frontier economics

PRIMARY CARE

Do Active GPs provide higher quality care?

October 2019

The Health Foundation

CONTENTS

ACKNOWLEDGEMENTS

This work contains statistical data from NHS Digital which is used under licence.

Frontier Economics received funding from The Health Foundation to carry out this piece of research. The robustness of the findings are the sole responsibility of Frontier Economics, and the findings and views presented in this report do not necessarily reflect those of The Health Foundation.

We are very grateful for the feedback provided by The Health Foundation Expert Advisory Group. In addition, the contributions of our own expert panel throughout this piece of work were extremely valuable. This panel consisted of:

- Professor Ron Smith
- Dr Deborah Freake
- Dr Mauro Laudicella
- Mark Dusheiko

We also extend our considerable gratitude to GPs we interviewed to help us contextualise our quantitative findings.

EXECUTIVE SUMMARY

General practice is one of the main pillars of the NHS. GPs provide in excess of 300 million patient consultations each year. Effective primary care, which typically serves as an access point to other NHS services, is now more important than ever (NHS England, 2016). However, GPs are facing significant challenges. In particular, primary care workforce shortages are making it increasingly difficult to meet rising patient needs (NHS England, 2019). This makes it even more important to understand what characterises an effective GP service. Such an understanding could help to focus efforts to improve primary care where they are likely to be most effective; something that is crucial given the pressure on human and financial primary care resources.

This report uses the variation in primary care characteristics, drawn from existing data and evidence collected specifically for this study, across England to try to understand the drivers of better patient outcomes. We examine the extent to which GP practices that exhibit certain behaviours are better able to treat their patients and potentially reduce the cost of secondary care. The analysis presented here seeks to help understand which practices provide high quality primary care, why and whether policy action could help to encourage behaviours linked to better outcomes.

Theory of change

Our research is based on the hypothesis that more engaged or "active" primary care can contribute to more effective care. For example an "active" GP practice may be in a better position to avoid unnecessary secondary care admissions or improve the health of their patients. We seek to examine different types of "activeness", control for a wide range of other local and GP characteristics, and determine whether particular dimensions of activeness are associated with improved care. We use four dimensions of activeness. These dimensions cover high profile policy initiatives and recent changes in the way primary care is delivered:

-  GP involvement in the **management of care at the Clinical Commissioning Group level**. The 2012 Health and Social Care Act lead to the creation of CCGs as clinically led statutory bodies responsible for the planning and commissioning of health care services for their local area. GPs who take an active role in the management of their local CCG may be more aware of local trends in their health economy and better aware of local services which could benefit their patients.

-  **GP prescription behaviour**. GPs who are actively seeking out new drugs may be better able to serve their patients if they can identify new more clinically effective treatments. It is also possible that the new drugs may be more expensive than the existing ones. Therefore, we are also interested in exploring cost effective prescribing and adherence to national drug prescription guidelines.

- Special **GP training** (e.g. GPs with Special Interest or GPSIs) which leads to the acquisition and deployment of specialist skills and services by clinicians within general practice. GPSIs may deliver a clinical service beyond the normal scope of general practice, undertake advanced procedures or develop services, which could improve outcomes in that area. There may also be spillover benefits to other aspects of general practice.

- Use of **new technologies**. New technological innovations within general practice have the capacity to deliver efficiency savings and improvements in health outcomes. Technologies that can aid lifestyle management and communication technologies can improve how GPs interact with patients. The NHS Long Term Plan (NHS England, 2019) set out a wide-ranging programme to upgrade technology across the NHS. Under this programme digital-first primary care will become an option for every patient. It is therefore vital to understand the benefits achieved to date.

This report examines which type of practices are more likely to be classed as active before linking the activeness characteristics to patient outcomes using a mixed methods approach.

Methodology

Our approach allows us to provide a holistic picture of primary care variation and a robust indication of activeness' impact on patient outcomes. It is based on data drawn from a very wide range of sources, including secondary care usage data and GP practice prescription data collected by NHS Digital, as well as our own primary survey of GP practices. Our survey collected information from 500 representative GP practices about their use of technology and GPSIs within the practice.

Firstly, we carried out a descriptive analysis at the practice level of both:

- the extent to which different practices face different local contexts and the knock-on effects on activeness; and
- differences in practice composition and structure and links to behaviours of interest.

This descriptive analysis allows us to uncover relationships and insights that would not be apparent from a causal analysis of the data.

We then undertook an in-depth econometric analysis of the links between GP "activeness" and quality of care. To facilitate this analysis we collected information on a number of GP activeness indicators which corresponded to the four characteristics listed above. Our outcomes covered:

- Healthcare Episode Statistics (HES) data on inpatient admissions and A&E attendances for patients registered to each practice;
- Usage of the 'two-week wait referral' (TWW) pathway for earlier diagnosis of cancer;

- Care Quality Commission (CQC) ratings; and
- Patient satisfaction.

Finally, we wanted to ensure that our interpretation of the quantitative results were informed by clinical expertise and in keeping with how practices actually operate on a day-to-day basis. Therefore, after our quantitative analysis was complete we engaged with a number of GPs from a variety of backgrounds via one-to-one semi-structured interviews to explore the quantitative findings, their possible interpretation and implications for improving practice performance.

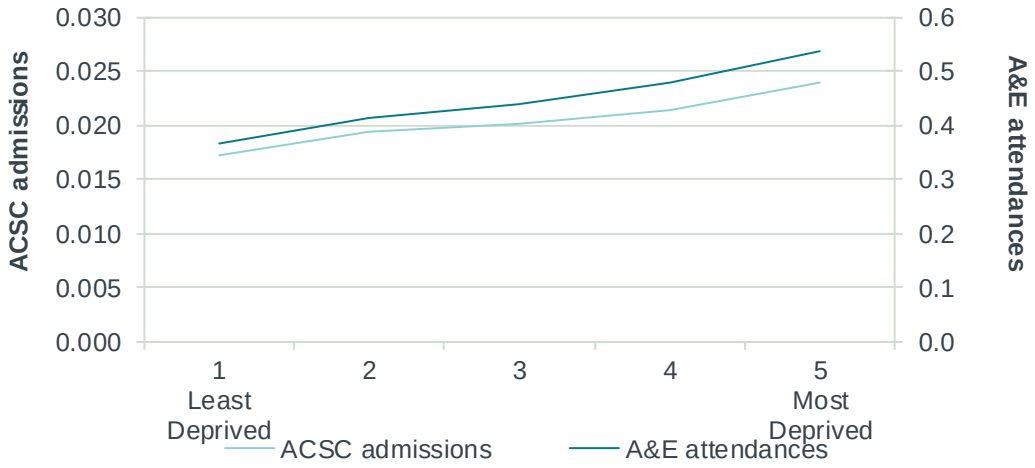
Impact of local context

Different practices operate within vastly different local environments. For example, some GPs predominantly treat patients who live in pockets of high deprivation. These practices tend to be located in urban areas such as inner cities or certain coastal towns. Other practices treat patients in very rural areas with large distances between them, yet others operate in relatively affluent areas.

Our descriptive analysis and engagement with clinicians confirms previous findings that clinicians working in deprived areas face a considerably higher workload both in terms of volume and complexity (Baird et al., 2016).

This could help to explain why these practices are generally speaking less likely to engage in most, but not all, of the activeness behaviours we set out above. It may be that day-to-day workload pressures are particularly acute amongst this group of GPs which inhibits their ability to focus on aspects of work which are judged to be "non-core". This would include setting up the processes and procedures needed to use new technology or taking part in the running of their local health economy. It is also evident from our descriptive analysis that patients who attend practices located in deprived areas also generally experience worse outcomes than patients who are registered to other practices.

Figure 1 GP practice attendance and admission rates by CCG deprivation quintile



Source: *Frontier Economics analysis of HES data*

Note: *Admissions and attendances metrics are defined as annual visits per weighted patient per year averaged over three years. A&E attendances cover all conditions whereas our measure of admissions cover emergency ACSC admissions only.*

This result holds even when observable patient characteristics are held constant. Figure 1 shows that as we move up deprivation quintiles, admission and attendance rates increase. We examine the rates for a "weighted patient" which strips out the effects of age and gender.[1] A patient who is registered at a practice in the least deprived quintile of CCGs is expected to have an emergency ACSC admission approximately once every 58 years. The equivalent figure for a patient in the most deprived practices is 42 years. The gradient in attendances is similar.

Impact of practice structure

Practices also vary in their internal make-up. Some practices employ a large number of clinicians and have patient list sizes in excess of 10,000 while other practices consist of a single-handed clinician.

Larger practices tend, on average, to be more active, according to our definition, than smaller practices (Figure 2). Our engagement with clinicians suggested that this could be driven by a sharing of best practice within a practice and peer-to-peer learning. Specifically, larger practices are more likely have at least one GP who has a formal role in their local CCG. They are also more likely to offer specialty clinics and online booking systems. However, this size gradient is not evidence across all activeness indicators. For example, small and larger practices have very similar rates of adherence to national prescription guidelines.

Figure 2 Summary of GP behaviours across practice size bands

Source: *Frontier Economics*

Note: *Large practices have more than 6 GP FTEs, medium practices have more than 3 GP FTEs and less than 6 GP FTEs, small practices have more than 1 GP FTEs and less than 3 GP FTEs and very small practices have less than 1 GP FTEs.*

In keeping with previous research (Kelly & Stoye, 2014) we see that patients who are registered to smaller practices have on average worse outcomes than patients registered to larger practices. This is not always the case and there are a considerable proportion of high performing small practices.

As well as differences in practice size we also find considerable variation in workforce composition across practices. Some practices use locum GPs to a greater extent whereas other practices have a far higher proportion of older GPs or GPs trained outside the UK for example. In reality it is impossible to separate

[1] Patient weights are used to allocate funding across GP practices in line with the average level of clinical need of their population in terms of age and gender

the impact of local context from practice structure entirely. This is because practice characteristics are shaped in part by local environments and multiple factors tend to be correlated.

When we explore indicators of local context and practice characteristics simultaneously using cluster analysis we see that several distinct groups emerge. For example, one cluster of practices tend to be relatively large, operate in areas with lower than average rates of deprivation and tend to have a higher proportion of female and UK-trained GPs. Other practice groupings rely more heavily on locums, face higher rates of deprivation and have a higher patient to GP ratio. Unsurprisingly the first cluster is generally more likely to engage in active behaviours and may face fewer barriers to innovation and quality improvement.

Link between activeness and quality

Our multivariate analysis helps us to determine if the variation outlined above is linked to patient outcomes and, central to the novelty of this study, the degree to which the activeness of GPs further improves patient outcomes over-and-above the local characteristics discussed above.

We investigated how the GP activities and behaviours are related to patient outcomes using regression analysis on the dataset described above at GP practice level. The regressions look in turn at a range of different outcome variables, in each case controlling for local demographics, practice characteristics, and activeness measures. We also use CCG dummies to control for unobservable differences between local areas.

We find that each dimension of activeness is significantly linked to at least one quality of care outcome. However, there are consistent patterns whereby certain activeness indicators are robustly linked with a wide range of positive outcomes whereas other dimensions of activeness are only weakly related to a small subset of outcomes.

In Figure 3 a green tick indicates a statistically significant positive relationship between a specific domain of activeness and a measure of quality (e.g. reduced admissions), and red crosses illustrate where we have found a negative relationship.[2]

Adhering to prescription guidelines is strongly associated with numerous quality of care outcomes. We were told that this could be driven by the fact that sticking to the guidelines will directly reduce medicine related harm and reduce the likelihood that patients will be admitted to hospital for an exacerbation of a long-term condition such as COPD. However, such adherence may also speak to broader good practice and up to-date knowledge of GPs.

Practices which offer more of these speciality clinics and have GPSIs on their staff both tend to have higher CQC ratings on average and also both perform better on our composite quality indicator.

Finally, there were also promising findings in relation to adoption of new forms of technology within primary care. Early adoption of online booking is associated with

[2] In Figure 3 we only report relationships with p-values < 0.05. Additional linkages at more marginal levels of significance (between 0.05 and 0.10) are also discussed in Chapter 5 along with effect sizes.

reduce usage of secondary care services and practices that make use of teleconsultations have more satisfied patients on average. Clinicians we spoke to agreed that technology can have a large positive impact on primary care provision but emphasised the need for a flexible approach which takes patient preferences in to account. They emphasised the need to avoid a “one-size-fits-all” approach to technology.

Figure 3 Effect of activeness behaviours on patient outcomes

	ACSC Admissions	Chronic ACSC Admissions	A&E Attendance	Cancer TWW detection	Cancer TWW conversion	Cancer TWW referral	Patient satisfaction	CQC rating	Composite indicator
Prescription of new drugs (% of total)							✓		
Prescription of obsolete drugs (% of total)	✓	✓	✓	✗	✓	✗			
Adherence to guidelines	✓	✓	✓	✓		✓			
Has GP on CCG						✗			
Early adopter of online booking / prescription services	✓	✓							
Use tele-consultations				✓			✓		✓
Use mobile apps				✓				✓	✓
Number of speciality clinics (PCA)								✓	✓
Total GPSI's								✓	✓

Source: Frontier analysis

Note: Coefficient values are presented in Annex A.

Our analysis also revealed that formal GP participation on CCG boards was generally not indicative of significantly better performance. Some GPs we interviewed told us that they became more aware of important local trends as a result of sitting on their CCG board and were able to bring back knowledge to their clinical practice. However, they noted that these effects may operate with a significant lag and could be difficult to observe at a practice level. In contrast, some, but not all, GPs noted that they found it difficult to balance the dual management and clinical role which is in keeping with previous research.

Conclusion

General practice is the cornerstone of the NHS. Our analysis shows how certain activeness measures, such as adherence to prescription guidelines and deploying new technology, can, in certain circumstances, lead to higher quality care and better patient outcomes.

This highlights the importance of practices continuing to evolve in order to best serve their patients. A large number of GP practices are not engaging in these

beneficial behaviours. Our qualitative research revealed that the single biggest barrier to increased activeness was GPs inability to think strategically about long term quality improvement mechanisms due to the size of the day-to-day clinical workload. These pressures are likely to be especially severe for certain types of practices but operate to a certain extent across all practices. This serves to re-emphasise the importance of addressing current workforce shortages.

It is possible that the recent introduction of Primary Care Networks (PCNs) will help to address current pressures. PCNs include funding for the employment of additional health professionals such as pharmacists and paramedics. However, GPs told us that the act of creating these networks requires time and energy and managing the expanded workforce could reduce the amount of GP time available for direct patient-facing activity or for developing the strategic thinking required, for example, to implement new technologies.

This work has helped to characterise GP performance in a much more complete manner to that which existing previously. Doing so has revealed that there are aspects of patient outcomes that, in some conditions, are improved by the engagement of GPs with up to-date practices – whether in areas of new technology, specific niches of clinical expertise or prescribing. There are other GP activities – particularly participation in commissioning – which do not appear to consistently improve outcomes for their patients.

1 INTRODUCTION

1.1 Background

This report follows a research award to Frontier Economics by The Health Foundation under their Efficiency Research Programme. Frontier was commissioned to investigate how primary care variation affects quality of care.

THE HEALTH FOUNDATION

The Health Foundation is an independent charity committed to bringing about better health and health care for people in the UK. The Health Foundation funds research and policy analysis work that aims to shine a light on how to make successful change happen.

The Efficiency Research Programme offered awards to innovative research ideas into issues of efficiency and sustainability that have the potential to make a transformational difference to health and social care provision in the UK.

1.2 Theory of change

We are interested in the extent to which more engaged primary care leads to better patient outcomes and potentially reduces the cost of secondary care by preventing unnecessary secondary care admissions. We use the term efficiency as a shorthand for this combination of increased quality of care and reduced system costs throughout this report. This hypothesis has often been formulated by policy makers, researchers and healthcare practitioners. However, despite strong intuitive sense behind this hypothesis, empirical evidence has been more difficult to obtain.

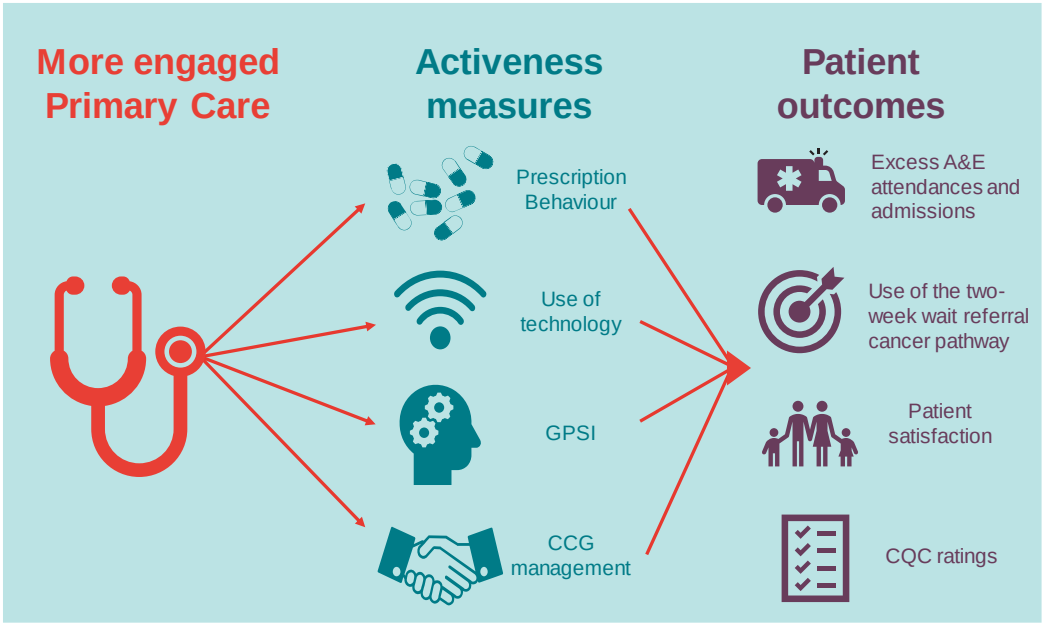
The characteristics we have considered are:

- special GP training (e.g. GPs with Special Interest or GPSIs);
- use of new technologies;
- GP involvement in the management of care at the CCG level; and
- GP prescription behaviour

We term the characteristics listed above as ‘activeness’ measures. GPs and practices which display these characteristics are active GPs who go above and beyond the core requirements of the role. The characteristics we are examining are all proxies for GP engagement which we expect to be linked to patient outcomes. We have focused on relatively recent, high profile policy initiatives which represent attempts to engage GPs as well as self-motivated changes in the way primary care is delivered.

We have illustrated our theory of change visually below in Figure 4. Further detail on the specific hypotheses we have considered is provided below.

Figure 4 Visual illustration of theory of change



Source: Frontier

1.3 GP activeness measures

In this section, we provide extra detail on each of our activeness measures. The precise metrics we use to measure each of our activeness domains are set out in Chapter 2.

1.3.1 Clinical Commissioning Group (CCG) management

Existing evidence

The first aspect of activeness we consider is related to formal engagement by GPs in clinical commissioning groups (CCGs). One of the central pillars of the 2012 Health and Social Care Act was the creation of CCGs as clinically led statutory bodies responsible for the planning and commissioning of health care services for their local area.

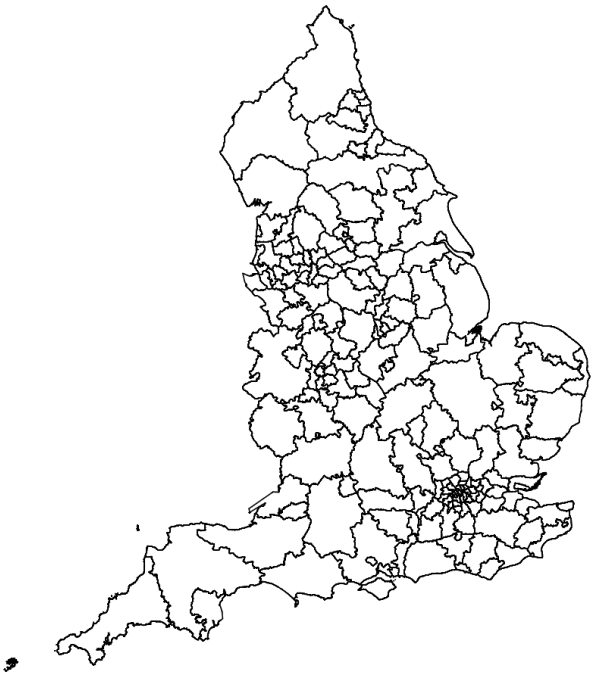
There are 207 CCGs in England (see Figure 5).[3] The intention was to encourage clinicians to play a greater role in deciding how funds are spent in order to ensure local needs are met (Naylor et al., 2013). All CCGs are led by an elected Governing Body which is composed of GPs, other clinicians and lay members. All GP practices are required to participate in CCGs to some extent. However, only a minority of GPs have a formal role with the CCG (Fisher et al., 2019). It is this formal role that we want to investigate further.

An initial review of early CCG operations found that on average GP engagement was considered to be higher than in previous practice-based commissioning arrangements. However, this varied around the country. GPs reported that they have more influence over their CCG than they had over their previous Primary

[3] The precise figure has been subject to change over time as certain CCG's have merged.

Care Trust (PCT) and that the voice of a GP was better represented. However, there was a stark difference in the pattern of responses from GPs who were active in their CCG relative to those who were not. Those actively involved were more likely to report a feeling of ownership and have a positive view of the decision-making process (Naylor et al., 2013).

Figure 5 Map of CCG areas



Source: NHS digital

A sample of CCGs has been tracked by the King's Fund as part of an ongoing evaluation. One year after their establishment the authors found that GP engagement had remained high (Robertson et al., 2014). However, fewer GPs were classified as "highly engaged" than was the case at the outset. Again, GPs reported that they could exert more influence over their CCG than they could over their PCT in the past. However, less than half of the GPs with a formal role in their CCG reported that they have the time and support necessary to fulfil their role (Robertson et al., 2014).

A follow-up study 12 months later focused on the same sample of CCGs found that overall GP engagement had been maintained. However, GP leader enthusiasm had waned due to significant pressures on clinicians' time and capacity (Holder et al., 2015). The authors indicated that recruiting and retaining GPs to fulfil leadership roles in CCG management could become more challenging as tight deadlines, inefficient governance structures and a complex external environment mean that applying the member voice in decision making is sometimes difficult (Holder et al., 2015).

A more recent study wave revealed that again the overall rate of GP engagement was again broadly constant (Holder et al., 2016). In keeping with previous waves a sizable proportion of GP leaders (40%) felt that they did not have the time necessary to fulfil their role in the CCG, although this was slightly lower than previous years. Worryingly over a third of GP leaders felt that their commissioning

role was having a negative impact on their clinical duties. Despite this obvious role tension clinical leaders are reporting greater confidence in their commissioning roles and would like to remain in their role for the foreseeable future (Holder et al., 2016).

Hypotheses to test

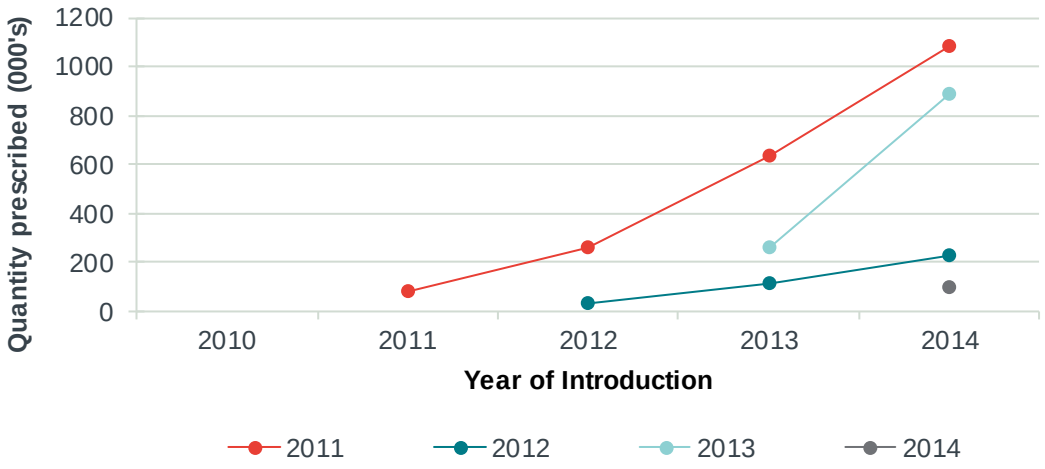
GPs who take an active role in the management of their CCG may be better informed of the needs of their local health economy and aware of recent developments in best practice. However, they may also have less time to commit to serving the needs of their patients. Our analysis tests these hypotheses.

1.3.2 Drug prescription behaviour

Existing evidence

The second element of activeness we are examining is variation in prescribing patterns across different practices. We know that a significant number of new medicines are prescribed by GPs across England each year. In Figure 6 below we illustrate the extent to which prescription of new drugs increases in the years following their initial introduction.

Figure 6 Number of "new" substances prescribed each year across England



Source: Frontier analysis of NHS Digital Practice Prescription Data

Note: Quantity prescribed refers to number of prescriptions across all of England in a given year

Historically a minority of practices have accounted for a large proportion of new drug prescriptions (Prosser and Walley, 2003). A more recent national review of GP prescription patterns highlighted marked variation even between geographically close practices with similar demographics. These differences could represent uneven quality of care and could potentially lead to extra expense related to wasteful use of resources (Duerden et al., 2011). Similarly, an older study looking specifically at prescribing rates for coronary heart disease drugs revealed that practices with similar levels of healthcare need had widely different prescribing levels (Ward et al, 2004).

A survey of GPs, stratified on the basis of their practices' novel drug prescription levels, identified pharmaceutical representatives as the most commonly cited influence on prescription behaviour (Prosser et al., 2003). Failure of current therapy, observation of hospital prescribing patterns and patient requests were also found to be influential in the prescription decision.

Several studies have been conducted which seek to investigate the differences between high and low new drug prescribing GPs. Jacoby et al. (2003) found that both high and low novel drug prescribers classified themselves as conservative in their prescribing behaviour. However, low prescribers were more likely to strongly conform to group norms and were more concerned with identifying a consensus among practice partners in terms of prescribing and cost-consciousness. High prescribers on the other hand more often indifferent to drug costs and were less interested in a shared practice ethos (Jacoby et al., 2003).

Prosser and Walley (2003) also conducted interviews with high and low new drug prescribing GPs and concluded that variability in GP prescribing of new drugs related not only to levels of acquired knowledge but also to differences in subjective and ideological beliefs. Low prescribing GPs were more likely to view new drugs as experimental and emphasised the risks involved while high prescribing GPs were more likely to emphasise the potential benefits of new drugs which may offer a relative advantage over current therapy.

Hypotheses to test

GPs who are actively seeking out new drugs may be better able to serve their patients if they can identify new more clinically effective treatments. It is also possible that the new drugs may be more expensive than the existing ones. Therefore, we are also interested in exploring cost effective prescribing. Guidelines, such as MO-KTT[4] set the preferred medicine to prescribe in each therapeutic class, taking account of cost and clinical effectiveness. For example, metformin is considered better and cheaper than other, newer, antidiabetics. It could be that greater adherence to the guidelines signals a more considered prescribing stance. Alternatively, GPs who adhere very closely to guidelines could deny individual patients the most appropriate medicine for their specific circumstances, if they always adopt risk averse 'by-the-book' approach.

Our analysis explores the extent to which GP practices outcomes vary according to tendency to prescribe newer drugs or adhere to national prescription guidelines.

1.3.3 Attitude to technology

Existing evidence

Adoption of technological innovations within general practice and more broadly throughout the health and social care system will play a crucial role in delivering efficiency savings and safeguarding the sustainability of the NHS going forward. However, previous research has shown that the NHS does not have a strong track

[4] Medicines Optimisation - Key Therapeutic Topics

record in implementing technology at scale and needs to get better at assessing the its benefits and associated challenges (Castle-Clarke, 2018).

Technology is a key focus on the NHS's Long Term Plan (2019) which set out a wide-ranging programme to upgrade technology across the NHS. Under this programme digital-first primary care will become a new option for every patient improving fast access to convenient primary care. This builds on the Department of Health and Social Care Future of Healthcare (2018) report which highlights the need to take a radical new approach to technology in this context.

Prior to this the General Practice Forward View (NHS England, 2016) pledged an 18% increase in funding to CCGs for the provision of IT services and technology within general practice. Additional funding was provided to stimulate the uptake of online consultation systems, improve online access for patients, establish online triage systems and develop an approved app library to support both clinicians and patients.

> Digital technology will provide convenient ways for patients to access advice and care.
>
> *NHS Long Term Plan*

The King's Fund has previously made the case that there is technology available that has the potential to transform the way patients interact with general practice by encouraging them to become co-producers of healthcare. However, the authors point out that general practice has in the past lagged behind other service industries in the uptake of new technology due to numerous factors including a tendency to focus on the up-front cost rather than future value and a lack of leadership (Goodwin et al., 2011).

More recent research has echoed these findings and advocated an accelerated uptake of technologies, such as telephone triage and email consultations within general practice as a mechanism for dealing with growing workload pressures (Baird et al., 2016). The authors claim that opportunities to make better use of online access channels thus far remain to be under-developed and under-researched.

The Royal College of General Practitioners (Ware and Mawby, 2015) have reported that several practices developed their own smartphone apps which allow patients to request appointments, send secure messages to clinicians and set appointment reminders. In addition, many practices are already making use of videoconferencing services such as Skype. These facilitate virtual consultations whereby patients can communicate with a GP from the comfort of their home and importantly the physician can pick up on non-verbal cues which are not possible with phone consultations for example (Ware and Mawby, 2015). However, the authors acknowledge that these developments could exacerbate health inequalities and will not be suitable for all patients.

There is very little evidence available currently regarding the impact of smartphone apps or teleconferencing on practice level outcomes. However, previous work has looked at the effect of introducing telephone consultations, the volume of which has grown by 63% between 2010-11 and 2014-15 (Baird, 2016). A systematic review of nine studies found that in most cases the introduction of telephone

consultations led to a significant decrease in visits to GPs (Bunn, et al., 2005). This could help free up clinicians' time and lead to improvements in the quality of care provided. However, in six out of the seven studies which report on A&E visits no effect was identified. The effects of introducing newer forms of long distance consultation may or may not be in accordance with the results of telephone consultations and merit careful exploration.

In addition to improving access to GP services via mobile apps, email or virtual consultations there has also been an increase in general practices delivering telehealth. Telehealth refers to the remote exchange of data between a patient and healthcare professional to assist in the diagnosis and management of health, generally provided to patients with long-term health conditions (MacNeill et al., 2014).

The Department of Health has funded the Whole System Demonstrator project which tested the benefits of integrated care supported by telehealth. As part of this project's evaluation 3,230 patients with COPD or heart failure were recruited from 179 practices from three areas in England (Steventon et al., 2012). Patients either received care as usual or a telehealth intervention. All sites used a pulse oximeter to remotely monitor COPD patients, a glucometer for diabetes patients and weighing scales for heart failure patients. Participants were asked to take clinical readings up to five times per week at the same time each day. The resulting information was then transferred to monitoring centres where it could be accessed by healthcare professionals who could take action when appropriate. Compared with the control group the intervention group had a lower admission proportion within 12 month follow-up and mortality at 12 months was also lower. Length of hospital stay was also shorter for intervention participants (Steventon et al., 2012). In addition, the same trial indicated that patients receiving the intervention did not require any more general practitioner and practice nurse contacts than the control group over the course of the trial (Bardsley et al., 2013).

Despite the potential for efficiency savings presented by telehealth there are some reservations amongst health practitioners. A qualitative study examining attitudes towards telehealth amongst front-line professionals revealed that most GPs saw telehealth as increasing their work burden and had the potential to undermine their professional autonomy (MacNeill et al., 2014). There was a worry that remote monitoring could identify patient issues that GPs did not have the resources to deal with.

Hypotheses to test

New technological innovations within general practice have the capacity to deliver efficiency savings and improvements in health outcomes. Technologies that can aid lifestyle management (wearable devices that monitor heart and activity) or apps to manage specific conditions can deliver direct health benefits. And communication technologies, such as electronic prescription services, online booking, and electronic record management can improve how GPs interact with patients. We explore empirically whether the evidence supports these hypotheses.

1.3.4 GPSI

Existing evidence

The final aspect of activeness we consider is centred on the acquisition and deployment of specialist skills and services by clinicians within general practice. This could take the form of a specific GP who has an interest or qualification in an area such as dermatology, they would then be defined as a general practitioner with a special interest (GPSI). The Royal College of General Practitioners (2018) started referring as GPSI's as GPs with Extended Roles (GPwERs). The RCGP Council noted that extended practice consisted of:

- an activity that is beyond the scope of GP training and the MRCGP exam and that a GP cannot carry out without undertaking further training;
- or l an activity undertaken within a contract or setting that distinguishes it from standard general practice; or
- an activity offered for a fee outside the care provided to the registered practice population (e.g. teaching, training, research, occupational medical examinations, medico-legal reports and cosmetic procedures).

For consistency, we continue to use the term GPSI throughout this report as we are focusing exclusively on those GPSIs who supplement their generalist role by delivering specific high quality services, while not offering the same breadth of clinical care as a consultant led service (Coast et al., 2006). GPSIs can provide localised services in familiar surroundings which will lead to easier access and speedier care for patients (Department of Health, 2002). They may deliver a clinical service beyond the normal scope of general practice, undertake advanced procedures or develop services.

Alternatively, GP practices may offer specialist services via a nurse led clinic. These clinics are run by experienced nurses and possibly supervised by a GP. They are focused on specific areas such as diabetes, COPD or coronary heart disease.

The Department of Health originally announced a policy of developing GPSI clinics in 2000. The aim was to manage patients with uncomplicated problems in a primary care setting and thereby ensure quicker access to hospital consultants for patients with serious conditions (Department of Health, 2000). An evaluation of GPSI services found that GPs with some additional training were able to manage half of all patients who would normally be referred to secondary care and patients were equally satisfied with the GPSI clinics as they were with secondary care clinics. However, GPSI clinics were more expensive than hospital clinics (Department of Health, 2006).

Two other evaluations of GPSIs services both found that the cost per patient to the NHS for the new service was higher than for hospital outpatient care. However, waiting times were reduced and there was an improvement in access (Bowling and Bond, 2001 and Coast et al., 2006).

An examination of 19 specialist GP diabetes services over three years revealed a significant reduction in out-patient attendances at hospital, indicating some deflection from secondary care, and also a significant increase in overall patient

attendances, indicating a possible improvement in access (Nocon et al., 2003). A London specific evaluation of specialist services for chronic diseases found that specialist diabetes management initiatives were significantly associated with decreased hospital admission rates but the same was not true for asthma management (Saxena et al., 2006)

There have also been several studies conducted which examine the efficacy of various nurse led clinics. Two separate evaluations of nurse led interventions both aimed at patients with diabetes and found that compared with usual care the intervention patients experienced a significant fall in blood pressure (Denver et al., 2003 and Harris and Cracknell, 2005). In addition, a separate intervention composed of a nurse led clinic combined with home visit services for patients suffering from chronic heart failure, reduced the rate of unplanned readmission amongst patients and lowered the number of days spent in hospital (Thompson et al., 2005).

The RCGP published a framework to support governance of GPs with Extended Roles in 2018. This sets out overarching principles which describe the knowledge, skills and competencies required for a GP to work in a particular scope of extended practice.

Hypotheses to test

GPSI's may deliver a clinical service beyond the normal scope of general practice, undertake advanced procedures or develop services, which could improve outcomes in that area. There may also be spillover benefits to other aspects of general practice. On the other hand it is also possible that the focus on a single specialist area comes at the expense of more general skills. Our quantitative analysis provides clarity on the direction of this relationship.

1.4 Outcomes of interest

It is difficult to definitively measure the quality of a GP practice's service without doing so on an in-depth case-by-case basis. Therefore, we drew on a number of distinct indicators to provide a holistic indication of effective care:

- *Excess A&E attendances and unscheduled secondary care admissions.* Poor quality primary care will result in more patients needing to go to hospital for unplanned reasons. In particular, for ambulatory care-sensitive conditions (ACSCs), effective care should make reduce hospitalisation rates.
- *Use of the two-week wait (TWW) referral cancer pathway.* TWW referral speeds up treatment where cancer is suspected, but is more expensive than other pathways. A skilled GP will know when use is warranted and avoid frivolous over-use. This will be manifest in a high proportion of cancer referrals being made through the TWW pathway (detection rate), in conjunction with a high proportion of TWW referrals resulting in positive diagnosis.
- *Patient satisfaction.* Although patients may have difficulty judging quality of care and have biases in forming their judgements, patient satisfaction still provides a signal of quality, as health outcomes and interaction with their GP will inform their perceptions.

- *CQC ratings*. This takes into account information from direct inspections, as well as administrative data from the CQC Insight database. Practices are inspected more frequently if they are already deemed to require improvement, or if the administrative data identifies a material deterioration in conditions.

1.5 Report structure

The remainder of the report is structured as follows:

- In Chapter 2 we outline the methodology we have applied to explore variation in activeness across England and test the hypotheses we set out above.
- In Chapter 3 we analyse the variation in local contexts and patient demographics faced by GPs.
- In Chapter 4 we present a descriptive analysis of practice characteristics.
- In Chapter 5 we use a multivariate regression model to measure the effects of the GP activeness measures and practice characteristics on quality of care.

Further detail on the regression results and our GP survey are presented in the Annex sections.

2 METHODOLOGY

2.1 Overall approach

Our primary methodology is centred around an in-depth econometric analysis of the links between GP "activeness" and quality of care. This allows us to systematically test these hypotheses and control for the relevant drivers that affect these outcomes.

This approach (which we describe in detail below) will allow us to be as confident as possible that identified effects are causal in nature. However, we recognise that the activity measures we have identified are likely to be interrelated and could all be proxies for different dimensions of practice quality. Therefore, we wanted to augment our multivariate econometric analysis will other methods to provide a more holistic picture of variations in primary care across the country.

In advance of the multi-variate analysis we have carried out a descriptive analysis of both:

- the extent to which different practices face different local contexts and the knock-on effects on activeness; and
- differences in practice composition and structure and links to behaviours of interest.

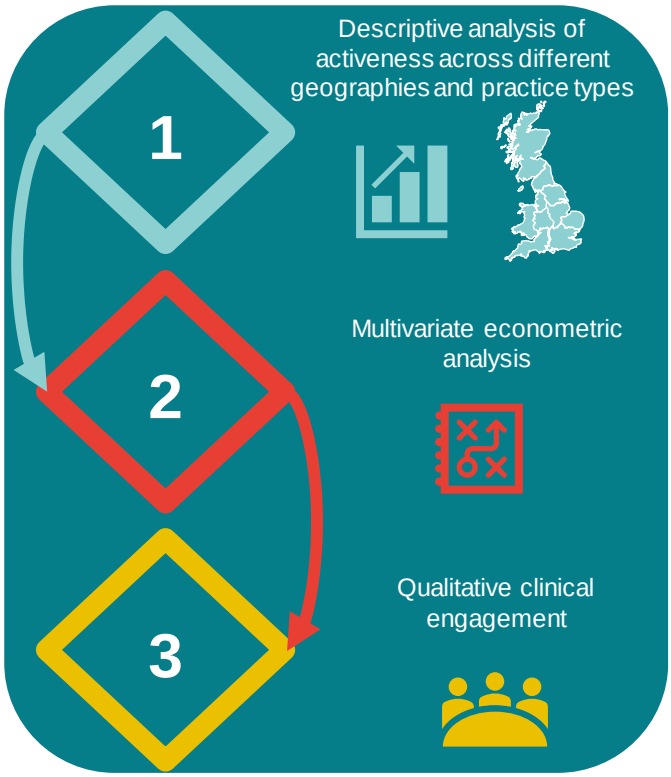
This descriptive analysis allows us to uncover relationships and insights that would not be apparent from a causal analysis of the data and will help to shape our model specifications.

Finally, we wanted to ensure that all of our results and associated interpretations are in keeping with how practices actually operate in practice. Therefore, after our quantitative analysis was complete we engaged with a number of GPs from a variety of backgrounds via one-to-one semi-structured interviews (described further below).

The purpose of this qualitative stage of the research was to clarify whether the observed relationships are intuitive from a clinical point of view and tease out underlying processes which may be driving the results. This helps to validate and reinforce our quantitative modelling.

We have illustrated this mixed methods approach visually below (Figure 7):

Figure 7 Methodological approach



Source: Frontier

In the following sections, we firstly outline how we constructed our central practice level dataset. We then step through the three stages outlined above in detail.

2.2 Dataset construction

All of our data was collected at the practice level rather than the practitioner level. During the years in which our analysis relates to there were approximately **8,000** GP practices across England.

Each GP practice is uniquely identified by a practice code. This code is used across NHS Digital and allowed us to join multiple datasets.

2.2.1 Outcome Measures

The outcomes under analysis in this project consist of emergency admissions data, A&E attendances data, cancer diagnosis, CQC ratings and GP satisfaction.

HES Attendances/Admissions Data

Our first category of outcome measures consists of Healthcare Episode Statistics (HES) data on inpatient admissions and A&E attendances over the period 2010/11-2016/17. Rather than focus on specific conditions, where the data suffers from small number suppression, necessitating cumbersome econometric procedures, we focused on the following two indicators:

- Number of emergency admissions for ambulatory care sensitive conditions (ACSCs).
- Number of A&E attendances.

Both variables are standardised by dividing through by the list size and transformed into a logarithmic form. This allows characteristics to have proportional effects on the outcome variables, which is a more plausible assumption than them having unit effects.[5]

Cancer data

We examine a number of variables relating to 'two-week wait referral' (TWW) usage. The TWW pathway referral pathway for earlier diagnosis of cancer was introduced in England in 2000. It is a direct measure of GP behaviour, and unlike survival or mortality, it is not affected by the quality of care that patients subsequently receive in hospital.

As measures of quality of care, both the detection rate (proportion of cancer referrals that come through the TWW pathway) and the conversion rate (proportion of TWW referrals that result in a positive diagnosis) have been suggested in previous literature.[6] It is worth noting that there is some tension between these indicators. In theory, if TWW use was just a measure of the GPs risk appetite, then greater propensity to use the TWW pathway to result in a higher detection rate (as a greater proportion of referrals come from this pathway), but in a lower conversion rate (as there are more TWW referrals that turn out to be false). However, we do not observe this negative correlation in practice, and in fact observe a positive correlation.[7] This suggests that practices can be both more proactive in using TWW, yet efficient in having a high conversion rate. For these reasons, we analyse both conversion and detection rates as outcomes.

The data on conversion and detection rates is aggregated over a 5 year period (2013-2017). Pooling across multiple years reduces the scope for atypical spike relating to a particular year to affect the results.[8]

Note that the conversion and detection rates are not available differentiated or standardised by condition mix. This is not ideal, as some cancers will have different conversion rates to others, so a different condition mix could arbitrarily affect the reported conversion and detection rates.[9]

[5] This is because admission and attendance rates vary considerably by practice, in line with local health. For example, we would assume that characteristics X reduces admissions by 10%, irrespective of whether a practice's baseline admission rate is 10 or 100. By contrast, a linear outcome variable would model the effect of reducing admissions by 5 for both the practice with a baseline of 10 and the practice with a baseline of 100, which is less plausible. Note that log transformation requires the variable to have strictly positive (non-zero) values. This is the case for the headline indicators we focus on, but for the condition specific indicators, it is necessary to add an arbitrary constant before making the log transformation.

[6] See for example Variation in use of the 2-week referral pathway for suspected cancer: A cross-sectional analysis: David Meechan, Carolynn Gildea, Louise Hollingworth, Mike A Richards, Di Riley and Greg Rubin, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3426597/

[7] Correlation coefficient 0.10. Meecham et al find a stronger positive correlation, although they use different data.

[8] Annual data gave similar results in the regression analysis.

[9] However, Meechan et al note that the relationships they observe in aggregate also apply at the level of individua cancers.

CQC ratings

The CQC inspects GP practices on a number of different criteria, reporting scores under the headings of safe, effective, caring, responsive and well-led, which gives rise to an overall score. As an outcome variable, we consider a binary 0/1 indicator of whether the practice is rated as good or excellent, as opposed to being inadequate or requiring improvement. Around 94%[10] of practices are rated good or excellent, so this indicator is focused on whether a practice is in the small proportion of problematic practices, rather than improvement at the top end of the scale.

The CQC data are reported in a series of monthly snapshot files containing each practice and result of most recent assessment. There are various difficulties, however:

- Monthly files do not contain all practices. The reasons for this are unclear. To build a ratings dataset with maximum coverage, it was necessary to combine multiple monthly snapshots, in case a practice is contained in one but not the other. We used waves covering 2013 to 2018, talking the latest observed rating.
- CQC data do not use the same practice identifiers as the rest of the data used. It was therefore necessary to match on the basis of practice address and practice name (within CCG), which is less perfect than matching on practice code.

GP patient survey

This provides a measure of patients' satisfaction with GP services. Numerous aspects are covered such as; ability to get an appointment quickly and having trust in your doctor. The survey data aggregates these into a single overall satisfaction score. Each GP/year observation is based on an average of 195 patient responses. As an outcome we use average scores over the period 2014/15-2016/17.

It is important to bear in mind the variation in patients' perceptions and expectations of quality and that the same quality of care may give rise to different levels of satisfaction among different populations. Satisfaction may also be disproportionately affected by factors that patients can more tangibly assess (e.g. courteous / polite staff and efficient operations) rather than harder measures of clinical performance such as diagnostic accuracy. These limitations cannot be overcome within the scope of this study, but we consider that patient satisfaction is a useful additional indicator as a potential signal of quality.

Composite indicator

The outcomes above are all considered as potential measures of quality of care. But they each have their own particular biases and limitations, which affect the estimated results. By combining the indicators together, we can reduce the impact of the biases affecting one variable only.

Principal Component Analysis (PCA) is a technique of data reduction that looks at the correlation between variables and identifies a set of latent variables that drive

[10] The CQC ratings cover smaller sample (6,622) than the main regression sample (7,248).

the common correlation between them. We applied a PCA to the following variables to generate a single indicator characterising their common movement: cancer (average of standardised detection and conversion rates), ACSC emergency admissions rate, GP patient satisfaction, CQC score.

The PCA confirmed that these four outcome variables are all correlated with each other in a manner consistent with each being a measure of quality. PCA then computes an index weighting each variable accordingly. The PCA outcome index places positive weight on the 'good' variables (cancer conversion and detection rates, patient satisfaction, CQC ratings) and negative weight on the 'bad' variables (ACSC admissions).[11]

2.2.2 Measures of GP 'Activeness'

CCG Participation metrics

All CCGs are led by an elected Governing Body which is composed of GPs, other clinicians and lay members.[12] To the best of our knowledge no accessible and comprehensive dataset existed prior to this project which detailed GPs CCG participation. As a first step, we therefore needed to create one aggregated dataset containing this information we examined the website of each CCG in England and determined which GPs are currently fulfilling an active role in the administration/management of their local commissioning group.

We then used publicly available HSCIC data to match the identified practitioners to their respective practices. This allowed us to determine which practices were 'active' in terms of CCG participation. This allowed activeness to be measured in terms of i) whether a GP practice has a GP with a management role in the CCG ii) the proportion of GPs with such a role. This was a one-off snapshot of participation as at September 2015.

In addition, we undertook our own primary data collection in the form of a GP survey.[13] A sample of practice managers were asked whether any of their member GPs actively take part in the management of their CCG, providing a second independent source of information on CCG participation.

Drug Prescribing Behaviour metrics

Our second 'activity' measure is based on the prescribing behaviour of practices. We are seeking to examine variation in the extent to which practices adapt their prescribing behaviour to take into account the emergence of new drugs, the obsolescence of others, and the extent to which they adhere to prescribing guidelines.

Prescribing data is held by NHS Digital, aggregated on a per practice, per month basis, showing the drug volumes prescribed, down to the level of the individual

[11] Loadings: cancer 0.5, ACSC admissions -0.36, satisfaction 0.66, CQC good/excellent 0.43; 1st component eigenvalue 1.43

[12] http://www.nhscc.org/ccgs/

[13] Further detail is provided in Annex B

preparation. This information is contained in very large and unwieldy datasets, with each month's file consisting of around 10 million observations in total, and involving 20 thousand different preparations and around 2 thousand different chemicals. This was transformed into a useable form by aggregating up to yearly frequency and combining individual preparations to the chemical level. The practice-level data goes back to August 2010. We also analysed Prescription Cost Analysis, which is reported at national, annual level going back to 1998. This allowed us to analyse slightly older drugs, e.g. those introduced between 2005 and 2009.

We analysed overall trends in prescribing behaviour, in order to identify newly prescribed drugs, or those declining in usage.[14] The novelty measure we use is the share of total prescription items in 2014 that were newly introduced within the previous 3 years. We also looked at alternative time horizons. Widely used new drugs of this type include substance dependence treatments, various anti-diabetic drugs, some incontinence drugs and various dressings.[15]

We derived an obsolesce index to examine which practices continue to prescribe drugs which are declining in usage across the country. This was done by looking at prescribing patterns from 2000 to 2014 and defining as obsolete a drug that has decreased in usage every year[16] and where volumes decreased by at least 30% between 2010 and 2014.

Finally, we derived a prescribing guideline adherence measure, following 'Medicines Optimisation Key Therapeutic Topics'.[17] This sets out a number of prescribing benchmarks showing volumes of drugs prescribed relative to practice population or volumes of other drugs.[18] For each MO-KTT topic, scores were calculated at practice level. These were then aggregated into a single indicator, by standardising each variable in turn (mean of zero, standard deviation of one), inverting sign if necessary (so that higher values correspond to 'good'), and averaging across them.

Attitudes towards new technology metrics

Our third measure of activeness relates to adoption of new technologies by practices. There is very limited existing data available on the attitudes of GP practices attitudes towards technology. We obtained quarterly data published by HSCIC (starting in the second quarter of 2012/13) relating to the uptake of online services covering booking appointments online, ordering prescriptions online, viewing medical records online, viewing letters online, viewing medical records online, and viewing test results online by practices. This gave us some

[14] We have cross-checked the introduction dates implied by this data against some other NHS data on date of introduction – which verifies that our approach is accurate.

[15] There will be other niche drugs that have emerged for a small number of practices; prescribing of these drugs would likely be driven by idiosyncrasies of the local population, rather than by a particular practice's stance relative to the national average. Therefore they are not of interest for this project.

[16] This is defined relative to 2 years earlier, e.g. 2008 vs 2006, because year-on-year changes are more likely to reject cases where there is atypically higher volume in an individual year.

[17] Formerly QIPP

[18] For example: the quantity of metformin (a low cost anti-diabetic drug) prescribed versus other the volumes of newer and costlier anti-diabetic drugs; the quantity of antibiotics prescribed per standardised patient.

sense of which practices are adopting certain new technologies earlier than others.

Additionally, we included questions on our GP survey[19] which relate to use of, and attitudes towards, technology. Firstly, practice managers are asked whether they use Skype or email to consult with patients. The respondents are then asked whether their practices use home monitoring equipment, bladder scanning, health monitoring devices, or mobile apps. Finally, the practice manager assesses the experience of their practice in relation to technology as a whole on a five-point scale, from very positive to very negative.

GPSI metrics

Our final measure of activity is centred on the acquisition and deployment of specialist skills and interests by practitioners. The hypothesis we wished to test was whether having GPSIs in the practice would improve the quality of care.

Initially we had planned to gather this data from either the General Medical Council or the Royal College of General Practitioners. However, it emerged that neither organisation collated such information. Although some local area teams might collate such data, this will only be sporadic, and there is no central or consistent definition. As no appropriate dataset existed, we were forced to look for alternatives.

Using one-off data published by NHS Choices in following an existing Freedom of Information Request we have examined which practices offer specialist clinics (including those focused on COPD and diabetes) or have GPs reporting particular specialties. This gives an indication of about which practices have a particular speciality.[20] However, we note that some of the data in NHS Choices are generated by practices populating their own site, which could give scope for different reporting styles to affect the results (e.g. a practice might have simply omitted to enter the specialties of its staff on the website).

Additionally we included questions on our GP survey[21] which relate to special interests. We ask all participating practice managers whether their practice includes at least one GP member with a special interest in diabetic medicine, cancer, dementia, COPD, or other special interest. We also ask whether their practice provides a nurse-led service in any of the following areas: insulin therapy, diabetes self-management programmes, cancer, dementia, or COPD.

2.2.3 Control Variables

Quality and Outcomes Framework Data

We have collected Quality and Outcomes Framework (QOF) GP performance data covering cancer, COPD, dementia and diabetes from NHS Digital. QOF is a voluntary scheme (in which virtually all practices participate) that awards points

[19] Further detail is provided in Annex B

[20] As a wide number of different types of clinic are used, and with different prevalence, we take a PCA of the presence of the different specialties.

[21] Further detail is provided in Annex B

and ultimately payments to practices based on the quality of care provided.[22] QOF points are awarded in relation to hard measures of clinical / procedural performance, for example proportion of diabetes patients that have had foot examinations, or screening rates in relation to certain conditions.

There is some debate as to how QOF scores should be interpreted, and the extent to which these are objectives that award quality, incentivise quality, or reflect skill in addressing an administrative mechanism. One interpretation would be that QOF scores are a simple measure of quality, in which case they could be modelled as an outcome. In the General Practice Forward View (NHS England, 2016) NHSE acknowledge that while QOF has helped with chronic disease management it may require review or replacement in the near future. The Report of the Review of the Quality and Outcomes Framework in England was published in 2018[23] which concluded that there is a need to refresh the scheme to support a wider view of high quality care and to align better with professional values.

We use average QOF scores over the period 2014-2017 in our regression analysis.

QOF data also contains some demographic information, and in particular includes data on prevalence of different conditions. We also use this information as a control variable in the regression analysis. In order to avoid overfitting the model with many different prevalence variables we use a Principle Component Analysis (PCA) of the different prevalence to generate a single dimension of prevalence.

Workforce characteristics

Each year NHS Digital publishes the results of a census of GP practices under the 'general and personal medical services release'. This summarises a large amount of information. Alongside many other variables, we extracted data on:

- the age mix of staff (both age band and average age);
- gender;
- country of qualification (% UK, EU, and continent).
- GP staff type (registrar, retainer, locum, salaried, partner);
- FTEs per headcount;
- Patient per staff ratio;

This data was averaged over the period 2014-17.

GP churn rates (proportion of GPs who were at the practice 3 or 5 years ago) were also calculated,[24] but these had very little explanatory power.

NHS Choices transparency indicators

This data was extracted in a snapshot form in 2016. It covers a set of indicators that are reported in the NHS Choices website and are suggested as drivers of patient choice. There are many different indicators including areas such as diabetes management, palliative care reviews, smoking cessation, and some measures of drug prescribing behaviour. In order to reduce the dimensionality of

[22] QOF measures have previously been used as outcomes relating to quality of GP care.

[23] https://www.england.nhs.uk/wp-content/uploads/2018/07/quality-outcome-framework-report-of-the-review.pdf

[24] Churn was calculated using the 'egpcur' dataset.

this data and overfitting a model with many variables, a PCA is performed to extract a single variable summarising this data. In many ways, this variable is analogous to the QOF points variable, and indeed we observe a correlation coefficient of 0.54 between the two within the main sample.

NHS Choices also publishes opening hours of the practice, which is used as a control variable.

GP Staffing Data

The Frontier research team has processed very detailed information published by HSCIC on the breakdown of staff within each practice. Information is provided on the age, country of qualification and gender and of each practitioner operating within a given practice (including or excluding registrars and retainers), together with breakdown of FTEs of other types of practice staff. This allows us to determine whether certain types of practices[25] are more or less likely to be active than others.

Local competition

We have gathered data from NHS Choices on the precise location of each GP practice in England. This will allow us to determine whether activeness and its relationship to secondary care outcomes vary according to traditional measures of choice and competition. The 'attribution dataset' shows for each GP practice, how much of its patient list comes from each census output area (OA), allowing us to look at how much competition a practice faces in the areas it draws its population from, and how dispersed is its patient list geographically.

We constructed a number of different competition indicators:

- Number of competitor practices within 500m
- Number of competitor practices within 2km
- Hirschman-Herfindal index (HHI) of local market shares. The HHI is the sum of the squared market shares. A monopoly has an HHI of one, whereas if there are many players with small shares, the HHI is near zero. We calculate the HHI for each local area in the practice's catchment and then take the average for the practice, weighted by its share of population in the different OAs. This gives a more nuanced measure of local competition, measuring the extent to which patients actually choose practices, rather than those that are physically present by have few patients.
- HHI of practice catchment dispersion. We calculate the shares of the practice population in different OAs and use this to generate an HHI score (sum of squared shares). This gives a measure of dispersion of the practice's population, i.e. from how wide its catchment is drawn.

These four variables were collapsed into a single measure using PCA. The PCA 'concentration' variable has positive loadings on the HHI variables and negative loadings on the 'number of competitor' variables.

[25] For example practices that containing a high proportion of relatively young GPs or practices.

GP contract type

The GP Payments dataset includes detail on whether a practice has a GMS or PMS contract. These may have different incentive properties on the GP [ADD], or alternatively they may act as an underlying signal of the characteristics of the GPs opting into different funding regimes.

By looking at successive waves of the data, we can also identify a number of practices that transitioned from PMS to GMS contract from 2014 to 2017. These represent around 14% of the sample (55% are GMS and 30% are PMS).

The GP payments dataset also includes variables to identify dispensing practices and rural practices, both of which are used as control variables.

Demographic data

Other demographic data used includes:

- Age mix of practice. We focus on proportion of population aged 75+.
- List size (both raw and population weighted).
- Index of multiple deprivation.

These are included as control variables in the regression.

2.3 Quantitative analysis

As described above we first explored activeness patterns descriptively before applying econometric techniques to uncover causal links between activity measures and outcomes of interest. These two stages are described below.

2.3.1 Stage 1: Descriptive analysis

Our final dataset is unique source of information on GP characteristics and behaviours. Therefore, before carrying out detailed econometric modelling we want to explore the data descriptively. We have mapped out these relationships not to identify causal effects but to better understand patterns of variation and correlation that exist. It will also serve to inform future researchers of the data we have collected to facilitate follow-up work on the topic. The results of this descriptive analysis helped to motivate our subsequent multivariate analysis.

Local area characteristics

Our dataset covers almost every GP practice in England. We have explored the extent to which key variables of interest covering activeness level activeness and patient outcomes vary geographically.

Specifically, we wanted to investigate how GP practices located in more deprived areas or more rural areas were more or less likely to be classified as active. And whether there are any consistent trends in patient outcomes for these groups of practices. For example, it could be that GP practices that are located in a highly deprived urban area tend to behave very different than practices who face a very different local context. We present the results of this analysis in Chapter 3.

Practice characteristics

We also wanted to exploit differences in the way practices structure themselves in terms of both size and workforce composition. There is considerable variation in both the number of full time equivalent (FTE) GPs per practice and the demographic breakdown of those GPs in terms of gender and age for example.

We have considered the extent to which outcomes of interest are correlated with these practice characteristic and whether certain practice types are more likely to be classified as active according to our indicators.

We then present a typology which groups practices together into a small number of clusters according to patterns of correlation in local area and practice characteristics. This shows how distinct groups emerge and the extent to which their outcomes vary. We present he result of this analysis in Chapter 4.

2.3.2 Stage 2: Multivariate analysis

To robustly assess the relationship between activeness and outcomes we carried out multivariate regression analysis dataset at the practice level. The regressions look in turn at a range of different outcome variables, in each case controlling for local demographics, practice characteristics, and activeness measures. We also use CCG dummies to control for unobservable differences between local areas.

For each practice $_i$ in CCG $_c$ the overall model can be written:

ECONOMETRIC SPECIFICATION

$$Outcome\_{ic} = a + b_1 * pop\ health\_i + b_2 * workforce\_i + b_3 * activeness\_i + b_4 * dummy\_c + u_i$$

In each case the same set of control variables is used for modelling each of the different patient outcomes, allowing for more direct comparison of results. A large number of different control variables were considered initially, but these needed to be whittled down to a smaller selection. This was done by drawing out the different conceptual drivers and retaining a limited number of variables for each so that the salient features can be captured and their effects measured reliably.[26]

The model results of particular interest are the coefficients on the activeness variables. These tell the effect of change in patient outcome resulting from a change in GP behaviour, controlling for the various demographic, local and practice characteristics. For example, a standard deviation increase in QOF achievement (30 points) is associated with a 1% reduction in ACSC admissions and a 0.5% reduction in A&E attendances.

We present the results of this analysis in Chapter 5.

[26] We test for multicollinearity using the variance inflation factor (VIF). As a rule of thumb, a VIF in excess of 10 is considered problematic. The average VIF obtained is 1.9, with a maximum of 6 in relation to local demographic controls, which in any event are not of direct interest. Our variable selection therefore avoids multicollinearity.

2.4 Qualitative analysis

As described above the associations that we observe from the multivariate analysis provide a strong indication of a link between activeness indicators and outcomes. However, we cannot be certain the effects are entirely causal in all cases. For example, it could be that the effects are being driven in part by the underlying quality of a practice and its constituent GPs which is not directly observable but is likely to be linked to some of our activeness indicators.

Therefore, to provide as robust an indication as possible of cause and effect we have drawn on the expertise of a panel of current and former GPs to help contextualise our findings and suggest transmission mechanisms which could be driving the observed linkages.

Specifically, after we carried our quantitative modelling we engaged with four primary care clinicians. We undertook semi-structured interviews to get their input on our key findings. The GPs we spoke practiced across a variety of backgrounds including major urban centres and rural areas which enabled us to include a range of perspectives.

The discussions allowed us to better appreciate how clinicians worked in practice and helped us explore the policy implications of our findings. We synthesised the views of clinicians across all interviews and the insights from this programme of qualitative engagement are included throughout Chapters 3 - 5.

3 IMPACT OF LOCAL CONTEXT

In this Chapter we explore the extent to which different practices face different local circumstances and the relationship between local context and activeness.

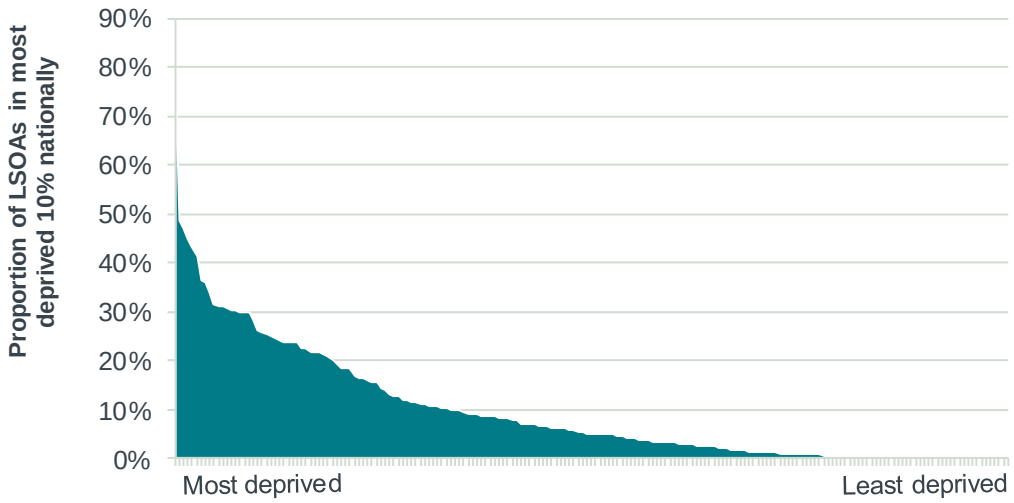
3.1 Deprivation varies across the country

The Ministry of Housing Communities & Local Government (MHCLG) (2019) have ranked each area of England from most deprived to least deprived.[27] Their Index of Multiple Deprivation (IMD) combine income, employment, education, health, crime, barriers to housing and services and living environment.

Deprivation is not concentrated in one part of the country. Instead there are small pockets of relatively extreme deprivation dispersed across England. 61% of local authority districts contain at least one of the neighbourhoods in the most deprived decile[28] in England.

In addition, we have analysed the proportion of small areas (known as Lower-Layer Super Output Areas) that are included in the most deprived 10% nationally within each CCG. 79% of Bradford City CCG's constituent areas are among the most deprived nationally. At the other end of the spectrum, there are only 33 CCGs which do not contain any of the most deprived areas (Figure 8).

Figure 8 Variation in IMD amongst CCGs, 2019



Source: *MHCLG (2019) Frontier calculations*
Note: *LSOAs refer to Lower-Layer Super Output Areas*

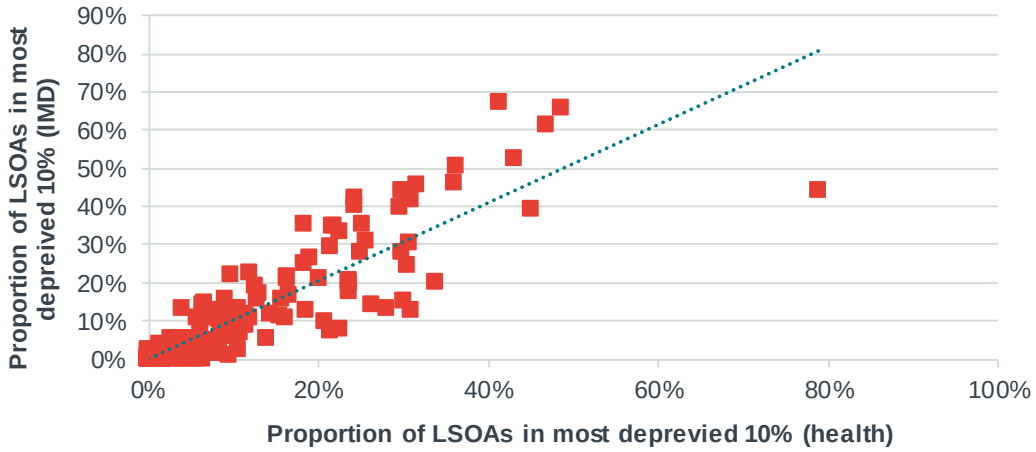
The most relevant domain of deprivation for GP practices is likely to be health, which measures the risk of premature death and the impairment of quality of life through poor physical or mental health (in 2019 this accounted for 13.5% of the overall IMD measure).

[27] https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019 There are 32,844 small areas in England with an average population of 1,500.

[28] A Lower Layer Super Output Area

Practices located in high deprivation areas will on average serve patients with more complex health issues than practices whose patients live in less deprived areas. There is a strong positive correlation between health specific deprivation and overall deprivation. Specifically, CCG's with a highest rates of health specific deprivation also tend to have high rates of overall deprivation (Figure 9).

Figure 9 Correlation between health & disability deprivation and IMD at CCG level, 2019



Source: *MHCLG (2019)*

Note: *Health deprivation measures the risk of premature death and the impairment of quality of life through poor physical or mental health*

3.2 Practices in deprived areas look different to other practices

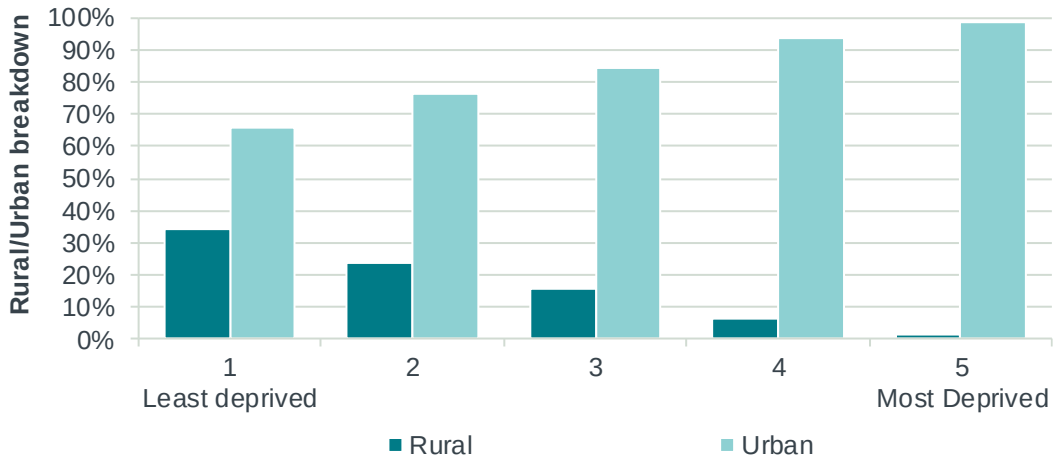
GP practices are spread across the country. Some practices will draw on patients from very deprived areas whereas other will serve patients who live in areas with low levels of deprivation. We have analysed our practice level dataset in conjunction with MHCLG data on deprivation to examine how practices in more deprived areas differ on average from other practices.[29]

Firstly, practices who are located in the most deprived CCG's are almost exclusively classified as urban. Figure 10 shows how the rural-urban composition of practices changes with levels of deprivation. On average across all practices 16% are rural and the remaining 84% are urban. However, 34% of practices in the least deprived quintile of CCG's are rural, compared with only 1% in the most deprived quintile.

This is in keeping with MHCLG's findings that deprivation is relatively common in large urban conurbations, areas that formally relied on heavy industry and/or mining sectors, and parts of east London.

[29] The remainder of the analysis in this chapter uses the 2015 wave of IMD data rather than the 2019 wave as the older dataset corresponds more closely with the remainder of our dataset.

Figure 10 Rural-urban breakdown of GP practices by CCG deprivation quintile

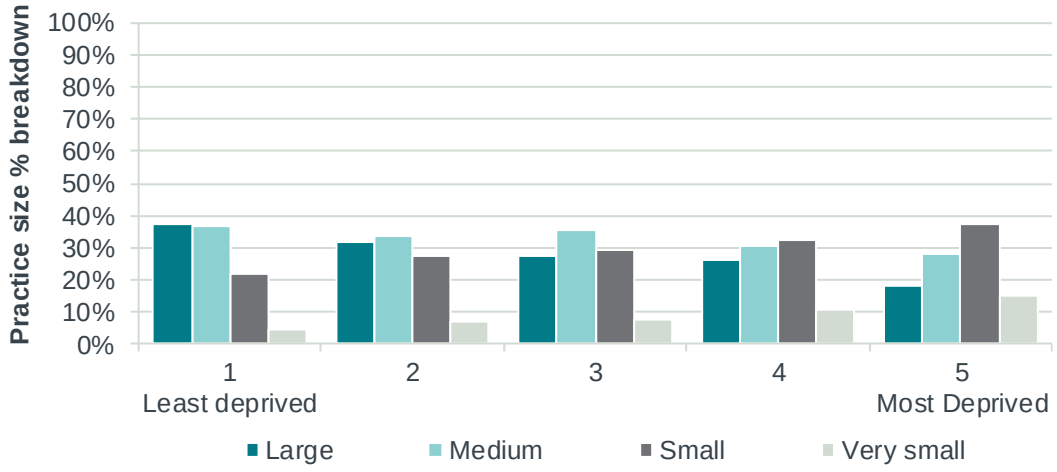


Source: Frontier Economics

Note: Deprivation scores are based on CCG quintiles for IMD values for 2015

It is also apparent that different types of practices operate in areas of different deprivation. We classify 37% of practices that are located in the least deprived CCG's as large (six or more GP FTE). The equivalent figure for practices in the most deprived CCG is only 18%. By contrast, the proportion of practices that are very small (one or less FTE) increases from 4% in least deprived CCGs to 12% in the most deprived (Figure 11).

Figure 11 Practice size breakdown by CCG deprivation quintile



Source: Frontier Economics

Note: Large practices have more than 6 GP FTEs, medium practices have more than 3 GP FTEs and less than 6 GP FTEs, small practices have more than 1 GP FTEs and less than 3 GP FTEs and very small practices have less than 1 GP FTEs.

In addition, older GPs are slightly more likely to work in deprived areas. GPs aged over 55 make up 38% of the workforce in practices located in the least deprived areas but 44% of the workforce in practices which are in the most deprived CCGs.

Our qualitative engagement suggested that this trend could in part reflect issues in recruiting new clinicians into deprived areas. GPs we interviewed noted that some of the best clinicians may work in disadvantaged areas. However, in general we were told that more disadvantaged areas are more likely to have persistent vacancies than less deprived areas. This in turn could mean that it takes longer to recruit replacement GPs leading to an overreliance on existing clinicians who will be older on average.

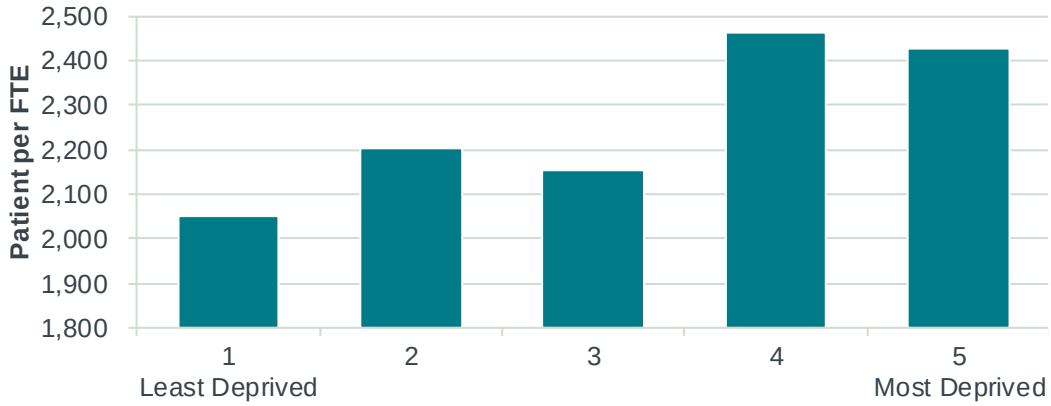
> Inner city deprived areas struggle more in terms of recruitment relative to well-heeled areas
>
> *GP*

GPs who we interviewed also noted that clinicians who work in practices located in more deprived areas will face a higher workload than GPs who work in less deprived areas.

Again, this is reinforced by our quantitative analysis. Practices that are based in more deprived ratio have a higher number of patients for each GP FTE. On average, there are 2,261 patients per FTE GP. However, in in the least deprived quintile there are only 2,052 patients per FTE GP. The equivalent figure in the most deprived quintile is 2,429.

> Deprivation also means a higher workload for GPs. There are so many issues in those deprived areas like housing and crime which affect people's health
>
> *GP*

Figure 12 Patients per FTE GP by CCG deprivation quintile



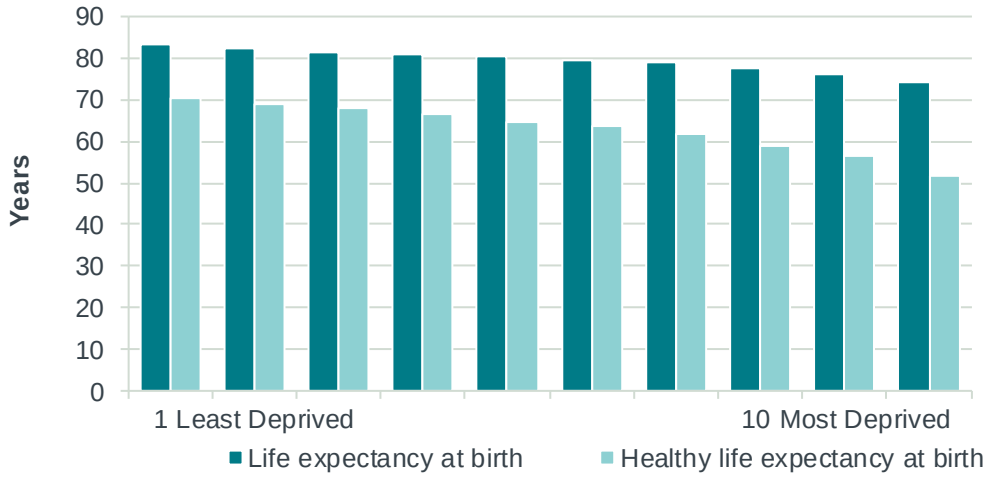
Source: Frontier Economics

This does not account for increased rates of morbidities in deprived areas which imply a greater *per patient* workload and would skew this picture even further. For example, previous analysis presented by Public Health England (2019)[30] has

[30] https://www.gov.uk/government/publications/health-profile-for-england-2019

shown how both life expectancy and healthy life expectancy are correlated with deprivation (Figure 13).

Figure 13 Male life expectancy and health life expectancy at birth by deprivation decile, England 2015 to 2017



Source: Public Health Outcomes Framework
Note: IMD 2015 deprivation deciles at lower-layer super output area (LSOA)

The least deprived areas had the highest male life expectancy (83.3 years) while the most deprived areas had the lowest life expectancy (74.0 years). Healthy life expectancy (years in good health) was highest in the least deprived areas (70.4 years) and lowest in the most deprived areas (51.7 years).

Our analysis above is cross-sectional in nature and shows how certain practices have higher workloads than others. Previous in work in this area has repeatedly highlighted that GP workloads are also increasing over time as the English population is expanding and aging. Health Education England's (2017) draft health and care workforce strategy noted that GP numbers have reduced since 2012. The Interim NHS People Plan (NHS Improvement, 2019) which followed the publication of the Long Term Plan also noted that there are urgent shortages across a wide range of NHS staff groups including GPs. Most worryingly these reductions may be most concentrated in deprived areas. Research by NimbleFins published in 2019 found that around 66% of GP surgeries that have closed since 2013 were based in poorer-than-average areas.[31] This will serve to accentuate the gradient in GP to patient ratios we present above.

3.3 Local context is related to GP behaviour

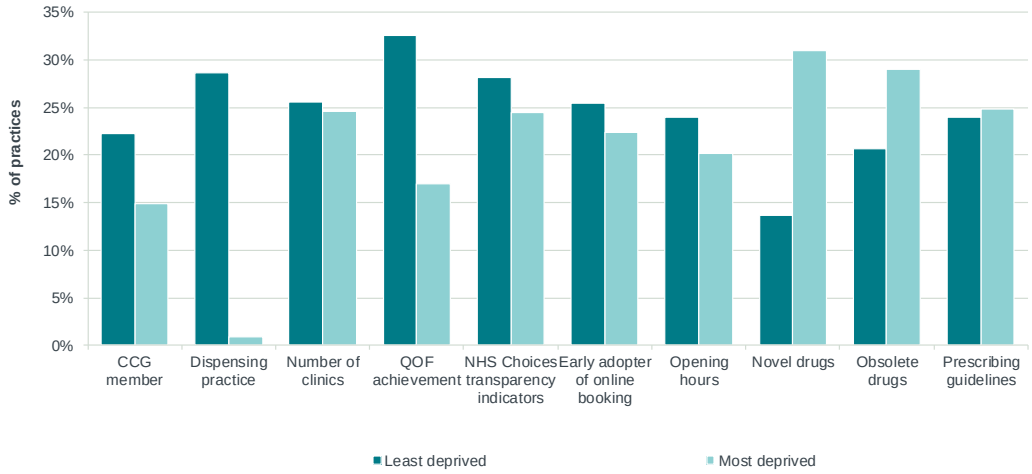
As described above we have defined activeness using a number of different dimensions. This includes participation in CCGs, various aspects of prescribing behaviour, provision of specialist clinics, and engagement with technology.

In Figure 14 we compare a selection of activeness indicators for GP practices in the most deprived and least deprived areas by deprivation quintile. Across the

[31] https://www.nimblefins.co.uk/more-nhs-surgeries-were-closed-lower-income-areas

different indicators we see a general trend that practices in less deprived areas show greater 'activeness' (Figure 14).

Figure 14 Comparison of GP behaviours between least deprived and most deprived quintiles



Source: *Frontier Economics*

Note: *'CCG membership' and 'dispensing' refer to proportion of practices that have a GP listed in CCG and proportion that are dispensing practices. The other variables refer to the proportion of practices that are in the 'best' quartile. With the exception of 'obsolete drugs', where a low value is considered good, this is the top quartile.*

Higher deprivation is associated with:

- lower participation in CCG management;
- a lower proportion of dispensing practices;
- lower provision of specialist clinics;
- lower QOF achievement scores;
- lower transparency indicator scores;
- shorter opening hours; and
- less early adoption of online booking technology.

One hypothesis for this is that higher workload in deprived areas may inhibit GPs' ability and scope to participate in more active behaviours.

This is consistent with our qualitative engagement. GPs noted that they often lacked the time to think about long term improvement and strategic priorities because they were struggling to keep us with the day-to-day clinical requirements.

Alternatively, there will be other factors correlated with deprivation that could drive some of the relationships we have highlighted above. For example, primary care provision will interact with other aspects of

> We are often fighting fires and working at full capacity so it can be difficult to make time. The moment you get a chance to step back you might see that things could be done differently
>
> *GP*

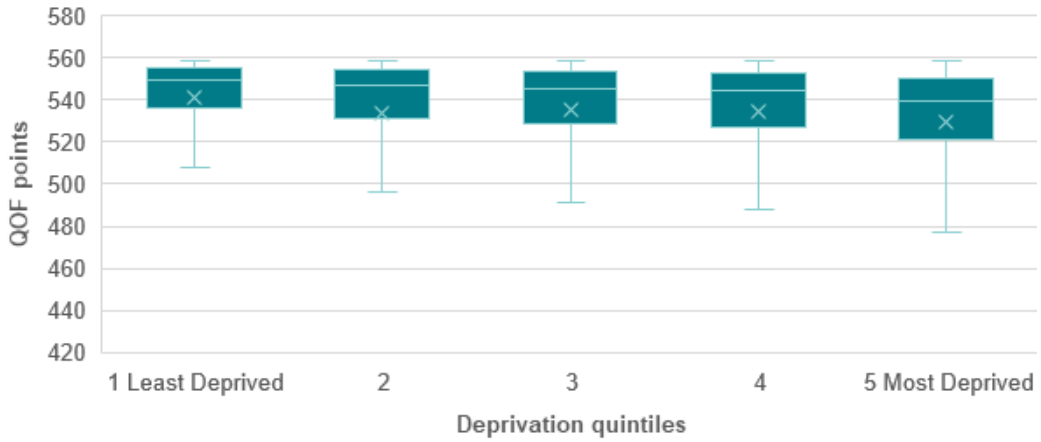
the NHS and the characteristics of the secondary care will also likely vary in conjunction with deprivation. This could directly affect GP behaviour.

We have explored the differences in activeness indicators (shown in Figure 14) further by also considering how the distribution of behaviours and outcomes is related to deprivation.

For example, we illustrate in Figure 15 the distribution QOF scores across each deprivation decile. Specifically, we can see for each deprivation quintile, the mean, and 10th, 25th, 50th, 75th and 90th percentiles of QOF achievement points (the maximum possible score is 600).

In keeping with the analysis we presented above, average QOF points decline slightly as we move into successively more deprived bands. Interestingly the upper bound scores in the most deprived decile are very similar to the scores achieved by the best performing practices in the least deprived CCGs. However, the worse performing practices in the more deprived areas are considerably worse than the equivalent group in the least deprived CCGs. This appears to be driving the mean difference for this indicator.

Figure 15 QOF points by deprivation quintile



Source: *Frontier Economics*

Note: *The upper bar refers to the 95th percentile and the lower bar refers to the 5th percentile in each quintile. The solid box covers the 75-25th percentiles. X represents the mean.*

The trend of less active and worse performing GP practices in more deprived areas is not evident across all metrics. Specifically, practices in more deprived areas have a greater likelihood of prescribing novel drugs and are also slightly more likely to adhere to drug prescription guidelines. This could reflect differences in prescribing requirements due to patient caseload or alternatively differences in the joint prescribing decisions made by clinicians in conjunction with their patients in these areas.

3.4 Local context is related to patient outcomes and quality of care

Local context is also related to patient outcomes and quality of care. In Chapter 2 we set out a number of quality indicators, and the rationale for them. In general, we see that patient outcomes are worse in more deprived areas.

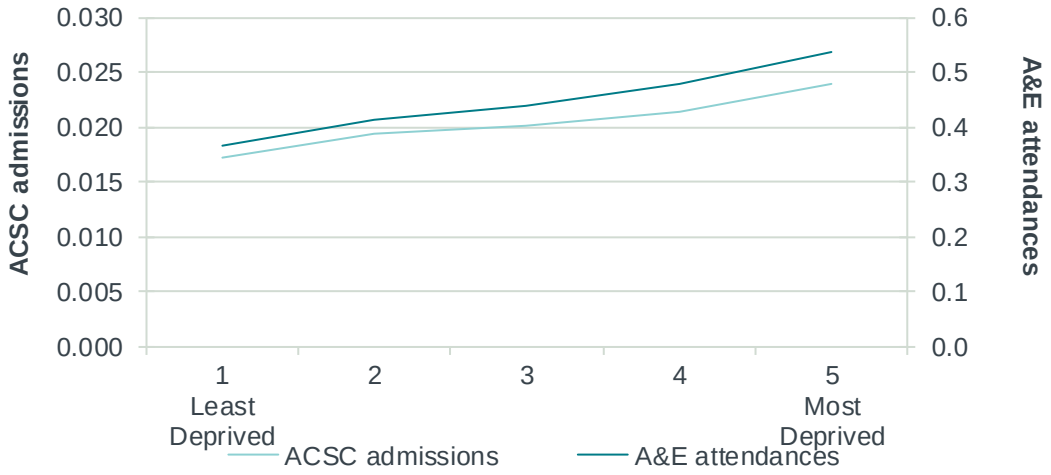
Attendance and admission rates

Emergency ACSC admissions are a signal of poor quality, as hospitalisation should generally not be required if the long term condition is well managed. Likewise, high A&E attendances may signal poor management of conditions. Both these rates are standardised for patient mix, so the fact that patients in deprived areas are less healthy should not directly affect these results.

Figure 16 shows that as we move up deprivation quintiles, admission and attendance rates increase. We examine the rates for a "weighted patient" which strips out the effects of age and gender.[32] A weighted patient who is registered at a practice in the least deprived quintile of CCGs is expected to have an emergency ACSC admission approximately once every 58 years. The equivalent figure for a patient in the most deprived practices is 42 years. The gradient in attendances is similar.

This could again reflect the higher workload faced by clinicians in more deprived areas which means they have to rely more on secondary care whereas GPs in less deprived areas have more capacity to deal with certain cases themselves. Alternatively, it could be that their proactive interventions prevent a patient from falling into secondary care.

Figure 16 GP practice attendance and admission rates by CCG deprivation quintile



Source: *Frontier Economics analysis of HES data*

Notes: *Admissions and attendances metrics are defined as annual visits per weighted patient per year averaged over three years. A&E attendances cover all conditions whereas our measure of admissions cover emergency ACSC admissions only.*

CQC rating

In addition, to admission and attendance rates we can also examine how the CQC perceives GP practices in more deprived and less deprived areas. The CQC provides a rating for each practice. This draws together a number of different clinical indicators. Specifically CQC draws on information from:

[32] Patient weights are used to allocate funding across GP practices in line with the average level of clinical need of their population in terms of age and gender

- Quality and Outcomes Framework (NHS Digital);
- GP Patient Survey (NHS England);
- NHS Business Services Authority; and
- Public Health England.[33]

CQC carries out an inspection to determine each practice's rating. The frequency of the inspections depends on the previous score awarded. If a practice is rated as ***good*** or ***outstanding***, CQC will inspect at least every 5 years. However, if a practice is rated as ***adequate*** or ***requires improvement*** the CQC will inspect again annually or within six months respectively.

The vast majority of practices are rated as either good or outstanding. However, as above practices located in high deprivation areas are slightly less likely to receive a favourable rating (82%) relative to practices in low deprivation areas (88%).

This is in keeping with the trend of practices in more deprived areas providing a slightly lower quality of care. This does not imply that the clinicians working in these practices are less skilled or less effective than their counterparts in other practices. However, it is important to be aware of how local context in which GPs find themselves effects both their behaviour and the outcomes of their patients.

[33] https://www.cqc.org.uk/guidance-providers/gps/how-we-monitor-gp-practices

4 GP PRACTICE CHARACTERISTICS

There is considerable variation in practice characteristics across the country. GP practice workforces differ in terms of age, gender, nationality and employment contract type. In addition, there are a number of different practice structures and contract types in place.

In this chapter we explore this variation and consider whether observed characteristics are in turn correlated with GP behaviours and patient outcomes. Finally, we put forward a typology which groups practices into different categories on the basis of sharing similar characteristics.

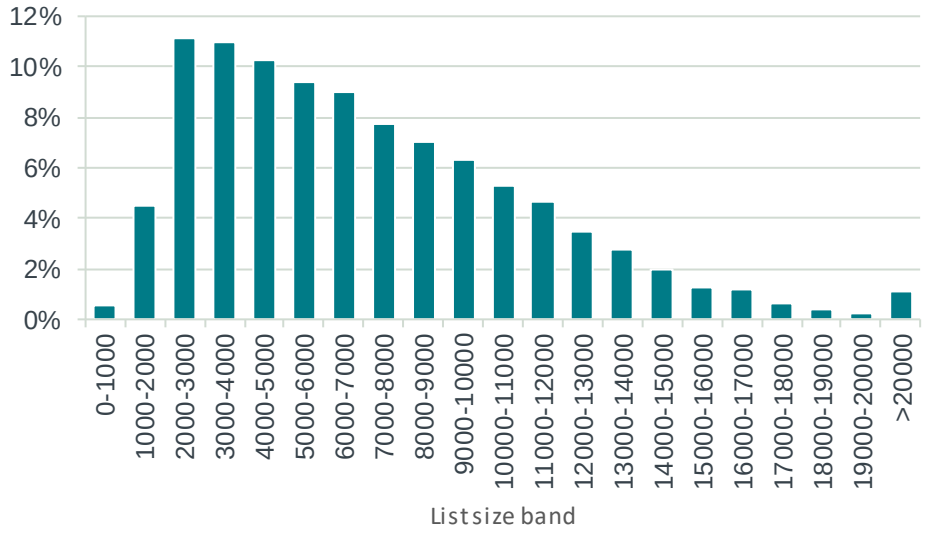
4.1 Variation in practice size

Practice size has been examined previously. For example, research carried out by the Institute for Fiscal Studies (Kelly & Stoye, 2014) concluded that there has been a shift towards large practices over the period 2004-2010.

Size can be assessed using either number of patients registered at a practice (list size) or number of FTE GPs employed at each practice. We have used both. We find that there is still considerable variation in size of GP practices both in in terms of list size (number of registered patients) and number of GPs employed.

The median list size of a GP practice is nearly 7,000, with a lower quartile of 4,000 and upper quartile of 10,000 (Figure 17). The largest 1% of practices have list sizes in excess of 20,000.[34]

Figure 17 Distribution of practices by list size



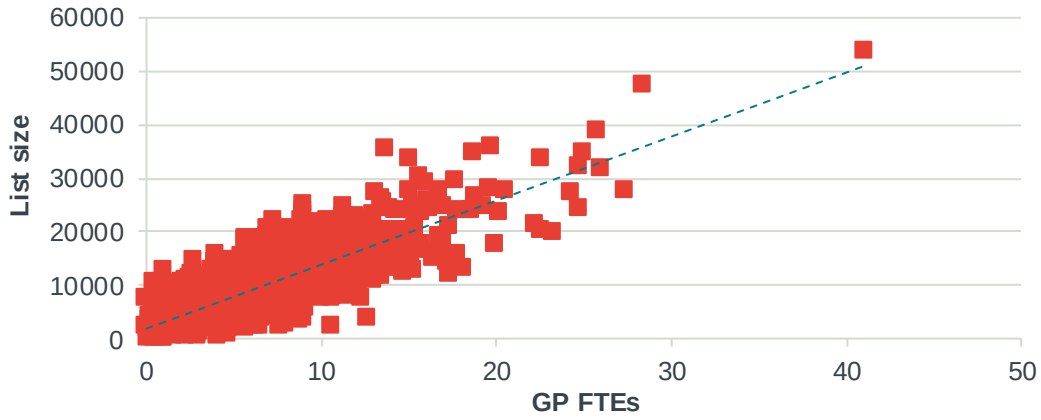
Source: *Frontier analysis of NHS Digital data*
Note: *Average list size 2014/15*

As we would expect there is a close relationship between list size and number of full-time equivalent GPs. Practices which employ more clinicians serve more

[34] Although many if not all of these practices will have multiple sites.

patients on average (Figure 19). Although as we showed in Chapter 3 certain practice types tend to have higher patient to GP ratios than others.

Figure 18 Scatterplot of list size against number of FTEs

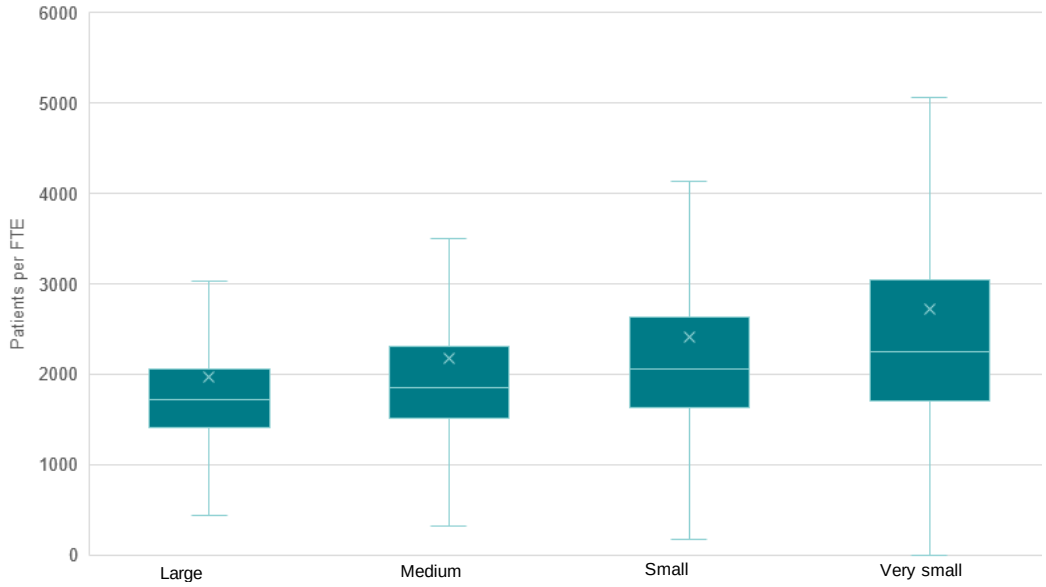


Source: Frontier analysis of NHS Digital data

Note: Average list size 2014/15

Although as we showed in Chapter 3 the relationship between number of patients and number of clinicians is not entirely linear and certain practice types tend to have higher patient to GP ratios than others. Specifically, we observe that smaller practices have a great workload per GP on average than larger practices (Figure 19). The median patient to FTE GP ratio for small practices (1 or less GP FTE) is 2,250. The equivalent figure for large practices (more than 6 GP FTE) is only 1,700.

Figure 19 Patients per GP FTE by FTE size band



Source: Frontier analysis of NHS Digital data

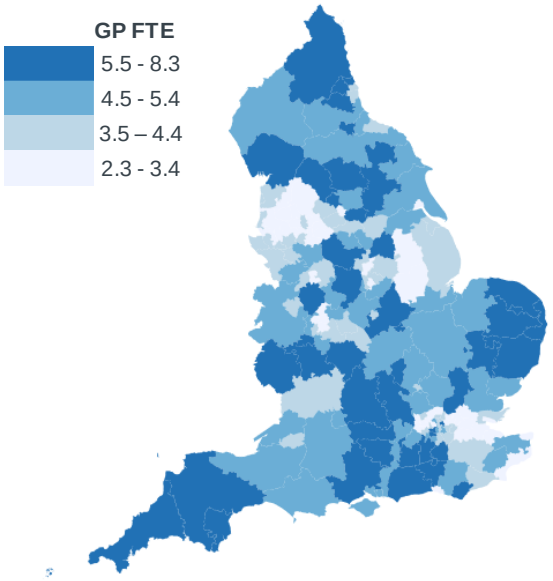
Note: Large practices have more than 6 GP FTEs, medium practices have more than 3 GP FTEs and less than 6 GP FTEs, small practices have more than 1 GP FTEs and less than 3 GP FTEs and very small practices have less than 1 GP FTEs.

In addition, we observe a higher degree of variation in GP FTE to patient ratios in the smallest practices.

The higher average workload in the smaller practices could be because large practices are more likely to be located outside of major urban centres and small practices are disproportionally concentrated in cities with high population densities. In Figure 20 below we have mapped the number of GP FTE across each CCG. We have classified each CCG into one of four groups which represent the quantiles of the size distribution.

It is immediately apparent that rural CCG's such as Kernow CCG in Cornwall or North Norfolk CCG have higher average practice sizes on average. CCG's in and around London tend to have a higher proportion of smaller practices and this is also the case around Manchester and Liverpool.

Figure 20 Average practice size by CCG



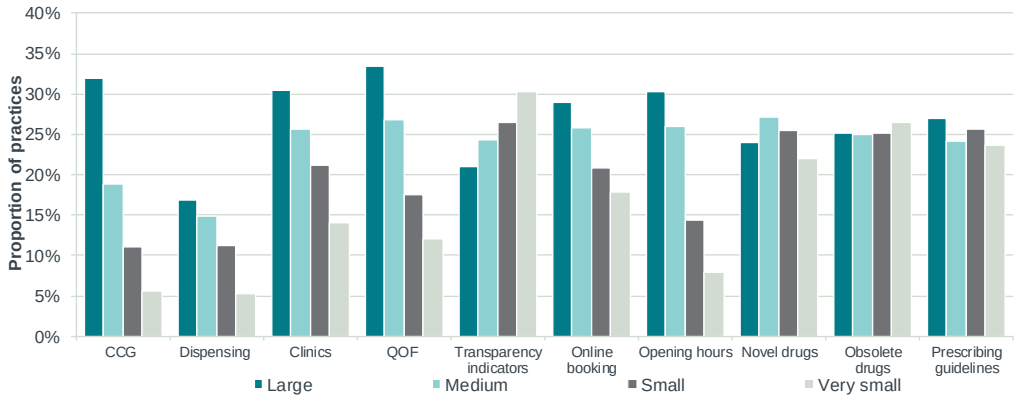
Source: Frontier analysis of NHS Digital data
Note: CCG boundaries are used. Darker shades represent larger average practice sizes

4.1.1 Relationship between practice size and activeness

Our definition of activeness includes multiple dimensions (see Chapter 2 for further details). We can see consistent patterns of correlation between many aspects of GP activeness with practice size.

Unsurprisingly, larger practices are more likely have at least one GP who is active in running their local CCG. They are also more likely to be dispensing practices, to offer specialty clinics, to have longer opening hours and be early adopters of online booking systems (Figure 21).

Figure 21 Summary of GP behaviours across practice size bands



Source: *Frontier Economics*

Note: *Large practices have more than 6 GP FTEs, medium practices have more than 3 GP FTEs and less than 6 GP FTEs, small practices have more than 1 GP FTEs and less than 3 GP FTEs and very small practices have less than 1 GP FTEs.*

Our qualitative research indicated that one of the key benefits of scale for GP practices is that individual clinicians (including practice nurses) can engage in a certain amount of specialisation. This could help to explain why bigger practices are far more likely to offer clinics for example.

Some of the GPs we spoke to noted that smaller GP practices may therefore be at a relative disadvantage. Single-handed GPs for example cannot engage in this specialisation to the same extent. It is important to note that some interviewees felt that the benefits of specialisation only occur in some large practices and are not universal. These GPs noted that certain practices have a collaborative culture where emphasis is placed on learning from colleagues while in other large practices individual clinicians work independently.

Some of the GPs we spoke to highlighted primary care networks as one possible avenue by which smaller practices could share best practice and collaborate. The NHS Long Term Plan (NHSE, 2019) announced £4.5 billion of new spending on primary medial and community health services. This includes funding for an expanded community multidisciplinary teams aligned with new primary care networks. These networks will be based on neighbouring GP practices that work together. These networks will have expanded teams including GPs, district nurses and pharmacists.

> Primary care networks are a way of facilitating skill sharing beyond the practice walls which could benefit single handed GPs These networks are in their infancy but it will be interesting to see if they work
>
> *GP*

The five-year framework for GP contract reform to implement The NHS Long Term Plan (BMA, NHSE, 2019) notes that the additional roles created as part of these Primary Care Networks could also help to address workload issues, which we have shown could be most acute for smaller practices currently.

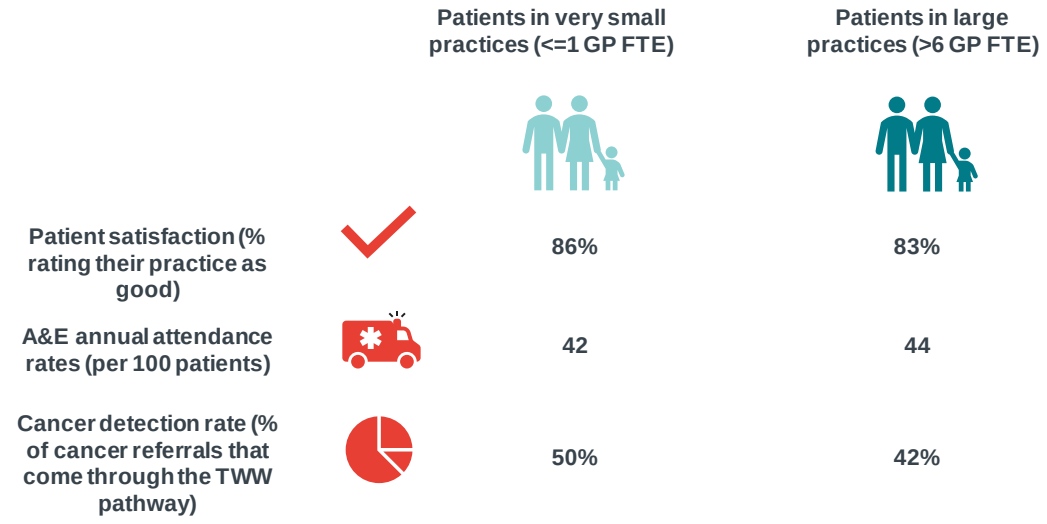
In addition, to the sharing of best practice in large practices it could also be that GPs in smaller practices simply do not have the capacity to engage in these non-core activities. We have shown above how smaller practices have a higher number of patients per FTE GP, this could imply that there is less time available to engage in activities which could have significant long term benefits such as investing in the practice's technology offering.

Interestingly the pattern of increased level of activeness within larger practices is not evident across all indicators. We do not observe an obvious size gradient in relation to prescription behaviour for example. Larger practices do tend to have higher QOF scores (which were introduced in 2004 to assess practice quality and historically formed the basis for a portion of GP practice income). However, somewhat surprisingly practice size is negatively correlated with a separate quality measure: NHS Choices transparency indicators scores. This score incorporates metrics covering diabetes care, flu vaccination rates and provision of smoking cessation advice.[35] One possible explanation for this apparent inconsistency could be that larger practices tend to have better administrative support functions which enables then to achieve higher QOF scores for a given level of performance captured in the transparency indicators.

4.1.2 Patient outcomes are related to practice size

In keeping with previous literature (e.g. Kelly & Stoye, 2014) we see that in a simple univariate setting bigger practices have better outcomes than smaller practices. For example, as we show in Figure 22 below patients who are registered to larger practices report slightly higher patient satisfaction scores and are slightly less likely to attend A&E in a given year. Also, large practices have a higher proportion of all cancer diagnoses coming through the TWW pathway.

Figure 22 Variation in patient outcomes by size band



Source: Frontier Economics

These relationships are not necessarily causal as they do not account for other differences between big and small practices which may also drive patient

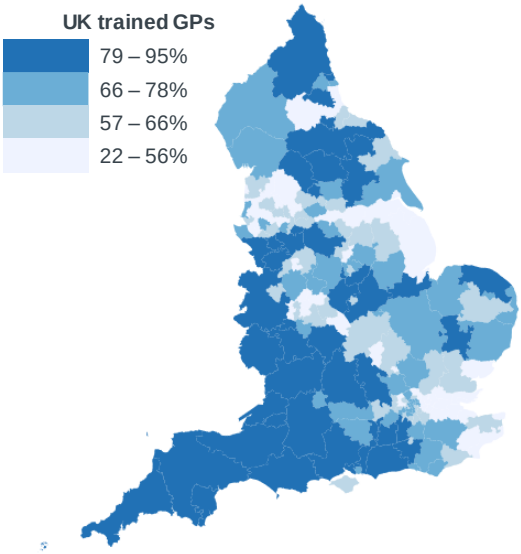
[35] https://www.england.nhs.uk/wp-content/uploads/2013/12/gp-outcome-data-ntes.pdf

outcomes. However, they are worth noting as they highlight the importance of accounting in adequately for practice structure as part of our multivariate analysis.

4.2 Variation in practice workforce

As well as variation in number of practitioners within a specific we also observe systematic differences between practices in terms of GP staff composition. A number of specific patterns and interactions with practice size are worth highlighting.

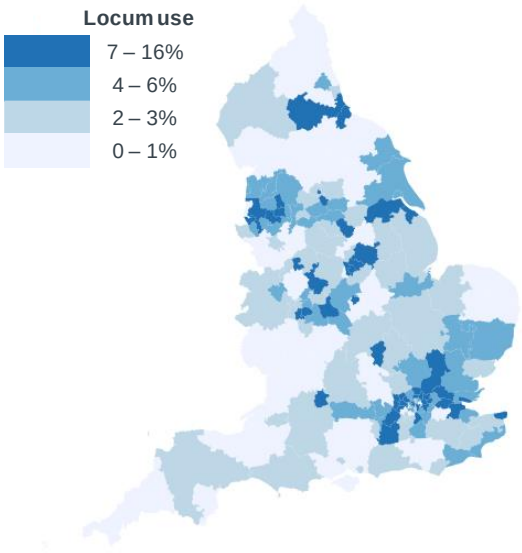
Figure 23. Average proportion of UK trained GPs by CCG



Source: *Frontier analysis of NHS Digital GP Census data*

Note: *CCG boundaries are used. Darker shades represent a higher proportion of UK trained GPs*

Figure 24. Average proportion of locum GPs by CCG



Source: *Frontier analysis of NHS Digital GP Census data*

Note: *CCG boundaries are used. Darker shades a higher reliance on locums*

In Figure 23 and Figure 24 below we illustrate how the proportion of UK trained GPs and the usage of locum GPs varies respectively varies across the country. In general, both non-UK trained GPs and locum GPs are more commonly found in major urban centres.

Specifically, we can see that UK trained GPs are relatively less common in major urban areas such as London and Birmingham and more common in rural areas. This could reflect the desires of migrant GPs to settle in big cities. In addition, the use of locums is more prevalent in urban areas. This is likely to be driven in part by the fact that urban areas feature a higher proportion of small practices. The staff breakdown in terms of locum[36], salaried GPs[37] and registrars[38] is shown in Figure

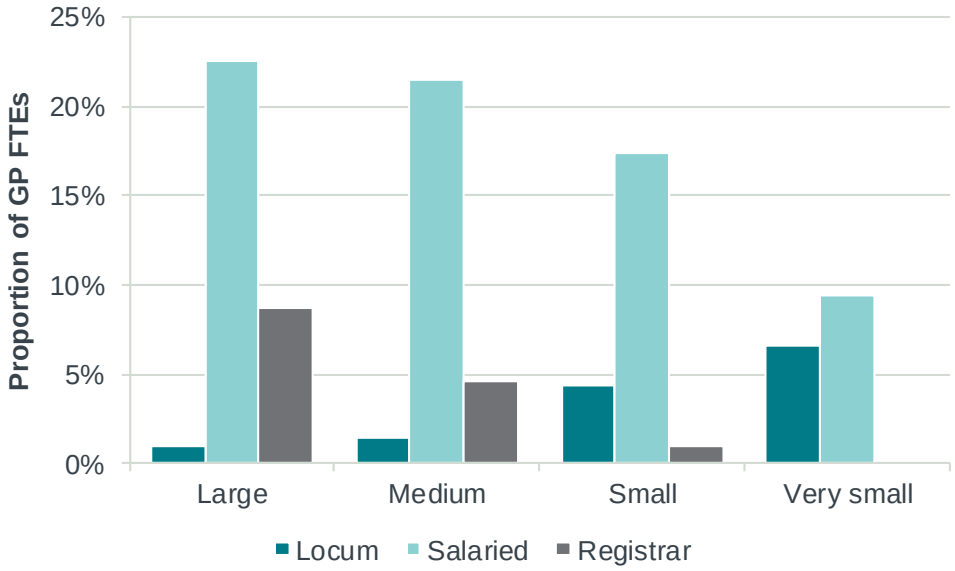
[36] A locum GP is defined as one who temporarily takes the place of another GP. Locums are usually self-employed and are sometimes also referred to as freelance GPs. https://www.bma.org.uk/-/media/files/pdfs/employment%20advice/contracts/sessional%20and%20locum%20contracts/locum-gp-handbook-2018.pdf?la=en

[37] https://www.nhsemployers.org/pay-pensions-and-reward/medical-staff/salaried-gps

[38] A GP Registrar is a qualified doctor who is training to become a GP through a period of working and training in a practice. They will usually have spent at least two years working in a hospital before entering practice and are closely supervised by a senior GP or trainer

25. Registrars are virtually absent in smaller practices and the use of salaried GPs is lower, whereas use of locums is significantly higher.

Figure 25 Proportion of GP FTEs that are registrar, locum and salaried, by practice size



Source: *Frontier analysis of NHS Digital GP Census data*

Note: *Large practices have more than 6 GP FTEs, medium practices have more than 3 GP FTEs and less than 6 GP FTEs, small practices have more than 1 GP FTEs and less than 3 GP FTEs and very small practices have less than 1 GP FTEs.*

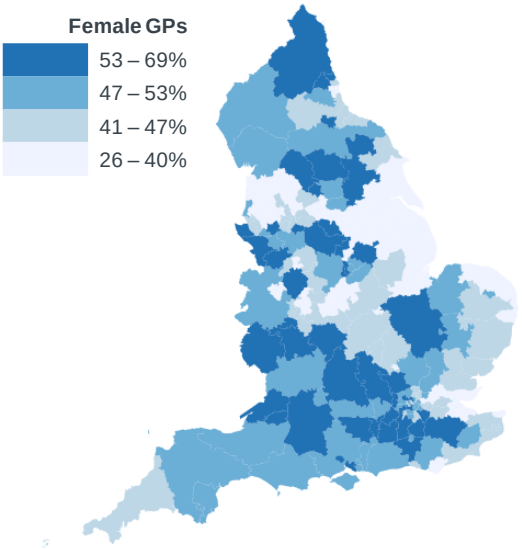
The choice to use locums instead of salaried could reflect smaller practices facing more uncertainty in terms of list size and the partner staff capacity, so that flexible arrangements are preferred to employing permanent staff. This could have implications for continuity of care in these small practices and may help to partly explain some of the differences in quality we observe above.

In Figure 26 and Figure 27 we examine the same patterns geographical variation in relation to the proportion of female GPs and the proportion of GPs aged over 55. On average across all practices women make up 51% of all GP FTEs. There is considerable variation in gender balance across England. The bottom 25% of CCG's have less than 40% of female GPs on average while 53% of GPs are female in the top 25% of CCGs.

GPs aged over 55 make up 20% of the total workforce in England. However, again certain CCGs are considerably above this average (more than 45% of GPs in the top quarter of CCGs are aged over 55) and others are considerably below (less than 36% of GP are aged over 55 in the bottom quarter of CCG's).

https://www.nhs.uk/choiceintheNHS/Yourchoices/GPchoice/Documents/rcgp_iyp_full_booklet_web_version.pdf

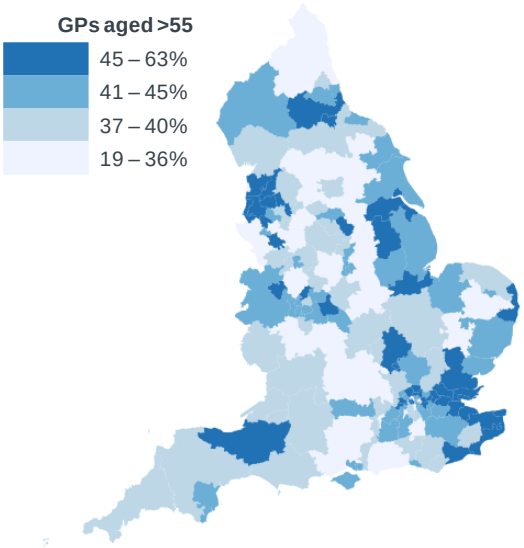
Figure 26. Average proportion of female GPs by CCG



Source: *Frontier analysis of NHS Digital GP Census data*

Note: *CCG boundaries are used. Darker shades represent larger average practice sizes*

Figure 27. Average proportion of GPs aged >55 by CCG

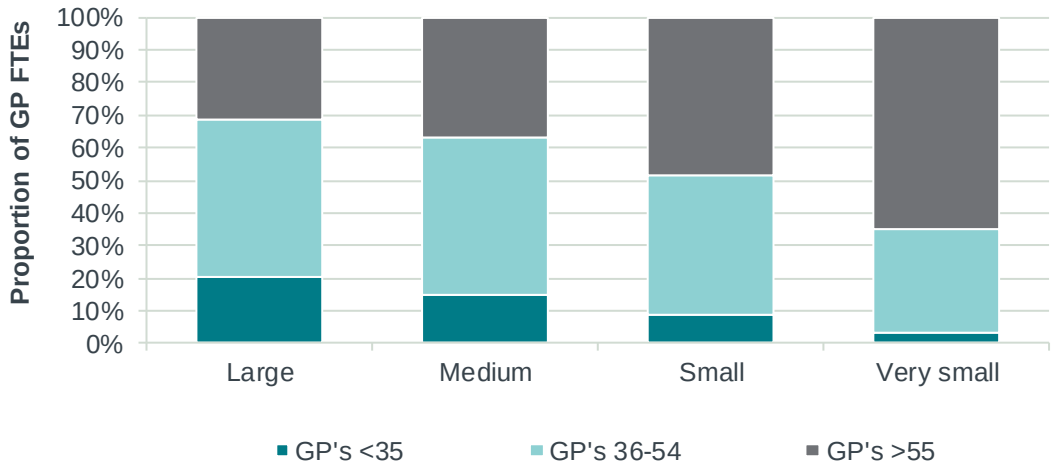


Source: *Frontier analysis of NHS Digital GP Census data*

Note: *CCG boundaries are used. Darker shades represent larger average practice sizes*

Again, much of this variation is linked to practice size. As we illustrate in Figure 28 larger practices have a smaller proportion of younger clinical staff. This fits with the concept of GPs starting out in larger practices and then either setting up independently or splinter off into smaller practices later in their career.

Figure 28 GP age breakdown by practice size



Source: *Frontier analysis of NHS Digital GP Census data*

Note: *Large practices have more than 6 GP FTEs, medium practices have more than 3 GP FTEs and less than 6 GP FTEs, small practices have more than 1 GP FTEs and less than 3 GP FTEs and very small practices have less than 1 GP FTEs.*

This clearly illustrates how practice characteristics are interrelated and their relationship to outcomes of interest need to be analysed jointly in a multivariate setting to identify causal pathways. We address this in two ways:

- Firstly, in the following subsection we group practices together into four clusters to identify archetypal practices.
- Secondly, in the next Chapter we present the results of a comprehensive regression analysis that links activeness measures to patient outcomes while controlling for local area demographics and practice characteristics.

4.3 Typology of practices

There is a high degree of interaction between various practice characteristics and local factors. It can be difficult to interpret any one of these relationships in isolation, as there will be other confounding factors that are not addressed. To get a better idea of how these factors move together we have used the statistical technique of cluster analysis to group practices in terms of observed characteristics.

CLUSTER ANALYSIS

Cluster analysis looks for a grouping of practices that maximises the difference between groups and minimises the difference within them. The clustering algorithm we use is "k median clustering". We first specify a list of variables on which the clustering is performed. Here we use a broad range of local demographic characteristics and practice workforce characteristics. The variables are then standardised so that each carries equal weight. On this basis distance is measured to each cluster average, and practices assigned to the nearest cluster.

Due to the iterative nature of the clustering algorithm, it can produce different results depending on which practices are used as the starting point ("seeds"), and how many clusters are requested. Analysis of variance (ANOVA) reveals that the optimal number of clusters in this case is 4. To address the sensitivity to seeding, the clusters are created 20 times on different starting seeds, and smaller groups assigned in to the top 4 on the basis of the distance metric.

The workforce and demographic characteristics of the 4 main clusters are shown in Figure 29. The largest cluster, A, has 4,249 practices. These are relatively large practices (5.19 FTEs on average), with lower than average rates of local area deprivation and tend to operate in relatively more concentrated local markets. This cluster has fewer patients per FTE than do the other clusters and includes virtually all rural practices. In terms of workforce characteristics, they have a higher proportion of female and UK-trained GPs, a higher share registrars and a lower share of locums.

Interestingly, across many dimensions the remaining three clusters (B-D) are quite similar. For example, cluster B-D all have consistently high rates of locum usage and contain very few rural practices. This suggests a significant proportion of observed variation can be captured by simply comparing Cluster A to all other practices. As a whole clusters B-D are also smaller and more operate in more deprived areas than Cluster A.

However, there are some notable subdivisions within clusters B-D. Cluster B has a significantly lower condition prevalence rate due to serving younger patients. Cluster C has the most patients per FTE and the highest rate of locum usage.

Whereas Cluster D has the smallest practices and the highest levels of deprivation. Clusters C and D also contain far fewer practices than do Clusters A and B.

Figure 29 Characteristics of four main clusters

Cluster	A	B	C	D
Number of practices in cluster	4,249	1,535	209	142
GP FTEs	5.19	3.56	3.16	2.80
List size	11,440	8,856	8,375	6,442
FTE per headcount	85%	80%	83%	84%
Patients per FTE	2,203	2,487	2,646	2,302
Patient weight (100 = average)	103	93	99	101
Condition prevalence (PCA)	0.5	-0.9	0.1	0.0
Deprivation	21.3	27.4	27.2	32.8
Rural	24%	1%	0%	1%
Local concentration (PCA)	0.50	-0.89	-0.62	-0.73
Contract PMS	25%	38%	30%	23%
Contract PMS to GMS	16%	11%	15%	19%
Contract GMS	59%	51%	55%	58%
% GPs female	50%	47%	39%	39%
% GPs UK-trained	75%	55%	46%	44%
% GPs locum	3%	10%	11%	8%
% GPs registrar	5%	3%	2%	1%
% GPs salaried	25%	28%	18%	20%

Source: Frontier analysis

Note: The clustering is done on standardised variables (scaled to have a mean of zero and standard deviation of one), so that each carries equal weight. The condition prevalence and local concentration variables are derived from principal component analysis (PCA): they summarise the common variation for a group of multiple correlated variables.

Finally, we can examine how the four clusters differ in terms of their propensity to display activeness behaviours and the patient outcomes they achieve (Figure 30).

Cluster A have high rates of participation in CCG management, are more likely to provide specialty clinics, offer longer opening hours, and achieve both higher QOF points and higher NHS Transparency Indicators scores than all other clusters. There is little variation in prescribing behaviour between clusters, other than lower guideline adherence in Cluster D.

Figure 30 Behaviours and outcomes across four main clusters

Cluster	A	B	C	D
GP behaviours				
CCG member	23%	13%	9%	12%
Specialty clinics (PCA)	0.2	-0.1	-0.4	-0.3
Weekly opening hours	30	27	24	24
NHS Choices Transparency Indicators (PCA)	20%	-26%	-17%	-20%
QOF achievement points	540	529	531	529
Novel drugs share	0.7%	0.5%	0.7%	0.7%
Obsolete drugs share	0.20%	0.24%	0.22%	0.22%
Prescribing guidelines adherence	0.008	0.034	-0.024	-0.098
Early adopter of online booking (PCA)	0.024	0.029	-0.139	-0.214
Quality of care outcomes				
ACSC admission rate (per head of population per year)	2.0%	1.8%	2.1%	2.2%
Chronic ACSC admission rate (per head of population per year)	0.9%	0.7%	0.9%	0.9%
A&E attendance rate (per head of population per year)	40%	49%	46%	47%
TWW detection rate %	48%	46%	46%	42%
TWW conversion rate %	9%	7%	9%	9%
TWW usage (referrals per 100,000 population over 5 years)	14,293	8,977	10,655	9,932
Patients satisfied %	87%	81%	83%	84%
CQC good / excellent %	97%	91%	90%	95%

Source: Frontier analysis

Note: The clustering is done on standardised variables (scaled to have a mean of zero and standard deviation of one), so that each carries equal weight. The condition prevalence and local concentration variables are derived from principal component analysis (PCA): they summarise the common variation for a group of multiple correlated variables.

In terms of patient outcomes as we would expect clusters B-D appear to be generally quite similar in terms of their outcomes. Relative to these three groups Cluster A has higher TWW usage and detection rate, higher levels of patient satisfaction and CQC ratings and lower A&E attendances per patient.

To conclude, there are many interrelated factors that affect GP behaviour and practice performance. When we consider a large number of metrics simultaneously we see that a distinctive group emerges of small, deprived, urban practices. These practices likely face extremely challenging conditions and encounter barriers to

innovation as a result. In the following Chapter we will explore the extent to which these activeness behaviours which there practices generally struggle to engage in are actually associated with improved patient outcomes.

5 REGRESSION ANALYSIS

We investigated how the GP activities and behaviours are related to patient outcomes, stripping out the effect of various contextual factors, and workforce composition effects.

This was done using regression analysis on dataset at GP practice level. The regressions look in turn at a range of different outcome variables, in each case controlling for local demographics, practice characteristics, and activeness measures. We also use CCG dummies to control for unobservable differences between local areas.

For each practice *i* in CCG *c* the overall model can be written:

ECONOMETRIC SPECIFICATION

$$Outcome\_{ic} = a + b_1 * pop\ health\_{i} + b_2 * workforce\_{i} + b_3 * activeness\_{i} + b_4 * dummy\_{c} + u_i$$

In each case the same set of control variables is used for modelling each of the different patient outcomes, allowing for more direct comparison of results. A large number of different control variables were considered initially, but these needed to be whittled down to a smaller selection. This was done by drawing out the different conceptual drivers and retaining a limited number of variables for each so that the salient features can be captured and their effects measured reliably.[39]

The results of particular interest are the coefficients on the activeness variables. These give the change in patient outcome resulting from a change in GP behaviour, controlling for the various demographic, local and practice characteristics.

We see statistically significant relationships between patient outcomes and GP activeness across a range of different outcome measures which we describe in detail below.

5.1 Effect of GP activeness variables on patient outcomes

In the following subsections we examine the links between individual domains of activeness and quality outcomes. In each case we present a summary table followed by discussion and interpretation which is supported by our qualitative engagement.

In each table green ticks indicate a statistically significant positive relationship between a specific domain of activeness and a measure of quality (e.g. reduced

[39] We test for multicollinearity using the variance inflation factor (VIF). As a rule of thumb, a VIF in excess of 10 is considered problematic. The average VIF obtained is 1.9, with a maximum of 6 in relation to local demographic controls, which in any event are not of direct interest. Our variable selection therefore avoids multicollinearity.

admissions), and red crosses illustrate where we have found a negative relationship.

Shading is grey if the confidence level is at a marginal level of significance (between 5% and 10%). The number of ticks and crosses reflects the magnitude of the effect. Three ticks/crosses means that a standard deviation change in the explanatory variable is associated with a change of at least .05 standard deviations in the outcome variable. Two ticks/crosses mean the effect is between 0.02 and 0.05, and one tick/cross means the effect is smaller, but still statistically significant.

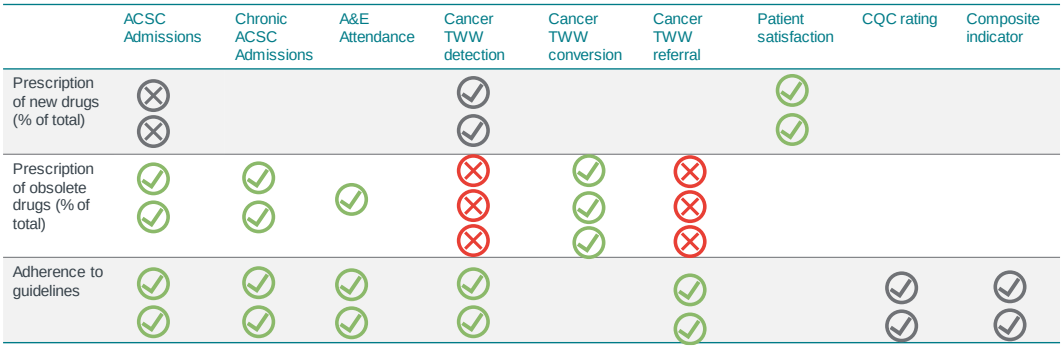
Full results are provided in Annex A.

5.2 Drug prescription behaviour

Results

In Figure 31 below we illustrate the effect of prescription behaviour on patient outcomes according to our multivariate regression analysis.

Figure 31 Effect of prescription behaviour on patient outcomes



Source: *Frontier analysis*

Note: *Coefficient values are presented in Annex A*

The only statistically significant finding in relation to prescription of new drugs is that practices with higher rates of new drug prescription tend to have higher rates of patient satisfaction. We were told by GPs we interviewed that in certain circumstances this could be driven by GPs prescribing newly emerging drugs which certain informed patient groups (such as those suffering from long term conditions) are requesting. Although other GPs noted that only occurred rarely in their experience. In addition, some GPs noted that prescription of new drugs may in some circumstances be driven by prescription patterns in local secondary care and therefore may not be totally in the control of primary care clinicians.

The results linking prescription of obsolete drugs to patient outcomes are more mixed. As we described in Chapter 2 we define a drug as obsolete if it is undergoing a consistent and significant decline in usage across the country. We initially expected to uncover mostly negative relationships between obsolete drug prescription rates and quality as prescription of older drugs may suggest a lack of engagement. We do find that greater reliance on older drugs is correlated with lower Cancer TWW detection and referral rates. However, somewhat surprisingly the use of obsolete drugs is also associated with lower admissions and attendance rates.

Our engagement with GPs suggested that there may be specific reasons why a GP opting to continue prescribing a drug in marked decline, could be consistent with high quality primary care. For example, it could that a GP is treating patients who have been on the same prescription for a long time and would be uncomfortable switching to a newer drug, as they may be concerned at the possibility of associated side effects. In these cases an engaged GP may continue to prescribe an older drug following an open discussion with their patient as to the best course of action. This could help to explain our findings.

> Some prescription guidelines might be based on research which was carried out with patients that are very different to the patient I am treating currently
>
> *GP*

Adherence to MO-KTT prescribing guidelines has a positive correlation with most of the outcomes. Our qualitative engagement with clinicians suggested that these effects were intuitive. It could be that lower admissions is driven directly by lower level of medicine related harm. One GP noted that following the most recent COPD prescription guidelines for example would mean that patients are less likely to be admitted for an exacerbation.

Given that adherence to these guidelines seems to be associated with better outcomes we were also interested in exploring why certain practices continue to deviate from mandated best practice. We were told by GPs that generally speaking guidelines are evidence based across populations and as a result they will not always be tailored to an individual patient. For example, interviewees indicated that following certain guidelines could lead to material quality of life issues for certain individual patients.

In addition, some GPs also indicated that they may in some cases take other aspects of a patient's circumstances into account. For example, we were told that certain medicines are no longer considered to be cost effective according to current guidelines and that patients are expected to buy these products themselves over the counter. Some GPs may continue to prescribe these medicines if for example they feel that an individual patient would struggle to afford the medicine over the counter. These examples would lead to deviation from guidelines in some cases. We were told that some GPs will feel more comfortable than others doing this.

As well as a lack of universal applicability of guidelines we were told by some GPs that a lack of information may also be related to certain GPs deviating from prescription guidelines. This can manifest itself in two ways. Some GPs told us that they were unaware how some local prescription guidelines were developed. One GP noted that they might be more willing to follow guidelines if there was more transparency

> It is very important that we understand where medicines guidelines come from
>
> *GP*

regarding the process underlying guideline development and the associated evidence.

Other GPs suggested that a lack of awareness, in terms of what the guidelines recommended could in some circumstances lead to GPs inadvertently deviating from best practice. Multiple GPs noted that it can be hard to keep abreast of the latest developments in best practice prescribing and that a generalist may not always be able to keep up.

> The guidelines are constantly changing and it can be hard to keep up with all the latest information across all areas. It may be that a clinician hasn't had time to read up on a certain area.
>
> *GP*

As with several dimensions of activeness we were told that this issue is likely to be most severe for single handed GPs who are less able to learn from colleagues' who may have specific areas of expertise.

Some GPs noted that a local medicines optimisation team operates across their CCG and provides feedback to clinicians in terms of their prescription behaviour which is considered to be valuable.

Implications

Our quantitative analysis clearly highlights the importance of prescribing in line guidelines. Our qualitative engagement suggests that further increases in adherence could be achieved by increasing GP awareness of guidelines both in terms of content and the process by which they are generated. In addition, as we described above certain guidelines may also benefit from additional flexibility which could explicitly acknowledge that specific cases could require a tailored approach which differs from standard practice.

5.2.1 Use of new technology within general practice

Results

In Figure 32 below we illustrate the effect of technology adoption by GP practices on patient outcomes according to our multivariate regression analysis. Each of our metrics which assessed technological usage across practices was positively and significantly associated with a different mix out outcome variables.

Patients who are registered to practices that were early adopters of online booking and online prescription services have fewer ACSC admissions and attendances than we would otherwise expect. This could be because higher quality practices are generally quicker to embrace new types of technology. Alternatively it could be that practices who make use of the online services are more accessible and patients therefore are less likely to require unexpected secondary care.

Figure 32 Effect of technology usage on patient outcomes

	ACSC Admissions	Chronic ACSC Admissions	A&E Attendance	Cancer TWW detection	Cancer TWW conversion	Cancer TWW referral	Patient satisfaction	CQC rating	Composite indicator
Early adopter of online booking / prescription services	✓ ✓	✓ ✓							
Use tele-consultations				✓ ✓ ✓			✓ ✓ ✓		✓ ✓ ✓
Use mobile apps				✓ ✓ ✓				✓ ✓ ✓	✓ ✓ ✓

Source: Frontier analysis

Note: Coefficient values are presented in Annex A

The data that we collected as part of our survey of GP practices revealed that practices which made use of tele-consultations (either over the phone or via Skype) and practices that prescribed apps to patients both had significantly better cancer TWW detection rates and scored highly on the composite quality indicators relative to practices that did not use these forms of technology. In addition, patient satisfaction was higher for practices that offered tele-consultations.

During our interviews GPs indicated that the observed link between higher patient satisfaction and use of Skype and telephone consultations is not surprising.

One GP noted that certain groups of patients are demanding more flexibility from primary care and that the rise in online only providers has revealed that traditional practices may not be serving all patient groups well currently. This GP cited recent examples of online only providers who were attracting lots of patients (primarily younger patients) away from existing practices. This could have a destabilising effect on practice funding and may be forcing certain practices to adapt.

> If you're busy younger person you want to use technology to see a GP quickly. You don't want to wait three weeks. Where people want instant access technology can work really well.
>
> *GP*

All of the clinicians we engaged with acknowledged that greater use of technology was likely to be mutually beneficial for both clinicians and patients. GPs felt that if technology is used sensibly it can be very powerful and can allow for a more efficient use of GP time. This could occur through improved GP to patient communications as well as more effect information sharing between clinicians facilitated by technology. However, there were a number of important reservations and potential barriers which are worth highlighting.

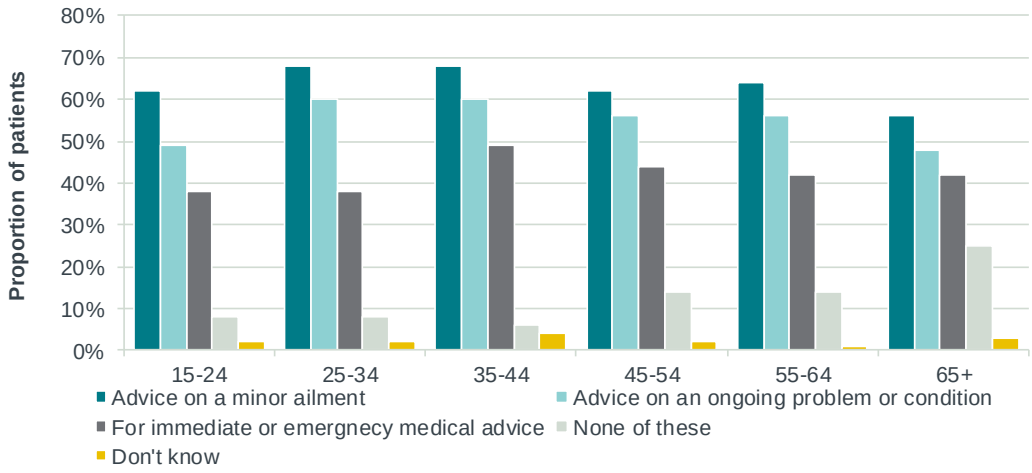
Firstly, several GPs noted that a one-size-fits-all approach in relation to technology was not appropriate. For example, one clinician highlighted how online consultations are not well suited to some rural areas of the country where connectivity may be limited.

In addition, certain patient groups (including older patients or those who value continuity over improved access) may not be comfortable using tele-consultation services and could become distressed if there is no other option. Therefore, variation in patient characteristics across practices will likely be an important driver of technological adoption.

> Technology needs to be one tool in our box not the only option which makes life more difficult for some people.
>
> *GP*

This is consistent with previous research (Castle-Clarke, 2018) which found that that technological advances offer significant opportunities to improve health care but are not a silver bullet for the pressures facing the NHS. Specifically, the analysis revealed that those aged over-65 are less willing to avail of video consultations than younger age-groups (Figure 33).

Figure 33 Public willingness to use video consultations with their own GP



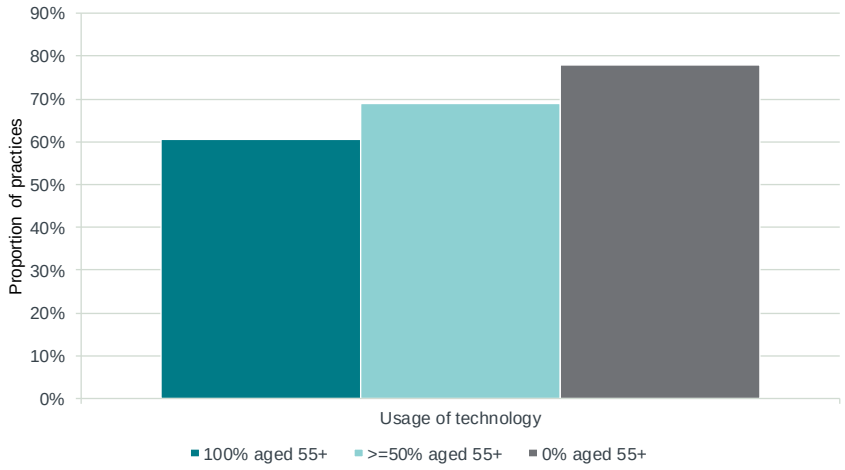
Source: The Health Foundation, IFS, Kings Fund, Nuffield Trust (2018)
Note: Sample covers all of UK

GPs that we engaged with also noted that certain clinician characteristics are also likely to be a factor in demining uptake of new technologies within general practice. GPs we engaged with noted that certain clinicians take pride in the fact that they only offer face-to-face consultations because they see this as a marker of care quality. This suggests that it may be difficult to achieve the objective set out in the Long Term Plan that over the next five years, every patient will have the right to online 'digital' GP consultations (NHSE, 2019). In addition, several GPs told us that older clinicians will on average be less comfortable using new technologies. This is consistent with the evidence from our survey of GP practices. Other GPs felt that this distinction was too simplistic. We can see that the majority of practices who we surveyed use at least of one of the technologies we listed.[40] On average practices where all of the GP workforce was aged over 55 were less likely to use

[40] Technology usage included bladder screening, telephone and email consultations, use of skype, home monitoring of hypertension, monitoring devices and usage of mobile apps.

technology than practices which contained a mixture of older and younger GPs or exclusively younger GPs (Figure 34).

Figure 34 Relationship between technology usage and practitioner age



Source: Frontier analysis of GP survey data collected for this project

Note: Technology usage included bladder screening, telephone and email consultations, use of skype, home monitoring of hypertension, monitoring devices and usage of mobile apps.

There are two additional barriers which could limit technological uptake even where both patients and GPs are keen to avail of newer technologies.

There are two additional barriers which could limit technological uptake even where both patients and GPs are keen to avail of newer technologies. Firstly, some GPs noted that IT software and hardware currently available could be a limiting factor. We were told that existing IT systems struggled to cope effetely with the standard patient database software. As a result there was some nervousness around introduction of teleconsultations for example as GPs could not guarantee that the patient experience would be entirely positive. Those GPs noted that upgrading the existing IT systems can be expensive and may not be possible within current budgets.

> IT is always a big thing. My computer is sometimes so slow it takes a significant amount of time just to load up the next patient. IT infrastructure is important. There is a question as to whether we have enough money in the budget.
>
> *GP*

Therefore, budgetary constraints could hamper the roll-out of online services. However, one GP noted that practices operating within the same CCG will generally have similar levels of available resources and we still observe considerable variation in technological adoption within CCG boundaries. This suggests that there are other barriers in operation.

Clinicians we interviewed indicated that expanding their practices' technological offering was also constrained by the amount of time someone in the practice could devote to it.

Some GPs told us that increased provision of online services could be viewed as non-core and therefore lower priority than ongoing day-to-day work.

This point was made specifically in relation to technology usage but could apply to a number of activeness dimensions such as developing a special interest or taking part in the management of a CCG.

> Making use of technology is one more thing we should be doing. We are often fighting fires and working at full capacity so it can be difficult to think about improvement activities. Currently the system is very stretched.
> *GP*

Implications

Our analysis provides clear evidence that GPs who make use of technology perform better than those who do not across a number of important dimensions. The recently announced initiatives which will ensure that all patients have the option of a teleconsultation in the near future therefore seem appropriate. However, clinicians emphasised how virtual consultations should remain to be an option and not patients' only choice.

As we describe above there are a number of barriers currently in place which are limiting adoption possibly to the detriment of patients. Easing workload pressures would help GPs to devote time to the adoption of new technologies. In addition, some clinicians also noted that a top down approach which mandated take-up of certain technologies may not be successful as individual clinicians have deep seated preferences. Instead some GPs suggested that clinicians will be more amenable to using technology if their colleagues and local networks encourage them to do so. Other GPs told us that clinicians were increasingly aware of the carbon emissions associated with patients driving to a consultation and then driving back home. They suggested that emphasising the potential abatement benefits could further encourage take-up.

5.2.2 Specialist GP training & services

Results

In Figure 35 below we illustrate the effect of provision of speciality clinics and development of GPSIs on patient outcomes according to our multivariate regression analysis.

Practices which offer more of these speciality clinics and have GPSIs on their staff both tend to have higher CQC ratings on average and also both perform better on our composite quality indicator. In addition, there is also some evidence that practices which offer a higher number of speciality clinics also have more satisfied patients.

Figure 35 Effect of GPSI usage on patient outcomes

	ACSC Admissions	Chronic ACSC Admissions	A&E Attendance	Cancer TWW detection	Cancer TWW conversion	Cancer TWW referral	Patient satisfaction	CQC rating	Composite indicator
Number of speciality clinics (PCA)							✓	✓✓	✓✓
Total GPSI's								✓✓✓	✓✓✓

Source: Frontier analysis

Note: Coefficient values are presented in Annex A

GPs who we engaged with were all positive about working with other GPSI's. However, several GPs pointed out that the specific impact on patient outcomes will be speciality specific. Therefore, it could be that if focused purely on certain types of GPSI we would see significant links to other outcomes for example.

There was a consensus that in general having a clinician with a specific niche of expertise within a practice will be of benefit to their colleagues. Specifically, they will be able to provide advice internally and their extra training will rub off on other GPs via informal communication mechanisms and formal knowledge sharing sessions.

> Generally GPSI's will be able to share their knowledge with colleagues at practice education sessions. There is then a wider ripple effect of that knowledge.
>
> *GP*

This may mean that other GPs in the practice find it easier to keep up-to-date with developments that relate to a specific groups of conditions for example. One GP noted that this type of peer-to-peer learning is particularly effective. GPs are better than visiting consultants at pitching things at the right level for their colleagues, meaning that they guidance they provide is more likely to be implemented.

As we noted in Chapter 4 this sharing of best practice and learning from clinical colleagues cannot operate within a single-handed practice. GPs we engaged with felt that this was a massive disadvantage overall and that GPSI's accentuated this.

In addition, some GPs felt that GPSI's can help to reduce a practice's rate of admissions by acting as an internal referral mechanism which reduces reliance on secondary care. Interestingly we do not find any significant links between our GPSI metrics and secondary case usage at the practice level. This could be because the link is only evident for certain specialisms.

Most GPs we engaged with suggested that GPSI are able to develop portfolio careers which are increasingly attractive to clinicians. There were a number of issues identified however. Firstly, some GPs felt that early career GPs were taking on GPSI roles too soon before they had developed a solid foundation within a standard primary care setting. Secondly, other GPs felt that the system of GPSI administration could be improved. They told us that there can be a lack of clarity

as to what is counted as a special interest and that the accreditation procedures are somewhat variable.

Implications

Our analysis revealed some promising links between development of specialist skills within a primary care setting and patient outcomes. The RCGP framework to support the governance of General Practitioners with Extended Roles which was published in 2018 could help with accreditation issues which some GPs highlighted in our interviews.[41] To further encourage development of special interests there may also be value in ensuring that GP in the middle of their career can develop a niche of expertise as well as those who recently qualified.

In addition, our subsequent clinical engagement suggested that there would be further value in future research examining the impact of specific GPSI specialisms.

5.2.3 CCG management

Results

In Figure 36 below we illustrate the effect of participation in CCG management on patient outcomes according to our multivariate regression analysis. As stated above CCG fixed effects are included in all regression analysis which implies that we are comparing the relative performance of practices in the same area rather than drawing out differences between areas.

Practices which have a representative on the board of their local CCG perform slightly better than other practices in terms of admissions and attendances. However these results are only at a marginal level of significance. In addition, this group of practices performed worse in terms of cancer TWW referral rates.

Figure 36 Effect of CCG management on patient outcomes

	ACSC Admissions	Chronic ACSC Admissions	A&E Attendance	Cancer TWW detection	Cancer TWW conversion	Cancer TWW referral	Patient satisfaction	CQC rating	Composite indicator
Has GP on CCG	✓	✓				✗			

Source: *Frontier analysis*

Note: *Coefficient values are presented in Annex A.*

Some GPs who we interviewed expressed some surprise that our quantitative analysis did not identify statistically significant effects in the hypothesised direction. They felt that on average clinicians who sit on CCG boards need to have a certain degree of clinical credibility with other GPs and therefore tend to come from higher quality practices on average.

[41] https://www.rcgp.org.uk/-/media/Files/CIRC/GPwSI/RCGP-framework-to-support-the-governance-of-GPwERs-2018.ashx?la=en

Apart from high quality GPs self-selecting into CCG roles we were also told that taking part in the management of a local health economy can have indirect benefits for a GPs own practice.

Several GPs spoke about how taking part in their local CCG had increased their awareness of local trends. Other GPs emphasised how participating in their CCG meant that they were aware of other local services in a greater level of depth. As a result they were more comfortable referring some of their patients to these other parts of the system.

> Doing work on behalf for CCG's raises your awareness of new important themes across the local area. You might then be able to get incorporate some of these systemwide trends into your practice.
>
> *GP*

Some GPs did note that the benefits described above which may arise from engagement with their local CCG may take a relatively long time to emerge (as opposed to prescribing appropriate medicines for example) and as a result our cross-sectional analysis may not have picked them up.

On the other hand some GPs did also note that there are definite drawbacks from participating in CCG management which could potentially reduce the magnitude of any net benefit to patients. As we described in Section 2.2.2 several previous studies (for example Robertson et al., 2014 and Holder et al., 2015) found that clinicians who took part in the management of their CCG experienced significant pressures on their time and capacity. Some of the GPs we interviewed expressed similar views. Specifically, they noted that their attention can be divided between CCG work and patient work and balancing the two roles can at times be a bit of a distraction. Other GPs felt that they were able to balance both roles effectively and could flexibly switch between patient work and CCG tasks without any negative impacts.

> My attention is often divided between CCG management and clinical practice. Sometimes I do find myself on my lunch break answering emails. This can be a bit of a distraction.
>
> *GP*

In general, there was a high degree of support for the objective to get clinicians more involved in the management of healthcare systems, provided that the input clinicians give is valued and acted upon. Some GPs did question whether this clinical input would continue to occur via CCGs. Specifically, Primary Care Networks were put forward as a potential alternative vehicle in the future which might seem like a more natural fit for some GPs.

Some GPs did note that there is a high degree of variation in terms of how different CCGs operate and the extent to which clinical GPs input is incorporated into decision making. This is consistent with previous research which found that the governance arrangements that were being put in place varied significantly from one group to another (Naylor et al., 2013). The authors also concluded that GP engagement was variable from one CCG to another.

> Anecdotally my understanding is that there is a lot of local variation in terms of how CCGs operate. Some GPs have fantastic experiences others struggle a bit more.
> *GP*

We were told that taking part formally in CCG management was not a goal for the majority of GPs. This is primarily driven by personal preferences and depends on what individuals want to get out of their careers. However, some GPs with experience working on CCG boards did note that some structural features can put off certain clinicians. Specifically, we were told that decision making and getting new initiatives signed-off can be very slow which in turn can cause frustration and disillusionment. In addition, some GPs noted that CCGs have a wide ranging remit which covers a lot of a local system. However, local budgets may be divided into specific pots which means that collaborative work is difficult and implementing new ideas can be hard.

Finally, GPs did acknowledge that smaller practices may struggle more than larger practices to free people up to work on CCG's, which is consistent with our quantitative analysis. However, some GPs pointed out that this was intertwined with the philosophical outlook of GPs who work in smaller practices, which means in some cases they may be less inclined to take part in CCG management anyway.

Implications

Our quantitative analysis found that in general practices which have a representative on the board of their local CCG perform at a similar level to other practices. Our qualitative engagement did note several routes by which formal CCG participation could lead to enhanced clinical outcomes but noted that these transmission mechanisms may take time to develop.

5.2.4 Composite quality measures

As we would expect both QOF scores and NHS Choices management variables are associated with better a range of better outcomes across the different indicators.

These findings are reassuring, given that these indicators are well established, with detailed clinical basis. It is also consistent with existing literature. For example, Dusheiko et al. (2011 A) found that GPs' quality of stroke care improved 10% between 2004-05 and 2007-08 and this was related associated with lower emergency admission rates and outpatient visits, reducing hospital expenditure by £130m within England.

Figure 37 Effect of composite quality measures on patient outcomes

	ACSC Admissions	Chronic ACSC Admissions	A&E Attendance	Cancer TWW detection	Cancer TWW conversion	Cancer TWW referral	Patient satisfaction	CQC rating	Composite indicator
NHS Choices quality indicators (PCA)	✓ ✓	✓ ✓ ✓			✓ ✓	✗ ✗	✓ ✓ ✓		✓ ✓ ✓
QOF points	✓ ✓	✓ ✓					✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓

Source: *Frontier analysis*

Note: *Coefficient values are presented in Annex A.*

In a separate study covering 2001-02 to 2006-07 Dusheiko et al. (2011 B) found that the quality of diabetic management within primary care was significantly related to subsequent emergency admission rates. Practices with 1% more patients with moderate rather than poor glycaemic control had on average 1.9% lower rates of emergency admission for acute hyperglycaemic complications.[42]

5.3 Discussion

Limitations

There is likely to be considerable heterogeneity across practices that is not fully addressed by the variables contained in the model. In particular, it is likely that many drivers of demand are not fully captured in the prevalence, deprivation or demographic controls. This is because there may be delays in updating patient lists, the data may be inaccurate, and in any case two patients with the same condition might have very different levels of severity and need for treatment.

In addition there are many other aspects of the local level that we cannot fully control for, most notably relating to the provision and administration of secondary care, or the wider tertiary care system. For example:

- There may be differences in how NHS trusts code A&E data. We understand that in some cases, trusts refer emergency admissions through A&E. In other cases, CCGs may have local measures in place to 'deflect' patients away from A&E, e.g. with walk-in centre or out-of-hours GP services that have the look and feel of A&E, though these would not be counted as such in the statistics. As such, the same demand for secondary care might give rise to different admission or attendance rates in different areas.
- NHS trusts that are capacity constrained may discourage doctors from making many TWW referrals, as they do not have the infrastructure to cope.

[42] We also ran the model, but excluding the QOF and Transparency Indicators variables. These already provide some measure of GP quality and are correlated with the activeness variables. They could be seen as 'intermediate' outcome or 'mediating' variables: GP activeness improves QOF achievement which improves observed outcomes. If so, the full effect of the activeness variables includes both a direct effect and an indirect effect via these variables. Excluding them should give the full effect, rather than just the indirect effect. As shown in the Annex, the effects are moderately larger when this change is made.

- Different local populations may have different expectations for quality of care and therefore result in different levels of satisfaction.

We controlled for this unobservable heterogeneity as far as possible using CCG-level fixed effects. These are dummy variables that absorb all variation at CCG level. When these are used, any remaining effects assigned to the control variables are entirely driven by intra-CCG variation.

Conclusion

Our analysis shows how activeness measures such as adherence to prescription guidelines and deploying new technology can, in certain circumstances, lead to higher quality care and better patient outcomes. This highlights the importance of practices continuing to evolve in order to best serve their patients.

However, larger number of GP practices are not engaging in these beneficial behaviours. Our qualitative research revealed that the single biggest barrier to increased activeness was GPs inability to think strategically about long term quality improvement mechanisms due to the ongoing strain of day-to-day clinical workload. These pressures are likely to be especially severe for certain types of practices but operate to a certain extent across all practices. This serve to re-emphasise the importance of addressing current workforce shortages.

It is possible that the recent introduction of Primary Care Networks (PCNs) will help to address current pressures. PCNs include funding for the employment of additional health professionals such as pharmacists and paramedics. However, GPs told us that the act of creating these networks requires time and energy and managing the expanded workforce could actually reduce the amount of GP time available for direct patient-facing activity in some cases.

This work has helped to characterise GP performance in a much more complete manner to that which existing previously. Doing so has revealed that there are aspects of patient outcomes that, in some conditions, are improved by the engagement of GPs with up to-date practices – whether in areas of new technology or prescribing. There are other GP activities – particularly participation in commissioning – which do not appear to improve outcomes for their patients.

6 REFERENCES

Baird, B., Charles, A., Honeyman, M., Maguire, D. and Das, P., 2016. Understanding pressures in general practice. The King's Fund. https://www.kingsfund.org.uk/sites/default/files/field/field_publication_file/Understanding-GP-pressures-Kings-Fund-May-2016.pdf

Bardsley, M., Steventon, A. and Doll, H., 2013. Impact of telehealth on general practice contacts: findings from the whole systems demonstrator cluster randomised trial BMC Health Services Research 13:395

Bowling, A. and Bond, M., 2001. A national evaluation of specialists' clinics in primary care settings British Journal of General Practice 51:264-269

British Medical Association & NHS England, 2019. Investment and evolution: a five-year framework for GP contract reform to implement The NHS long term plan https://www.england.nhs.uk/wp-content/uploads/2019/01/gp-contract-2019.pdf

Bunn, F., Byrne, G. and Kendall, S., 2005. The effects of telephone consultation and triage on healthcare use and patient satisfaction: a systematic review British Journal of General Practice 55:956-961

Castle-Clarke, S., 2018. What will new technology mean for the NHS and its patients? The Health Foundation, Institute for Fiscal Studies, The King's Fund, Nuffield Trust. https://www.kingsfund.org.uk/sites/default/files/2018-06/NHS_at_70_what_will_new_technology_mean_for_the_NHS_0.pdf

Coast, J., Noble, S., Noble, A., Horrocks, S., Asim, O., Peters, T.J. and Salisbury, C., 2005. Economic evaluation of a general practitioner with special interest led dermatology service in primary care British Medical Journal 331:1444

Denver, E., Woolfson, R., Barnard, M. and Earle, K. (2003) Management of Uncontrolled Hypertension in a Nurse-Led Clinic compared with Conventional Care for Patients with Type Diabetes Diabetes Care 26:2236-2260.

Department of Health, 2000. The NHS Plan: A plan for investment. A plan for reform http://1nj5ms2lli5hdggbe3mm7ms5.wpengine.netdna-cdn.com/files/2010/03/pnsuk1.pdf)

Department of Health, 2006. Briefing Paper: An assessment of the clinical effectiveness, cost and viability of NHS General Practitioners with Special Interest (GPSI) services http://www.nets.nihr.ac.uk/__data/assets/pdf_file/0005/81266/BP-08-1210-035.pdf

Department of Health & Social Care, 2018. The future of healthcare: our vision for digital, data and technology in health and care https://www.gov.uk/government/publications/the-future-of-healthcare-our-vision-for-digital-data-and-technology-in-health-and-care/the-future-of-healthcare-our-vision-for-digital-data-and-technology-in-health-and-care

Dusheiko, M., Gravelle, H., Martin, S., Rice, N. and Smith, P.C., 2011 A. Does Better Disease Management in Primary Care Reduce Hospital Costs The University of York Centre for Health Economics CHE Research Paper 65

Dusheiko, M., Doran, T., Gravelle, H., Fullwood C. and Roland M., 2011 B. Does Higher Quality of Diabetes Management in Family Practice reduce Unplanned Hospital Admissions? Health Services Research 46(1): 27-46

Duerden, M., Millson, D., Avery, A. and Smart, S., 2011. The quality of GP prescribing: An Inquiry into the Quality of General Practice in England The King's Fund http://www.kingsfund.org.uk/sites/files/kf/field/field_document/quality-gp-prescribing-gp-inquiry-research-paper-mar11.pdf

Fisher, R., Thorlby, R. and Alderwick, H., 2019. Briefing: Understanding primary care networks. https://www.health.org.uk/sites/default/files/upload/publications/2019/Understanding%20primary%20care%20networks.pdf

Goodwin, N., Dixon, A., Poole, T. and Raleigh, V., 2011. Improving the Quality of Care in General Practice: Report of an independent inquiry commissioned by the King's Fund http://www.kingsfund.org.uk/sites/files/kf/improving-quality-of-care-general-practice-independent-inquiry-report-kings-fund-march-2011_0.pdf

Harris, D.I. and Cracknell, P., 2005. Improving diabetes care in general practice using a nurse-led, GP supported clinic: a cohort study Practical Diabetes International 22(8):295-301

Health Education England, 2017. Facing the facts, shaping the future: a draft health and care workforce strategy for England to 2027 https://www.hee.nhs.uk/sites/default/files/documents/Facing%20the%20Facts,%20Shaping%20the%20Future%20%E2%80%93%20a%20draft%20health%20and%20care%20workforce%20strategy%20for%20England%20to%202027.pdf

Holder, H., Robertson, R., Ross, S., Bennett, L., Gosling, J. and Curry, N., 2015. Risk or reward? The changing role of CCGs in general practice The King's Fund http://www.kingsfund.org.uk/sites/files/kf/field/field_publication_file/risk-or-reward-the-changing-role-of-CCGs-in-general-practice.pdf

Holder, H., Robertson, R., Naylor, C., Ross, S. and Machaquerio, 2016. Has clinical commissioning found its voice? GP perspectives on their CCGs The King's Fund (http://www.kingsfund.org.uk/sites/files/kf/media/ccg-survey-kingsfund-nuffieldtrust-apr16.pdf)

Jacoby, A., Smith, M. and Eccles, M., 2003. A qualitative study to explore influences on general practitioners' decisions to prescribe new drugs British Journal of General Practice 53: 120-125

Kelly, E. and Stoye, G., 2014. Does GP practice size matter? GP practice size and the quality of primary care (No. R101). IFS Report. https://www.ifs.org.uk/publications/7450

MacNeill, V., Sanders, C., Fitzpatrick, R., Hendy, J., Barlow, J., Knapp, M., Rogers, A., Bardsley, M. and Newman S.P., 2014. British Journal of General Practice 64(624):e401-e407

Ministry of Housing, Communities & Local Government, 2015. English indices of deprivation 2015.
https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015

Ministry of Housing, Communities & Local Government, 2019. English indices of deprivation 2019.
https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019

NHS England, 2016. General Practice Forward View.
https://www.england.nhs.uk/wp-content/uploads/2016/04/gpfv.pdf

NHS England, 2019. Long Term Plan.
https://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf

NHS Improvement, 2019. Interim NHS People Plan.
https://improvement.nhs.uk/resources/interim-nhs-people-plan/

Nocon, A., Rhodes, P.J., Wright, J.P., Eastham, J., Williams, D.R.R., Harrison, S. R. and Young, R. J., 2004. Specialist general practitioners and diabetes clinics in primary care: a qualitative and descriptive evaluation. Diabetic Medicine 21:32–38

Prosser, H. and Walley, T., 2003. New drug uptake: qualitative comparison of high and low prescribing GPs' attitudes and approach Family Practice 20(5): 583-591

Prosser, H., Almond, S. and Walley, T., 2003. Influences on GPs' decision to prescribe new drugs – the importance of who says what Family Practice 20(1): 61-68

Robertson, R., Holder, H., Bennett, L., Ross, S. and Gosling, J., 2014. CCGs one year on: member engagement and primary care development The King's Fund
http://www.kingsfund.org.uk/sites/files/kf/media/clinical-commissioning-groups-one-year-on.pdf

Royal College of General Practitioners, 2018. RCGP framework to support the governance of General Practitioners with Extended Roles
https://www.rcgp.org.uk/-/media/Files/CIRC/GPwSI/RCGP-framework-to-support-the-governance-of-GPwERs-2018.ashx?la=en

Saxena, S., George, J., Barber, J., Fitzpatrick, J. and Majeed, A., 2006. Association of population and practice factors with potentially avoidable admission rates for chronic diseases in London: cross sectional analysis Journal of the Royal Society of Medicine 99:81-89

Steventon, A., Bardsley, M., Billings, J., Dixon, J., Doll, H., Hirani, S., Cartwright, M., Rixon, L., Knapp, M., Henderson, C., Rogers, A., Fitzpatrick, R., Hendy, J. (2012) Effect of telehealth on use of secondary care and mortality: findings from the Whole system Demonstrator cluster randomised trial British Medical Journal 344

Thompson, D., Roebuck, A. and Stuart, S., 2005. Effects of a nurse-led, clinic and home-based intervention on recurrent hospital use in chronic heart failure The European Journal of Heart Failure 7:377-384

Ward, P.R., Noyce, P.R., and St Leger, A.S., 2004. Are GP practice prescribing rates for coronary heart disease drugs equitable? A cross sectional analysis in four

primary care trusts in England Journal of Epidemiology & Community Health 58:89-96

Ware, J. and Mawby, R. (2015) Patient Access to general practice: ideas and challenges from the front line Royal College of General Practitioners http://www.rcgp.org.uk/policy/~/media/Files/Policy/A-Z-policy/Patient-access-to-general-practice-2015.ashx

ANNEX A ECONOMETRIC RESULTS

A.1 Detailed regression results

The following tables show full regression result tables. All models are estimated using OLS in Stata 15.0.

Each column corresponds to a different dependent variable. The rows correspond to control variables. For each control variable there are two rows. The upper row shows the regression coefficient. The lower row show the p-value. The models also include a large number of CCG fixed effects, which are not shown for brevity. Standard errors are clustered by CCG.

For certain groups of variables, a subset of practices have missing data. Excluding these observations would result in losing nearly a quarter of the sample. We therefore adopted a 'zero dummy' approach, where these observations were retained, missing values set to zero and a dummy variable added to prevent them affecting the coefficient for that variable in question. On a conceptual level, it is also desirable to retain these observations, as having missing data may also be correlated whether a practice is active.

Figure 38 Regression results – main specification

	Log ACSC admissions per weighted patient	Log chronic ACSC admissions per weighted patient	Log A&E attendances per weighted patient	TWW detection rate	TWW conversion rate	TWW usage	Patient satisfaction	CQC rating good	Composite indicator
Missing workforce dummy	0.030	0.031	0.022	0.304	-0.261	234.5	-0.019	-0.036	-0.303
	0.00	0.00	0.00	0.29	0.01	0.10	0.00	0.00	0.00
Missing survery hours dummy	0.013	0.001	0.006	0.681	0.154	-212.5	-0.010	-0.026	-0.103
	0.20	0.94	0.57	0.09	0.32	0.37	0.04	0.13	0.10
Missing clinic data	0.048	0.079	0.052	0.909	-0.485	939.6	-0.005	0.004	-0.026
	0.08	0.03	0.02	0.40	0.17	0.02	0.63	0.92	0.89
Missing NHS Transparency Indicators	-0.013	-0.045	0.008	-0.090	-0.449	-309.2	-0.008	-0.032	-0.218
	0.56	0.10	0.57	0.93	0.17	0.40	0.31	0.34	0.11
Log of list size (weighted)	-0.010	-0.017	-0.007	1.355	-0.563	132.5	-0.044	0.015	-0.339
	0.26	0.13	0.44	0.00	0.00	0.38	0.00	0.12	0.00
Patient weight	-0.485	-0.289	-0.821	7.214	5.087	9050.2	0.237	0.062	3.086
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00
Prevalence rates (PCA)	0.081	0.128	0.035	-0.011	0.119	705.7	-0.007	-0.004	-0.152
	0.00	0.00	0.00	0.92	0.00	0.00	0.00	0.18	0.00
Index of multiple deprivation	0.009	0.011	0.009	-0.093	-0.024	-96.9	-0.003	-0.001	-0.040
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
% patients > 85	5.729	5.155	0.643	32.679	35.508	76266.8	-0.494	-0.650	-7.077
	0.00	0.00	0.22	0.01	0.00	0.00	0.00	0.20	0.00
% patients 0-4	2.251	0.650	2.109	14.987	-11.550	-33871.2	-0.060	-0.208	-5.133
	0.00	0.07	0.00	0.11	0.00	0.00	0.51	0.44	0.00
Rural dummy	0.073	0.071	0.071	0.382	0.195	289.5	0.006	-0.009	-0.060
	0.00	0.00	0.00	0.27	0.13	0.11	0.10	0.37	0.22
GP headcount	0.006	0.007	0.000	0.046	0.004	145.4	0.003	0.000	0.024
	0.00	0.00	0.83	0.29	0.80	0.00	0.00	0.85	0.00
Market concentration	-0.002	0.000	-0.009	0.029	0.018	219.6	-0.004	-0.005	-0.038
	0.57	0.95	0.01	0.78	0.60	0.00	0.00	0.19	0.01

PMS contract	0.006	-0.001	0.014	0.118	-0.272	91.8	0.002	0.016	0.043
	0.42	0.95	0.08	0.59	0.00	0.48	0.52	0.03	0.23
PMS to GMS transition	-0.011	-0.016	-0.005	-0.265	0.100	-463.9	0.000	0.012	0.048
	0.10	0.09	0.52	0.32	0.28	0.00	0.95	0.17	0.24
% GPs female	-0.013	-0.019	-0.019	1.863	-0.246	1075.0	-0.003	0.037	0.050
	0.21	0.17	0.03	0.00	0.09	0.00	0.48	0.01	0.42
% GPs <35	0.015	0.014	0.013	-0.082	-0.237	319.6	0.001	-0.020	-0.057
	0.34	0.51	0.28	0.88	0.22	0.32	0.84	0.37	0.49
% GPs >=50	-0.049	-0.048	-0.015	-1.404	1.027	-1479.5	0.005	-0.050	0.036
	0.00	0.00	0.08	0.00	0.00	0.00	0.17	0.00	0.46
% GPs UK	-0.024	-0.035	-0.037	2.247	-0.579	1453.6	0.042	0.056	0.487
	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FTEs per headcount	-0.036	-0.034	-0.024	-0.786	0.379	-0.4	0.003	-0.022	0.040
	0.01	0.04	0.05	0.15	0.04	1.00	0.58	0.25	0.62
Patients per FTE	0.000	0.000	0.000	0.000	0.000	0.0	0.000	0.000	0.000
	0.95	0.80	0.07	0.04	0.33	0.43	0.00	0.11	0.03
% GPs locum	-0.009	-0.002	0.031	-0.324	-0.091	-227.1	-0.043	-0.016	-0.378
	0.60	0.94	0.07	0.65	0.73	0.53	0.00	0.63	0.00
% GPs registrar	0.058	0.051	-0.014	1.704	-0.598	727.6	0.052	0.016	0.273
	0.03	0.15	0.59	0.07	0.05	0.18	0.00	0.54	0.06
% GPs salaried	0.039	0.040	0.030	0.928	-0.523	724.9	-0.019	-0.028	-0.305
	0.00	0.01	0.01	0.03	0.00	0.00	0.00	0.07	0.00
Dispening practice	-0.052	-0.055	-0.031	0.525	-0.077	-133.6	0.012	0.009	0.170
	0.00	0.00	0.01	0.03	0.37	0.42	0.00	0.23	0.00
Has GP on CCG	-0.008	-0.011	-0.002	0.084	0.035	-226.7	0.003	0.002	0.037
	0.08	0.10	0.65	0.65	0.53	0.03	0.19	0.73	0.16
Number of specialty clinics (PCA)	0.000	0.000	0.000	0.012	0.006	-7.7	0.001	0.003	0.012
	0.59	0.79	0.94	0.70	0.57	0.67	0.08	0.02	0.02
Surgery opening hours	0.000	0.000	0.000	0.010	-0.002	3.6	0.000	0.000	-0.002
	0.00	0.03	0.02	0.03	0.20	0.17	0.26	0.06	0.01
NHS Choices quality indicators (PCA)	-0.006	-0.009	-0.004	0.107	0.033	-66.5	0.004	0.001	0.047
	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.65	0.00
QOF points	0.000	0.000	0.000	0.005	-0.002	-1.8	0.000	0.001	0.005
	0.00	0.00	0.41	0.13	0.25	0.40	0.00	0.00	0.00
Prescribing - new drugs % of total	2.822	2.879	0.969	75.510	10.950	22234.5	0.999	0.773	8.255
	0.10	0.11	0.41	0.06	0.45	0.28	0.01	0.55	0.14
Prescribing - Obsolete drugs % of total	-8.959	-6.813	-3.819	-280.317	111.209	-213616.9	-0.889	0.349	0.595
	0.00	0.00	0.01	0.01	0.00	0.00	0.18	0.90	0.95
Prescribing - QIPP / MO-KTT adherence	-0.057	-0.057	-0.037	2.589	-0.263	820.6	-0.007	0.033	0.113
	0.00	0.00	0.01	0.00	0.12	0.00	0.11	0.06	0.09
Early adopter of online booking / presription	-0.004	-0.005	-0.001	0.046	-0.021	24.7	0.000	-0.002	0.002
	0.00	0.01	0.24	0.34	0.19	0.33	0.93	0.22	0.80
Constant	-4.178	-4.909	-1.295	32.839	16.725	11639.0	1.190	0.168	2.175
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.00
N	7248	7248	7248	7234	7234	7234	7286	6622	6608
R-squared	0.67	0.63	0.76	0.43	0.43	0.51	0.40	0.12	0.45

As the survey sample size is much smaller than the GP practice population used elsewhere, it is not possible to use as many control variables within the regression. Model 1 includes the bare minimum control variables, while model 2 adds in some workforce variables as controls.

Figure 39 Regression results – survey model

	Log ACSC admissions per weighted patient	Log A&E attendances per weighted patient	TWW detection rate	TWW conversion rate	TWW usage	Patient satisfaction	CQC rating good	Composite indicator
Model 1								
Log of list size (weighted)	0.077	-0.071	2.578	-0.448	1797.205	-0.014	0.041	-0.114
	0.00	0.00	0.00	0.16	0.00	0.05	0.02	0.28
Index of multiple deprivation	0.013	0.013	-0.120	-0.021	-66.871	-0.002	-0.002	-0.047
	0.00	0.00	0.00	0.17	0.00	0.00	0.14	0.00
Use teleconsultation	-0.031	-0.006	2.256	0.156	-213.145	0.022	0.022	0.335
	0.33	0.86	0.01	0.65	0.71	0.02	0.25	0.01
Use mobile apps	0.023	0.008	1.996	-0.142	306.517	-0.007	-0.043	-0.131
	0.37	0.81	0.01	0.67	0.53	0.44	0.12	0.32
Total GPSIs	-0.006	0.006	-0.242	0.022	-61.821	0.002	0.009	0.044
	0.27	0.33	0.11	0.77	0.55	0.34	0.03	0.06
Constant	-4.975	-0.496	25.633	13.833	-2778.422	1.040	0.562	2.188
	0.00	0.04	0.00	0.00	0.46	0.00	0.00	0.03
N	457	457	453	453	453	459	419	417
R-squared	0.25	0.23	0.11	0.01	0.08	0.08	0.05	0.19
Model 2								
Log of list size (weighted)	0.087	-0.077	2.266	0.048	1389.165	-0.031	0.030	-0.242
	0.00	0.00	0.00	0.87	0.00	0.00	0.17	0.03
Index of multiple deprivation	0.011	0.009	-0.105	-0.013	-20.809	-0.001	-0.001	-0.031
	0.00	0.00	0.00	0.37	0.33	0.01	0.67	0.00
Use teleconsultation	-0.027	0.003	2.338	0.021	-199.719	0.020	0.021	0.294
	0.39	0.93	0.01	0.95	0.72	0.03	0.25	0.02
Use mobile apps	0.024	0.006	1.938	-0.087	277.928	-0.009	-0.044	-0.150
	0.34	0.86	0.01	0.78	0.55	0.29	0.11	0.22
Total GPSIs	-0.007	0.003	-0.251	0.062	-64.535	0.002	0.009	0.058
	0.16	0.59	0.10	0.40	0.52	0.10	0.03	0.01
PMS contract	0.005	0.029	-0.464	-0.402	-343.692	-0.018	-0.041	-0.254
	0.84	0.27	0.53	0.15	0.45	0.03	0.09	0.03
Rural dummy	0.071	0.220	-0.174	-1.332	-2499.708	-0.038	-0.036	-0.575
	0.01	0.00	0.84	0.00	0.00	0.00	0.02	0.00
% GPs female	-0.095	-0.013	-0.629	-1.495	29.900	-0.012	0.069	0.150
	0.06	0.83	0.70	0.01	0.97	0.45	0.16	0.55
% GPs <35	0.149	0.170	-3.023	-0.351	-732.299	0.010	-0.039	-0.451
	0.05	0.04	0.13	0.70	0.60	0.64	0.59	0.18
% GPs >=50	-0.069	-0.057	-2.552	1.971	-2489.279	-0.006	-0.036	0.154
	0.17	0.33	0.09	0.00	0.01	0.66	0.41	0.48
% GPs UK	-0.142	-0.126	1.068	-0.193	1312.479	0.095	0.028	1.051
	0.00	0.00	0.40	0.67	0.10	0.00	0.58	0.00
Constant	-4.998	-0.657	29.867	11.233	5027.771	1.190	0.692	3.337
	0.00	0.01	0.00	0.00	0.17	0.00	0.00	0.00
N	457	457	453	453	453	459	419	417
R-squared	0.31	0.34	0.12	0.10	0.16	0.27	0.08	0.32

Figure 40 Regression results – effect on GP behaviours

	Has GP on CCG	Number of specialty clinics (PCA)	Surgery opening hours	Prescribing - new drugs % of total	Prescribing - Obsolete drugs % of total	Prescribing - QIPP / MO-KTT adherence (average of Z-scores)	Early adopter of online booking / presription services	NHS Choices quality indicators (PCA)	QOF points
Missing workforce dummy	-0.005	-0.143	2.190	0.000	0.000	0.0	0.030	-7.161	-0.087
	0.72	0.11	0.00	0.20	0.08	0.05	0.69	0.00	0.34
Missing survery hours dummy	-0.001	-0.780	-30.041	0.000	0.000	0.0	-0.013	-0.198	0.112
	0.98	0.00	0.00	0.79	0.62	0.58	0.88	0.88	0.37
Missing clinic data	-0.007	1.077	-0.685	0.001	-0.001	0.0	0.171	24.127	-0.359
	0.85	0.00	0.63	0.11	0.07	0.40	0.34	0.00	0.03
Missing NHS Transparency Indicators	-0.028	-0.377	0.660	0.000	0.000	0.0	-0.021	-27.106	0.292
	0.32	0.04	0.62	0.08	0.16	0.37	0.87	0.00	0.02
Log of list size (weighted)	0.038	0.285	6.741	0.000	0.000	0.0	0.164	5.656	-0.617
	0.00	0.00	0.00	0.07	0.02	0.10	0.01	0.00	0.00
Patient weight	0.010	0.759	-9.177	0.002	-0.002	-0.2	-0.313	4.688	0.377
	0.92	0.24	0.07	0.00	0.03	0.01	0.52	0.58	0.58
Prevalence rates (PCA)	0.008	-0.013	-0.318	0.000	0.000	0.0	-0.035	5.406	0.202
	0.05	0.64	0.09	0.00	0.58	0.02	0.08	0.00	0.00
Index of multiple deprivation	-0.001	-0.002	0.018	0.000	0.000	0.0	-0.002	-0.559	-0.032
	0.06	0.64	0.67	0.00	0.21	0.00	0.67	0.00	0.00
% patients > 75	-0.164	-2.942	15.434	-0.015	0.006	-0.1	-0.237	-130.386	-7.699
	0.59	0.17	0.28	0.00	0.00	0.75	0.87	0.00	0.00
Rural dummy	0.000	-0.228	2.749	0.000	0.000	0.0	0.005	-0.839	0.066
	0.99	0.10	0.00	0.00	0.06	0.07	0.96	0.60	0.58
GP headcount	0.024	0.034	-0.112	0.000	0.000	0.0	0.020	0.053	0.046
	0.00	0.09	0.31	0.96	0.68	0.05	0.12	0.77	0.00
Market concentration	0.005	-0.008	-0.098	0.000	0.000	0.0	0.023	0.351	0.044
	0.29	0.81	0.70	0.00	0.02	0.49	0.37	0.32	0.14
PMS contract	0.026	0.254	2.439	0.000	0.000	0.0	0.090	1.090	0.076
	0.04	0.00	0.00	0.32	0.00	0.01	0.08	0.26	0.32
PMS to GMS transition	0.017	0.212	1.605	0.000	0.000	0.0	0.126	1.444	-0.027
	0.27	0.06	0.02	0.15	0.17	0.02	0.08	0.22	0.79
% GPs female	0.002	-0.110	1.353	0.000	0.000	0.0	-0.088	7.649	0.438
	0.88	0.34	0.10	0.25	0.00	0.00	0.30	0.00	0.00
% GPs <35	0.037	-0.053	-1.437	0.000	0.000	0.0	0.270	1.405	0.264
	0.20	0.78	0.18	0.23	0.05	0.01	0.05	0.54	0.13
% GPs >=50	0.019	-0.503	-1.740	0.000	0.000	-0.1	-0.122	-7.581	-0.322
	0.24	0.00	0.02	0.02	0.00	0.00	0.09	0.00	0.00
% GPs UK	0.060	-0.160	1.004	0.000	0.000	0.0	0.200	4.194	0.074
	0.00	0.12	0.15	0.01	0.00	0.69	0.00	0.00	0.52
FTEs per headcount	-0.068	-0.147	-0.477	0.000	0.000	0.0	-0.020	-3.085	0.109
	0.00	0.36	0.62	0.42	0.20	0.84	0.84	0.10	0.52
Patients per FTE	0.000	0.000	0.000	0.000	0.000	0.0	0.000	0.000	0.000
	0.06	0.63	0.59	0.31	0.57	0.28	0.06	0.08	0.72
% GPs locum	-0.041	0.119	1.736	0.000	0.000	0.0	-0.215	-7.030	0.006
	0.18	0.56	0.24	0.07	0.86	0.43	0.08	0.02	0.98
% GPs registrar	-0.001	0.180	0.975	0.000	-0.001	0.0	0.264	3.404	0.548
	0.99	0.61	0.68	0.87	0.00	0.19	0.31	0.19	0.05
% GPs salaried	-0.014	0.056	3.882	0.000	0.000	0.0	0.005	-6.849	-0.280
	0.49	0.67	0.00	0.43	0.02	0.06	0.95	0.00	0.02
Dispening practice	-0.020	-0.109	-2.627	-0.001	0.000	0.0	0.017	2.292	0.157
	0.20	0.38	0.00	0.00	0.38	0.00	0.83	0.13	0.09
Constant	-0.358	-1.003	-42.661	0.004	0.004	0.2	-1.655	493.903	5.042
	0.01	0.16	0.00	0.00	0.00	0.04	0.01	0.00	0.00
N	7286	7286	7286	7286	7286	7286	7286	7286	7286
R-squared	0.16	0.11	0.34	0.38	0.18	0.31	0.07	0.32	0.16

Figure 41 Regression results – model omitting QOF and NHS Choices Transparency Indicators as control variables

	Log ACSC admissions per weighted patient	Log chronic ACSC admissions per weighted patient	Log A&E attendances per weighted patient	TWW detection rate	TWW conversion rate	TWW usage	Patient CQC rating good	Composite indicator
Missing workforce dummy	0.033	0.035	0.024	0.262	-0.251	249.9	-0.021	-0.042	-0.324
	0.00	0.00	0.00	0.36	0.01	0.08	0.00	0.00	0.00
Missing survery hours dummy	0.012	-0.001	0.005	0.705	0.155	-225.0	-0.009	-0.023	-0.089
	0.25	0.96	0.63	0.08	0.32	0.34	0.06	0.18	0.16
Missing clinic data	0.042	0.074	0.051	0.986	-0.541	928.8	-0.002	0.034	0.064
	0.11	0.04	0.01	0.37	0.13	0.02	0.85	0.44	0.72
Missing NHS Transparency Indicators	-0.005	-0.038	0.011	-0.198	-0.391	-285.4	-0.012	-0.069	-0.341
	0.82	0.16	0.41	0.84	0.23	0.43	0.11	0.04	0.01
Log of list size (weighted)	-0.008	-0.013	-0.005	1.309	-0.591	168.2	-0.046	0.017	-0.362
	0.35	0.23	0.54	0.00	0.00	0.25	0.00	0.07	0.00
Patient weight	-0.483	-0.287	-0.821	7.189	5.102	9055.2	0.237	0.054	3.045
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00
Prevalence rates (PCA)	0.079	0.124	0.033	0.032	0.116	686.2	-0.005	0.001	-0.122
	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.68	0.00
Index of multiple deprivation	0.009	0.011	0.009	-0.098	-0.024	-94.4	-0.003	-0.002	-0.043
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% patients > 85	5.864	5.329	0.721	30.494	35.383	77367.6	-0.586	-0.834	-8.265
	0.00	0.00	0.17	0.02	0.00	0.00	0.00	0.12	0.00
% patients 0-4	2.206	0.592	2.083	15.694	-11.471	-34245.2	-0.032	-0.158	-4.760
	0.00	0.09	0.00	0.10	0.00	0.00	0.73	0.58	0.00
Rural dummy	0.073	0.071	0.071	0.386	0.200	285.6	0.006	-0.010	-0.063
	0.00	0.00	0.00	0.26	0.12	0.12	0.10	0.31	0.20
GP headcount	0.006	0.007	0.000	0.050	0.005	143.1	0.003	0.001	0.026
	0.00	0.00	0.88	0.25	0.74	0.00	0.00	0.67	0.00
Market concentration	-0.002	-0.001	-0.009	0.033	0.019	217.1	-0.004	-0.004	-0.036
	0.52	0.88	0.01	0.75	0.59	0.00	0.00	0.23	0.02
PMS contract	0.006	-0.001	0.014	0.124	-0.273	89.3	0.002	0.017	0.046
	0.44	0.92	0.08	0.57	0.00	0.50	0.49	0.03	0.20
PMS to GMS transition	-0.011	-0.016	-0.005	-0.267	0.096	-460.9	0.000	0.014	0.053
	0.11	0.10	0.53	0.31	0.30	0.00	0.97	0.14	0.22
% GPs female	-0.018	-0.025	-0.022	1.942	-0.246	1037.2	0.000	0.047	0.101
	0.09	0.07	0.01	0.00	0.09	0.00	0.97	0.00	0.11
% GPs <35	0.013	0.011	0.012	-0.051	-0.231	302.0	0.002	-0.019	-0.045
	0.40	0.60	0.33	0.93	0.23	0.35	0.70	0.40	0.60
% GPs >=50	-0.046	-0.044	-0.013	-1.461	1.032	-1454.4	0.003	-0.058	-0.004
	0.00	0.00	0.13	0.00	0.00	0.00	0.47	0.00	0.94
% GPs UK	-0.025	-0.037	-0.038	2.272	-0.584	1443.9	0.043	0.061	0.510
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FTEs per headcount	-0.036	-0.034	-0.023	-0.783	0.388	-6.0	0.003	-0.025	0.033
	0.01	0.04	0.05	0.15	0.04	0.98	0.60	0.20	0.69
Patients per FTE	0.000	0.000	0.000	0.000	0.000	0.0	0.000	0.000	0.000
	0.83	0.71	0.06	0.04	0.32	0.47	0.00	0.10	0.03
% GPs locum	-0.007	0.001	0.032	-0.359	-0.078	-216.2	-0.045	-0.025	-0.405
	0.70	0.97	0.06	0.62	0.76	0.55	0.00	0.49	0.00
% GPs registrar	0.055	0.047	-0.016	1.763	-0.588	694.8	0.054	0.020	0.308
	0.04	0.19	0.53	0.06	0.05	0.20	0.00	0.44	0.03
% GPs salaried	0.043	0.045	0.032	0.861	-0.520	755.6	-0.022	-0.035	-0.340
	0.00	0.00	0.01	0.04	0.00	0.00	0.00	0.02	0.00
Dispening practice	-0.054	-0.058	-0.032	0.569	-0.076	-155.1	0.014	0.014	0.195
	0.00	0.00	0.01	0.02	0.38	0.35	0.00	0.07	0.00
Has GP on CCG	-0.011	-0.014	-0.003	0.122	0.041	-247.6	0.004	0.005	0.058
	0.03	0.03	0.44	0.52	0.47	0.02	0.05	0.46	0.03
Number of specialty clinics (PCA)	-0.001	-0.001	0.000	0.018	0.006	-10.8	0.001	0.003	0.015
	0.33	0.49	0.85	0.56	0.52	0.55	0.02	0.01	0.00
Surgery opening hours	0.000	0.000	0.000	0.010	-0.002	3.5	0.000	0.000	-0.001
	0.01	0.04	0.03	0.02	0.19	0.19	0.37	0.14	0.04
Prescribing - new drugs % of total	2.781	2.841	0.955	76.167	10.514	22125.1	1.024	0.934	8.753
	0.11	0.12	0.42	0.06	0.47	0.29	0.01	0.47	0.12
Prescribing - Obsolete drugs % of total	-8.193	-5.830	-3.380	-292.316	110.289	-207462.3	-1.377	-0.662	-6.678
	0.00	0.02	0.02	0.00	0.00	0.00	0.05	0.82	0.49
Prescribing - QIPP / MO-KTT adherence	-0.067	-0.070	-0.043	2.758	-0.248	733.3	0.000	0.047	0.211
	0.00	0.00	0.00	0.00	0.14	0.00	0.92	0.01	0.00
Early adopter of online booking / presription services	-0.005	-0.006	-0.002	0.055	-0.020	19.6	0.000	-0.001	0.008
	0.00	0.00	0.14	0.24	0.22	0.44	0.47	0.42	0.28
Constant	-4.394	-5.149	-1.396	36.065	16.055	10414.1	1.318	0.815	4.860
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	7248	7248	7248	7234	7234	7234	7286	6622	6608
R-squared	0.66	0.63	0.75	0.43	0.43	0.51	0.38	0.11	0.43

A.2 Model robustness checks

A.2.1 Variable selection

Given the range of datasets analysed, and the large number of variables under consideration, there are many potential variables to include. But it is not feasible to consider each of them separately, or indeed to include them all within the same regression. We therefore needed to reduce the number of variables in the regression down to a more manageable number, in order to be able to interpret the variable while holding others constant.

The initial model selection was informed by a general to specific (stepwise) regression approach to identify those that had little explanatory power. However, such an approach is likely to overfit models. For these reasons, we identified different conceptual fields of relevance and then for each of these whittled down to the variables with the strongest explanatory power and plausible relationships. This same set of variables was then applied to each of the outcomes in turn. Some of these will be statistically insignificant, but are nevertheless retained in order to maintain consistency across the different outcome variables.

A.2.2 Multicollinearity

The overall model selection approach is to identify, for each conceptual field of interest, a small number of variables with strong theoretical justification and explanatory power. This avoids having too many variables in the model and reduces the risk of multicollinearity affecting the estimates, as we purposefully avoid having many highly correlated variables.[43]

A more systematic measure of multicollinearity is provided by the Variance Inflation Factor (VIF). As a rule of thumb, a VIF in excess of 10 is considered problematic. As we use the same control variables across regressions for the different dependent variables, the VIF scores are largely[44] the same across regressions.

The VIFs are summarised below. Across the different dependent variables, we report the maximum, minimum and average VIF observed. The rows show this for the following categories of variables: local demographics/ health, GP workforce, activeness, CCG fixed effects (where applicable), and overall average. The first group of columns shows these results for the basic model, and the second set of columns shows results for the model with CCG dummies included.

[43] In cases where multiple variables appear relevant, but it is not obvious which can be excluded, we use principal component analysis to reduce the number of independent variables.

[44] They can differ slightly, to the extent that different dependent variables have different estimation samples.

Figure 42 Summary of Variance Inflation Factors

	Basic model			CCG dummies		
	Max	Min	Average	Max	Min	Average
Local health	3.6	1.8	3.0	6.0	2.4	4.3
Workforce	3.2	1.1	1.5	3.6	1.1	1.8
Activeness	1.6	1.0	1.2	2.0	1.1	1.4
CCG dummies	n/a	n/a	n/a	3.6	1.1	1.8
Average	3.6	1.0	1.8	6.0	1.1	1.9

Source: Frontier analysis

The key variables of interest are the activeness measures, which have a VIF ranging from 1.1 to 2.0 in the CCG dummy model. These are well below levels that can be considered problematic. The highest-observed VIF for an activeness measure is in relation to QOF achievement (VIF 2.0).

The workforce variables are slightly higher for the workforce variables. This is driven in particular by size of practice (we have number of FTEs as well as list size), and local concentration (which has some relation to demographic factors). The VIFs are somewhat higher for the local health variables. The patient weight variable can change sign depending on which other local health controls are used.

A.3 Patient age bands

We control for the effect of various demographic variables on the outcomes. However, these are not of direct interest – we merely seek to absorb control for this variation rather than estimate the drivers of local health demand.

There is rich data available at practice level showing the breakdown of patients by age band. The most detailed age split possible has 0-4, 5-15, 15-44, 45-64, 65-74, 75-84, and 85 plus. These are further split by male/female, giving up to 14 categories. We considered how heavily to control for patient age mix in the regression.

We had originally used a single variable to control for patient age, the proportion of patients aged over 75. This was used alongside a number of other variables to control for demographics and local health demand: prevalence of long-term conditions (from QOF), patient funding weights (from GP Payments), IMD, as well as CCG dummies. This approach already gave some multicollinearity, but it is only moderate. It gave VIFs of 3.6 for deprivation, age and weight; 1.8 for prevalence. When the CCG dummies were included, the VIFs on the demographic controls reach 5.5-6.

The model with the full age-gender splits gave very similar results to our main specification, but with slightly larger standard errors. However, the age band variables themselves took implausible values. In the original case of the %>75 years variable, there was a coefficient of 1.47 for log ACSC admissions. This means that a 10% point increase in %>75 give a 15% increase[45] in admissions, even holding constant the other local health factors, which is plausible. But in the case of using the 14 bands, some coefficients become very large, and the

[45] The increase is given by Exp(1.46*0.1)-1 = 0.16

coefficients on older males become implausibly negative. Even including both a %>75 and %>85 band together results in %>75 taking the wrong sign and a high VIF. It therefore appears that >85 is stronger than >75 in driving admissions. We also found that a control for proportion of patients aged less than 5 years could be included, which improved the statistical significance of the results and increased the VIF. Our preferred specification includes %>85 and %<5 variables.

A.4 Correlation between outcome variables

While the variables we have proposed as quality indicators have some conceptual justification, for the quality interpretation to be valid, we should see some correlation between them. It is desirable to do so with reference to the residuals, as these strip out explained variation (for example, demographic controls). They are indeed correlated with each other in the hypothesised manner in the majority of cases.

Figure 43 Correlation of outcome variables

	ACSC admission	A&E attendance	Detection rate	Conversion rate	TWW usage	Patient satisfaction	CQC
ACSC admissions	1						
A&E attendance	0.35	1					
Detection rate	-0.06	-0.20	1				
Conversion rate	-0.02	-0.29	0.10	1			
TWW usage	0.15	-0.21	0.41	-0.16	1		
Patient satisfaction	-0.18	-0.33	0.14	0.27	0.17	1	
CQC rating	-0.02	-0.10	0.09	0.02	0.09	0.22	1

Source: Frontier analysis

A further check to make is whether the residuals for the different variables are correlated. This strips out observed variation, for example if deprivation affects all outcomes in the same way, this could exaggerate the level of correlation observed between them. When this is done, the correlations become somewhat smaller. Interestingly, the conversion and detection rate continue to be positively correlated. Other things being equal, we would might expect the opposite: for a given level of accuracy knowing when to use TWW, a higher propensity to use it (conversion rate) would result in lower detection rate (fewer diagnoses result in positive diagnosis). That we see a positive correlation reinforces the quality interpretation.

Figure 44 Correlation of residuals

	ACSC admission	A&E attendance	Detection rate	Conversion rate	TWW usage	Patient satisfaction	CQC
ACSC admissions	1						
A&E attendance	0.38	1					
Detection rate	0.03	0.00	1				
Conversion rate	-0.20	-0.10	0.12	1			
TWW usage	0.23	0.08	0.31	-0.59	1		
Patient satisfaction	-0.12	-0.17	0.08	0.11	-0.09	1	
CQC rating	-0.01	-0.04	0.03	0.01	-0.01	0.16	1

Source: Frontier analysis

Finally, we perform a seemingly unrelated regression. This tests for correlation between the residuals from the individual regressions for each outcome in turn. The hypothesis that the residuals are uncorrelated is rejected.

ANNEX B GP SURVEY

B.1 Background and design

We commissioned and co-designed a survey GP practices in collaboration with TNS. We decided to survey 500 GP practices which is just over 6% of the overall GP population of approximately 8,000. We thought this provided us with a good sample, large enough for the econometric modelling that we are intending to do in later stages of this project.

As we were interested in the activeness at the practice level we decided that the practice manger was the most appropriate person to contact as they would be informed of the special interests, CCG participation and attitudes towards technology across the practice. When formulating the specific questions we received input from multiple clinicians who provided insights into the type of information that practice mangers would be aware of.

The final questionnaire consisted of 11 questions. The Frontier research team devised a first draft of the interview script which predominantly focused on engagement with new technology and GP special interests at the practice level (one additional question was included to assess CCG participation) in October 2015. We then consulted with both our expert advisory panel and TNS in to ensure that the questions we included would elicit the information of interest and could be practically implemented in the field[46]. A revised version of the questionnaire was then taken to the piloting stage; following a number of minor revisions a final protocol and questionnaire were established[47].

We discussed the draft questionnaire with a number of GP experts. They included our expert adviser, Dr Debbie Freake, a former GP and a commissioner, Dr Kushal Barai, a London GP and former research fellow at the Nuffield Trust with special interest in technology, and Prof. Steve Fields, a GP and Chief Inspector of General Practice at the CQC. Their views were reflected in the final questionnaire.

TNS carried out a small pilot with 5 GP practices before the survey was started to ensure that our questionnaire was well understood by GP practices. Following from that, we carried out further amendments to the questionnaire.

Practices received advanced notice of the study via email which contained summary information regarding the purpose of the current project. TNS then followed-up with a phone call requesting to speak to the practice manager. The survey took approximately 5 minutes to administer. Practices could opt out of taking part at any stage.

B.2 Sample selection

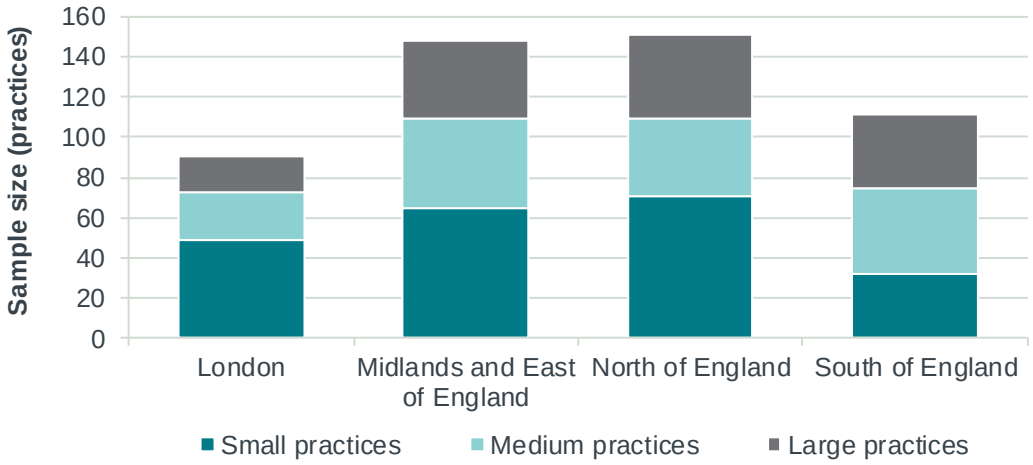
In conjunction with TNS we examined HSCIC data on the number of full time equivalent practitioners operating in each practice in England to ensure that the selection of GP practices was representative. We then established practice size

[46] For example our expert advisory panel provided us with valuable insight in terms of what information a practice manager would and would not be aware of.

[47] A copy of the survey is attached in the Annex.

quotas which would stratify the target sample (the size of the practice is to be established at the start of the interview.[48] A graphical illustration of the final sample of 500 practices is illustrated below in Figure 45.

Figure 45. Size and location of surveyed GP practices



Source: TNS Survey, 2016 Frontier Calculations
Note: Quotas based on HSCIC national data

The fieldwork was undertaken between March-May 2016.

B.3 Questionnaire

Introduction

Read out: Good morning/afternoon, my name is … calling from TNS BMRB an independent research company, on behalf of the Health Foundation, is it possible to speak to [named practice manager/GP]?

If named practice manage or GP is not available, read out: We are conducting a very short survey on behalf of the Health Foundation about activities that help or hinder GP practices deliver good quality care. We need to speak to either a practice manager or a GP at your practice. Would you be able to put me through to someone?

INTERVIEWER: Ensure that you are **NOT** transferred to a **locum GP**. The survey must be completed with a practice manager or a GP permanently employed at this practice.

***Once speaking to practice manager or GP read out*:** "I'm calling about a survey we are conducting on behalf of the Health Foundation, an independent healthcare think tank. The survey aims to understand which activities used by GP practices help or hinder delivery of good quality care. We are interested in the views of GP practices and would be very grateful if you could spare 3 minutes to talk to us?

[48] In accordance with national averages 43% of the sample are small practices consisting of 3 or fewer full time equivalent GPs, a further 30% are medium practices which employ between 3 and 6 full equivalent GPs and the remaining 27% of the sample are larger practices with over 6 full time equivalent GPs. In terms of geographical coverage 22% of the sample practices were based in the South of England, 18% were based in London, 30% were based in the midlands and East of England and the final 30% were based in the North of England.

Ask all

Q1: Do any of the GP members of your practice have a formal role in the running of your Clinical Commissioning Group?

[Code one answer]

(a) Yes
(b) No
(c) Don't Know

Ask all

Q2: Does your practice include at least one GP member with the following specialist interests? By 'specialist interest' we mean GPs who have pursued significant training in an additional area of medicine such as gynaecology, cardiology, etc**.**

Read out if necessary: "For instance, if GPs in your practice were presented with an unusual skin problem, would they consult a specific GP in this practice with interest in dermatology? If so, we would qualify this as specialist interest"

[Read out answer options]

[Code all that apply]

(a) Diabetic medicine
(b) Cancer
(c) Dementia
(d) COPD (Chronic obstructive pulmonary disease)
(e) GPs with other specialist interests
(f) No GPs with specialist interests [exclusive code, cannot be combined with others]
(g) Don't know [exclusive code, cannot be combined with others]

Ask all

Q3: Does your practice provide a specialist nurse-led service in any of the following areas?

[Read out]

[Code all that apply]

(a) Insulin therapy
(b) Structured diabetes self-management programmes such as DESMOND (Diabetes Education and Self-Management for Ongoing and Newly Diagnosed)
(c) Cancer
(d) Dementia
(e) COPD or Chronic obstructive pulmonary disease
(f) No specialist clinic [exclusive code, cannot be combined with others]

Don’t know [exclusive code, cannot be combined with others]

Ask all

Q4: Thinking about the use of communication technology in your practice, do you use either of the following to consult with patients?

[Read out]

[Code all that apply]

a) Skype or videoconferencing
b) Email
c) Neither [exclusive code, cannot be combined with others]

Ask if Q4=a

Q5a. Does your practice have a protocol in place about how Skype and videoconference consultation requests are handled?

Yes

No
Don’t know

Ask if Q4=b

Q5b. Does your practice have a protocol in place about how email consultation requests are handled?

Yes

No
Don’t know

Ask all

Q6: Thinking about the use of latest technologies and devices to monitor patient health in your practice, do any of the following statements represent your practice:

[Read out]

[Code yes/no/ not applicable/don’t know] for each option

(a) Our GPs routinely use home monitoring equipment in their management of hypertension.
(b) Our GPs make use of bladder scanning to manage urinary tract problems in primary care, either scanning themselves or as part of a locality service.
(c) Our Practice has achieved an increase in uptake of health monitoring devices, such as pedometers, among our patients in the past year.
(d) Our Practice has a number of selected mobile phone “apps” which it recommends to patients.

Ask all

Q7: Thinking about your general practice and its experience with the use of technology as a whole, such as Skype consultations, health monitoring devices, mobile phone apps, etc., which of the following best describes your experience:

[Read out]

[Code one answer]

(a) Very positive.
(b) Generally positive
(c) Neither positive nor negative
(d) Generally negative
(e) Very negative
(f) Don't know

Ask all

Q8: We are working with Frontier Economics, an economic consultancy on this research and they may wish to contact a few GP practices who took part in the survey for a more in-depth discussion of these issues. Would you be willing for them to contact you about this?

[Code one answer]

(a) Yes
(b) No

If Q8="Yes" Go to Q9

If Q8= "No" **END**

Ask if yes at Q8

Q9: Please could I take your name?

OPEN TEXT

Ask if yes at Q8

Q10: Please can you provide a phone number that you can be reached on?

INTERVIEWER: If respondent indicates that the number you are currently using is the best number, please capture it again below.

Numeric box

END

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