. The updated Consolidated Framework for Implementation Research based on user feedback. Implementation Science. 2022;17(1):75.

46. van Scherpenseel MC, te Velde SJ, Veenhof C, Emmelot-Vonk MH, Barten JA. Contextual determinants influencing the implementation of fall prevention in the community: a scoping review. Frontiers in Health Services. 2023;3.

47. Bice TW, Boxerman SB. A quantitative measure of continuity of care. Med Care. 1977;15(4):347-9.

48. Jee SH, Cabana MD. Indices for continuity of care: a systematic review of the literature. Med Care Res Rev. 2006;63(2):158-88.

49. Herrett E, Gallagher AM, Bhaskaran K, Forbes H, Mathur R, van Staa T, et al. Data Resource Profile: Clinical Practice Research Datalink (CPRD). Int J Epidemiol. 2015;44(3):827-36.

50. Shewhart, W A. Economic control of quality of manufactured product. New York Springer; 1931 1931.

51. Yin R, K, . Case Study Research Design and Methods. Applied Soc Res Methods Series, Sage, Vol 5: Sage; 1994.

52. Baxter R, Taylor N, Kellar I, Lawton R. A qualitative positive deviance study to explore exceptionally safe care on medical wards for older people. BMJ Quality & Safety. 2019;28(8):618.

53. Maatla T, Kerry A, David C, Sarah D, Lisa D, James F, et al. Intervening to eliminate the centre-effect variation in home dialysis use: protocol for Inter-CEPt—a sequential mixed-methods study designing an intervention bundle. BMJ Open. 2022;12(6):e060922.

54. Fusch PI, Ness LR. Are we there yet? Data saturation in qualitative research. Qualitative report. 2015;20(9):1408-16.

55. Wilkie P. Patient participation groups in general practice: Building better partnerships. Br J Gen Pract. 2016;66(652):548-9.

56. Gale NK, Heath G, Cameron E, Rashid S, Redwood S. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. BMC Med Res Methodol. 2013;13:117.

57. Braun V, Clarke V. Toward good practice in thematic analysis: Avoiding common problems and be(com)ing a knowing researcher. Int J Transgend Health. 2023;24(1):1-6.

58. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007;19(6):349-57.

59. O'Cathain A, Murphy E, Nicholl J. Three techniques for integrating data in mixed methods studies. Bmj. 2010;341:c4587.

60. Tariq S, Woodman J. Using mixed methods in health research. JRSM Short Rep. 2013;4(6).

61. Ride J, Kasteridis P, Gutacker N, Aragon Aragon MJ, Jacobs R. Healthcare Costs for People with Serious Mental Illness in England: An Analysis of Costs Across Primary Care, Hospital Care, and Specialist Mental Healthcare. Appl Health Econ Health Policy. 2020;18(2):177-88.

62. Mather M, Pettigrew LM, Navaratnam S. Barriers and facilitators to clinical behaviour change by primary care practitioners: a theory-informed systematic review of reviews using the Theoretical Domains Framework and Behaviour Change Wheel. Systematic Reviews. 2022;11(1):180.

63. Davis R, Campbell R, Hildon Z, Hobbs L, Michie S. Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. Health Psychol Rev. 2015;9(3):323-44.

64. Groot LJJ, Schers HJ, Burgers JS, Schellevis FG, Smalbrugge M, Uijen AA, et al. Optimising personal continuity for older patients in general practice: a study protocol for a cluster randomised stepped wedge pragmatic trial. BMC Family Practice. 2021;22(1):207.

65. El Turabi A. Unintended Consequences: Empirical Studies of Continuity of Care in Primary Care. : Harvard University. ; 2019.

66. Foundation TH. Increasing Continuity of Care in General Practice 2020.

67. Coombs C, Cohen T, Duddy C, Mahtani KR, Owen E, Roberts N, et al. Primary care micro-teams: an international systematic review of patient and healthcare professional perspectives. Br J Gen Pract. 2023;73(734):e651-e8.

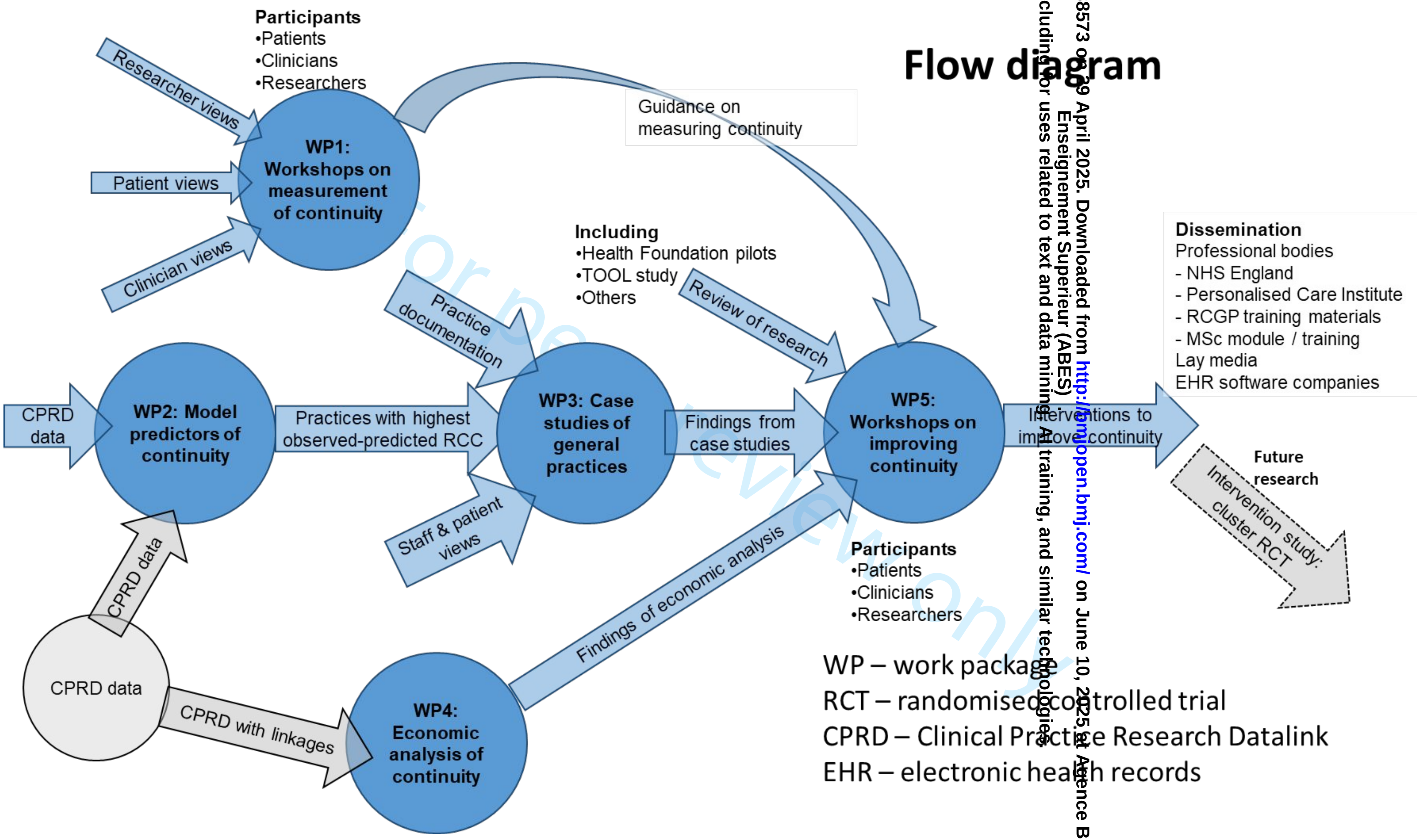
68. Sandra M, Michelle W-W, Gillian M, Sean P, Alexis B, Michelle P, et al. Are you really doing ‘codesign’? Critical reflections when working with vulnerable populations. BMJ Open. 2020;10(11):e038339.

69. Realpe BA WL. What is Coproduction What is Coproduction? [Internet]. 2010 3 5 2024. Available from: https://www.qi.elft.nhs.uk/wp-content/uploads/2017/01/what_is_co-production.pdf.

70. Asbury N, Walshe A. Involving women with breast cancer in the development of a patient information leaflet for anticipatory nausea and vomiting. Eur J Oncol Nurs. 2005;9(1):33-43.

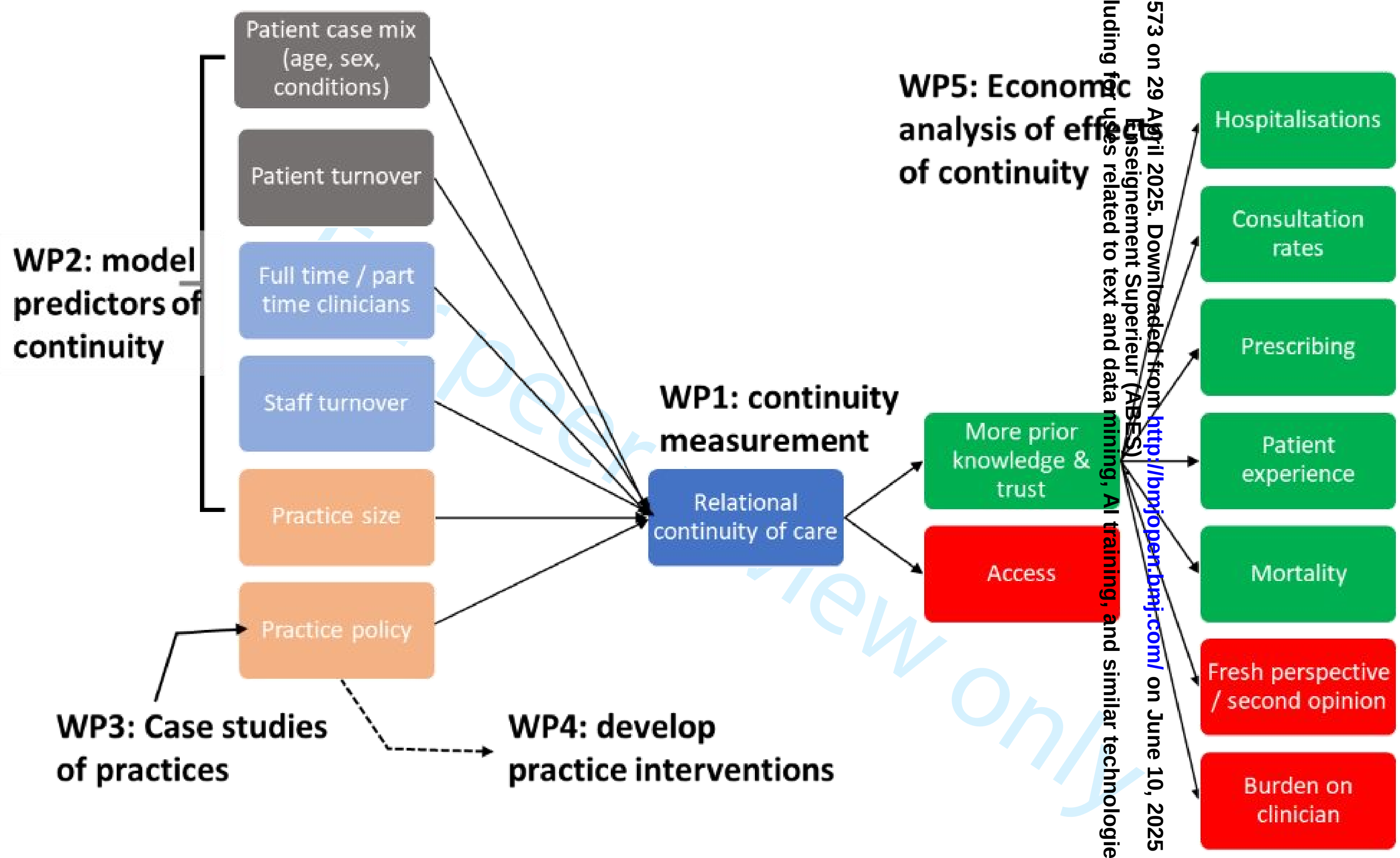
71. O'Cathain A, Murphy E, Nicholl J. The Quality of Mixed Methods Studies in Health Services Research. Journal of Health Services Research & Policy. 2008;13(2):92-8.

Figure 1 QUERCC Work packages and description of data sets, data collection and analysis



WP – work package
RCT – randomised controlled trial
CPRD – Clinical Practice Research Datalink
EHR – electronic health records

Figure 2: Work packages addressing the core determinants of and effects of relational continuity of care



1 Full title of project

Quantifying, Understanding and Enhancing Relational Continuity of Care (QUERCC)

2 Summary of Research (abstract)

Relational continuity of care (RCC) is the extent to which patients see the same clinicians over time. Considered a core feature of general practice, it is linked to patient satisfaction and better health outcomes, especially for older patients, those with long-term conditions and the vulnerable. Although current NHS policy is to maintain continuity for patients with long-term conditions, it has been declining for at least a decade. Contributing factors are thought to include growth in practice size, more part-time working, greater staff and patient turnover. It may also be because practice policies have focused on access, rather than continuity.

Because they often neither measure nor monitor it, general practices may be unaware how their within-practice policies impact RCC. Furthermore, conceptions of RCC differ between clinicians and between patients, and there are different ways of measuring RCC which reflect these different conceptions. A shared understanding of continuity will help practices decide on the purpose of measurement, what they want to measure and which RCC index best meets their aims. We do not know the extent to which practice-level characteristics - practice size, part-time working, staff turnover and patient turnover - affect RCC. We therefore do not know the extent to which within-practice policies to maintain RCC can mitigate the effects of practice-level characteristics. The health of older patients and those with chronic diseases may benefit most from continuity. The optimum balance between access and continuity may therefore vary across different patient groups. For a realistic strategy to improve RCC it would help to know if there are groups in which there is a stronger case for RCC and in which it should therefore be prioritised. There are potentially many ways to optimise continuity. As no two general practices are the same, the most successful approach is likely to depend on the practice context. This project uses a variety of methodologies to address these questions, with the overall aim of helping practices optimise continuity of care.

First, we will develop an understanding of RCC to help practices determine how best to measure and monitor their own RCC. This will be achieved by hosting consensus workshops of patients, primary care clinicians and researchers.

Second, in a large number of general practices, we will model the association between RCC and practice-level characteristics including staff turnover, part-time working, practice size and if linkage is possible, practice funding per patient. From this we will understand the drivers of RCC and identify practices showing higher-than-predicted RCC (positive deviants) for investigation as case studies.

Third, we will undertake detailed case studies in a sample of general practices, focusing on positive deviants. We will explore staff and patient experience of continuity (including possible trade-offs between access and continuity) and investigate the interplay between measured RCC and informational or management continuity. We will identify practice policies contributing to RCC, along with barriers and facilitators to their implementation. Qualitative findings will be triangulated with the practice's measured continuity and subjectively reported continuity in the General Practice Patient Survey (GPPS).

Fourth, we will undertake economic analysis to estimate the projected effects of RCC on resource costs and health outcomes, using linked primary and secondary care data. This will help us understand the likely effects of changing RCC in a general practice and whether these effects vary in different patient groups (by age, sex, deprivation status and chronic disease status).

Fifth, we will develop empirically-informed practical guidance to improve continuity of care, collating findings of our quantitative analysis of predictors of RCC, case studies, economic analysis, and existing work on continuity of care in the UK and internationally.

We have already established links to report our findings to, and develop training materials for, the Royal College of General Practitioners (RCGP). Patient and public involvement (PPI) is embedded in the project. Our PPI co-applicant will chair a lay advisory group whom we will consult quarterly and will be trained in and contribute to analysis of qualitative data.

3 Background and Rationale

Continuity of care can include **informational** continuity, sharing information between clinicians and organisations; **management** continuity, following the same management plan across different clinicians and organisations; and **relational** continuity, patients seeing the same clinician.[1] Informational and management continuity are facilitated by shared medical records and treatment plans. Both are also enabled and supported through relational continuity, an ongoing affiliation between a clinician and a patient across many illness episodes.[2] This project focuses on relational continuity of care (RCC) in primary care. RCC is important for two main reasons: it is valued by patients and GPs, and it is associated with better health care delivery and with better health. Policy documents express the need to maintain RCC for patients to whom it is important.[3,4] Professional bodies actively promote increasing RCC.[5] In the UK concerns about declining RCC have been identified as a potential disadvantage of the advent of primary care networks and large practices.[6]

Valued by patients

Patients value continuity of care, especially older patients and those with chronic conditions and it is strongly linked to positive patient experience.[7,8] They associate RCC with doctors taking responsibility, trust, respect, safety and avoiding having to repeat their story.[7,9,10,11,12,13,14] Evidence suggests continuity is important in delivery of primary care to diverse populations. In the UK those not in work, women, South Asians, with chronic conditions or mental health problems more often prefer continuity (i.e. have a preferred GP) but reported continuity is lower in some of these groups (South Asians, blacks and women).[15,16] Among young people, relational continuity with a GP is associated with better health care system navigation and engagement.[17] Multimorbid patients also say it helps them navigate health care systems and to feel safe.[18,19]

Systematic review of qualitative research has identified a high degree of congruence between doctors' and patients' views of RCC. Both doctors and patients see it as enabling person-centred care; increasing quality of care; and giving patients greater confidence in medical decision-making. Both groups also identify some drawbacks (access, overfamiliarity, physician burden). Both see absence of RCC leading to harm (misdiagnosis, patients withdrawing from care) and loss of trust in the care team.[20] In a quantitative analysis of survey data, having a named GP and being proactive in seeking to use them were both strong predictors of satisfaction with primary care.[21]

In the conception and development of this proposal we consulted 8 patients in 2 workshops in 2019. Participants felt RCC was important and shared many narratives illustrating RCC or its absence in primary care consultations. They generally stressed the importance of developing a relationship with a GP and avoiding the need to explain their circumstances at every visit. They felt continuity would reduce over prescription and unnecessary medication changes. Some felt RCC was crucial, but others were less concerned about seeing the same GP or even valued a different GP's opinion. All participants acknowledged the importance of continuity for patients with long term conditions, the elderly, and more disadvantaged patients. They perceived RCC as becoming more difficult to maintain with longer waiting times and pressure on health services to provide better access. They identified part-time working, larger practices and automated booking systems as potential barriers to continuity and identified receptionists as playing a key role in continuity. When asked about measuring continuity patients emphasised that RCC did not have to be with a single GP but a small number of GPs (e.g. 2 to 3) would count as continuity. They also said continuity could be with another healthcare professional (e.g. a nurse). They were supportive of the proposed research, some adding that it was important to elicit the views of healthcare professionals on continuity. We found a striking congruence between the personal observations and intuitions of our patient participants and the findings of published research. This suggests patients have considerable insight into RCC and have an important role in shaping this research.

Valued by GPs

Research shows GPs identify RCC as the most essential feature of general practice but consider it has been eroded by changes in working practices.[15,22,23,24] Like patients, they see it as having an important role in patient safety.[25] Doctors see RCC as particularly important for patients with serious, chronic, complex, or psychological problems.[20] They also say it brings joy and meaning to their work.[20] The RCGP values RCC, encouraging research and supporting practices to improve continuity.[5] Recent policy emphasises the need to preserve RCC for patients with long-term conditions, but while policy mandates extended opening hours to improve access, it gives no advice on how to improve continuity.[3]

In preparation for this bid, in May 2019 we surveyed 43 GPs from teaching practices. Respondents overwhelmingly confirmed they viewed RCC as important to GPs and patients, that it influences health and is generally declining. Importantly for this proposed research, two thirds believed it is possible to increase RCC and the vast majority wanted to know how to do so. Views on regular measurement of RCC were more nuanced: 21% felt it would be useful, 21% felt it would not, but most were uncertain of its value. Themes in free-text comments included: tension between rapid access and continuity; the greater importance of RCC for older patients and those with long-term conditions; challenges to continuity posed by part-time working and trends towards larger practices. A few GPs also drew attention to drawbacks of RCC and the value of a second opinion. Others suggested interventions to improve continuity, such as patients having assigned GPs or receptionist training.

Continuity is linked to health outcomes

Longstanding evidence shows RCC is associated with reduced emergency care consultations, unplanned admissions and even mortality.[26,27,28,29,30,31,32,33] This is true for patients with diabetes, COPD, asthma, serious mental illness and dementia.[34,35,36,37,38,39] Natural experiments provide further evidence of causation: disruption of RCC by departure of a physician is followed by increased use of specialty, urgent, and emergency care by older patients.[40,41] Systematic reviews of RCC in both primary care and specialist settings, have found an association with reduced mortality.[42,43]

Continuity is linked to resource use

RCC in primary care is associated with reduced health care resource use in secondary care.[44,45] Recent analyses confirms RCC is associated with reduced emergency department attendance;[46] reduced hospital readmission in patients with stroke;[47] older patients,[48] patients with dementia,[49] and with serious mental illness.[50] A Norwegian cohort study also found continuity measured at a practice level to be associated with significant reductions in emergency admissions.[51] RCC is also associated with reduced resource use in primary care. Analysis of UK primary care data found patients aged 65+ at the 25th rather than the 75th percentile of measured RCC, have 56 per 1000 fewer emergency admissions and 900 per 1000 fewer GP consultations annually.[52] This is equivalent to 1708 fewer consultations and 106 fewer admissions for an average practice (list 8757 of whom 22% are 65+). While higher RCC may have as significant impact on healthcare utilisation and health outcomes it is likely the impact also across different population groups, no economic analysis has quantified the costs and benefits of higher RCC or how this may vary by patient age, socioeconomic status and chronic disease status.

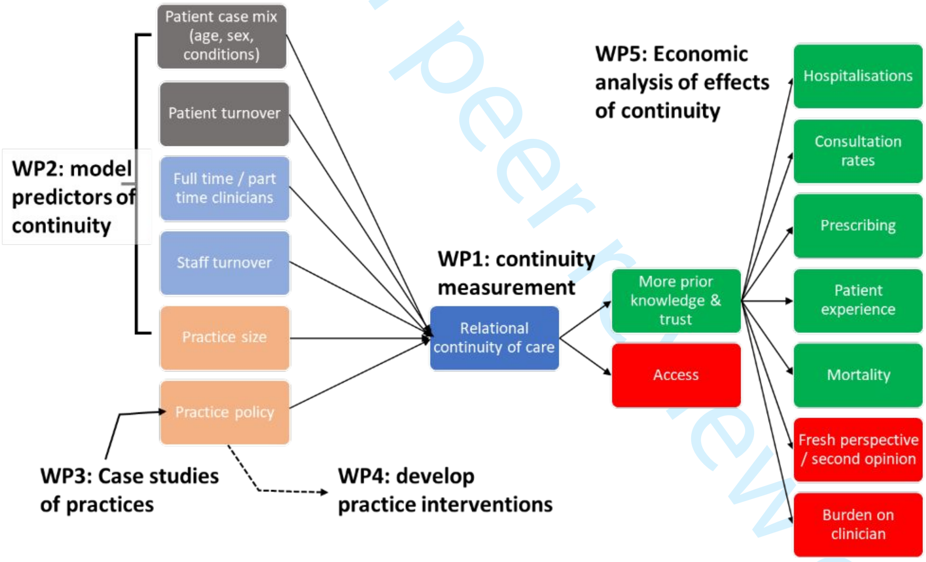
Drawbacks of continuity

Potential disadvantages of RCC include the value of a second opinion and increased burden on individual GPs. There is a potential trade-off between access and continuity for both patients and practices. Patients value rapid access for acute problems and may prioritise access over continuity.[53,54,55,56,57] In an analysis of 287 Catalonian general practices, those optimised for access had poorer continuity.[58] Yet, improving access may also improve continuity. An analysis of 190 primary care physicians that improved their access also increased RCC.[46] Moreover, in the long run, higher continuity may improve access by reducing demand, with over 65s in the highest quartile of RCC having 0.9 fewer GP visits per year than those in the lowest.[52] Figure 1 illustrates the possible determinants of RCC (patient characteristics, patient and staff turnover, part-time and full time working, practice size and within-practice policies) and its effects. Both positive effects (on hospitalisations, consultation rates, prescribing, patient experience and mortality) and negative effects (lack of a second opinion, clinician burden) are thought to be mediated through better clinician knowledge and patient trust. RCC also has effects on access.

Mechanisms by which RCC may influence health
There are a number of ways in which RCC could influence health and health service use. Qualitative research suggests longitudinal RCC increases GP communication with, knowledge of, and responsibility for patients.[2,9,59] It reduces the tendency for successive GPs to deal only with immediate problems.[9,60] Patients with a deep relationship with their GP discuss more problems and issues.[61] However, we don't fully know how RCC influences health in different contexts.

RCC seems to influence GP decision-making. Personal knowledge of patients affects diagnostic test and referral decisions, and GPs interpret patients' symptoms in the light of personal knowledge about how likely they are to consult.[62] RCC reduces antibiotic prescribing for self-limiting illness in children.[63] Comparing the 25th to the 75th percentile of RCC, patients aged over 65 are prescribed antibiotics less frequently (aOR=0.58; 95%CI: 0.56-0.66) and if prescribed any, receive fewer (aRR=0.66; 95%CI: 0.58-0.75).[52] RCC is associated with more appropriate prescribing in patients with dementia.[39] GPs are more likely to deprescribe if they know the patient.[64]

Figure 1: Determinants of and effects of relational continuity of care



RCC may also affect patients' knowledge and behaviour. Studies report associations with better chronic disease management,[65,66,67] better medication adherence,[68,69,70,71,72,73] patient behaviour change[74] and a reduced intention to use emergency departments.[75] These associations between RCC and health care delivery processes, patient intentions and patient outcomes are plausible explanations for the relationship between RCC and health outcomes.

Measurement of RCC
There is a long-recognised need for consistent measures of RCC.[31,60,76] The RCGP emphasises the need to measure relational continuity as a first step in its management.[5] But choosing an appropriate measure is complex.[77] Subjective RCC (the patient's experience of continuity), measured through questionnaires, is impractical for monitoring.[78,79,80,81] Objective RCC measurement (a quantitative measure of frequency of consultation with the same clinician) is feasible using electronic health records (EHR) and correlates with subjective measures.[82] But different objective measures capture different conceptions of RCC.[83] Continuity may be with the GP or with any clinician; it may be in all patients or in specific patient groups (e.g. ≥65 years); it may be measured quarterly, monthly, or weekly. There are different RCC indices. Some measure density: Usual Provider of Care index (UPC) % of consultations with most frequently seen GP, or the St Leonard's Index of Continuity of Care (SLICC) % of consultations with a named GP.[84] Others measure dispersion, taking account of the number of different clinicians consulted, using the Bice-Boxerman (BB) or Herfindahl (HI) indices. There is a measure of Sequential Continuity (SECON). (Table 1) Research has also explored effects of regularity and minimum frequency of

contact on patients with chronic conditions.[85,86] Density measures decline with consultation frequency but dispersion measures are less affected.[52] In practice, BB, HI, UPC and SECON are often highly correlated.[87] SLICC is easy to calculate at the practice level and does not require patients to have a minimum number of consultations, but it may differ from the UPC if the patients' usual GP and named GPs differ.[88]

There are questions about measuring RCC and the answers vary with the aim of measurement. Should RCC be measured only in older or chronic disease patients? Should it include consultations with all clinicians or only with GPs? Should RCC reflect the patient's, the doctor's, or the healthcare system's perspectives of RCC? Over what time period should RCC be assessed? Which RCC index should be used?[76] A measure of RCC should be practical, understandable and reflect what patients and clinicians mean by continuity. For example, our patient workshop participants (see above) emphasised RCC could be provided by non-GP clinicians, or by 2 or 3 rather than 1 clinician. This view is consistent with a RCC index including consultations with all clinicians and measuring dispersion. But density indices are more widely used and to date no measure includes consultations with non-GPs. Our survey of 43 GPs (see above) revealed some support for monthly (or 2-3 monthly) RCC monitoring. While measurement of RCC is both feasible and useful, the aims of measurement vary and neither what to measure nor the optimum choice of index are clear.

Table 1: Main indices of relational continuity of care (RCC)

Name	What is measured	Formula
Bice-Boxerman (BB)	Dispersion	$\frac{\left(\sum_{i=1}^{p} n_i^2\right) - n}{n(n-1)}$
Herfindahl Index (HI)	Density	$\sum_{i=1}^{p} \left(\frac{n_i}{n}\right)^2$
Usual Provider of Care (UPC$^{\text{Patient}}$)	Density	$max\left(\frac{n_i}{n}\right)$
St Leonards Continuity of Care (SLICC or UPC$^{\text{GP level}}$)	Density	$named\ clinician\left(\frac{n_i}{n}\right)$
Sequential (SECON)	Handoffs	$\frac{\left(\sum_{j=1}^{n-1} c_j\right)}{(n-1)}$

p = total number of providers (clinicians); n = total number of visits during episode; n_i *= number of visits to provider i;*
c_j *= indicator of sequential visits to same providers, equal to 1 if visits j and j+1 are to the same provider, 0 otherwise*

Trends in RCC in the UK

RCC is declining.[32,89,90,91,92] In the GPPS, subjectively reported continuity (seeing preferred GP a lot, almost always or always) fell from 73% in 2011 to 45% in 2021.[93] From 2011 to 2017, it fell more rapidly in older patients, but downward trends were similar by sex, ethnicity and deprivation status.[16] The decline was observed across rural or urban practices, with high or low baseline continuity, and high or low deprivation.[94] The decline was faster (-6.6%) in practices that grew larger between 2013 and 2017 than those that did not.[95] The downward trend continued from 2018 to 2021: falling from 59% to 49% in those aged 65+, and from 47% to 44% in those aged <65. The underlying trend in continuity continued in the Covid-19 pandemic, declining in all age groups from 2019 to 2020. But in 2021 it then rose slightly in those aged <55, stabilised in ages 55-64, and fell further in those aged 65+.[93] Within general practices, subjective continuity shows some consistency over time: 40% of practices in the top quintile and 52% in the bottom quintile of continuity in 2011 were in the same quintiles in 2021. [TM analysis of GPPS]

Objectively measured RCC shows similar trends. In an analysis of 100 general practices' electronic health records, RCC declined from 2007 to 2016, with greater declines among patients aged ≥75 years or with ≥3 comorbidities. This analysis also found that the rate of decline varied greatly between general practices.[52]

Determinants of relational continuity of care (RCC)

In Canada, RCC was observed to vary both by practice and patient characteristics.[96] It was lower in city practices, practices with more doctors and in some types of practice organisation. It also varied by patient age, sex, ethnicity, length of time in the practice and the presence of psychological or longstanding problems. In the UK 20 years ago, RCC was shown to be markedly lower in practices with over 6300 registered patients, but higher in practices with personal list systems, higher in older patients and those with long-term conditions.[92] As the average UK practice now has ≈9000 patients, growing practice size is one external practice-level factor which may explain declining RCC. Others include, scaling-up of practices into networks,[97] increased part-time working by GPs, greater patient turnover and greater turnover of GPs.[98,99,100] Indeed GP turnover is directly associated with unplanned hospital admissions. However, declining RCC may not be inevitable. The association between RCC and practice organisation (e.g. personal list systems) and extent of between-practice variation suggests general practices can still influence RCC through their within-practice policies. Indeed, some large practices (list sizes >10,000) report intentionally maintaining or increasing RCC.[101,102] We need to identify what these general practices do that enables them to maintain high RCC, and establish if their policies might be desirable and practical in other general practices.

Interventions to improve RCC

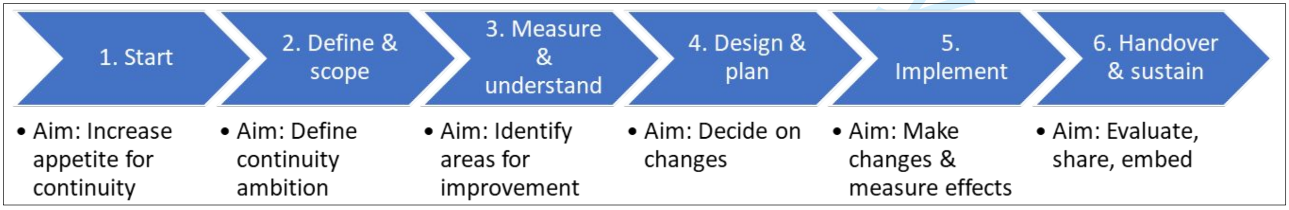
Interventions to improve RCC can operate at multiple levels, from national to practice, although evidence suggests mixed results.

High-level policies: In England, a national requirement to have a named GP for older patients had no effect on RCC.[103] Systematic review suggests, fee for service payment may increase RCC.[104] An Australian cluster RCT is investigating financial incentives for improved RCC.[105] Higher primary care funding is associated with better GPPS scores on continuity, access, professionalism and overall satisfaction.[106] However increased resources or financial incentives are unlikely to be realistic given economic constraints and post-pandemic demands on health care. Implementing changes at this level is therefore outside of the scope of this research, but using the Consolidated Implementation Framework for Research (CFIR) these effects can be considered as part of the Outer Setting.[107]

Within-practice policies: Practice policies can influence RCC. Some UK practices use personal lists, where patients usually consult a single GP.[101,108,109] Others operate as micro-teams, allocating patients to a small group of clinicians (such as two GPs and a nurse), which may be more resilient where some practice staff are part-time.[110] Other approaches include: reserving appointments for patients who benefit most from continuity; encouraging patients to seek continuity by making them aware of its importance; using receptionists supported by flexible booking systems and written practice policies, to direct patients to the right clinician.[15]

Some within-practice initiatives have been shown to increase continuity. A policy requiring patients to consult their own GP substantially increased continuity in a large Israeli primary care provider.[111] In Germany, a programme to strengthen general practice increased continuity of care.[112] In the UK an RCT promoting patient-centred micro-teams for older, complex patients, significantly improved their continuity of care.[113] In 2019, The Health Foundation funded five projects to improve RCC through within-practice changes in organisation.[114]

Figure 2: Health Foundation and RCGP six-step continuity toolkit

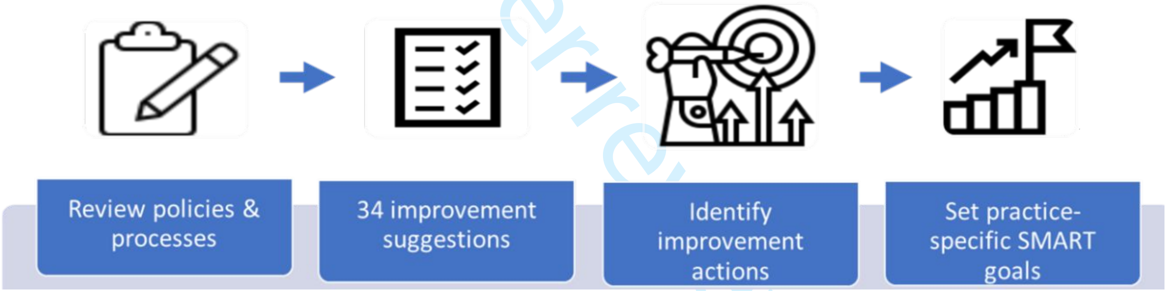


Health Foundation projects: In five Exeter general practices, staff support for continuity was built by running seminars on the advantages of continuity and challenging myths. The project measured RCC monthly using SLICC (UPC$^{\text{GP level}}$) and implemented a personal list approach. Four practices significantly increased continuity. South Cumbria Primary Care Collaborative developed a dashboard to measure and compare continuity. They also implemented a usual GP approach, which increased continuity in most of the 10 participating practices, despite the impact of the Covid-19 pandemic. One Care developed a software tool for 23 practices to measure their own RCC. Of these, 22 increased their RCC, either through adoption of personal lists or micro-teams models. Both patient experience and staff job satisfaction improved. In Pier Health (North Somerset), 9 practices were experiencing excessive workload, an unsatisfactory working environment and difficulties recruiting staff. After implementing personal lists they demonstrated substantial improvements in continuity and improved staff experience.[115] The Valentine Health Partnership in Woolwich focused on improving continuity for those patients who were consulting more frequently due to new symptoms. They successfully increased their RCC. Staff were overwhelmingly supportive, but did identify some drawbacks, including delays in accessing GPs, patients becoming dependent on one GP and a lack of a second opinion (fresh pair of eyes).[116]

Across all five projects, key facilitators were persuading clinicians of the potential benefits and staff engagement. Barriers included external factors (e.g. recruitment, reorganisation), the Covid-19 pandemic, a focus on access over continuity and the increased burden challenging patients can put on GPs. Additional benefits included improved patient and GP experience. In collaboration with the RCGP these projects resulted in development of a 6-step continuity toolkit [117] (Figure 2).

TOOL study: The TOOL study in the Netherlands is a stepped wedge RCT evaluating an intervention intended to improve continuity of care among complex older patients.[118] The intervention asks practices to review their current practice in relation to continuity and offers a menu of 34 evidence-based suggestions to help practices improve continuity. Practices then develop their own improvement plans with specific, measurable, achievable, relevant & time-bound goals. (Figure 3) The TOOL intervention emphasises flexible, practice-led, sustainable approaches to improving continuity. There is less focus on quantitative measurement of RCC. The outcome of the intervention is assessed using the Nijmegen Continuity Questionnaire, supplemented by staff and patient interviews.[80] The study finishes in early 2022.

Figure 3: The TOOL study intervention to improve continuity



Within-practice policies can optimise RCC. But as within-practice policies and general practices differ. It is not known which solutions work best in which practices. The Health Foundation's pilot projects share some similarities: all were supported by funding, generally made sophisticated use of IT and were implemented across groups of general practices. The TOOL study, in the Netherlands' broadly similar primary care system, adopted a more flexible approach with less use of IT or measurement. Applying the CFIR analytical framework, suggests that the Health Foundation interventions emphasise Process, whereas the TOOL study emphasises adaptation to the Internal Setting. Other UK practices have developed varying home-grown innovations, often without external support and within a single practice.[101,102,109,110] Mapping within-practice strategies for improvement to an appropriate implementation framework such as CFIR will provide a fuller understanding of the range of within-practice policies to improve RCC.

Summary

RCC is important to patients and GPs. It is associated with improved health outcomes and resource use. Despite its advantages, it is declining, more rapidly among older patients, who may most need continuity. The contribution of different factors to its decline is not fully understood. Some practices achieve high continuity and within-practice interventions have shown RCC can be increased. General practices seeking to improve continuity will need to measure and monitor their own continuity, but need guidance about how best to do so, to meet their own needs. To inform expectations about managing continuity, we need a better understanding of the contribution of a practice population's demographics, practice size, staff and patient turnover and part-time working to changes in RCC. There are invaluable lessons to be learned from general practices which have maintained higher than predicted RCC (positive deviants). There is a need to combine learning from home-grown approaches to improving continuity, including recent UK pilot studies funded by the Health Foundation, and other innovations such as the recent intervention study in the

Netherlands. From the experience of general practices, UK pilot studies and interventions in other settings (e.g. Netherlands) it would be useful to develop interventions to improve RCC in primary care, while maintaining other features of care such as access. Because it is associated with better health outcomes and lower health care costs, higher RCC may be cost-effective but this has not been demonstrated and the economic case for improving RCC has not been articulated. Furthermore, costs and effects are likely to vary by patient group (e.g. age band, chronic disease status) and this may help clarify where to prioritise efforts to improve continuity.

3a. Evidence explaining why this research is needed now

There are calls for research into the meaning of different measures of RCC; the role of continuity with clinicians other than doctors; which patients benefit from continuity; and how general practices may optimise RCC.[119] Recent plans for improving access in general practice specifically state that NHS England will work with the NIHR to understand the role of continuity of care.[120] In 2022, some key stakeholders in health policy have emphasised the need for continuity of care. For example a recent report by The Policy Exchange (endorsed by the present health secretary) notes that primary care is scaling up into larger practices and federations, with some practices run by hospitals. It envisages acceleration of this trend and emphasises the importance of maintaining continuity of care.[4] The report endorses a model based on Modality (in the West Midlands), where within a large general practice organisation, care teams are organised around groups of 3500-5000 patients, in order to maintain continuity of care.[4] The Rebuilding General Practice campaign of March 2022 (led by the BMA and a former health secretary) emphasises the importance of continuity of care, warning against the 'Uberisation' of GP services.[121] Continuity is a salient, pressing issue, but practices need clarity about whether to develop their own solutions to improve continuity, or to adopt, for example, a micro-team model, those described in the Health Foundation's projects or the TOOL study.

RCC and Covid-19

The Covid-19 pandemic dramatically affected primary care. In spring 2020, consultation rates were a third lower than pre-pandemic and face-to-face appointments fell from 80% to under 50%. By late 2021 consultations had risen to above pre-pandemic levels, with 64% face-to-face.[122] But there was little change in long-term trends in RCC during the pandemic. This supported by the views of at-risk patients in Switzerland, who felt that continuity did not suffer during the pandemic and reported their GPs made efforts to maintain continuity.[93,123] Overall the pandemic's effects on RCC may have been less dramatic than its effects on consultation frequency. However, in the longer term, the disruption is argued to be a decisive change point in primary care, both an opportunity to improve RCC and a danger that if overlooked, it may decline further.[124] In the emergence of long-Covid, the pandemic has also generated a new need for RCC, with recent NICE guidelines recognising the importance of relational continuity in its management.[125]

4 Aims and objectives

Aim: to understand how to enhance relational continuity of care (RCC) in primary care.

Objectives:

1. Develop guidance for general practices on quantitative measurement of RCC
2. Quantify the practice-level determinants of RCC: including staff and patient turnover, part-time working, practice size and practice funding.
   - Identify practices showing unusual variation (positive deviants) in RCC
3. Conduct in-depth case-studies to understand how practices achieve high RCC
4. Undertake economic analysis of the likely causal effects of changing RCC on resource costs and health outcomes across different segments of the registered practice population
5. Develop empirically-informed practical guidance to help general practices optimise RCC

5 Research Plan / Methods

The research uses a variety of methods. WP1 develops a shared understanding of RCC to guide the choice of measurement indices. WP2 undertakes quantitative analysis to investigate determinants of RCC and to identify outlier practices. WP3 is an investigation of outlier practices (positive deviants) as case studies. WP4 is an economic analysis of the effects of RCC. WP5 develops empirically-informed practical guidance to help general practices optimise RCC.

WP1. Develop guidance for general practices on quantitative measurement of RCC

Months: 0 to 12 (Months 0-4 obtain approval; preparation prior to workshop; 5-9 two workshops and consensus statement). Led by IW and TM.

RCC indices in use to date have mainly been selected by researchers and measurement has only included consultations with doctors. Depending on the practice's preferences, RCC indices could include consultations with all patients or with some patients (e.g. age 65+); consultations with all clinicians, or only with GPs; may measure density or dispersion. We will host facilitated workshops on RCC measurement, to develop a shared understanding and guidance for practices choosing a RCC index to meet their own needs.

Aim: develop a shared understanding of RCC indices and guidance to help general practices choose RCC indices to meet their internal needs for monitoring.

Objectives:

- Gather patient, practitioner and researcher views on the characteristics of RCC relevant to its measurement, including inclusion of non-GPs and in which populations to measure RCC
- Develop guidance for general practices choosing to measure their own RCC

Method: We will recruit clinicians, patients and researchers to 2 events (2-hour workshops) facilitated by a professional facilitator and the research team. We will recruit professionals working in a variety of settings including rural and inner-city, large and small practices across England. To avoid only including research-active practices we will recruit via several methods including the RCGP and social media (www.doctors.net.uk). Similarly we will recruit patient representatives through a range of methods. We will ensure diversity of representation by age, gender, ethnicity, education level and chronic disease status, identifying participants through research team networks and drawing on the expertise of our advisory group and PPI experts. We have requested funds to support accessibility for lay participants (accessible transport, childcare costs, interpretation). We will invite the following groups and organisations to participate:

- Primary care practitioner organisations e.g. RCGP, primary care networks, social media
- Patient and health consumer representative groups e.g. HealthWatch, local charities, Patient Participation Groups from participating general practices, posters in general practices
- Other health care representative organisations e.g. NHS Clinical Commissioners, NHS Providers and Integrated Care Organisations

As far as possible, we will ensure diversity in the final sample through purposive sampling and recruitment, and we will ensure that the balance between patient and professional participants is broadly equal (total n ≈ 15). We will use an equality and diversity form to collect details of participants' age, gender, educational background, ethnicity and chronic disease status in order to ensure representation. Potential participants will be sent written invitations with detailed explanations of the study and the WP. Written consent will be obtained from participants on the day of the workshops and we will seek permission to audio record under assurances of anonymity and confidentiality. To ensure both workshops run efficiently we will use a professional facilitator.

Stage 1: key characteristics (dimensions) of RCC

In stage 1 we will use the nominal group technique (NGT), a face-to-face, structured interaction, for identifying areas of consensus and divergence in priorities between different groups.[126] NGT is efficient as a means of gathering such data, and is especially useful where a range of perspectives exist and some groups may be more vocal than others.[127] Although typically used to gather professional views, NGT has been successfully employed with patients.[128] It is less resource intensive than alternatives (such as Delphi) and more likely to both reach a clear outcome, and provide a sense of achievement for participants.[129] In this instance, NGT will be important in enabling us to bridge any discursive gap between lay and medical understandings of RCC.[130]

The professional facilitator and theme lead will begin by explaining the workshop purpose and methodology in a short presentation with questions, clarify ground rules regarding respect, voice and confidentiality. The theme lead will explain the problem of RCC measurement. This will be followed by information giving regarding the problem of RCC measurement, based on existing evidence.[126] This stage is crucial in translating the topic into simple language and reducing the requirement for technical knowledge, in order that all participants are able to contribute to subsequent discussion.

Participants will then be asked to individually reflect on the key components of RCC (e.g. “Is continuity primarily with one GP, more than one GP or all clinicians?” “What aspects of care are most important in providing continuity?” “How frequently should it be measured?”) and to record their views in note form. We will devote between 10 and 20 minutes to this task and researchers will be on hand for any participants requiring assistance. These notes will then be shared with the full group, without discussion, and recorded by facilitators on flipcharts. This will be followed by facilitated group discussion in which verbal explanation and elaboration are provided between group members in relation to each of the identified components. This clarification phase may involve grouping of items and further inclusion/exclusion where this is universally agreed.

The final phase involves participants in developing a series of questions to help identify characteristics or dimensions of a measure of RCC: first identifying the purpose of a measure, then identifying the characteristics we might seek in an ideal measure. This is likely to involve list reduction and/or voting, and will be facilitated so as to respect diversity of opinion, enabling full and equal participation across each of the groups. We anticipate asking participants to identify the potential purposes of measuring RCC. They will then select the characteristics of a measure of RCC (e.g. which population, density v dispersion, GPs or all clinicians, understandability etc) that correspond to the potential purposes. We will give participants clear instructions and dedicate ample time for them to carry out the selection process. A researcher will quality check the process, for example by reviewing submitted suggestions as these are handed in.

In total, the workshop will be attended by 3 members of the research team. IW or TM will lead the discussions, a second researcher will be responsible for visual materials (e.g. whiteboards) used in the discussion, and a third will take notes and ensure workshops are audio-recorded. If Covid-19 restrictions make face-to-face workshops impractical, or if a different mode of delivery supports more diverse participation, we will conduct hybrid or virtual workshops. Workshop conduct will be informed by research on best practice and guided by recommendations in the literature.[131,132]

We will enter summary data of the characteristics of a RCC index into a Microsoft Excel Database. It is our intention that practices will prioritise these characteristics themselves, in order to identify their own preferred measure. However if a consensus emerges, we may also provide a recommendation on the most important characteristics in a measure, based on the views of workshop participants. We will report the outputs to participants towards the end of the workshop. Qualitative data derived from the audio-recordings will be analysed to enable us to provide context to the summary results, and to understand the rationale behind them. After the workshops, transcriptions will be entered into NVivo 11 and we will develop a coding framework inductively during a process of qualitative content analysis carried out independently by two members of the research team.[129]

Output: a shared patient and professional conception of the potential aims of measuring RCC and the main characteristics of an RCC measurement.

Table 2: Illustration of pros & cons of different measures of relational continuity of care

Clinician group	Patient group	Criterion	Continuity index				
			SLICC	UPC	BB	HI	Secon
Consultations with GPs only	All ages	Understandable	Good	Good	Fair	Fair	Fair
		Unaffected by consultation rate	Poor	Poor	Good	Good	Fair
		Patient conception	Fair	Fair	Good	Good	Poor
		Clinician conception	Fair	Fair	Fair	Fair	Fair
	Aged 65+ only	Understandable					
		Unaffected by consultation rate					
		Patient conception					
		Clinician conception					
Consultation with all clinical staff	All ages	Understandable					
		Unaffected by consultation rate					
		Patient conception					
		Clinician conception					
	Aged 65+ only	Understandable					
		Unaffected by consultation rate					
		Patient conception					
		Clinician conception					

Stage 2: identifying and appraising current measures

At a separate 2-hour workshop, held approximately 2 months later, the research team will present the same participants (or substitutes if some cannot attend the second workshop) with a summary of currently existing indices (e.g. BB, HI, $\text{UPC}^{\text{Patient}}$ or $\text{UPC}^{\text{GP level}}$), or modified indices reflecting views on how RCC should be measured from the first workshop.[133,134] To aid discussion, illustrations of the types of measures will be provided using analysis of anonymised primary care electronic health records data. Facilitated group discussion will be used to map current tools against the characteristics identified in the first workshop. This process will enable the group to identify the extent to which each RCC index addresses the desirable characteristics. It will also identify what is unknown. The outcome of this phase will be a menu of RCC indices from which practices might choose depending on which characteristics they prioritise in a measure. If a consensus emerges from the workshop participants about a single best RCC index, it will be reported. We will again audio-record these discussions and analyse the qualitative data in order to provide context and rationale to the final outcome. Acknowledging the challenges of integrating qualitative and quantitative data, all participants (patients, clinicians and researchers) will be involved in final decisions.[135]

Output: A menu of approaches to measuring RCC for monitoring in primary care.

We do not anticipate agreeing on a single way to measure RCC, but expect to produce a menu of approaches, along with guidance to help practices choose the approach most appropriate to their particular needs. Table 2 illustrates assessing the pros and cons of different approaches.

WP2. Investigation of determinants of relational continuity of care & identification of outliers

Months 0-19. (Months 0-6 obtain approval and undertake data linkages; months 7-18 extract data, analyse determinants of RCC; identify outlier practices). Led by TM, PK.

RCC is influenced by the practice population's characteristics (age, sex and chronic disease status) and practice characteristics (practice size, patient turnover, clinician turnover, part-time working) and may be influenced by practice funding levels. We will investigate the determinants of RCC through analysis of a large primary care database, linked to data on practice funding and subjectively reported continuity.

Aim: to investigate patient and practice-level determinants of measured RCC in general practices and to identify practices showing unusually high continuity given their characteristics.

Method: Clinical Practice Research Datalink (CPRD) collects fully coded and de-identified patient electronic health records from a network of GP practices using the Vision® (CPRD GOLD) or EMIS® (CPRD Aurum) software systems. We have full access to both datasets. CPRD includes records of clinical events (medical diagnoses), referrals to specialists and secondary care settings, prescriptions issued in primary care, records of immunisations/vaccinations, diagnostic testing, and all other types of care administered as part of routine general practice. Clinical information is captured as hierarchical Read codes, which are recorded by practice staff as part of routine data entry. CPRD data are broadly representative of the English general population.[136] We will use data from the CPRD GOLD database for the period 1st January 2005 until the most recent data upload, with two additional linkages. One is to GPPS data (2007 onwards), to allow comparison between subjectively reported continuity to objectively and measured RCC. The other is to the General and Personal Medical Services database (NHS Digital), to obtain data on average funding per registered patient.

We will measure monthly RCC outcome at the level of general practice using the continuity index most strongly associated with health outcomes and resource use. The chosen index may differ to indices prioritised in WP1, which are selected to reflect staff and patient preferences and are for internal practice use. To assess its construct validity, we will correlate practice-level measured RCC with annual subjectively reported RCC from the GPPS. Candidate predictors of RCC include patient characteristics and practice-level characteristics, all measured monthly. Patient characteristics are mean age (a), percentage female ($f_{\%}$), prevalence of chronic disease ($CD_{\%}$) and prevalence of multimorbidity ($M_{\%}$). Chronic disease prevalence is the proportion of patients with one or more of the chronic diseases in the Quality and Outcomes Framework (QOF) and multimorbidity is the proportion of patients with ≥4 chronic diseases. We already have code lists for over 80 chronic conditions including those in QOF. Practice list size (L) is based on monthly counts and patient turnover (P_T) from monthly registration and deregistration data. We will determine total number of GPs (GP_n) in the practice month from the numbers with attributable consultations in that month. We will infer a GP has left when they have no consultations for >13-weeks and use this to calculate a monthly turnover rate of GPs (GP_t). We will do the same for non-GP clinicians if our RCC index requires it. We will infer part-time working from the usual pattern of weekday consultation over each month (consultations morning and afternoon on 5 days = full time) and calculate an appropriate summary measure of part-time working: percentage full time equivalent ($FTE_{\%}$). If available we will include linked data on practice funding per registered patient ($F_{£}$).

We expect to have roughly 15 years-worth of data, from 1800 general practices. Using monthly summaries will provide 180 (15×12 observations) for each practice. We will model the association between monthly RCC outcome and candidate predictors (listed above and including both patient and practice characteristics, all measured at the practice-level: a, $f_{\%}$, $CD_{\%}$, $M_{\%}$, L, P_T, GP_n, GP_t, $FTE_{\%}$, $F_{£}$) using regression analysis. To examine the independent contributions of these characteristics to RCC, the regression analysis will include all ten candidate predictors of interest in the model regardless of statistical significance - no stepwise variable selection will be used - as is recommended.[137] Using monthly practice summary statistics for each candidate predictor will ensure there will be no missing data in either candidate predictors or RCC outcome. Monthly practice RCC outcomes are expected to be correlated - with outcomes measured close in calendar time expected to be more highly correlated than those measured further apart in calendar time. To allow for this serial correlation all regression analysis will allow for auto-correlations. The exact form of these correlations will be dependent on the data, but we will explore various forms, such as auto-regressive structures as well as allowing for seasonality, using recommended approaches to identify best fitting structures.[138] The contribution of the ten candidate predictors will be modelled to allow for non-linear effects, and without categorising any continuous predictors.[139] Again, appropriate forms to model non-linear effects will be explored and are likely to include splines or fractional polynomials. To internally validate the model all coefficients and standard errors (including associated confidence intervals) will use bootstrap-based confidence intervals with shrinkage. The ability of the model to correctly identify high performing RCC practices will be summarised using calibration and discrimination statistics (again using appropriate shrinkage to avoid over fitting).

It has long been recognised that unusual variation in a process is more likely to have an assignable cause.[140] Evidence from analysis and simulation shows that selecting case studies from outliers (deviant cases) is an efficient way to find out about causal pathways and causes of heterogeneity.[141] We will identify potential case studies from the top decile of general practices over a period of one year. In the most recent year's data, we will use the derived prediction model to identify practices which, given their patient and practice characteristics, appear to be consistent high performers in RCC. Using the derived model, we will calculate a predicted monthly RCC for each participating general practice for each month. We can then calculate an observed to predicted ratio of RCC. These monthly practice level observed / predicted ratios averaged over the most recent year, ranked and practices in the top decile of these ratios identified.

Output: A model of the contribution of patient and general practice-level characteristics to trends and variations in RCC. An observed to predicted ratio of RCC in CPRD practices. A list of general practices in the top decile for RCC in the most recent data quartile for inclusion as potential case studies.

WP3. Investigate a sample of general practices as case studies

Months 7-32. (Months 7-10 ethical approval; months 10-19 recruit practices for case-studies; months 11-26 practice interviews and focus groups; 12-32 qualitative analysis. Led by SG.

Aim: To understand in depth the internal features of general practices which are barriers and facilitators to RCC and how external features are experienced within practices.

Method: RCC is a complex and multi-faceted topic and therefore an exploratory multiple case study design is best suited to achieve our aim as this enables exploration and description of the complex underpinning links and processes in practices which display unusual RCC variation.[142] Evidence from analysis and simulation indicates that selecting case studies from outliers (deviant cases) is an efficient way to find out about causal pathways and causes of heterogeneity.[141] A similar method has been used to investigate wards providing safe hospital care.[143] From WP2 we will identify approximately 180 practices in each decile of observed to predicted ratio of RCC. In order to achieve the required depth and breadth of perspectives, we aim to recruit 8 practices as in-depth case studies.[144] Through CPRD we will purposively select 6 positive deviants (top decile) practices and 2 average practices (median decile). We will aim to include practices of diverse sizes, inner-city urban and rural locations, however CPRD's anonymity rules mean we are unable to identify individual practices in advance of recruitment and are thus limited to those which agree to take part.

We will collate any practice documentation, receptionist guidelines or policies regarding RCC e.g. some practice websites emphasise RCC as an objective.[145] In each selected practice we will undertake 2 focus groups, each including between 6 and 12 participants: one with a range of clinical and non-clinical staff; and one with practice patient participation groups.[146,147] These will be supplemented with semi-structured interviews with up to 3 key informants per practice (identified during the focus groups). This will provide transcripts from 16 focus groups and between 8 and 24 interviews in total. Amalgamating documentation and transcripts will enable us to undertake an in-depth analysis for each case and cross-case comparison. We will use a Framework approach to analysis as it is focussed, systematic and efficient.[148] Based on our previous experience this is manageable, particularly if data are analysed as soon as it is collected.[149] Data collection is illustrated in Table 3. Focus groups will inform subsequent interview topic guides. The focus groups and interview topic guides will explore positive and negative experience and effects of RCC from the perspective of patients, clinical and non-clinical staff and possible mechanisms by which RCC affects clinical care. This will specifically include the potential negative effects of higher RCC: the trade-off between access and continuity, potential burden on GPs, patient dependency on one GP and a lack of a second opinion. They will also explore examples of good practice in addressing barriers and facilitating RCC (e.g. patient engagement, organisational culture, appointments systems, leadership, philosophy, formal/informal policies on RCC).

In the focus groups the facilitator will enable discussion of RCC between practice staff allowing participants themselves to introduce and debate views and practice processes around RCC and the areas in the topic guide.[150] We will take into account documented guidance for maximising success of focus groups in healthcare settings e.g. sample heterogeneity, difference in status of participants, timing of groups.[151] In contrast in the interviews the researcher and stakeholder will be involved in dialogue designed to explore that participant's responses to the areas within the topic guide. Within each practice we will also collect any documentation on formal or informal policies which refer to RCC.[144,152,153] If required because of Covid-19 restrictions, focus groups and interviews will be conducted online using video conferencing software. We will follow best practice in this approach.[154]

Table 3: Data collection and analysis for case studies

Source	Data obtained	Analysis	Between practices
Focus groups (staff) - Clinical (GPs, nurses, allied health professionals) - Non-clinical (receptionists, practice managers) Interviews with key informants identified from focus groups	Staff experience Implementation of practice policies	Framework analysis	Cross-case comparison
Documentation of policies	Practice policies		
Focus groups (patients) - With and without long-term conditions - Older and younger - Diverse educational level - Diverse ethnicity Interviews with key informants identified from focus groups	Patient experience Experience of policies		

Focus group and interview data will be recorded, transcribed and entered into NVivo11 for data management. Thematic analysis of transcripts will be carried out using the Framework Method and themes compared within and across practices, focus group, interview and documentary data.[155] A summary of overall themes from their discussion will be sent to participants for comment. PPI representatives and members of the multi-disciplinary research team will read a selection of transcripts and documents, then discuss and agree on emerging themes to develop the data coding framework. Overall data will then be combined to seek common features associated with positive deviant RCC. To ensure robustness and quality our research is also guided by the COREQ checklist for reporting qualitative research.[156] We will follow good practice and consider or 'triangulate' our findings from the qualitative data with the findings from the other pieces of work in the study. Comparing individual findings to see where they might be similar or different is likely to provide additional insights and enhance understanding of overall findings. Overall findings will then be brought together and considered by the whole research team.[157,158]

Output: The primary output of WP3 is an understanding of the practice characteristics which contribute to RCC and understanding of barriers and facilitators to RCC and the mechanisms by which RCC influences health.

To support dissemination of findings, a secondary output will be identifying individuals as potential advocates for general practices which have maintaining high levels of continuity. These may be research participants or individuals identified as champions within individual general practices.

WP4. Economic analysis of the effects of RCC

Months 0-32. (Months 0-6 obtain approval and undertake data linkages; months 7-32 extract data, analyse effects of RCC on health service use and health). Led by PK.

We anticipate that higher RCC may result in better information flow between patients and their GPs, potentially affecting: consultation rates and prescribing in primary care; unplanned inpatient admissions; A&E attendances; and outpatient appointments in secondary care. We also anticipate higher RCC may influence management of patients with specific chronic diseases (e.g. diabetes, COPD, asthma, mental health, dementia, heart failure) thus affecting health outcomes.

Aim: to analyse the potential effects on resource use and health outcomes of changes in practice-level RCC using patient-level data. We will analyse the effects across different population groups within the registered practice population.

Data: We will use primary care data from the CPRD database from 1st January 2005 until the most recent upload, with standard linkages to: i) Hospital Episode Statistics data (including inpatient admissions, outpatient appointments and A&E attendances), ii) Office for National Statistics (ONS) mortality data, and iii) area level deprivation. We will also use one non-standard linkage to funding per patient. CPRD Gold includes about 9 million patients eligible for linkage, in around 400 general practices and CPRD Aurum 38 million eligible patients in around 1400 general practices.[159]

We will analyse the effects of RCC on i) two types of primary care use: consultations and prescribing; ii) three types of hospital use, unplanned admissions, A&E presentations, outpatient appointments; iii) costs, and iv) mortality. We will identify primary care activity from the CPRD records of consultations, clinical events, and prescription records and secondary care activity from HES inpatient, outpatient and A&E records. We will cost primary and secondary care activities using a methodology that we have previously used.[160]

Method: We will undertake a patient-level analysis with the explanatory variable of interest (RCC) measured at practice level. We will undertake preliminary analyses to explore the relationship between RCC and unplanned admissions (the main driver of costs) over time. If the relationship was altered during the pandemic years we will consider whether to model pre-pandemic and post-pandemic years separately. We will also undertake preliminary analyses to explore whether the relationship between RCC and unplanned admissions varies by chronic disease status (using chronic diseases included in the Quality and Outcomes Framework) to determine whether analysis should be stratified by chronic disease status.

The study population will consist of patients who were registered with a GP practice any time during the period from 1 January 2006 to 31 March 2021 (or the most recent CPRD upload available). We will observe these patients until outcome or censoring, where censoring is due to the patient changing GP practice, death, or the end of the study period (date of last upload). The observation period for each patient will be divided into periods of 3 months and outcomes will be binary variables indicating whether or not the particular event occurred in each 3-month period (except from costs which are a continuous variable). For instance, a patient who was first observed on 1st January 2017 and experienced an inpatient hospitalisation in March 2018 will contribute to the data in five quarters: four quarters in 2017 where the outcome takes values of zero and one quarter in 2018 where the outcome takes a value of one. The resulting dataset will be an unbalanced panel as individuals contribute to the sample in a different number of quarters. RCC will be measured at practice level over the 12 months prior to the outcome period using the indices from WP1 and WP2 (e.g. in the above example the RCC associated with patient's first observation will be measured over the period 1st January 2016 – 31st December 2016). We will include a mix of patient level confounders such as age, sex, deprivation status, ethnicity, chronic disease status, prior healthcare utilisation and practice level confounders such as practice size, practice funding, staff turnover and part-time working.

We will employ discrete time survival analysis to evaluate the association between risk of each outcome in a particular 3-month period and RCC in the prior 12 months. Specifically, we will estimate complementary log-log (cloglog) models (the discrete-time analogue of the continuous-time proportional hazards models) which are appropriate when an outcome occurs rarely.

Output: A model assessing the impact of changes in RCC on healthcare resources and health outcomes. The model will describe the effects of changing RCC on different population groups.

WP5. Develop empirically-informed practical guidance to help to improve RCC in primary care

Months 10-12 (disseminate shared understanding of measurement). Months 28-36 ethical approval and preparation for workshops; host workshops; write up findings. Led by IW, TM and SG.

We anticipate varied within-practice policies will contribute to maintaining RCC in different general practices and varying factors which may adversely affect continuity. Some strategies or principles will be context specific and others more generalisable. The final phase of this research is to collate and integrate findings from different settings and work-packages, generate and disseminate learning, and create impact. WP5 uses co-design principles and methodologies to develop guidance on how to improve and enhance RCC.

Aim: Develop empirically-informed practical guidance to help general practices optimise RCC, using a behaviour change framework and disseminate findings to stakeholders.

Method: Co-design and dissemination

Co-design: We will undertake a rapid **review of evidence** on within-practice interventions (e.g. the Health Foundation pilot projects, the TOOL study, any other published or grey literature studies), making use of ongoing reviews on this topic.[161] We will follow good practice and consider or 'triangulate' findings from the evidence review and from our own study's **work packages**: WP2 (determinants of RCC), WP3 (detailed case-studies) and preliminary results from WP4 (economic analysis). Each separate WP will have individual and stand-alone findings analysed separately using techniques appropriate to their methods, but we will additionally look at all of the different sets of findings together, to identify what each contributes to the overall picture. Overall findings will then be brought together and considered by the whole research team. We will convene two 3-hour deliberative facilitated workshops (either face-to-face, hybrid or online) to integrate these findings and develop practical guidance on how best to improve RCC. This process will be informed by existing research on how to ensure the needs of diverse groups are taken into consideration.[162] WP5 follows the MRC framework.[163] It synthesises an understanding of determinants of RCC within a wider context (WP2), evidence on the within-practice impacts of policies to increase RCC (WP3), estimates of the value of RCC relative to the resources required to deliver it and how it contributes to system change (WP4), to build an overall understanding of how to develop optimal policies to improve RCC. This approach

As with WP1, participants will include a **purposive sample of clinical and non-clinical** professionals and patient representatives. Workshop participants from WP1 will be given the opportunity to participate again. If needed we will recruit additional participants, drawing on networks and groups identified through WP1, WP2 and WP3 while continuing to ensure diversity. To help workshops run efficiently we will again use a professional facilitator. The aims of the facilitated workshops are to co-design guidance on optimising RCC, to identify practical strategies to overcome barriers to RCC optimisation and to develop an action plan for implementation.[164] It also will ensure the recommendations are acceptable to both patients and clinicians, and that they are realistically deliverable.[165]

The **first workshop** will therefore be carried out with the **patients only** (n ≈ 15), in order to determine their views. In this workshop we will investigate what role patients and the public might have in facilitating RCC in different settings. We will explain the background to the project and share preliminary findings from our case-studies (WP3) on the characteristics of general practices with high RCC and the perspectives of staff and patients in these practices. We will also share relevant findings on measurement of RCC (WP1), on external practice-level characteristics linked to RCC (WP2) and from our economic analysis (WP4). Before the workshop we will provide the findings in written form, for participants to read and will briefly present the findings at the start of the workshop. We will ask participants to reflect on the evidence in relation to their own experience, to identify which practice characteristics might form the basis of practice policies which are acceptable to patients and feasible for general practices. We will also ask them to consider any potential negative effects of greater RCC, including effects on access, and to identify possible knowledge gaps. To encourage discussion, participants will be broken up into smaller groups (6 or less). At the end of the workshop, its headline conclusions will be summarised, to ensure these have been captured accurately. Workshop notes and minutes will be collated and summarised by the research team, then circulated to workshop participants for their final approval.

In the **second workshop** both **patients** and **practice staff** (n ≈ 30) will meet together for joint discussion. We will again provide the findings from WP3 in written form for participants to read before the workshop and briefly present findings at the start of the workshop. For the second workshop this will include a brief overview of the findings of the first (patient) workshop. We will ask participants to identify practice characteristics which might form the basis of acceptable and feasible practice policies on RCC. We will ask them to consider how each policy might work (IF → THEN logic model) and how a practice might find evidence they are working. We will ask participants to achieve satisfactory agreement on the information content and medium of delivery of a final report on optimising RCC. We will also ask participants to identify any knowledge gaps. To encourage discussion participants will be broken up into smaller groups (6 or less). Overall conduct of the workshop will be overseen by the professional facilitator. Two members of the study team will facilitate the small groups, the workshop will be audio-recorded with recordings deleted following verification of anonymised transcript. Transcripts will be analysed using the principles of Framework analysis with the specific purpose of informing the development of good practice principles to support RCC.[166] Following the workshop deliberations, the key conclusions of the workshop will be summarised at the end of the workshop. This will include possible actions to improve continuity, the logic model explaining how the actions achieve their effect and practical ways a practice could seek evidence they are working (e.g. structural changes, process measures or by assessing interpersonal process). We will map these to appropriate frameworks depending on whether they are intended to influence individuals (e.g. change patients', receptionists' or clinicians' behaviour) or to alter processes (e.g. appointment systems, named GPs, micro-teams). The research team will then draft a written document with recommendations and circulate this to participants for final comment.

We have experience of developing guidance for general practices in this way. In a previous study on communication of diagnostic test results we identified six areas of weakness in communication of diagnostic test results in general practices and proposed solutions. Practices and patients were then asked to consider which were most pertinent, acceptable and logically feasible in their own practice and we worked with them to decide which measures would be adopted, the operational requirements and timescale.[167]

Output: From these workshops we will develop guidance deriving from existing research, WP2, WP3 and WP4 on how practices can improve RCC whilst continuing to meet other requirements and objectives. WP5 will produce in-depth empirical data on the strategies for increasing and/or maintaining RCC in primary care settings. We will document the full range of these strategies and interventions and provide a summary of evidence on their efficacy and implementation in different settings. These outputs will be a key part of our dissemination and knowledge exchange activities, and will therefore inform practice in the immediate term. We will also identify areas where there might be a need for intervention *adaptation* or de novo intervention *development,* and put forward evidence-based recommendations for how this should be pursued.

Dissemination strategy

Dissemination will make use of a number of methods tailored to each audience. We will seek to maximise impact through a range of pathways, and these will be a standing agenda item on project team and steering group meetings.

For an **academic audience** we anticipate a report for NIHR and five peer-reviewed publications: a shared understanding of measures of RCC (BJGP, BMC Fam Pract); an analysis of the determinants of RCC in UK primary care (BJGP, BMC Fam Pract); learning from our case study practices (BMJ, Ann Fam Med); practical guidance to improve RCC (BJGP, BMC Fam Pract); an economic analysis the effects of RCC (BJGP, BMC Fam Pract). We will present our findings at SAPC and RCGP conferences. After WP1 we will engage with **software manufacturers** (Samir Dhalla of Cegedim and Chris Bates of TPP) to share findings on measurement of RCC in primary care to stimulate work on development of tools to measure RCC. We will provide an interim report on measurement of RCC and a final report on completion of WP5 to **regional GP networks** (Dudley Integrated Care Service, Our Health Partnership), to **national bodies** (the RCGP and NHS England). To directly reach **primary-care clinicians** we will develop a podcast or short video with the Personalised Care Institute to disseminate to clinicians and have fully costed development of **two webinars** and a package of marketing and communications with the RCGP. University of Birmingham's Centre for Primary Care Improvement will create a **postgraduate module** for primary care professionals on managing continuity of care. We will write a brief lay summary for use as a discussion document at practice Patient Participation Groups.

Debates about continuity of care to date have been led by clinicians and researchers. A key benefit of our work is involvement of the public and a key output will be in making publicly accessible the findings of our research on the causes of declining RCC, its effects and solutions to the problem. For a **lay audience**, we will create a project website and commission a short animation version of our final report to communicate findings in an accessible way. A project website will make available regular publicly accessible bulletins of interest to the general public. We will ensure these bulletins are press released so that the media are aware of each developing stage of the research. We will write short articles for relevant forums online and international newspapers. We will initiate a social media campaign to garner interest in and share information about the project, and will share research progress and encourage feedback via blogs and personal stories of continuity of care. Through our digital profile we will engage with patient groups and 3rd sector organisations as intermediaries and knowledge brokers to help us develop an effective implementation and dissemination strategy and to ensure we engage heterogeneous groups of stakeholders.

Impact

We intend our research to help GPs and patients reflect on and consider implementing changes in the way they organise their practices in order to improve RCC. This will enhance patient experience, increase efficiency and effectiveness of clinical care. Our research addresses capability, opportunity and motivation.[168]

The output of WP5 is the **capability** to change, supported by the output of WP1 on how practices can measure RCC. These outputs will be disseminated through several channels: directly influencing GPs, informing policymakers in NHS England, generating public interest through the lay media and stimulating development of software solutions. We will recruit change champions from “best practice” general practices. We will include a module on maintaining RCC in University of Birmingham’s new MSc Primary Care. To reach primary care clinicians, we have costed the development of two webinars and a package of marketing and communications with the RCGP.

To support change we will share WP1 outputs with Samir Dhalla of Cegedim and Chris Bates of TPP (electronic medical records software companies which produce Vision and SystmOne respectively) to facilitate development of software solutions for measurement of RCC. The current trend towards larger general practices, networks and hospital-run practices provide an **opportunity** for thinking strategically about the aims of practice organisation. Publicising the effects of RCC on increased patient satisfaction, reduced demand for consultations and improved antibiotic and opioid stewardship provide **motivation** within primary care to maintain RCC. Economic analysis (WP4) contributes to the wider **motivation** to change.

We plan to build on this research by designing a cluster-randomised controlled trial (cRCT) to investigate implementation. This will be informed by the experiences of the Dutch TOOL study. This could most efficiently be implemented within a large network of general practices (e.g. CPRD or similar), with the primary outcome as measured RCC. Such an approach would also allow investigation of the effects of increased RCC on unplanned hospitalisations, A&E consultation rates, primary care consultation rates, prescribing, patient experience and staff experience.

NIHR152277 Quantifying, Understanding and Enhancing Relational Continuity of Care (QUERCC)

Quercc -protocol vs 0.1_18 July 2022

Timetable

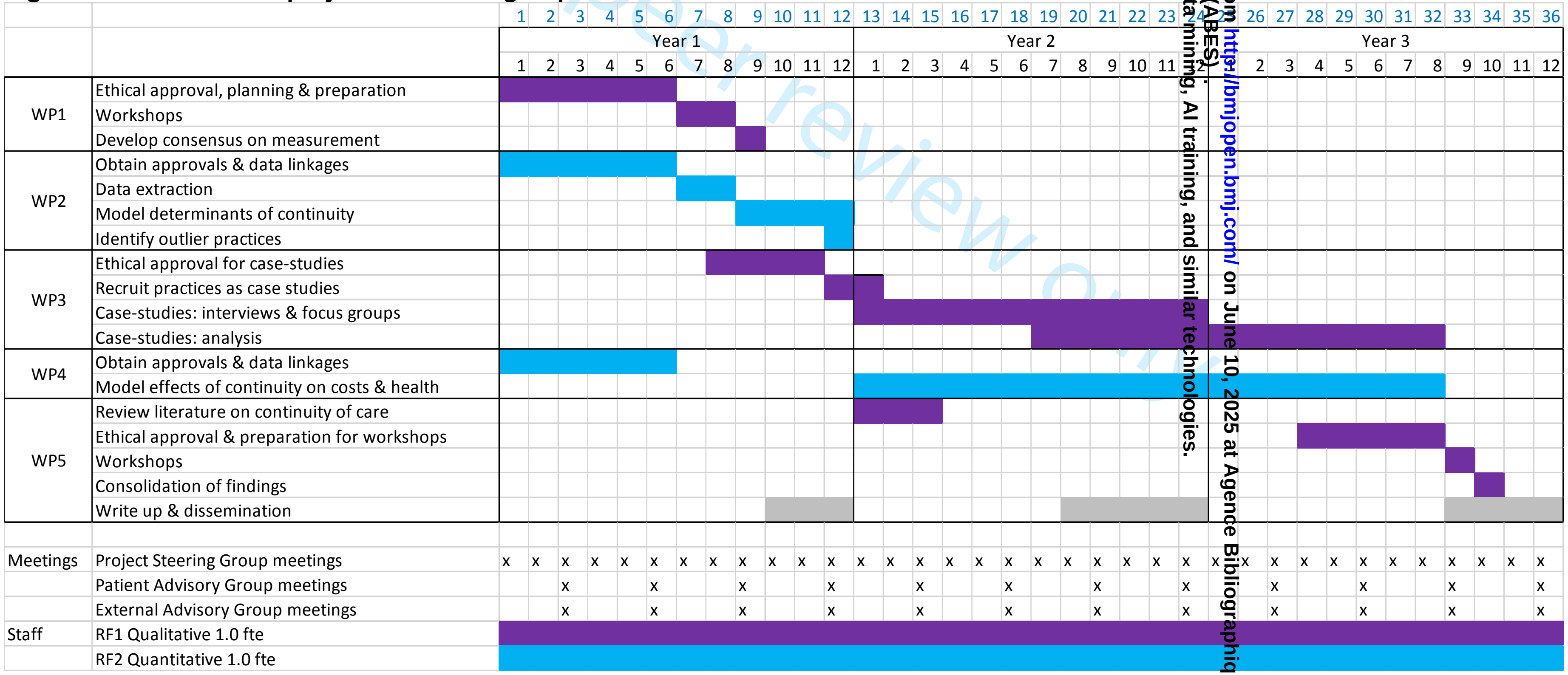
The timetable is shown in the Gantt chart. (Figure 4)

Months 0-6: We will obtain ethical approval for the workshops, recruit participants, undertake a brief review to identify different ways of measuring RCC and produce analyses to illustrate what these mean. (WP1) We will also obtain necessary approvals for use of data and undertake data linkages. (WP1 and WP4)

Months 7-9: Conduct two workshops, write up and circulate the conclusions to participants for approval. (WP1) In WP2 we will undertake data extraction and begin to model practice-level determinants of RCC. (WP2) In preparation for WP3 we will seek ethical approval for the interviews and focus groups in the case-study general practices.

Months 10 to 12: In WP2 we will model determinants of continuity and identify outlier practices. In WP3 we will secure ethical approval for the case-studies and recruit general practices. We will also review literature on interventions to increase RCC, write up and disseminate initial findings (WP5).

Figure 4: Gantt chart of project and staffing requirements



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
		Year 1												Year 2												Year 3											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
WP1	Ethical approval, planning & preparation	🟪	🟪	🟪	🟪	🟪	🟪																														
	Workshops							🟪	🟪																												
	Develop consensus on measurement									🟪																											
WP2	Obtain approvals & data linkages	🟦	🟦	🟦	🟦	🟦	🟦																														
	Data extraction							🟦	🟦																												
	Model determinants of continuity									🟦	🟦	🟦	🟦																								
	Identify outlier practices												🟦																								
WP3	Ethical approval for case-studies								🟪	🟪	🟪	🟪																									
	Recruit practices as case studies												🟪	🟪																							
	Case-studies: interviews & focus groups													🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪												
	Case-studies: analysis																			🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪				
WP4	Obtain approvals & data linkages	🟦	🟦	🟦	🟦	🟦	🟦																														
	Model effects of continuity on costs & health													🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦				
WP5	Review literature on continuity of care													🟪	🟪	🟪																					
	Ethical approval & preparation for workshops																												🟪	🟪	🟪	🟪	🟪				
	Workshops																																	🟪			
	Consolidation of findings																																		🟪		
	Write up & dissemination										▨	▨	▨								▨	▨	▨	▨	▨									▨	▨	▨	▨
Meetings	Project Steering Group meetings	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Patient Advisory Group meetings			x			x			x			x			x			x			x			x			x			x			x			x
	External Advisory Group meetings			x			x			x			x			x			x			x			x			x			x			x			x
Staff	RF1 Qualitative 1.0 fte	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪
	RF2 Quantitative 1.0 fte	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦

Months 7 to 32: In WP3 we will undertake and then analyse case-studies in up to 8 general practices. In WP4 we will undertake an economic analysis of the effects of continuity on health and resource use.

Months 24 to 36: Develop practical guidance (WP5) from literature review, case-studies (WP3), analysis of RCC (WP2) & economic analysis (WP4).

Months 33 to 36: Write up all work packages.

Project management

TM, SG and IW will jointly manage the qualitative research fellow (RF1) and PK, RW and TM will jointly manage the quantitative research fellow (RF2).

Day to day management will be undertaken at monthly meetings of the Project Steering Group, including all co-applicants.

A Patient Advisory Group will meet three monthly and provide into the next month's Project Steering Group meeting.

An External Advisory Group will be convened including Dr Mairead Murphy (University of Bristol) a qualitative researcher with an interest in continuity of care, Dr Otto Maarsingh (Amsterdam University Medical Centre) who leads the TOOL study, and a member to be identified by the RCGP. This will be convened and meet with the Project Steering Group every third month: half of the meetings will be online.

Ethics / Regulatory Approvals

We will seek ethical approval for the study from the Health Research Authority (HRA) along with relevant research governance approvals. University ethical approvals for WP1 will be obtained on confirmation of the award.

The main ethical questions relate to participant anonymity and the safeguarding of any private data. These will be addressed in the WP1 application and in greater detail for the HRA processes for WP3 and WP5 where we will submit data collection instruments such as topic guides for review.

We will ensure informed consent for all interviews and will provide potential participants with information about the study, and time to consider participation. Data will be stored in line with institutional policies (see data handling above). Interview participants will not be named or identifiable and we will use pseudonyms to report any direct quotes.

Project / research expertise

TM is Professor of Public Health and Primary Care with expertise in health services research in particularly using electronic primary care records. He will lead the project and directly supervise RF2 (quantitative). He will be supported in this by BW. BW has extensive experience of analysis of primary care records and is both a practising GP and an Associate Professor. He holds a PhD in Medical Statistics.

SG is Professor of Medical Sociology. She is a qualitative methodologist and with extensive experience in the design and implementation of qualitative methodology as a component of mixed methods research, particularly in primary care. Recent research has included practices' use and attitudes to patient safety tools and the role of receptionists. SG leads WP3.

IW is an experienced health services researcher focussing on health organisation, implementation research and complex intervention development. He has methodological expertise in mixed methods including consensus methods and will lead WP1. He has extensive experience of qualitative case studies and, through his role at the Health Services Management Centre, is linked to extensive networks of current and future NHS leaders, for example through the national Nye Bevan and Elizabeth Garrett Anderson Leadership programmes.

PK is a health economist with an econometrics background. He has an interest in quality in primary care and extensive experience of analysis of using linked electronic health records for research. This includes analysis of the effects of continuity of primary care on admissions for mental health problems.

KS is a patient with a chronic condition who will lead PPI, chairing Patient Advisory Group meetings and liaising with the Project Steering Group.

SG and IW will supervise RF1 (qualitative). Both are experienced qualitative researchers.

10. PPI Lead

The involvement of patients, services users and the public (PSUP) is integral to the aims and design of the research. This is reflected in the composition of the research team which includes a patient expert (see section 'Expertise and justification of support required') whose role will include overseeing an integrated plan of PSUP input from project inception through to data collection, analysis and write-up. We will recruit a further PSUP specialist to the External Advisory Group, who will provide an independent patient advocate/public view over the life of the project.

Our lay co-applicant (KS) will sit on Project Steering Committee. He will chair and lead recruitment of a Patient Advisory Group (PAG) of 4 to 6 participants.

To ensure diversity of lay participants in the research and lay we will have requested contingency fund to cover potential costs of interpretation, rendering information accessible (e.g. if visually impaired), alternative care arrangements for carers, accessible transport or other cost which might be barriers to participation.

11. Success criteria and barriers to proposed work

Success in WP1 would be developing guidance for general practices on how they can measure their own RCC. There are few risks to achieving this as there is no requirement that we reach agreement on measurement, just an understanding of what criteria need to be considered.

The criterion for success in WP2 is to develop a prediction model for RCC in a large number of general practices and identify some practices showing unusual variation. We already have access to most of the data through CPRD. There is a small risk that the non-standard linkages to GPPS data on continuity and to practice funding data may not be possible, but the former is not essential and the latter is only one of a number of the explanatory variables and unlikely to be critical.

Success in WP3 means conducting case study investigations in a number of general practices, showing positive deviance in RCC. This requires us to recruit practices as case studies. The main risk is that practices are reluctant to engage with the research. However practices will mainly be invited from the top decile of measured RCC in CPRD and are being invited to share good practice, which may make involvement more attractive. If needed we could also approach practices with which we have established links in the West Midlands. We have extensive experience of successfully recruiting to this kind of study, therefore the risk of difficulty recruiting research participants for interviews and focus groups is low.

A successful WP4 will estimate the cost-effectiveness of increasing RCC at a general practice level. Data-related risks are low as we have access to all of the data to undertake this analysis already. A positive outcome would be building an economic case for higher RCC, but a finding that improving RCC is not cost-effective would be equally important.

A successful WP5 will create an intervention framed around an appropriate behaviour-change model to help practices implement higher RCC. There is a risk that general practices investigated as case-studies may not identify any readily applicable lessons. For example practices maintaining high levels of RCC may pay an unacceptable price in terms of access or have characteristics which cannot be replicated, such as a remote location, high level of resourcing or idiosyncratic practice organisation. While disappointing, such findings would nevertheless be important. We also feel this is unlikely as evidence from the Health Foundation pilot projects suggests practice-based initiatives can successful in improving RCC.

References

---

[1] Reid R et al Defusing the confusion: concepts and measures of continuity of healthcare. Canadian Health Services Research Foundation March 2002.

[2] Haggerty JL et al. Continuity of care: a multidisciplinary review. BMJ. 2003 Nov 22;327(7425):1219-21. doi: 10.1136/bmj.327.7425.1219.

[3] NHS Five Year Forward View. Primary Care. [Accessed 1 Mar 2022]

[4] At Your Service. A proposal to reform general practice and enable digital healthcare at scale Policy Exchange 4 March 2022

[5] RCGP Continuity of care resources [Accessed 1 Mar 2022]

[6] Smith JA et al. Early evidence of the development of primary care networks in England: a rapid evaluation study. Southampton: NIHR Health Services and Delivery Research Topic Report; 2020. DOI: https://doi.org/10.3310/hsdr-tr-129678

[7] Saultz JW et al. Interpersonal continuity of care and patient satisfaction: a critical review. Ann Fam Med 2004; 2: 445–451.

[8] Waibel S et al. What do we know about patients' perceptions of continuity of care? A meta-synthesis of qualitative studies. Int J Qual Health Care 2012; 24, 39-48.

[9] Murphy M et al. Relational continuity and patients' perception of GP trust and respect: a qualitative study BJGP 10 August 2020; bjgp20X712349.

[10] van Walraven C et al. The association between continuity of care and outcomes: a systematic and critical review. J Eval Clin Pract. 2010;16:947-56.

[11] Fernholm R et al. Patient and provider perspectives on reducing risk of harm in primary health care: a qualitative questionnaire study in Sweden. Scand J Prim Health Care. 2020;38:66-74.

[12] Morris RL et al. Identifying primary care patient safety research priorities in the UK: a James Lind Alliance Priority Setting Partnership. BMJ Open. 2018 28;8:e020870.

[13] Rolfe A et al. Interventions for improving patients' trust in doctors and groups of doctors. Cochrane Database Syst Rev, 2014; CD004134.

[14] Tarrant C et al. Continuity and trust in primary care: a qualitative study informed by game theory. Ann Fam Med, 2010; 8, 440-6.

[15] Palmer B et al Improving access and continuity in general practice the Nuffield Trust. November 2018. [Accessed 14th June 2021]

[16] Saunders CL et al. Sociodemographic inequalities in patients' experiences of primary care: an analysis of the General Practice Patient Survey in England between 2011 and 2017. J Health Serv Res Policy. 2021 Jan 31:1355819620986814.

[17] Kang M et al. The relationship between having a regular general practitioner (GP) and the experience of healthcare barriers: a cross-sectional study among young people in NSW, Australia, with oversampling from marginalised groups. BMC Fam Pract. 2020; 28;21:220.

[18] Cowie L et al. Experience of continuity of care of patients with multiple long-term conditions in England. Journal of Health Services Research and Policy 2009; 14: 82-7.

[19] Rhodes P et al. Relationship continuity: when and why do primary care patients think it is safer? BJGP 2014; 64(629): e758–64.

[20] Nowak DA et al. Why does continuity of care with family doctors matter? Review and qualitative synthesis of patient and physician perspectives. Can Fam Physician. 2021 Sep;67(9):679-688.

[21] Lautamatti E et al. Continuity of care is associated with satisfaction with local health care services. BMC Fam Pract. 2020; 4;21:181.

[22] BMA The Future of General Practice Survey - Essentials Last updated: 07 December 2018

[23] Croxson CH et al. GPs' perceptions of workload in England: a qualitative interview study. BJGP 2017; 67, e138-e147.

[24] Pereira Gray D et al Towards a theory of continuity of care J R Soc Med 2003;96:160–166

[25] Fernholm R et al. Validation and initial results of surveys exploring perspectives on risks and solutions for diagnostic and medication errors in primary care in Sweden. Scand J Prim Health Care. 2020;38:381-390.

[26] van Loenen T et al. Organizational aspects of primary care related to avoidable hospitalization: a systematic review. Fam Pract. 2014; 31:502-16.

[27] Cheng SH et al. A longitudinal examination of continuity of care and avoidable hospitalization. Arch Intern Med 2010;170:1671-1677.

[28] Cunningham C et al. Patient-Physician Relational Continuity and Health System Utilization among Patients in Alberta. Healthc Q. 2020;22:13-21.

[29] Tammes, P et al. Continuity of primary care and emergency hospital admissions among older patients in England. Ann Fam Med 2017; 15, 515-522.

[30] Barker I et al. Association between continuity of care in general practice and hospital admissions for ambulatory care sensitive conditions: cross sectional study of routinely collected, person level data BMJ 2017;356:j84

[31] Saultz JW et al. Interpersonal continuity of care and care outcomes: a critical review. Ann Fam Med. 2005 Mar-Apr;3:159-66.

[32] Raivio R et al. Patients' assessments of the continuity of primary care in Finland: a 15-year follow-up questionnaire survey. BJGP 2014; 64:e657-63.

[33] Sandvik H et al. Continuity in general practice as predictor of mortality, acute hospitalisation, and use of out-of-hours care: a registry-based observational study in Norway. BJGP. 2021 Aug 26:BJGP.2021.0340.

[34] Cho KH et al. The Association between Continuity of Care and All-Cause Mortality in Patients with Newly Diagnosed Obstructive Pulmonary Disease: A Population-Based Retrospective Cohort Study, 2005-2012. PLoS One. 2015 Nov 3;10(11):e0141465.

[35] Kao YH et al Is continuity of care associated with avoidable hospitalization among older asthmatic patients? Medicine 2016: 95:38

[36] Ride J et al. Impact of family practice continuity of care on unplanned hospital use for people with serious mental illness. Health Serv Res. 2019; 54:1316-1325.

[37] Kim W et al. Association between continuity of care and subsequent hospitalization and mortality in patients with mood disorders: Results from the Korea National Health Insurance cohort. PLoS One. 2018; 13(11):e0207740.

[38] Chan KS, et al. Effects of continuity of care on health outcomes among patients with diabetes mellitus and/or hypertension: a systematic review. BMC Fam Pract. 2021 Jul 3;22(1):145. doi: 10.1186/s12875-021-01493-x.

[39] Delgado J et al. Continuity of GP care for patients with dementia: impact on prescribing and the health of patients. BJGP. 2022: BJGP.2021.0413.

[40] Sabety AH et al. Changes in health care use and outcomes after turnover in primary care. JAMA Intern Med. 2021 1; 181:186-194.

[41] Skarshaug LJ et al. How does general practitioner discontinuity affect healthcare utilisation? An observational cohort study of 2.4 million Norwegians 2007-2017. BMJ Open. 2021 16; 11:e042391.

[42] Pereira Gray DJ et al. Continuity of care with doctors-a matter of life and death? A systematic review of continuity of care and mortality. 2018 BMJ Open, 8, e021161.

[43] Baker R, et al Primary medical care continuity and patient mortality: a systematic review. BJGP 10 August 2020; bjgp20X712289.

[44] Bazemore A et al Higher Primary Care Physician Continuity is Associated With Lower Costs and Hospitalizations. Ann Family Med. 2018; 16:492-497.

[45] Romaire MA et al. Primary care and specialty providers: an assessment of continuity of care, utilization and expenditures. Med Care 2014; 52:1042-9.

[46] Cook LL et el. Association between continuity and access in primary care: a retrospective cohort study. CMAJ Open. 2020 16;8:E722-E730.

[47] Nkemdirim Okere A et al. A quantitative analysis of the effect of continuity of care on 30-day readmission and in-hospital mortality among patients with acute ischemic stroke. J Stroke Cerebrovasc Dis. 2020 Sep; 29:105053.

[48] Reddy A, et al. Association between Continuity and Team-Based Care and Health Care Utilization: An Observational Study of Medicare-Eligible Veterans in VA Patient Aligned Care Team. Health Serv Res. 2018 Dec;53 Suppl 3:5201-5218. doi: 10.1111/1475-6773.13042.

[49] Lei L et al Continuity of care and health care cost among community-dwelling older adult veterans living with dementia. Health Serv Res 2020 Aug 19.

[50] Jacobs R et al. The association between primary care quality and health-care use, costs and outcomes for people with serious mental illness: a retrospective observational study. Southampton (UK): NIHR Journals Library; 2020 Jun.

[51] Hetlevik Ø et al. Continuity of care, measurement and association with hospital admission and mortality: a registry-based longitudinal cohort study. BMJ Open. 2021 Dec 2;11(12):e051958.

[52] El Turabi, A. 2019. Unintended Consequences: Empirical Studies of Continuity of Care in Primary Care. PhD thesis, Harvard University.

[53] Cheraghi-Sohi S et al. What patients want from primary care consultations: a discrete choice experiment to identify patients' priorities. Ann Fam Med. 2008 Mar-Apr; 6:107-15.
[54] Turner D et al. Do patients value continuity of care in general practice? An investigation using stated preference discrete choice experiments. J Health Serv Res Policy. 2007 Jul; 12:132-7.
[55] Gerard K et al. Is fast access to general practice all that should matter? A discrete choice experiment of patients' preferences. J Health Serv Res Policy. 2008 Apr; 13 Suppl 2:3-10.
[56] Rubin G, et al. Preferences for access to the GP: a discrete choice experiment. BJGP 2006; 56:743–8.
[57] Oliver D et al. Patient trade-offs between continuity and access in primary care interprofessional teaching clinics in Canada: a cross-sectional survey using discrete choice experiment. BMJ Open. 2019; 9:e023578.
[58] Coma E et al. Influence of organization and demographic characteristics of primary care practices on continuity of care: analysis of a retrospective cohort from 287 primary care practices covering about 6 million people in Catalonia. BMC Fam Pract. 2021 Mar 25;22(1):56.
[59] Hjortdahl P. Continuity of care: general practitioners' knowledge about, and sense of responsibility toward their patients. Fam Pract. 1992; 9:3-8.
[60] Freeman G, Hughes J. Continuity of care and the patient experience. An inquiry into the quality of general practice in England. The King's Fund. 2010.
[61] Merriel SW et al. Depth of the patient-doctor relationship and content of general practice consultations: cross-sectional study. BJGP 2015;65:e545-51.
[62] Michiels-Corsten M et al. Individual utilisation thresholds and exploring how GPs' knowledge of their patients affects diagnosis: a qualitative study in primary care. BJGP. 2017 May;67(658):e361-e369.
[63] Barrera SC et al. The impact of continuity of care on antibiotic prescribing in acute otitis media. Int J Pediatr Otorhinolaryngol. 2019; 126:109616.
[64] Magin Pet al. Deprescribing in older patients by early-career general practitioners: Prevalence and associations. Int J Clin Pract. 2021 Aug;75(8):e14325.
[65] Khanam MA et al. Association of continuity of care with blood pressure control in patients with chronic kidney disease and hypertension Aust J Gen Pract. 2019; 48:300-306.
[66] Maciejewski ML et al. Prescriber Continuity and Disease Control of Older Adults. Med Care. 2017 Apr;55(4):405-410.
[67] Younge R et al. Does continuity of care have an effect on diabetes quality measures in a teaching practice in an urban underserved community? J Health Care Poor Underserved. 2012 Nov;23(4):1558-65.
[68] Brookhart MA, et al. Physician follow-up and provider continuity are associated with long-term medication adherence: a study of the dynamics of statin use. Arch Int Med 2007; 167:847–852
[69] Hansen RA et al. Prescriber continuity and medication adherence for complex patients. Ann Pharmacother. 2015 Mar;49(3):293-302.
[70] Warren JR et al. Association of Continuity of Primary Care and Statin Adherence. PLoS One. 2015 Oct 8;10(10):e0140008.
[71] Youens D et al. Regularity and continuity of GP contacts and use of statins amongst people at risk of cardiovascular events. J Gen Int Med. 2021 Mar 2.
[72] Uijen AA et al. Heart failure patients' experiences with continuity of care and its relation to medication adherence: a cross-sectional study. BMC Fam Pract. 2012 Aug 20;13:86.
[73] Cohen Castel O et al. Patients' Perceived Continuity of Care and Adherence to Oral Anticancer Therapy: a Prospective Cohort Mediation Study. J Gen Intern Med. 2021 Jun;36(6):1525-1532.
[74] Parchman ML et al. Continuity of care, self-management behaviors, and glucose control in patients with type 2 diabetes. Med Care. 2002;40:137-44.
[75] Henninger S et al. Deciding whether to consult the GP or an emergency department: A qualitative study of patient reasoning in Switzerland. Eur J Gen Pract. 2019; 25:136-142.
[76] Salisbury C et al. How should continuity of care in primary health care be assessed? BJGP. 2009;59(561):e134-41.
[77] Jackson C, Ball L. Continuity of care: Vital, but how do we measure and promote it? Aust J Gen Pract. 2018; 47(10):662-664.
[78] Ball LE et al. Questionnaires that measure the quality of relationships between patients and primary care providers: a systematic review. BMC Health Serv Res. 2018; 18:866.
[79] Dolovich LR et al. The Diabetes Continuity of Care Scale: the development and initial evaluation of a questionnaire that measures continuity of care from the patient perspective. Health Soc Care Community, 2004; 12: 475-87.
[80] Uijen AA et al. Measuring continuity of care: psychometric properties of the Nijmegen Continuity Questionnaire. BJGP 2012; 62, e949-57.
[81] Hill KM et al. Measuring patient-perceived continuity of care for patients with long-term conditions in primary care. BMC Fam Pract 2014; 15: 191.
[82] Tousignant, P et al Validation of 2 New Measures of Continuity of Care Based on Year-to-Year Follow-up With Known Providers of Health Care Ann Fam Med 2014;12:559-567.
[83] Salisbury C et al How should continuity of care in primary health care be assessed? BJGP 2009
[84] Sidaway-Lee K et al. A method for measuring continuity of care in day-to-day general practice: a quantitative analysis of appointment data BJGP 25 February 2019; bjgp19X701813.
[85] Einarsdóttir K, Preen DB, Emery JD, et al. Regular primary care plays a significant role in secondary prevention of ischemic heart disease in a Western Australian cohort. J Gen Intern Med 2011;26:1092–7.
[86] Ha NT, et al Time protective effect of contact with a general practitioner and its association with diabetes-related hospitalisations: a cohort study using the 45 and Up Study data in Australia BMJ Open 2020;10:e032790.
[87] Pollack CE et al. Measuring Care Continuity: A Comparison of Claims-based Methods. Med Care. 2016 May; 54:e30-4.
[88] Swanepoel R. Poster presentation BJGP Conference 12 March 2020
[89] Wright M et al. Can continuity of care in primary care be sustained in the modern health system? Aust J Gen Pract. 2018; 47: 667-669.
[90] Frohlich N et al. Profiling primary care physician practice in Manitoba. Manitoba Centre for Health Policy. 2006.
[91] Canadian Institute for Health Information. Continuity of Care With Family Medicine Physicians: Why It Matters. Ottawa, 2015.
[92] Guthrie B. Continuity in UK general practice: a multilevel model of patient, doctor and practice factors associated with patients seeing their usual doctor. Family Practice 2002; 19: 496–499.
[93] GP Patient Survey https://www.gp-patient.co.uk/analysistool [Accessed 9th Jul 2021]
[94] Tammes P, et al Is continuity of primary care declining in England? Practice-level longitudinal study, 2012-2017 BJGP14 2020; BJGP.2020.0935.
[95] Forbes LJL et al. Changes in patient experience associated with growth and collaboration in general practice: observational study using data from the UK GP Patient Survey BJGP 2020; 70 (701): e906-e915. DOI: https://doi.org/10.3399/bjgp20X713429
[96] Kristjansson et al. Predictors of relational continuity in primary care: patient, provider & practice factors BMC Fam Pract 2013, 14:72
[97] Pettigrew LM et al. The impact of new forms of large-scale general practice provider collaborations on England's NHS: a systematic review. BJGP. 2018 Mar;68(668):e168-e177.
[98] https://practiceindex.co.uk/gp/blog/patient-list-churn-they-come-they-go-but-what-level-is-acceptable/ 26 Oct 2017 by Practice Index
[99] https://www.nuffieldtrust.org.uk/media/sir-simon-stevens-at-summit-2020-in-conversation-with-mark-dayan
[100] Parisi R, et al Rates of turnover among general practitioners: a retrospective study of all English general practices between 2007 and 2019 BMJ Open 2021;11:e049827.
[101] Sayers LD. Whitley Bay Health Centre Bucking the trend, don't blame part time GPs BJGP eletters. Published on: 4 June 2018
[102] Tomlinson J. Better continuity of care. https://abetternhs.net/2015/10/01/better-continuity-of-care/ [Posted on October 1, 2015]
[103] Tammes P et al. The impact of a named GP scheme on continuity of care and emergency hospital admission: a cohort study among older patients in England, 2012-2016. BMJ Open. 2019; 9:e029103.

[104] Gosden T et al. Capitation, salary, fee-for-service and mixed systems of payment: effects on the behaviour of primary care physicians. Cochrane Database of Systematic Reviews 2000, Issue 3. Art. No.: CD002215. DOI: 10.1002/14651858.CD002215.
[105] Peterson GM et al. Effectiveness of quality incentive payments in general practice (EQuIP-GP): a study protocol for a cluster-randomised trial of an outcomes-based funding model in Australian general practice to improve patient care. BMC Health Services Research volume 2019; 19: 529.
[106] L'Esperance V et al. Impact of primary care funding on patient satisfaction: a retrospective longitudinal study of English general practice, 2013-2016. BJGP 2020 Dec 28; 71(702):e47-e54.
[107] Consolidated Framework for Implementation Research https://cfirguide.org/
[108] Marsh GN et al Team Care in General Practice. London: Croom Helm, 1976
[109] Butler M, Kim H, Sansone R. Improved continuity of care in a resident clinic. Clin Teach 2017;14:45-8.
[110] Risi L et al. Micro-teams for better continuity in Tower Hamlets: we have a problem but we're working on a promising solution! BJGP 2015; 65:536.
[111] Golan-Cohen A et al. Does a policy that requires adherence to a regular primary care physician improve the actual adherence of patients? Isr J Health Policy Res. 2021 Aug 25;10(1):50. doi: 10.1186/s13584-021-00475-9.
[112] Wensing M et al. Continuity in general practice and hospitalization patterns: an observational study. BMC Fam Pract. 2021; 22:21.
[113] Salisbury C et al. Management of multimorbidity using a patient-centred care model: a pragmatic cluster-randomised trial of the 3D approach. Lancet (London, England). 2018;392(10141):41-50.
[114] The Health Foundation. Increasing Continuity of Care in General Practice 2020 [Accessed 13th March 2020]
[115] Continuity by Design Jul 2021 https://www.youtube.com/watch?v=PgxP1fuj6ik&list=PLNZJMhpCZQ46y3ro5G3itMliF01zpyyT6&index=3
[116] Valentine Health Partnership Relational continuity for general practice patients with new and changing symptoms. July 2020. [Link to report]
[117] HF Continuity Toolkit https://www.rcgp.org.uk/clinical-and-research/resources/toolkits/continuity-of-care-toolkit.aspx
[118] Groot LJJ et al. Optimising personal continuity for older patients in general practice: a study protocol for a cluster randomised stepped wedge pragmatic trial. BMC Fam Pract. 2021 Oct 20;22(1):207.
[119] Engamba SA et al. Tackling multimorbidity in primary care: is relational continuity the missing ingredient? BJGP 2019; 69:92-93.
[120] https://www.england.nhs.uk/coronavirus/publication/our-plan-for-improving-access-for-patients-and-supporting-general-practice/ Oct 2021
[121] Meredith S. Hunt Pairs with BMA in Campaign To Rebuild General Practice March 22, 2022 https://www.medscape.com/viewarticle/970726
[122] Appointments in General Practice October 2021 [Link to NHS Digital data]
[123] Deml MJ et al. The impact of the COVID-19 pandemic on the continuity of care for at-risk patients in Swiss primary care settings: A mixed-methods study. Soc Sci Med. 2022 Feb 24;298:114858.
[124] Gray DP et al. Covid 19: a fork in the road for general practice BMJ 2020; 370: m3709
[125] NICE. COVID-19 rapid guideline: managing the long-term effects of COVID-19. NICE guideline [NG188] Published date: 18 December 2020
[126] Potter M et al. The nominal group technique: A useful consensus methodology in physiotherapy research. N Z J of Physiotherapy 2004; 32: 126–130.
[127] Harvey N, Holmes CA. Nominal group technique: an effective method for obtaining group consensus. Int. J of Nurs Pract, 2012; 18: 188-194.
[128] Tuffrey-Wijne I et al. Using Nominal Group Technique to investigate the views of people with intellectual disabilities on end-of-life care provision. J of Adv Nursing 2007; 58: 80-89.
[129] McMillan SS, et al. Using the nominal group technique: how to analyse across multiple groups. Health Services and Outcomes Research Methodology 2014; 14(3), 92-108.
[130] Sheaff R et al. Bridging the discursive gap between lay and medical discourse in care coordination. Soc of Health & Illness, 2017; 39(7): 1019-1034.
[131] Benson T et al. Virtual Co-creation: A guide to conducting on-line co-creation workshops. International Journal of Qualitative Methods 2021, 20;1-15
[132] Taylor MJ et al. Using virtual worlds as a platform for collaborative meetings in healthcare: a feasibility study. BMC Health Serv Res 2020, 20, 442.
[133] Bice TW, Boxerman SB. A quantitative measure of continuity of care. Med Care 1977; 15: 347-9.
[134] Jee SH. and Cabana MD. Indices for continuity of care: a systematic review of the literature. Med Care Res Rev 2006; 63, 158-88.
[135] Tariq S, Woodman J. Using mixed methods in health research. Journal of the Royal Society of Medicine Short Reports 2013, 4(6)
[136] Herrett E et al. Data Resource Profile: Clinical Practice Research Datalink (CPRD). Int J Epidemiol. 2015 Jun;44(3):827-36.
[137] Steyerberg, Ewout W., et al. Prognosis Research Strategy (PROGRESS) 3: prognostic model research. PLoS medicine 2013: 10.2: e1001381.
[138] Turner SL et al. Evaluation of statistical methods used in the analysis of interrupted time series studies: a simulation study. BMC Med Res Methodol. 2021;21(1):181. doi: 10.1186/s12874-021-01364-0.
[139] Royston P, Altman DG. Regression using fractional polynomials of continuous covariates: parsimonious parametric modelling. J R Stat Soc: Series C (Applied Statistics) 43.3 (1994): 429-453.
[140] Shewhart WA. Economic control of quality of manufactured product. New York. 1931.
[141] Seawright J. Multi-Method Social Science: Combining Qualitative and Quantitative Tools. Chapter 4 - Case Selection after Regression. Cambridge University Press 2016; 75-106.
[142] Yin RK. Case Study Research Design and Methods. 2nd ed, Applied Soc Res Methods Series, Sage, Vol 5: 1994, ISBN 0-8039-5662-2
[143] Baxter R et al A qualitative positive deviance study to explore exceptionally safe care on medical wards for older people BMJ Qual Saf 2019; 28:618-626.
[144] Crowe S et al. The Case study approach. BMC Medical Research Methodology. 2011, 11, 100
[145] Whitley Bay Health Centre https://whitleybayhealthcentre.nhs.uk/welcome-2/
[146] Fusch P, Ness LR. Are we there yet? Data saturation in qualitative research. The Qualitative Report 2015, 20, 9, 1408-1416
[147] Wilkie P. Patients participation groups in general practice: building better partnerships. BJGP 2016, 66 (562): 548-549
[148] Gale NK., et al. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. BMC Med Res Meth 2013; 13: 117.
[149] Heath G et al Paediatric 'care closer to home': stake-holder views and barriers to implementation. Health Place. 2012 Sep;18(5):1068-73.
[150] Nyumba TO et al The use of focus group discussion methodology: Insights from two decades of application in conservation Methods Ecol Evol 2018; 9:1
[151] Tausch AP et al Methodological aspects of focus groups in health research. Global qualitative nursing research. 2016 Jan-Dec 3: 2333393616630466
[152] Marshall MN. The key informant technique Family Practice 1996; 13: 92-97.
[153] Guest G et al. How Many Interviews Are Enough? An Experiment with Data Saturation & Variability Field Methods. 2006; 18: 59-82
[154] Santosh L et al. Zooming into focus groups: strategies for qualitative research in the era of social distancing. ATS Scholar 2021
[155] Braun V, Clarke V. Using thematic analysis in psychology. Qualitative Research in Psychology 2006; 3:77-101.
[156] Tong A et al. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007;19(6):349-357
[157] Tariq S, Woodman J. Using mixed methods in health research. JRSM Short Rep 2013;4:2042533313479197
[158] O'Cathain A, Murphy E, Nicholl J. Three techniques for integrating data in mixed methods studies. BMJ 2010;341:c4587
[159] https://cprd.com/data-highlights
[160] Ride J et al. Healthcare Costs for People with Serious Mental Illness in England: An Analysis of Costs Across Primary Care, Hospital Care, and Specialist Mental Healthcare. Appl Health Econ Health Policy. 2020 Apr;18(2):177-188.
[161] Coombs CRH et al. Primary care micro-teams: a protocol for an international systematic review to describe and examine the opportunities and challenges of implementation for patients and healthcare professionals. BMJ Open. 2022 Mar 1;12(3):e052651.
[162] Moll S et al. Are you really doing 'co-design'? Critical reflections when working with vulnerable populations. BMJ Open 2020;f 10:e038339
[163] Skivington K et al. A new framework for developing and evaluating complex interventions: update of MRC guidance. BMJ. 2021 Sep 30;374:n2061.

[164] Realpe BA, Wallace LM. What is co-production? The Health Foundation 2010

[165] Asbury N, Walshe A. Involving women with breast cancer in the development of a patient information leaflet for anticipatory nausea and vomiting. Eur J Oncol Nurs. 2005;9:33-43.

[166] O'Cathain A et al “Any other comments?" Open questions on questionnaires – a bane or a bonus to research? BMC Med Res Meth 2004: 25.

[167] Litchfield I et al. Adaption, implementation, and evaluation of collaborative service improvements in the testing and result communication process in primary care from patients and staff perspectives: A qualitative study. BMC Health Services Research, 2017; 17;615.

[168] Michie S, et al. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implementation Sci 2011;6: 42.

BMJ Open

Quantifying, Understanding and Enhancing Relational Continuity of Care (QUERCC) A mixed methods protocol.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2024-088573.R1
Article Type:	Protocol
Date Submitted by the Author:	25-Mar-2025
Complete List of Authors:	Marshall, Tom; University of Birmingham - Edgbaston Campus, Public Health and Epidemiology School of Health Sciences, College of Medicine and Health Scheibl, Fiona; University of Birmingham, School of Health Sciences, College of Medicine and Health, University of Birmingham. Williams, Iestyn; University of Birmingham College of Social Sciences, Social Policy Nirantharakumar, Krishnarajah; University of Birmingham - Edgbaston Campus, School of Health Sciences, College of Medicine and Health, University of Birmingham. Willis, Brian; University of Birmingham College of Medical and Dental Sciences, School of Health Sciences Kasteridis, Panagiotis; University of York, Economics Sterniczuk, Kamil; University of Birmingham - Edgbaston Campus, School of Health Sciences, College of Medicine and Health, University of Birmingham. Chen, Jinyang; University of York, Economics Anteneh , Zecharias; University of York, Center for Health Economics Greenfield, Sheila; University of Birmingham - Edgbaston Campus, School of Health Sciences, College of Medicine and Health
Primary Subject Heading:	General practice / Family practice
Secondary Subject Heading:	Health services research, Health economics, Qualitative research, General practice / Family practice
Keywords:	Patient Care Management, Person-Centered Care, HEALTH ECONOMICS, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

Title page

Quantifying, Understanding and Enhancing Relational Continuity of Care (QUERCC) - A mixed methods protocol.

Authors:
Tom Marshall,
t.p.marshall@bham.ac.uk

Fiona Scheibl,
f.scheibl@bham.ac.uk

Iestyn Williams,
i.p.williams@bham.ac.uk

Krishnarajah Nirantharakumar,
k.nirantharan@bham.ac.uk

Brian Willis,
b.h.willis@bham.ac.uk

Panagiotis Kasteridis,
panos.kasteridis@york.ac.uk

Kamil Sterniczuk,
k.sterniczuk@bham.ac.uk

Jinyang Chen,
jinyang.chen@york.ac.uk

Zecharias Anteneh,
zecharias.anteneh@york.ac.uk

Sheila Greenfield,
s.m.greenfield@bham.ac.uk

Corresponding author
Tom Marshall
t.p.marshall@bham.ac.uk

Word count 7860 (manuscript excluding abstract, title page, references and figures)

Key Words: Continuity, Primary care, Measurement, Improvement

Abstract

Introduction

Relational continuity of care is where patients see the same clinicians over time. Evidence suggests relational continuity of care is valued by patients and clinicians and results in better health. While current NHS policy aims to maintain relational continuity of care it has been declining in recent years which may be linked to the growth in practice size, increased staff turnover, part time working, and the focus on patient access. Our research aims to develop resources to help clinicians measure, manage and improve relational continuity of care.

Methods and Analysis: A mixed methods approach in UK primary care commencing with two workshops drawing patients, clinicians, and researchers together to establish an agreed approach on the measurement of continuity of care. Second, analysis of national data will provide insight into how staff turnover, part-time working, practice size and funding per patient affects continuity. Third, case studies in a sample of high performing practices will document the barriers and facilitators to the establishment and maintenance of continuity of care. Forth, an economic analysis of resource costs and health outcomes using linked primary and secondary care data will show whether costs influence continuity for different patient groups (by age, sex, deprivation status and chronic disease status). Fifth, we will develop practical guidance for clinicians to improve continuity of care, based on the findings from each stage of the research.

Ethics and dissemination: Ethical approval will be obtained prior to collection of participant data and analysis of national data sets. Findings will be disseminated through peer-reviewed publications, participatory workshops, podcasts, clinical networks and academic conferences.

Strengths and Limitations of this study

- This mixed methods study engages a breadth of stakeholders in the development of resources aimed at understanding the context and measurement of relational continuity in primary care.

- A key benefit of the study design is involvement of patients in the wider debate around the measurement and definition of RCC
- Engagement with stakeholders is maintained throughout the study to maximise the relevance, quality and dissemination of study findings.
- Only general practices and stakeholders in England will be included in the study

Introduction

Background

Continuity of care includes informational continuity, sharing information between clinicians and organisations; management continuity, following the same management plan across different clinicians and organisations; and relational continuity, an ongoing therapeutic relationship between clinician and patient. [1] Relational continuity of care (RCC) enables and underpins informational and management continuity and is important in primary care for two main reasons: it is valued by patients and GPs, and it is associated with better health care delivery, and better health outcomes. [2]. Doctors and patients value RCC as facilitating the conditions required for person-centred care [3-6] and view its absence as increasing the risk of harm and loss of trust [2, 7-9]. Longstanding evidence shows RCC is associated with reduced emergency consultations, unplanned admissions and even mortality [5, 10-17] across a range of acute and long-term conditions [18-23]. Disruption of continuity is associated with increased use of specialty, urgent, and emergency care in older patients [24, 25]. Furthermore, RCC is often particularly important in the delivery of primary care to diverse populations [6, 26] and can result in better care navigation and engagement among young people. [27].

However, continuity is declining. Lower continuity is associated with more clinicians working part-time, use of locums, the growth in practice size with greater numbers of clinicians in practices and patient turnover [28, 29]. There is also an increased focus on patient access, rather than continuity. We currently do not know the extent to which practice-level characteristics undermine continuity or the extent to which continuity might be maintained or enhanced by within-practice policies. There are potentially many ways to optimise continuity. As no two general practices are the same, the most successful approach is likely to depend on the practice context. The Royal College of General Practitioners (RCGP) emphasises the need to measure relational continuity as a first step in its management [30].

Very few general practices monitor the impact of their within-practice policies on continuity of care and conceptions of how to measure it differ. There is a long-recognised need for consistent measures of RCC [5, 31, 32]. However, choosing an appropriate measure is complex [33]. Subjective measures based on patients' experience of continuity using questionnaires is impractical for monitoring [34-37]. Measurement of the frequency of consultation with the same clinician is feasible using electronic health records (EHR) and correlates with subjective measures [38]. But different objective measures capture different conceptions of RCC [31]. Continuity may be with the GP or with any clinician; it may be in all patients or in specific patient groups (e.g. ≥65 years); it may be measured quarterly, monthly, or weekly. There are different RCC indices. Some measure density: the Usual Provider of Care index (UPC) % of consultations with most frequently seen GP, or the St Leonard's Index of Continuity of Care (SLICC) % of consultations with a named GP [39]. Others measure dispersion, taking account of the number of different clinicians consulted, using the Bice-Boxerman (BB) or Herfindahl (HI) indices. There is also a measure of Sequential Continuity (SECON). (**TABLE 1**)

Table 1: Main indices of relational continuity of care (RCC)

Name	What is measured	Formula
Usual Provider of Care ($\text{UPC}^{\text{Patient}}$)	Concentration with usual provider	$max\left(\frac{n_i}{n}\right)$
St Leonards Continuity of Care (SLICC or $\text{UPC}^{\text{GP}}_{\text{level}}$)	Concentration with named provider	$named\ clinician\left(\frac{n_i}{n}\right)$
Herfindahl Index (HI)	Concentration taking into account all providers	$\sum_{i=1}^{p}\left(\frac{n_i}{n}\right)^2$
Bice-Boxerman (BB)	Concentration accounting for the number of consultations	$\frac{\left(\sum_{i=1}^{p} n_i^2\right) - n}{n(n-1)}$
Sequential (SECON)	Sequential aspect of continuity	$\frac{\left(\sum_{j=1}^{n-1} c_j\right)}{(n-1)}$

Modified-Modified Continuity Index (MMCI)	Dispersion (lack of concentration)	$\dfrac{1-\frac{p}{n+0.1}}{1-\frac{1}{n+0.1}}$

p = total number of providers (clinicians); n = total number of visits during episode; n_i *= number of visits to provider i;*
c_j *= indicator of sequential visits to same providers, equal to 1 if visits j and j+1 are to the same provider, 0 otherwise*

Research has explored effects of regularity and minimum frequency of contact on patients with chronic conditions. [40, 41]. For patients who consult infrequently, measured continuity is arithmetically high, therefore measured continuity declines with consultation frequency.. Some RCC measures (e.g. the Bice-Boxerman) account for this. In practice, BB, HI, UPC and SECON are often highly correlated [42]. SLICC is easy to calculate at the practice level and does not require patients to have a minimum number of consultations, but it may differ from the UPC if the patient's usual GP and named GPs differ [43]. A realistic strategy to improve continuity would also need to consider for which patient group it needs to be prioritised as the optimum balance between access and continuity may vary across different patient groups.

Given the complexity of the issues at stake the QUERCC study aims to develop a menu of approaches to measuring RCC, and empirically informed practical guidance to help general practices optimise it. QUERCC uses a mixed methods design across five work-packages with defined objectives **(TABLE 2)** leading toward project outputs and dissemination. To ensure QUERCC outputs are impactful the team will work closely with the RCGP and international colleagues leading research addressing the same issues in different contexts [44].

Table 2: Objectives of QUERCC study

Objectives	**Work package**	**Outcome**
Develop guidance for general practices on quantitative measurement of RCC.	WP1	A menu of approaches to measuring RCC for monitoring in primary care.
Quantify the practice-level determinants of RCC: including staff and patient turnover, part-time working, practice size and practice funding. Identify practices showing unusual variation (positive deviants) in RCC.	WP2	A model of the contribution of patient and general practice-level characteristics to trends and variations in RCC. An observed to predicted ratio of RCC in Clinical Practice Research Datalink (CPRD) practices. A list of general practices in the top decile for RCC will be abstracted and sites selected for inclusion as potential case studies.

Conduct in-depth case-studies to understand how practices achieve high RCC.	WP3	The primary output is an understanding of the practice characteristics which contribute to RCC and understanding of barriers and facilitators to RCC and the mechanisms by which RCC influences health.
Undertake economic analysis of the likely causal effects of changing RCC on resource costs and health outcomes across different segments of the registered practice population.	WP4	A model assessing the impact of changes in RCC on healthcare resources and health outcomes. The model will describe the effects of changing RCC on different population groups.
Develop empirically informed practical guidance to help general practices optimise RCC.	WP5,	Develop guidance deriving from existing research will and stakeholder input to produce in-depth empirical data on the strategies for increasing and/or maintaining RCC in primary care settings. We will document the full range of these strategies and interventions and provide a summary of evidence on their efficacy and implementation in different settings. These outputs will be a key part of our dissemination and knowledge exchange activities and will therefore inform practice in the immediate term. We will also identify areas where there might be a need for intervention *adaptation* or de novo.

METHODS AND ANALYSIS

Research design

A mixed methods approach is used to capture the complexities of continuity of care as a measurable event with associated outcomes and subjective experience and an organisational process and value. Our approach is designed to develop empirically informed strategies for improving and maintaining RCC in primary care settings (see FIGURE 1). The study will commence in April 2023 and conclude in May 2026. Work packages (WPs) 1–3, will draw together insights from consensus workshops (WP1), case studies (WP3) and CPRD data (WP2) to identify factors that explain the practice level drivers of continuity of care (see FIGURE 2). These findings will be integrated with the economic evaluation (WP4) leading to the development of a menu of approaches to measuring RCC, and empirically informed practical guidance to help general practices optimise it (WP5).

Figure 2 HERE

Data collection across the five work packages addresses the possible determinants of RCC (patient characteristics, patient and staff turnover, part-time and full time working, practice size and within-practice policies) and its effects, including both positive effects (on hospitalisations, consultation rates, prescribing, patient experience and mortality) and negative effects (lack of a second opinion, clinician burden). Consideration is also given the interplay between RCC and access to primary care.

Ethics and dissemination

This study has approval from the HRA and Health and Care Research Wales (HCRW) Research Ethics Committee (23/SW/0101 and 24/EM/0031). Information about the study will be provided in a participant information sheet to all potential participants. A written informed consent form will be obtained prior to data collection and participants will be informed of their right to withdraw from the study. We will share research findings across a range of academic publications, networks and conferences. For a lay audience, we will commission a short animation of our final report. We will initiate a social media campaign to garner interest and encourage feedback via blogs and personal stories of continuity of care.

Funding Statement

This work was supported by NIHR HSDR. Reference: NIHR152277 Quantifying, Understanding and Enhancing Relational Continuity of Care (QUERCC). HSDR Funding call: 22/16 HSDR May 2022.

Data Statement

Technical Appendix including topic guides and qualitive data set will be made available at OSF | Quantifying, Understanding and Enhancing Relational Continuity of Care (QUERCC). Quantitative data set and models available from the authors.

Patient and public involvement and engagement

During the conception and development of this proposal we consulted with 8 patients in two workshops. Participants had lived experience of RCC becoming more difficult to maintain and something that they valued in health care. They identified more doctors working part-time, larger practices and automated booking systems and receptionists as potential barriers to continuity. These issues are also reported in the literature and informed our decision to conduct a mixed methods programme of research. We established a Patient Advisory Group PAG group (five members) in

October 2023 and recruited three Patient and Public Involvement (PPI) representatives in January 2024. The study PPI lead /co-applicant (KS) came through to work on the project from the original cohort consulted in 2019. The PAG and PPI have contributed to patient facing documents developed for WP1 and WP3 and worked together to shape the content of the study website. PAG and PPI will contribute to data review across all five work packages, working with the team to maximise knowledge sharing. The PPI lead will attend monthly management meetings and three PPI members will have optional attendance to contribute to management of the project.

Theoretical framework

Synthesis and interpretation of data collected across the five work-packages will be guided by the recently updated Consolidated Framework for Implementation Research (CFIR) [45]. CFIR is one of the most widely used frameworks to organise and interpret data on factors that shape implementation of change within health care settings [45, 46]. It provides a framework of 39 implementation constructs which facilitates the organisation and interpretation of data across five core domains: outer setting (e.g., the economic, political, and social context), inner setting (e.g., the structural, political and cultural context where the implementation takes place, such as an organization), characteristics of individuals (e.g., attitudes, values and believes of the individuals involved) and process (e.g., components that impact the implementation process). Working in this way the analysis will aim to unpack the key components of a workable intervention.

Work package 1: Identifying areas of divergence and consensus in the measurement of RCC in two qualitative consensus workshops

Using coproduction and consensus methods across two workshops this WP aims to determine how clinicians, patients and researchers define continuity and which RCC measures they recognise as offering the best intuitive approach to its measurement. This WP opens a stakeholder debate around the development of guidance for practices and the choice of RCC index to adopt and in which populations to measure RCC which will feed into all five work packages.

Selection of workshop participants: Clinicians, patients and researchers will be recruited using purposive sampling methods. We aim to recruit through local patient networks to sample a range of patients by age, gender, ethnicity, education level and where possible chronic disease status. Professionals will be identified and recruited through national and regional professional networks who will be selected to represent a diversity of age, gender, ethnicity. Working in this way we aim to recruit a minimum of 15 – and a maximum of 30 participants with equal numbers in across the patient and professional categories.

Data collection

Data is collected face to face in two workshops convened in central Birmingham and professionally facilitated. All participants will be consented to take part and reimbursed for their time at appropriate NHS locum rates (clinicians) and rates set by NIHR guidelines (lay participants) [Payment guidance for researchers and professionals | NIHR]

Approach

In workshop 1 participants will be invited to contribute three key ideas on what RCC means to them and given time ahead of the workshop to write these ideas down. Once in the workshop a professional facilitator skilled in coproduction approaches and the theme lead will work with participants in three break- out groups to select a key idea to bring to a wider group discission. During the group discussion the theme lead will explain the breadth of issues in RCC measurement and participants will be asked to individually reflect on the key components of RCC (e.g. “Is continuity primarily with one GP, more than one GP or all clinicians?” “What aspects of care are most important in providing continuity?”. The discussion and break out group ideas will be charted visually, and key ideas generated in the debate summarised under thematic headings. Participants will be invited to vote on key thematic headings built on the ideas they contributed. The facilitator will use coproduction methods to work towards a consensual perspective that respects the range and depth of the stakeholder themes generated. Coproduction approaches will enable us to bridge any discursive gap between lay and medical understandings of RCC.

At the second workshop, which will be held approximately 2 months later, we will work with the same participants (or substitutes if some cannot attend) and professional facilitator to examine the issue of RCC measurement. The team lead will generate a series of visual scenarios and outline the pros and cons (see **TABLE 3)** of currently used indices (BB, HI, UPC^{Patient} or UPC$^{GP\ level}$) [47, 48]. We will record the discussion to aid analysis and thematic summary.

Table 3: Illustration of pros & cons of different measures of relational continuity of care

			Continuity index				
Clinician group	**Patient group**	**Criterion**	**SLCC**	**UPC**	**BB**	**Hi**	**Secon**
Consultation with GP only	Age ages	Understandable	Good	Good	Fair	Fair	Fair
		Unaffected by consultation rate	Poor	Poor	Good	Good	Fair
		Patient conception	Fair	Fair	Good	Good	Poor
		Clinician conception	Fair	Fair	Fair	Fair	Fair
	Aged 65+ only	Understandable					
		Unaffected by consultation rate					
		Patient conception					
		Clinician conception					
Consultation with all clinical staff	All Ages	Understandable					
		Unaffected by consultation rate					
		Patient conception					
		Clinician conception					
	Aged 65+ only	Understandable					
		Unaffected by consultation rate					
		Patient conception					
		Clinician conception					

Facilitated group discussion will examine key problems involved in measurement of RCC (e.g. "Is continuity primarily with one GP, more than one GP or all clinicians?" "What aspects of care are most important in providing continuity?" "How frequently should it be measured?"). Stakeholders will be invited to vote on a range of measures of RCC (e.g. which population, density v dispersion, GPs or all clinicians, understandability etc). It is anticipated that voting will be supported with an online voting tool (Interactive presentation software - Mentimeter) to gauge support for different measures presented.

Data analysis

A manifest content analysis approach will be used to examine the overlap and divergence of views on the definition of continuity of care obtained in workshop 1. Summary analysis will identify the points of convergence and difference across the participant groups (clinicians, researchers, and patients). Transcripts and voting results from workshop 2 will be summarised in an Excel spreadsheet and further content analysis will summarise the range of perspectives on measurement and the value of a range of RCC indexes.

Output

We do not anticipate that the workshop data will generate a complete consensus on a single way to measure RCC but expect these stakeholder conversations to inform and sensitise analysis and modelling in WP2 and subsequent work packages.

WP2 Investigation of determinants of relational continuity of care (RCC) & identification of outliers

The aim of this work package is to investigate practice-level determinants of measured RCC in general practices and to identify practices showing unusually high continuity given their characteristics for inclusion as case studies in work package 3. We will examine how RCC is related to the practice population's characteristics (age, sex, ethnicity, chronic disease status, deprivation) and practice characteristics (practice size, patient turnover, clinician turnover, workload, part-time working, funding levels).

Data and Methods:

We will investigate the determinants of RCC using Clinical Practice Research Datalink (CPRD) data; a large primary care database linked to data on practice funding. CPRD collects fully coded and de-identified patient electronic health records from a network of GP practices using the Vision® (CPRD GOLD) or EMIS® (CPRD Aurum) software systems (further details provided in supplementary material). CPRD data are broadly representative of the English general population [49]. We will use data from the CPRD GOLD database for the period 1st January 2005 until the most recent data upload linked to the General and Personal Medical Services database (NHS Digital) from which we will obtain data on average funding per registered patient [further details provided in supplementary material]. Modelling will enable us to calculate a predicted monthly RCC for each participating general practice from this we can calculate an observed to predicted ratio of RCC. Unusual variation in a process is more likely to have an assignable cause [50]. Therefore it is likely to be productive to investigate outlier practices as case studies. To shortlist potential case studies in the most recent quartile of RCC data we will identify the top decile of general practices by their observed to predicted ratio of RCC. We will use a range of measures to predict the ratio of RCC: Usual Provider of Care, Herfidahl Index, Bice-Boxerman, Modified Modified Continuity Index and the Sequential Continuity Index. Prior analysis shows that these measures report very similar lists of positive deviants. We will ultimately use the measure that best predicts clinical costs and outcomes. The measure used may not be the same measure preferred by stakeholders [clinicians, patients and researchers] in the workshops in WP1. This reflects the pragmatic requirement that WP2 model is specified to incorporate costs and clinical outcomes.

Output: A model of the contribution of patient and general practice characteristics to trends and variations in RCC. An observed to expected ratio of RCC in CPRD practices. Identification of general practices in the top decile for RCC for inclusion as potential case studies in WP3.

WP3 Qualitative case study research into determinants of continuity of care

In WP3 we will use an exploratory multiple case study design sampling deviant cases which will enable exploration and rich description of the relevant everyday processes and interactions in practices [51]. Previous research suggests that selecting case studies from outliers (deviant cases) is a valid way to find out about causal pathways and causes of heterogeneity [52]. For example, a similar method has been used to investigate wards providing safe hospital care [52, 53].

Sample selection

Deviant 'outlier' sites for WP3 case study will be identified during analysis of CPRD data completed in WP2. We will identify a quartile (180) with the highest continuity of care (RCC) and a quartile (180) with average RCC. Within these quartiles we will also consider the size of practices with high and low RCC and whether the populations they serve are more, or less, deprived. We aim to sample eight 'deviant' sites: six general practices from the quartile with the highest continuity of care (from the top 10%) and two general practices from those with average continuity of care (the lowest 10%).

Site recruitment

CPRD data is anonymised which means it is not possible to identify organisations prior to obtaining their agreeing to take part as case studies. To facilitate recruitment, we will enlist the CPRD agency to send invites to practices that meet the inclusion criteria on behalf of the QUERCC study. We will supply CPRD with a template letter to send out. Recruitment will be ongoing until 8 sites agree to take part. To maximise recruitment rates, we will facilitate participation by offering flexible times and either hybrid or in person options for data collection.

Participant recruitment at case study sites

We will recruit 15-30 participants at each of the eight case study sites to take part in two focus groups: one with a range of clinical and non-clinical staff; and one with practice patient participation groups. Focus groups will be supplemented with semi-structured interviews with up to three key informants per practice (identified during the focus groups). Interviews will enable the further investigation of themes across the organisational strata, including depth perspectives from reception and administration staff who may not be able to join the focus group. A depth patient interview will also add nuance to understandings and make provision for any patient who for example cannot make the focus group. This size and number of focus group is optimal for data collection in a case study context [54, 55].

We will aim to recruit a diversity of clinicians and patients by age, gender, ethnicity. We will also aim to select a range of patients by education level and chronic disease status and use an equality and diversity form to collect participants details anonymously. An interpreter will be made available to any potential participant whose first language is not English and wants to take part, we will translate the PIS/ E&D/ ICF documents on their behalf to enable them to fully consult the terms of the study and consider the implications of participation. We will use topic guides to structure the focus group discussion and interviews. Recruitment will exclude patients who lack capacity to consent and a lower age limit of >20 and an upper age limit of <95 years. The number of participants recruited and consented to take part will be in the region of n =72-216 (two focus groups (6-12 people) + three interviews x 8 sites).

Data analysis and synthesis

Thematic and framework approaches [56] will be used to work with qualitative data and integrate these with the findings of the quantitative data collected in WP2. Themes will be compared within and across practices, and across data collection method focus group, interview and documentary data [57]. A summary of overall themes from their discussion will be sent to participants for comment. PPI representatives and members of the multi-disciplinary research team (SG, Sociologist, TM, Public Health Clinician, IW, Health Service Policy analyst) will read a selection of transcripts and documents, then discuss and agree on emerging themes to develop the data coding framework. To ensure robustness and quality our research and analysis will also be guided by the COREQ checklist for reporting qualitative research [58] and data will be 'triangulated' across the work packages data sources across the study. Comparing and synthesising data in this way will provide additional insights and enhance understandings. Overall findings will then be brought together and considered by the whole research team [59, 60].

Output: The primary output of WP3 is an understanding of the practice characteristics which contribute to RCC and the barriers and facilitators to the provision of RCC. A secondary output will be to gain insight into the mechanisms by which RCC influences health.

WP4 Economic analysis of the effects of RCC

In this work package we will analyse the potential effects on resource use and health outcomes of changes in practice-level RCC using patient-level data. We will analyse the effects across different segments of the registered practice population.

Data and Methods

We will use primary care data from the CPRD database from 1st January 2005 until the most recent upload, with standard linkages to: i) Hospital Episode Statistics data (including inpatient admissions, outpatient appointments and A&E attendances), ii) Office for National Statistics (ONS) mortality data, and iii) area level deprivation. We will also use one non-standard linkage to funding per patient. CPRD Gold includes about 9 million patients eligible for linkage, in around 400 general practices and CPRD Aurum 38 million eligible patients in around 1400 general practices (Clinical Practice Research Datalink | CPRD.)

We will analyse the effects of RCC on i) two types of primary care use: consultations and prescribing; ii) three types of hospital use: unplanned admissions, A&E presentations, outpatient appointments; iii) costs, and iv) mortality. We will identify primary care activity from the CPRD records of consultations, clinical events, and prescription records and secondary care activity from HES inpatient, outpatient and A&E records. We will cost primary and secondary care activities using methodology that we have previously used [61].

We will undertake a patient-level analysis with the explanatory variable of interest (RCC) measured at practice level. We will undertake preliminary analyses to explore the relationship between RCC and unplanned admissions (the main driver of costs) over time. If the relationship was altered during the pandemic years we will consider whether to consider pre-pandemic and post-pandemic years separately. We will also undertake preliminary analyses to explore whether the relationship between RCC and unplanned admissions varies by chronic disease status (using chronic diseases included in the Quality and Outcomes Framework) to determine whether analysis should be segmented by chronic disease status.

The study population will consist of patients who were registered with a GP practice any time during the period from 1 January 2006 to 31 March 2021 (currently most linked data are available up to 2021). We will observe these patients until outcome or censoring, where censoring is due to the patient changing GP practice, death, or the end of the study period (date of last upload). The observation period for each patient will be divided into periods of 3 months and outcomes will be binary variables indicating whether or not the particular event occurred in each 3-month period (except from costs which are a continuous variable). For instance, a patient initially observed on 1st January 2017, who underwent inpatient hospitalisation in March 2018, will contribute data for five quarters: four quarters in 2017 where the outcome value of zero and one quarter in 2018. The resulting dataset will be an unbalanced panel as individuals contribute to the sample different number of quarters depending on when they experience an outcome. RCC will be measured at practice level over the 12 months prior to the outcome period using the indices from WP1 (e.g. in the above example the RCC associated with patient's first observation will be measured over the period 1st January 2016 – 31st December 2016). We will include a mix of patient level confounders such as age, gender, deprivation, ethnicity, morbidity profile, prior healthcare utilisation and practice level characteristics such as practice size, practice funding, staff turnover and part-time working.

We will employ discrete time survival analysis to evaluate the association between risk of each outcome in a particular 3-month period and RCC in the prior twelve months. Specifically, we will estimate complementary log-log (cloglog) models (the discrete-time analogue of the continuous-time proportional hazards models) which are appropriate when the occurrence of an outcome is rare.

Output: A model assessing the impact of changes in RCC on healthcare resources and health outcomes. The model will help us understand the effects of changing RCC on different population segments.

WP5 Empirically-informed practical guidance to help to improve RCC in primary care

This final phase of this research is to collate and integrate findings from different work-packages, generate and disseminate learning, and create impact. It involves co-designing principles and methodologies to develop guidance on how to improve and enhance RCC. We will develop empirically-informed practical guidance to help general practices optimise RCC using a Normalisation Process Theory framework relevant to primary care interventions [62, 63] and disseminate findings to stakeholders.

Method: Co-design and dissemination

We will undertake a rapid review of evidence on within-practice interventions [64-66] making use of ongoing reviews on this topic [67]. We will follow good practice and consider or 'triangulate' findings from the evidence review and this study's work packages. We will follow good practice and consider or 'triangulate' findings from the evidence review and from our own study's work packages: WP1 (meaning of RCC), 0 (determinants of RCC), WP3 (detailed case-studies) and preliminary results from 0 (economic analysis). Each separate WP will have individual and stand-alone findings analysed separately using techniques appropriate to their methods, but we will additionally look at all of the different sets of findings together, to identify what each contributes to the overall picture. We will use principles of Normalisation Process Theory(NPT) to combine the findings from each work package. Comparing and contrasting individual WP findings against NPT is likely to provide additional insights and enhance overall understanding. Overall findings will then be brought together and considered by the whole research team. We will convene two 3-hour deliberative workshops (either face-to-face or online) to integrate these findings and develop practical guidance on how best to improve RCC. This process will be informed by existing research on how to ensure the needs of diverse groups are taken into consideration [68] using coproduction methods [69] to ensure that recommendations are acceptable to patients and clinicians and are deliverable [70].

As with WP1 participants will include a purposive sample of clinical and non-clinical professionals and patient representatives. Participants who attended workshops in WP1 will be given the opportunity to take part and if needed we will invite additional attendees, drawing on networks and groups identified over the life course of the study.

The first workshop will be carried out with the patients only (n = approx. 15), in order to determine their views. In this workshop we will investigate what role patients and the public might have in facilitating RCC in different settings. We will explain the background to the project and share preliminary findings from our case-studies on the characteristics of general practices associated with high RCC and the perspectives of staff and patients in these practices. Before the workshop we will summarise the findings in plain language form, for participants to read and will briefly present the findings at the start of the workshop. We will ask participants to reflect on the evidence in relation to their own experience, to identify which characteristics might form the basis of practice policies which are acceptable to patients. We will also ask them to identify any knowledge gaps. To facilitate discussion participants will be broken up into smaller groups (6 or less). The headline conclusions of the workshop will be summarised at the end of the workshop to ensure these have been captured accurately. Notes and minutes of the workshop will be collated and summarised by the research team and circulated to workshop participants for their final approval.

In the second workshop both patients and practice staff (n= approx. 30) will meet together for joint discussion. We will again provide the findings from in written form for participants to read before the workshop and briefly present findings at the start of the workshop, including key messages from the first workshop. We will ask participants to identify practice characteristics which might form the basis of acceptable and feasible practice policies on RCC. We will ask participants to achieve satisfactory agreement on the information content and medium of delivery of a final set of recommendations on optimising RCC. We will also ask participants to identify any knowledge gaps. To facilitate discussion participants will be broken up into smaller groups (6 or less). Workshops will be facilitated by a professional facilitator supported by the study team and audio-recorded, audios will be deleted following verification of anonymised transcript. Transcripts will be analysed using the principles of framework analysis with the specific purpose of informing the development of good practice principles to support RCC [71]. The research team will then draft a written document with recommendations and circulate this to participants for final comment.

Ethics and dissemination

We will seek ethical approval for the study from the Health Research Authority (HRA) along with relevant research governance approvals. The main ethical questions relate to participant anonymity and the safeguarding of any private data.We will ensure informed consent for all interviews and will provide potential participants with information about the study, and time to consider participation. Data will be stored in line with institutional policies Interview participants will not be named or identifiable and we will use pseudonyms to report any direct quotes.

A key benefit of our work is involvement of patients in the wider debate around the measurement and definition of RCC. A key output will include findings on the causes of declining RCC, its effects and solutions to the problem. For a lay audience, we will create a project website and commission a short animation version of our final report to communicate findings in an accessible way. A project website will make available regular publicly accessible bulletins of interest to the general public. We will initiate a social media campaign to garner interest in and share information about the project and will share research progress and encourage feedback via blogs and personal stories of continuity of care. Through our digital profile we will engage with patient groups and 3rd sector organisations as intermediaries and knowledge brokers to help us develop an effective implementation and dissemination strategy and to ensure we engage heterogeneous groups of stakeholders. We plan to share our code for measurement of RCC with manufacturers of primary care records software, [initial discussions have been advanced with developers at Cededim and clinical computer system developed by Horsforth-based The Phoenix Partnership TPP] to stimulate and facilitate development of tools to measure RCC. To directly reach primary-care clinicians we will develop a podcast or short video with the Personalised Care Institute to disseminate to clinicians and have fully costed development of two webinars and a package of marketing and communications with the RCGP. The University of Birmingham's Centre for Primary Care Improvement will create a postgraduate module for primary care professionals on managing continuity of care.

Declaration of Helsinki

This study complies with the Declaration of Helsinki, adopted by the 18th World Medical Association (WMA) General Assembly, Helsinki, Finland, June 1964 and last revised by the 64th WMA General Assembly, Fortaleza, Brazil, October (2013).

Acknowledgements

The study team thank the participants of the workshops held during the development of the project and our PAG group and PPI members who have contributed to the development of the research.

Author Contributions

Tom Marshall: Conception and design, acquisition, drafting, writing, and approving content for publication. Professor T P Marshall is the guarantor
Fiona Scheibl, drafting writing and approving content for publication.
Iestyn Williams: Conception and design, acquisition, drafting, writing, and approving content for publication.
Krishnarajah Nirantharakumar: Conception and design, and approving content for publication.
Brian Willis, Conception and design, acquisition, and approving content for publication.
Panagiotis Kasteridis: Conception and design, acquisition, drafting, writing, and approving content for publication.
Kamil Sterniczuk: PPI coordination reviewing and approving content for publication.
Jinyang Chen: reviewing manuscript approving content for publication.
Zecharias Anteneh: reviewing manuscript approving content for publication.
Sheila Greenfield: Conception and design, acquisition, drafting, writing and approving content for publication.

Conflicting interests

None

REFERENCES

1. Haggerty JL, Reid RJ, Freeman GK, et al. Continuity of care: a multidisciplinary review. Bmj. 2003;327(7425):1219-21. PMID: 14630762 PMCID: PMC274066

2. Nowak DA, Sheikhan NY, Naidu SC, et al. Why does continuity of care with family doctors matter? Review and qualitative synthesis of patient and physician perspectives. Can Fam Physician. 2021;67(9):679-88. PMID: 34521712 PMCID: PMC9683367

3. Murphy M, Salisbury C. Relational continuity and patients' perception of GP trust and respect: a qualitative study. Br J Gen Pract. 2020;70(698):e676-e83. PMID: 32784221 PMCID: PMC7425201

4. Rolfe A, Cash-Gibson L, Car J, et al. Interventions for improving patients' trust in doctors and groups of doctors. Cochrane Database Syst Rev. 2014;2014(3):Cd004134. PMID: 24590693 PMCID: PMC7386923

5. Saultz JW, Lochner J. Interpersonal continuity of care and care outcomes: a critical review. Ann Fam Med. 2005;3(2):159-66. PMID: 15798043 PMCID: PMC1466859

6. Tarrant C, Dixon-Woods M, Colman AM, et al. Continuity and trust in primary care: a qualitative study informed by game theory. Ann Fam Med. 2010;8(5):440-6. PMID: 20843886 PMCID: PMC2939420

7. Waibel S, Henao D, Aller MB, et al. What do we know about patients' perceptions of continuity of care? A meta-synthesis of qualitative studies. Int J Qual Health Care. 2012;24(1):39-48. PMID: 22146566

8. Fernholm R, Holzmann MJ, Malm-Willadsen K, et al. Patient and provider perspectives on reducing risk of harm in primary health care: a qualitative questionnaire study in Sweden. Scand J Prim Health Care. 2020;38(1):66-74. PMID: 31975643 PMCID: PMC7054932

9. Morris RL, Stocks SJ, Alam R, et al. Identifying primary care patient safety research priorities in the UK: a James Lind Alliance Priority Setting Partnership. BMJ Open. 2018;8(2):e020870. PMID: 29490970 PMCID: PMC5855454

10. Cheng SH, Chen CC, Hou YF. A longitudinal examination of continuity of care and avoidable hospitalization: evidence from a universal coverage health care system. Arch Intern Med. 2010;170(18):1671-7. PMID: 20937927

11. Cunningham C, Patil T, Shahid R, et al. Patient-Physician Relational Continuity and Health System Utilization among Patients in Alberta. Healthc Q. 2020;22(4):13-21. PMID: 32073386

12. Tammes P, Purdy S, Salisbury C, et al. Continuity of Primary Care and Emergency Hospital Admissions Among Older Patients in England. Ann Fam Med. 2017;15(6):515-22. PMID: 29133489 PMCID: PMC5683862

13. Barker I, Steventon A, Deeny SR. Association between continuity of care in general practice and hospital admissions for ambulatory care sensitive conditions: cross sectional study of routinely collected, person level data. Bmj. 2017;356. PMID: 28148478

14. Raivio R, Holmberg-Marttila D, Mattila KJ. Patients' assessments of the continuity of primary care in Finland: a 15-year follow-up questionnaire survey. Br J Gen Pract. 2014;64(627):e657-63. PMID: 25267052 PMCID: PMC4173729

15. Sandvik H, Hetlevik Ø, Blinkenberg J, et al. Continuity in general practice as predictor of mortality, acute hospitalisation, and use of out-of-hours care: a registry-based observational study in Norway. Br J Gen Pract. 2022;72(715):e84-e90. PMID: 34607797 PMCID: PMC8510690

16. Cho KH, Kim YS, Nam CM, et al. The Association between Continuity of Care and All-Cause Mortality in Patients with Newly Diagnosed Obstructive Pulmonary Disease: A Population-Based Retrospective Cohort Study, 2005-2012. PLoS One. 2015;10(11):e0141465. PMID: 26529224 PMCID: PMC4631362

17. Wasson JH, Sauvigne AE, Mogielnicki RP, et al. Continuity of outpatient medical care in elderly men. A randomized trial. Jama. 1984;252(17):2413-7. PMID: 6481927

18. Kao YH, Wu SC. STROBE-compliant article: Is continuity of care associated with avoidable hospitalization among older asthmatic patients? Medicine (Baltimore). 2016;95(38):e4948. PMID: 27661052 PMCID: PMC5044922

19. Ride J, Kasteridis P, Gutacker N, et al. Impact of family practice continuity of care on unplanned hospital use for people with serious mental illness. Health Serv Res. 2019;54(6):1316-25. PMID: 31598965 PMCID: PMC6863233

20. Kim W, Jang SY, Lee TH, et al. Association between continuity of care and subsequent hospitalization and mortality in patients with mood disorders: Results from the Korea National Health Insurance cohort. PLoS One. 2018;13(11):e0207740. PMID: 30452465 PMCID: PMC6242689

21. Chan KS, Wan EY, Chin WY, et al. Effects of continuity of care on health outcomes among patients with diabetes mellitus and/or hypertension: a systematic review. BMC Fam Pract. 2021;22(1):145. PMID: 34217212 PMCID: PMC8254900

22. Delgado J, Evans PH, Gray DP, et al. Continuity of GP care for patients with dementia: impact on prescribing and the health of patients. Br J Gen Pract. 2022;72(715):e91-e8. PMID: 35074796 PMCID: PMC8803082

23. Sabety AH, Jena AB, Barnett ML. Changes in Health Care Use and Outcomes After Turnover in Primary Care. JAMA Intern Med. 2021;181(2):186-94. PMID: 33196767 PMCID: PMC7670398

24. Skarshaug LJ, Kaspersen SL, Bjørngaard JH, et al. How does general practitioner discontinuity affect healthcare utilisation? An observational cohort study of 2.4 million Norwegians 2007-2017. BMJ Open. 2021;11(2):e042391. PMID: 33593777 PMCID: PMC7888374

25. Pereira Gray DJ, Sidaway-Lee K, White E, et al. Continuity of care with doctors-a matter of life and death? A systematic review of continuity of care and mortality. BMJ Open. 2018;8(6):e021161. PMID: 29959146 PMCID: PMC6042583

26. Lautamatti E, Sumanen M, Raivio R, et al. Continuity of care is associated with satisfaction with local health care services. BMC Fam Pract. 2020;21(1):181. PMID: 32887566 PMCID: PMC7487808

27. van Walraven C, Oake N, Jennings A, et al. The association between continuity of care and outcomes: a systematic and critical review. J Eval Clin Pract. 2010;16(5):947-56. PMID: 20553366

28. Winkel MTT, Slottje P, de Kruif AJ, et al. General practice and patient characteristics associated with personal continuity: a mixed-methods study. Br J Gen Pract. 2022;72(724):e780-e9. PMID: 36192355 PMCID: PMC9550318

29. Kajaria-Montag, Harshita and Freeman, Michael, Explaining the Erosion of Relational Care Continuity: An Empirical Analysis of Primary Care in England (September 25, 2020). INSEAD Working Paper No. 2020/47/TOM, http://dx.doi.org/10.2139/ssrn.3699385

30. RCGP. Continuity of care resources RCGP; 2022 [Available from: https://elearning.rcgp.org.uk/mod/book/tool/print/index.php?id=12895.

31. Salisbury C, Sampson F, Ridd M, et al. How should continuity of care in primary health care be assessed? Br J Gen Pract. 2009;59(561):e134-41. PMID: 19341548 PMCID: PMC2662124

32. Freeman GHJ. Continuity of care and the patient experience. An inquiry into the quality of general practice in England. The King's Fund; 2010. http://www.kingsfund.org.uk/current_projects/gp_inquiry/dimensions_of_care/continuity_of_care.html

33. Jackson C, Ball L. Continuity of care: Vital, but how do we measure and promote it? Aust J Gen Pract. 2018;47(10):662-4. PMID: 31195766

34. Ball LE, Barnes KA, Crossland L, et al. Questionnaires that measure the quality of relationships between patients and primary care providers: a systematic review. BMC Health Serv Res. 2018;18(1):866. PMID: 30453957 PMCID: PMC6245854

35. Dolovich LR, Nair KM, Ciliska DK, et al. The Diabetes Continuity of Care Scale: the development and initial evaluation of a questionnaire that measures continuity of care from the patient perspective. Health Soc Care Community. 2004;12(6):475-87. PMID: 15717895

36. Uijen AA, Schers HJ, Schellevis FG, et al. Measuring continuity of care: psychometric properties of the Nijmegen Continuity Questionnaire. Br J Gen Pract. 2012;62(600):e949-57. PMID: 22782001 PMCID: PMC3381279

37. Hill KM, Twiddy M, Hewison J, et al. Measuring patient-perceived continuity of care for patients with long-term conditions in primary care. BMC Fam Pract. 2014;15:191. PMID: 25477059 PMCID: PMC4264317

38. Tousignant P, Diop M, Fournier M, et al. Validation of 2 new measures of continuity of care based on year-to-year follow-up with known providers of health care. Ann Fam Med. 2014;12(6):559-67. PMID: 25384820 PMCID: PMC4226779

39. Sidaway-Lee K, Gray DP, Evans P. A method for measuring continuity of care in day-to-day general practice: a quantitative analysis of appointment data. Br J Gen Pract. 2019;69(682):e356-e62. PMID: 30803982 PMCID: PMC6478463

40. Ha NT, Harris M, Preen D, et al. Time protective effect of contact with a general practitioner and its association with diabetes-related hospitalisations: a cohort study using the 45 and Up Study data in Australia. BMJ Open. 2020;10(4):e032790. PMID: 32273312 PMCID: PMC7245390

41. Einarsdóttir K, Preen DB, Emery JD, et al. Regular primary care plays a significant role in secondary prevention of ischemic heart disease in a Western Australian cohort. J Gen Intern Med. 2011;26(10):1092-7. PMID: 21347875 PMCID: PMC3181311

42. Pollack CE, Hussey PS, Rudin RS, et al. Measuring Care Continuity: A Comparison of Claims-based Methods. Med Care. 2016;54(5):e30-4. PMID: 24309664 PMCID: PMC4101051

43. Swanepoel R, Evaluating the relational continuity of care of four GP practices, one of which uses personalised lists British Journal of General Practice 2020; 70 (suppl 1): bjgp20X711713. DOI: https://doi.org/10.3399/bjgp20X711713S

44. Te Winkel MT, Damoiseaux-Volman BA, Abu-Hanna A, et al. Personal Continuity and Appropriate Prescribing in Primary Care. Ann Fam Med. 2023;21(4):305-12. PMID: 37487715 PMCID: PMC10365882

45. Damschroder LJ, Reardon CM, Widerquist MAO, et al. The updated Consolidated Framework for Implementation Research based on user feedback. Implementation Science. 2022;17(1):75. PMID: 36309746 PMCID: PMC9617234

46. van Scherpenseel MC, te Velde SJ, Veenhof C, et al. Contextual determinants influencing the implementation of fall prevention in the community: a scoping review. Frontiers in Health Services. 2023;3. PMID: 37249947 PMCID: PMC10210634

47. Bice TW, Boxerman SB. A quantitative measure of continuity of care. Med Care. 1977;15(4):347-9. PMID: 859364

48. Jee SH, Cabana MD. Indices for continuity of care: a systematic review of the literature. Med Care Res Rev. 2006;63(2):158-88. PMID: 16595410

49. Herrett E, Gallagher AM, Bhaskaran K, et al. Data Resource Profile: Clinical Practice Research Datalink (CPRD). Int J Epidemiol. 2015;44(3):827-36.PMID: 26050254 PMCID: PMC4521131

50. Shewhart, W A. (1931) Economic control of quality of manufactured product. New York Springer.

51. Yin R, K. (1994) Case Study Research Design and Methods. Applied Soc Res Methods Series, Sage, Vol 5: Sage.

52. Baxter R, Taylor N, Kellar I, et al. A qualitative positive deviance study to explore exceptionally safe care on medical wards for older people. BMJ Quality & Safety. 2019;28(8):618. PMID: 30760607 PMCID: PMC6716359

53. Maatla T, Kerry A, David C, et al. Intervening to eliminate the centre-effect variation in home dialysis use: protocol for Inter-CEPt—a sequential mixed-methods study designing an intervention bundle. BMJ Open. 2022;12(6):e060922. PMID: 35676002 PMCID: PMC9189878

54. Fusch, P. I., & Ness, L. R. (2015). Are We There Yet? Data Saturation in Qualitative Research. The Qualitative Report, 20(9), 1408-1416. https://doi.org/10.46743/2160-3715/2015.2281

55. Wilkie P. Patient participation groups in general practice: Building better partnerships. Br J Gen Pract. 2016;66(652):548-9. PMID: 27789485 PMCID: PMC5072890

56. Gale NK, Heath G, Cameron E, et al. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. BMC Med Res Methodol. 2013;13:117. PMID: 24047204 PMCID: PMC3848812

57. Braun V, Clarke V. Toward good practice in thematic analysis: Avoiding common problems and be(com)ing a knowing researcher. Int J Transgend Health. 2023;24(1):1-6. PMID: 36713144 PMCID: PMC9879167

58. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007;19(6):349-57. PMID: 17872937

59. O'Cathain A, Murphy E, Nicholl J. Three techniques for integrating data in mixed methods studies. Bmj. 2010;341:c4587. PMID: 20851841

60. Tariq S, Woodman J. Using mixed methods in health research. JRSM Short Rep. 2013;4(6). PMID: 23885291 PMCID: PMC3697857

61. Ride J, Kasteridis P, Gutacker N, et al. Healthcare Costs for People with Serious Mental Illness in England: An Analysis of Costs Across Primary Care, Hospital Care, and Specialist Mental Healthcare. Appl Health Econ Health Policy. 2020;18(2):177-88. PMID: 31701484 PMCID: PMC7085478

62. Mather M, Pettigrew LM, Navaratnam S. Barriers and facilitators to clinical behaviour change by primary care practitioners: a theory-informed systematic review of reviews using the Theoretical Domains Framework and Behaviour Change Wheel. Systematic Reviews. 2022;11(1):180. PMID: 36042457 PMCID: PMC9429279

63. Davis R, Campbell R, Hildon Z, et al. Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. Health Psychol Rev. 2015;9(3):323-44. PMID: 25104107 PMCID: PMC4566873

64. Groot LJJ, Schers HJ, Burgers JS, et al. Optimising personal continuity for older patients in general practice: a study protocol for a cluster randomised stepped wedge pragmatic trial. BMC Family Practice. 2021;22(1):207. PMID: 34666678 PMCID: PMC8526277

65. El Turabi, Anas. 2019. Unintended Consequences: Empirical Studies of Continuity of Care and Financial Incentive Gaming in Primary Care. Doctoral dissertation, Harvard University, Graduate School of Arts & Sciences. http://nrs.harvard.edu/urn-3:HUL.InstRepos:41121282

66. The Health Foundation Increasing Continuity of Care in General Practice 2020. https://www.health.org.uk/funding-and-partnerships/programmes/increasing-continuity-of-care-in-general-practice

67. Coombs C, Cohen T, Duddy C, et al. Primary care micro-teams: an international systematic review of patient and healthcare professional perspectives. Br J Gen Pract. 2023;73(734):e651-e8. PMID: 37549994 PMCID: PMC10428005

68. Sandra M, Michelle W-W, Gillian M, et al. Are you really doing ‘codesign’? Critical reflections when working with vulnerable populations. BMJ Open. 2020;10(11):e038339. PMID: 33148733 PMCID: PMC7640510

69. Realpe BA WL. What is Coproduction What is Coproduction? 2010 [date accesssed 3 5 2024] Available from: https://www.qi.elft.nhs.uk/wp-content/uploads/2017/01/what_is_co-production.pdf.

70. Asbury N, Walshe A. Involving women with breast cancer in the development of a patient information leaflet for anticipatory nausea and vomiting. Eur J Oncol Nurs. 2005;9(1):33-43. PMID: 15774339

71. O'Cathain A, Murphy E, Nicholl J. The Quality of Mixed Methods Studies in Health Services Research. Journal of Health Services Research & Policy. 2008;13(2):92-8. PMID: 18416914

FIGURE LEGENDS

FIGURE 1 QUERCC WORK PACKAGES AND DESCRIPTION OF DATA SETS, DATA COLLECTION AND ANALYSIS

FIGURE 2: WORK PACKAGES ADDRESSING THE CORE DETERMINANTS OF AND EFFECTS OF RELATIONAL CONTINUITY OF CARE

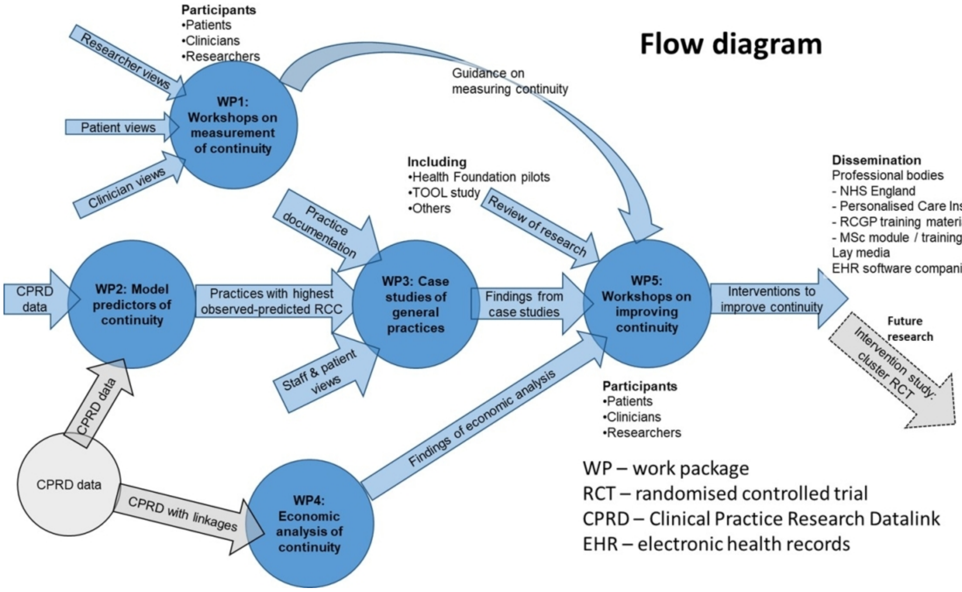


FIGURE 1 QUERCC WORK PACKAGES AND DESCRIPTION OF DATA SETS, DATA COLLECTION AND ANALYSIS

242x143mm (150 x 150 DPI)

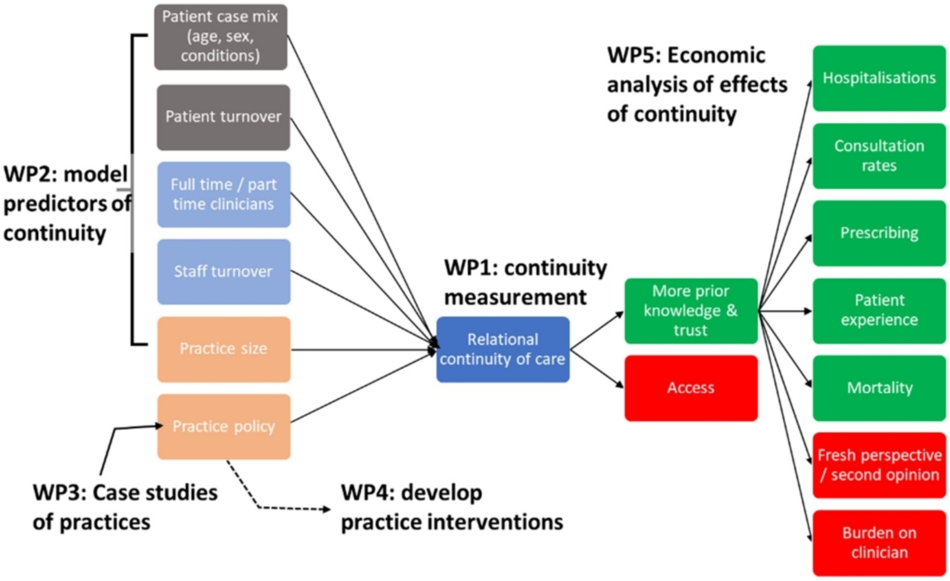


FIGURE 2: WORK PACKAGES ADDRESSING THE CORE DETERMINANTS OF AND EFFECTS OF RELATIONAL CONTINUITY OF CARE

211x125mm (220 x 220 DPI)

TECHNICAL SUPPLEMENT QUERCC WP2

WP2 Investigation of determinants of relational continuity of care & identification of outliers

Research suggests RCC is influenced by the practice population’s characteristics (age, sex and chronic disease status) and practice characteristics (practice size, patient turnover, clinician turnover, part-time working) and may be influenced by practice funding levels. We will investigate the determinants of RCC through analysis of a large primary care database, linked to data on practice funding and subjectively reported continuity.

Aim: to investigate patient and practice-level determinants of measured RCC in general practices and to identify practices showing unusually high continuity given their characteristics.

Method: Clinical Practice Research Datalink (CPRD) collects fully coded and de-identified patient electronic health records from a network of GP practices using the Vision® (CPRD GOLD) or EMIS® (CPRD Aurum) software systems. We have full access to both datasets. CPRD includes records of clinical events (medical diagnoses), referrals to specialists and secondary care settings, prescriptions issued in primary care, records of immunisations/vaccinations, diagnostic testing, and all other types of care administered as part of routine general practice. Clinical information is captured as hierarchical Read codes, which are recorded by practice staff as part of routine data entry. CPRD data are broadly representative of the English general population.[i] We will use data from the CPRD GOLD database for the period 1st January 2005 until the most recent data upload, with two additional linkages. One is to GPPS data (2007 onwards), to allow comparison between subjectively reported continuity to objectively and measured RCC. The other is to the General and Personal Medical Services database (NHS Digital), to obtain data on average funding per registered patient.

We will measure monthly RCC outcome at the level of general practice using the continuity index most strongly associated with health outcomes and resource use. The chosen index may differ to indices prioritised in **Error! Reference source not found.**, which are selected to reflect staff and patient preferences and are for internal practice use. To assess its construct validity, we will correlate practice-level measured RCC with annual subjectively reported RCC from the GPPS. Candidate predictors of RCC include patient characteristics and practice-level characteristics, all measured monthly. Patient characteristics are mean age (a), percentage female ($f_{\%}$), prevalence of chronic disease ($CD_{\%}$) and prevalence of multimorbidity ($M_{\%}$). Chronic disease prevalence is the proportion of patients with one or more of the chronic diseases in the Quality and Outcomes Framework (QOF) and multimorbidity is the proportion of patients with ≥4 chronic diseases. We already have code lists for over 80 chronic conditions including those in QOF. Practice list size (L) is based on monthly counts and patient turnover (P_T) from monthly registration and deregistration data. We will determine total number of GPs (GP_n) in the practice month from the numbers with attributable consultations in that month. We will infer a GP has left when they have no consultations for >13-weeks and use this to calculate a monthly turnover rate of GPs (GP_t). We will do the same for non-GP clinicians if our RCC index requires it. We will infer part-time working from the usual pattern of weekday consultation over each month (consultations morning and afternoon on 5 days = full time) and calculate an appropriate summary measure of part-time working: percentage full time equivalent ($FTE_{\%}$). If available we will include linked data on practice funding per registered patient ($F_{£}$).

We expect to have roughly 15 years-worth of data, from 1800 general practices. Using monthly summaries will provide 180 (15×12 observations) for each practice. We will model the association between monthly RCC outcome and candidate predictors (listed above and including both patient and practice characteristics, all measured at the practice-level: a, $f_{\%}$, $CD_{\%}$, $M_{\%}$, L, P_T, GP_n, GP_t, $FTE_{\%}$, $F_{£}$) using regression analysis. To examine the independent contributions of these characteristics to RCC, the regression analysis will include all ten candidate predictors of interest in the model regardless of statistical significance - no stepwise variable selection will be used - as is recommended.[ii] Using monthly practice

TECHNICAL SUPPLEMENT QUERCC WP2

summary statistics for each candidate predictor will ensure there will be no missing data in either candidate predictors or RCC outcome. Monthly practice RCC outcomes are expected to be correlated - with outcomes measured close in calendar time expected to be more highly correlated than those measured further apart in calendar time. To allow for this serial correlation all regression analysis will allow for auto-correlations. The exact form of these correlations will be dependent on the data, but we will explore various forms, such as auto-regressive structures as well as allowing for seasonality, using recommended approaches to identify best fitting structures.[iii] The contribution of the ten candidate predictors will be modelled to allow for non-linear effects, and without categorising any continuous predictors.[iv] Again, appropriate forms to model non-linear effects will be explored and are likely to include splines or fractional polynomials. To internally validate the model all coefficients and standard errors (including associated confidence intervals) will use bootstrap-based confidence intervals with shrinkage. The ability of the model to correctly identify high performing RCC practices will be summarised using calibration and discrimination statistics (again using appropriate shrinkage to avoid over fitting).

It has long been recognised that unusual variation in a process is more likely to have an assignable cause.[v] Evidence from analysis and simulation shows that selecting case studies from outliers (deviant cases) is an efficient way to find out about causal pathways and causes of heterogeneity.[vi] We will identify potential case studies from the top decile of general practices over a period of one year. In the most recent year's data, we will use the derived prediction model to identify practices which, given their patient and practice characteristics, appear to be consistent high performers in RCC. Using the derived model, we will calculate a predicted monthly RCC for each participating general practice for each month. We can then calculate an observed to predicted ratio of RCC. These monthly practice level observed / predicted ratios averaged over the most recent year, ranked and practices in the top decile of these ratios identified.

TECHNICAL SUPPLEMENT QUERCC WP2

Output: A model of the contribution of patient and general practice-level characteristics to trends and variations in RCC. An observed to predicted ratio of RCC in CPRD practices. A list of general practices in the top decile for RCC in the most recent data quartile for inclusion as potential case studies.

---

[i] Herrett E et al. Data Resource Profile: Clinical Practice Research Datalink (CPRD). Int J Epidemiol. 2015 Jun;44(3):827-36.

[ii] Steyerberg, Ewout W., et al. Prognosis Research Strategy (PROGRESS) 3: prognostic model research. PLoS medicine 2013: 10.2: e1001381.

[iii] Turner SL et al. Evaluation of statistical methods used in the analysis of interrupted time series studies: a simulation study. BMC Med Res Methodol. 2021;21(1):181. doi: 10.1186/s12874-021-01364-0.

[iv] Royston P, Altman DG. Regression using fractional polynomials of continuous covariates: parsimonious parametric modelling. J R Stat Soc: Series C (Applied Statistics) 43.3 (1994): 429-453.

[v] Shewhart WA. Economic control of quality of manufactured product. New York. 1931.

[vi] Seawright J. Multi-Method Social Science: Combining Qualitative and Quantitative Tools. Chapter 4 - Case Selection after Regression. Cambridge University Press 2016; 75-106.