Institute for Fiscal Studies

Does GP Practice Size Matter? GP Practice Size and the Quality of Primary Care

IFS Report R101

Elaine Kelly
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E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

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Preface

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Understanding competition and choice in the NHS

The Health and Social Care Act 2012 paved the way for an extension of competition and market mechanisms in the NHS in England, with more competition for the provision of health services.

To inform these developments, and help evaluate their progress, the Nuffield Trust and the Institute for Fiscal Studies formed a partnership to conduct a joint research programme that will aim to establish a long-term expertise in the use of competition and market mechanisms in health care – both in the NHS in England and internationally. This is the third report from the programme.

The first and second reports from this project, *Choosing the Place of Care: The Effect of Patient Choice on Treatment Location in England, 2003–2011* and *Public Payment and Private Provision: The Changing Landscape of Health Care in the 2000s*, are available from http://www.nuffieldtrust.org.uk/our-work/projects/understanding-competition-choice-nhs.

Contents

	Executive Summary	1
1.	Introduction	3
2.	Changes in the Organisation of GP Practices, 2004–10	5
	2.1 Changes in GP practice size	7
	2.2 Changes in GP practice characteristics	11
	2.3 Practice size and population, practice and local area characteristics	13
	2.4 Summary	16
3.	Practice Size and Quality and Outcomes Framework Scores	18
	3.1 Differences in QOF scores, by practice size	19
	3.2 Practice size and QOF scores: multivariate analysis	20
	3.3 Summary	23
4.	Emergency Inpatient Admissions Related to Ambulatory Care Sensitive Conditions	24
	4.1 Differences in ACS admissions, by practice size	25
	4.2 Multivariate analysis: ACS admissions	27
	4.3 Summary	31
5.	Referrals	32
	5.1 Mean differences in referral behaviour, by practice size	33
	5.2 Practice size and referral behaviour: multivariate analysis	34
	5.3 Summary	37
6.	Summary and Conclusions	38
	Appendix A. Data	40
	Appendix B. Specifications	45
	References	56

Executive Summary

This report examines trends in the organisation of general practitioner (GP) practices in England between 2004 and 2010, and the relationship between practice size and two indicators of the quality of care: Quality and Outcomes Framework (QOF) scores; emergency inpatient admissions for ambulatory care sensitive (ACS) conditions. We also examine the relationship between practice size and outpatient referral behaviour.

- There has been a substantial change in the organisation of GP practices over time. There has been an increase in the average number of full-time equivalent (FTE) GPs in each practice, which rose from 3.6 in 2004 to 4.2 in 2010. The share of single-handed GP practices fell by a third, from 22% to 15% over this period.

- These changes have resulted in a shift of registered patients towards larger practices. By 2010, 76% of those who were registered with a GP practice were registered with one that had more than three FTE GPs. This compares with a figure of 69% in 2004.

- Using data from 2010/11, all three indicators of quality that we examined show that smaller practices are associated with poorer quality in primary care services. The precise nature and size of this relationship vary across the different measures.

- There is a small, positive association between QOF scores and practice size. Single-handed practices have the lowest average (mean) QOF scores, while large practices (with more than six FTE GPs) achieve the highest average scores.

- For ACS admissions, there is some evidence that smaller practices perform worse, on average, than larger practices and are more likely to be among the worst performing. This precise relationship differs across different conditions. Across all the conditions studied, practices with more than six FTE GPs have lower admission rates on average than smaller practices. In the case of chronic conditions, single-handed practices are most likely to be among the poorest-performing practices.

- Practices with three or fewer FTE GPs are less likely to refer their patients for secondary care than larger practices. Single-handed practices are also less likely than larger practices to refer patients for treatment by independent sector providers (ISPs).

- However, there is substantial variation in the quality of care within the same practice size categories. This is particularly true for single-handed practices: despite the significant prevalence of poor performance among single-handed practices, many also provide high-quality care.

- The relationships between GP practice size and GP behaviour are not necessarily causal. This report controls for differences in the characteristics of the practice population, the local area and the GPs themselves in order to adjust for factors that may impact on both practice size and the indicators we examine. However, a considerable number of unobservable factors remain, such as the underlying health status of the practice populations, and could explain why smaller practices tend to perform differently.

- This report focuses on GP practice size. There are many other characteristics of GPs that may affect patient outcomes. Further research is required in this area.

1. Introduction

General practitioners (GPs) are the first and most frequent point of contact with the National Health Service (NHS) for most people in England. They provide a range of primary medical care services to those who are registered with them and act as gatekeepers to most other NHS services, referring patients to specialist care where appropriate. People living in England can register with one GP. In principle, patients have a choice over which GP practice to register with but many patients choose practices close to where they live.

GPs have always played a vital role in both maintaining population health and controlling health care costs. This is set to be expanded further as a result of the Health and Social Care Act 2012, with some GPs gaining an increased role in commissioning secondary care services. Patient health is dependent on correct diagnosis, treatment and management, and referrals to the appropriate secondary care where required. Costs to the public purse are determined by whether GPs prescribe the most cost-effective medication, manage conditions to prevent avoidable admissions to hospitals and refer to secondary care only when appropriate.[1] Over the last decade, there have been substantial changes in the way GP practices are organised. The number of GPs working in each practice has increased and a larger proportion of patients are now registered with larger practices.

This report examines the relationship between GP practice size, as defined by the number of full-time equivalent (FTE) GPs per practice, and measures of GP practice behaviour. We start by describing changes in the size of GP practices between 2004 and 2010 before considering the relationship between GP practice size and three sets of outcomes measured in 2010/11:[2]

- Quality and Outcomes Framework (QOF) scores – these were introduced in 2004 to measure the quality of primary care services provided to patients and to form the basis of a portion of GP practices' income;
- admissions for ambulatory care sensitive (ACS) conditions – these are admissions to hospital that could have been prevented through more effective primary care, and therefore impose additional costs on patients and the NHS;
- measures of the prevalence and variety of referral behaviour.

[1] It is worth noting that patients can in fact bypass GPs and receive care directly from hospitals through accident and emergency (A&E) departments. Recent trends suggest that patients are using these services in increasing numbers, and this has led to concern about overcrowding in hospital departments.

[2] 2010/11 is the most recent year for which all relevant outcome data are available.

The first of these outcomes provides an overall measure of practice quality, and is used to determine a proportion of payments to GP practices. The second attempts to capture a specific aspect of the quality of primary care treatment: the management of certain health conditions to prevent unnecessary admissions to hospital. The final outcome aims to assess GP practices in their function as the gatekeepers to secondary care services.

The rest of this report is organised as follows. Chapter 2 summarises the changes in the size of GP practices between 2004 and 2010, and considers the relationship between practice size and practice and local area characteristics. Chapters 3–5 examine the relationship between practice size and each of the three outcomes under consideration. Chapter 6 summarises the results and offers some policy conclusions.

2. Changes in the Organisation of GP Practices, 2004–10

This chapter examines changes in the organisation of primary care between 2004 and 2010. The principal data source is the National Health Applications and Infrastructure Services (NHAIS)/'Exeter' GP payment system, a computerised payment system for GPs in England, which provides doctor-level data for all permanently employed GPs on the following:[3]

- GP age and sex;
- GP practice where the GP works;
- FTE status, calculated by dividing the total number of hours worked by the GP by the full-time working week of 37.5 hours (a GP who works half the time will have a FTE of 0.5 and so on), which makes it possible to aggregate the hours of both full-time and part-time GPs by practice or area;
- GP type: provider (partner), registrar (trainee), other/salaried (fully qualified but not a partner) or retainer (who works a limited number of hours);
- country of qualification.

Table 2.1 shows the total number of GPs and GP practices in each year between 2004 and 2010. Over the period we consider, the number of GPs present in the annual census rose by 18.2%, from just over 36,000 to just under 43,000. The rise in the number of FTE GPs was slightly less, at 15.2%, reaching just under 37,200 in 2010. At the same time, the number of registered patients rose by just 4.7%. This resulted in an increase in the number of FTE GPs per patient from 0.614 to 0.676 per 1,000 patients, or approximately 10%.

While the number of GPs and patients rose between 2004 and 2010, the number of GP practices fell from around 9,000 to around 8,800, leading to a 6.9% increase in the average number of patients registered per practice and a 17.6% increase in the number of FTE GPs per practice. It is the latter measure – the number of FTE GPs in each practice – that is the focus of this report.

The rest of this chapter is divided into four sections. The next section examines the change in GP practice size, as measured by the number of FTE GPs, in more detail. This is followed by a brief overview of the changes in the characteristics of GPs, which provide some context for the increasing practice size. Then, we examine the relationship between practice size and population, practice and local area characteristics in 2010. Here the objective is to understand why GP practice

[3] The data do not cover locums.

Table 2.1. Numbers of GPs and GP practices, 2004–10

Year	Total number of GPs	Total number of FTE GPs	Total number of practices	Registered population (1,000s)	FTE GPs per head of population	Patients per practice (1,000s)	FTE GPs per practice
2004	36,240	32,263	9,016	52,528	0.614	5.83	3.58
2005	37,217	33,064	8,948	52,818	0.626	5.90	3.70
2006	37,691	34,984	8,821	53,088	0.659	6.02	3.97
2007	37,335	34,559	8,749	53,529	0.646	6.12	3.95
2008	39,734	35,909	8,717	53,945	0.666	6.19	4.12
2009	41,498	37,297	8,711	54,474	0.685	6.25	4.28
2010	42,831	37,173	8,832	55,018	0.676	6.23	4.21
% change 2004–10	18.2%	15.2%	–2.0%	4.7%	10.0%	6.9%	17.6%

Source: Authors' calculations using NHAIS GP data.

outcomes (analysed in Chapters 3–5) could vary with practice size. The chapter concludes with a summary.

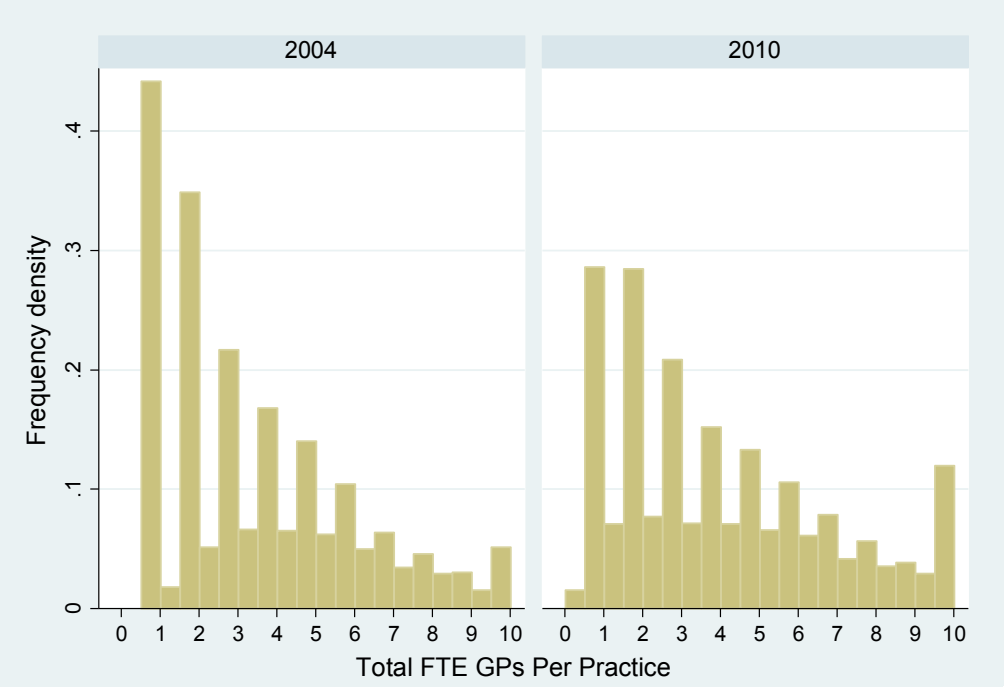
2.1 Changes in GP practice size

Table 2.1 indicates that the average (mean) number of FTE GPs in each practice increased between 2004 and 2010. Figure 2.1 provides more detail by comparing the distribution of GP practice sizes at the beginning and end of the period. The figure shows a general shift towards larger practices, with particularly large falls in the proportion of practices with no more than two FTE GPs.

To summarise the changes in GP practice size in a clearer and more concise way, we have divided practices into four size groupings:

- single-handed – one or fewer FTE GPs per practice;[4]
- small-medium – more than one and up to three FTE GPs;
- medium-large – more than three and up to six FTE GPs;
- large – more than six FTE GPs.

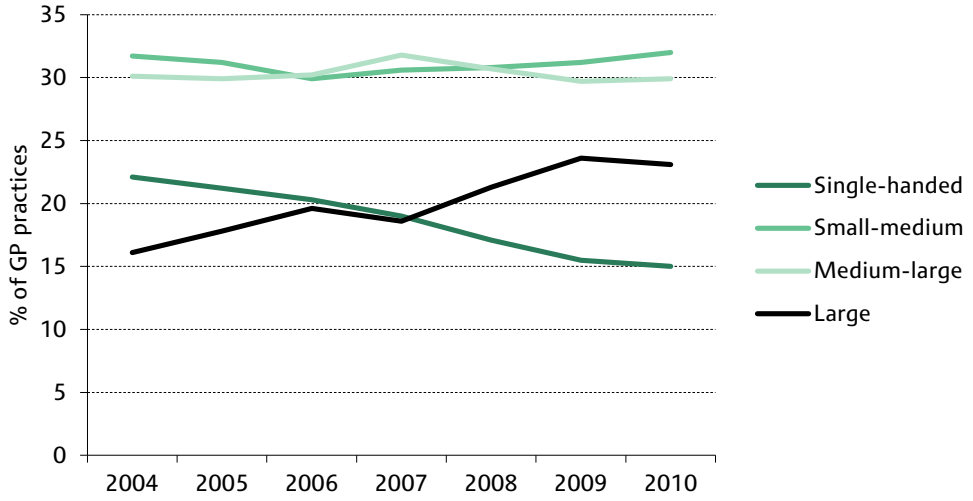
Figure 2.1. Distribution of GP practice sizes, 2004 and 2010



Source: Authors' calculations using NHAIS GP data.

[4] In 2004, all single-handed practices had one registered FTE GP in the practice; by 2012, this had fallen to 93%. In other words, 7% of single-handed GP practices had less than one FTE GP.

Figure 2.2. Share of GP practices, by FTE GPs (all practices)

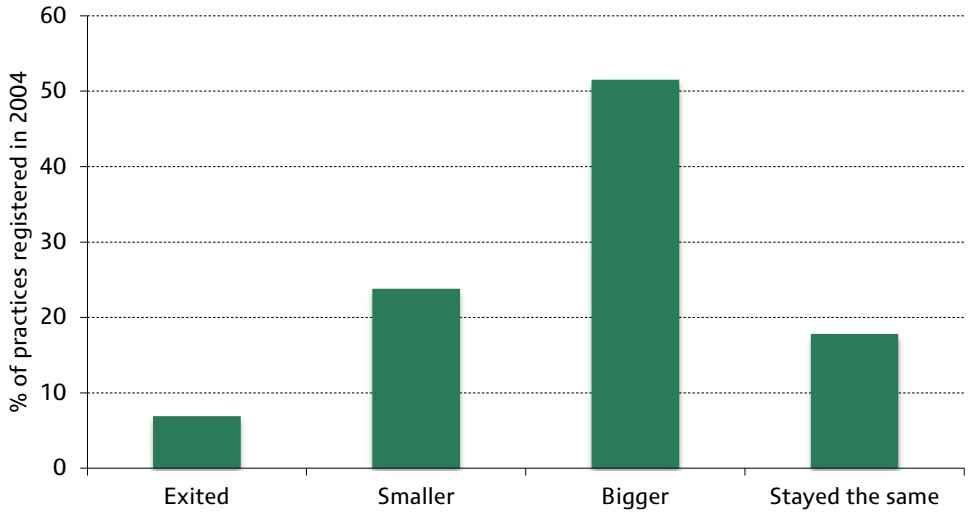


Note: Includes all GP practices with at least one registered GP in the year in question.
Source: Authors' calculations using NHAIS GP data.

Figure 2.2 shows the percentage of all GP practices in these different size categories between 2004 and 2010. The shares of the two medium-sized practice categories remained stable at a third each. However, there were substantive changes in the shares of single-handed and large practices. The share of single-handed practices fell by a third from 22.1% to 15.0%, while large practices (staffed by more than six FTE GPs) grew from 16.1% to 23.1%.

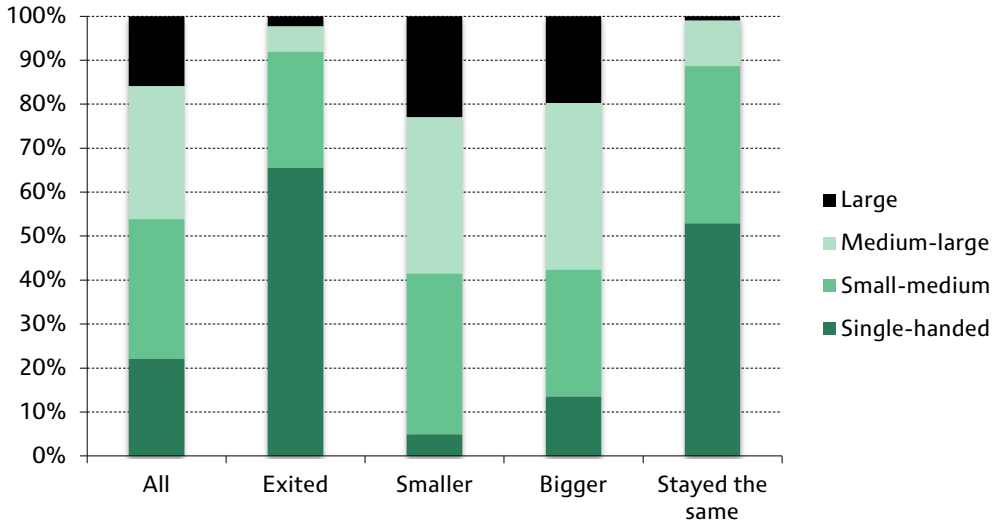
To understand whether the shift towards larger GP practices was caused by a change in the composition of practices (i.e. with entry and exit) or by a growth in the size of existing practices, we next examine what happened to GP practices that existed in 2004. Figure 2.3 shows the percentage of all GP practices in existence in 2004 that had exited, shrunk, grown or stayed the same in terms of

Figure 2.3. GP practice size in 2010 of practices in existence in 2004



Note: Includes the 9,016 practices that contained at least one GP in 2004.
Source: Authors' calculations using NHAIS GP data.

Figure 2.4. Distribution of GP practice sizes in 2004, by change in practice size between 2004 and 2010



Source: Authors' calculations using NHAIS GP data.

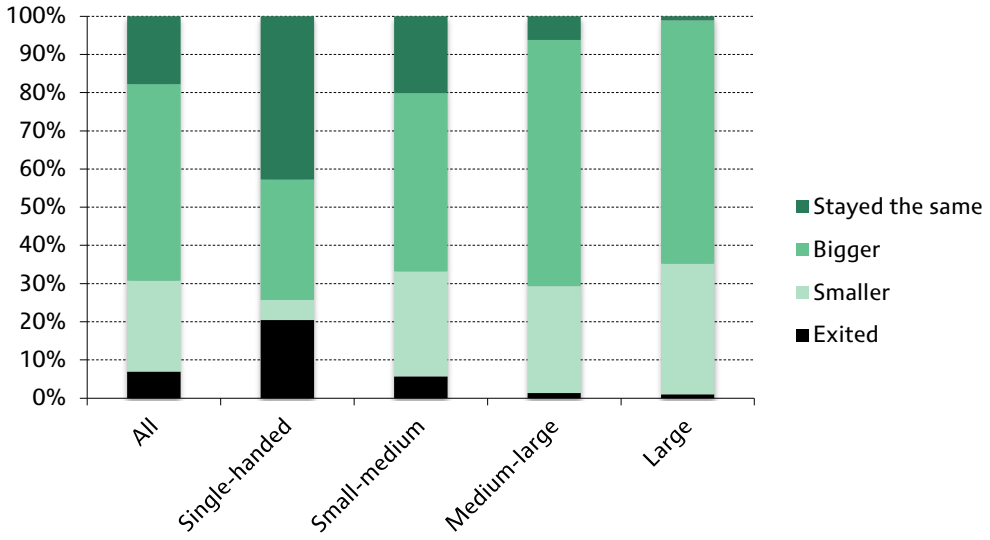
FTE GPs by 2010. Just over half of the practices had increased in size, with another 17.8% remaining the same size. Almost a quarter had got smaller, while 6.9% were no longer in existence. Of practices that grew, the average increase was 1.4 FTE GPs; of practices that shrank, the average fall was 0.8 FTE GPs.

Figure 2.4 shows the distribution of 2004 GP practice sizes, by change in practice size between 2004 and 2010. The aim is to understand whether changes in practice size are related to initial practice size in 2004. The first 'All' bar shows the size composition of all practices that existed in 2004, and provides a point of comparison for the composition of the other groups. If changes in practice size were unrelated to initial size, each subsequent bar in Figure 2.4 would look identical to the first.

The figure indicates that the majority of practices that exited were single-handed practices, accounting for two-thirds of all the exits despite only comprising 22.1% of practices in 2004. Larger practices were very unlikely to exit: GP practices staffed by more than three FTE GPs in 2004 accounted for more than half of all practices in 2004, but fewer than 10% of the exits. The pattern was very similar for practices that remained the same size: over half of all practices that stayed the same size were single-handed practices and almost 90% were staffed by three or fewer FTE GPs in 2004. Results for practices that changed size are less clear. Large and medium-large practices were more likely to have changed size (getting both bigger and smaller), but this is in part because size will change if either the number of GPs changes or some GPs change their FTE status.

Figure 2.5 presents the same data, but this time examining the change in practice sizes between 2004 and 2010, for each size category in 2004. Here the figure

Figure 2.5. Distribution of changes in GP practice size between 2004 and 2010, by practice size in 2004



Source: Authors' calculations using NHAIS GP data.

makes it possible to compare the likelihood of a practice exiting, shrinking, growing or remaining the same size, by initial practice size. Again, the first bar gives the breakdown for all practices registered in 2004.

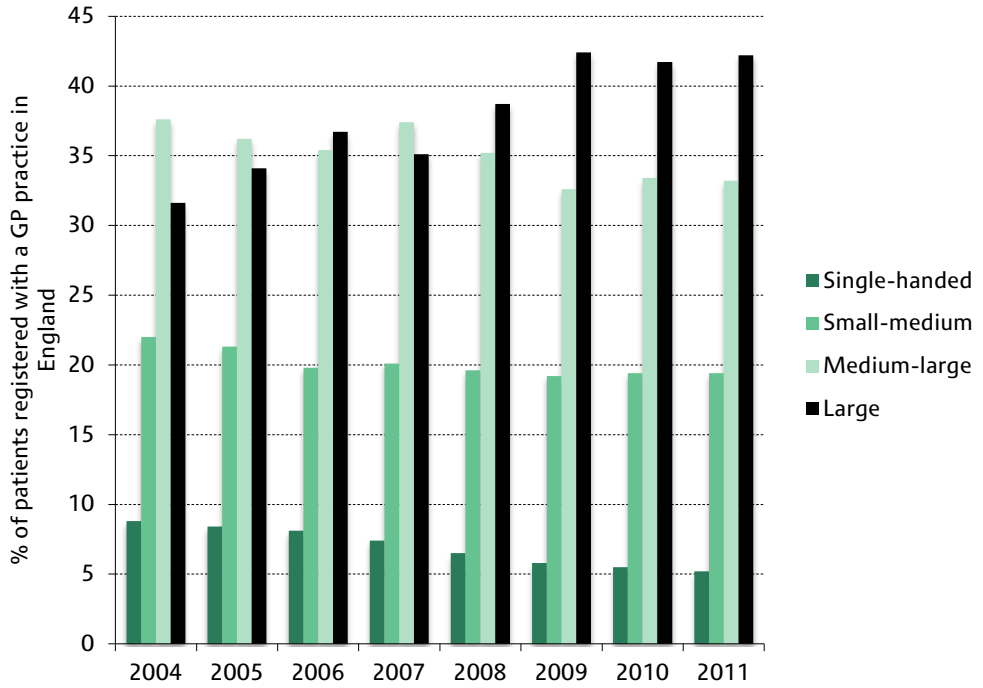
The figure shows three points of note. First, as shown in Figure 2.4, single-handed practices were disproportionately likely to leave the market, with the share that exited falling with initial practice size. Second, in all size categories, the share of practices that grew in size exceeded the share that got smaller. Third, the share of practices that grew between 2004 and 2010 increased with initial practice size. Approximately a third of single-handed practices increased in size between 2004 and 2010, compared with almost two-thirds of medium-large and large practices.

The final group of practices to consider are those that entered the market between 2004 and 2010. There were 437 practices in existence in 2010 that did not exist in 2004, compared with 621 that had exited. Practices that entered between 2004 and 2010 were on average smaller (2.6 FTE GPs in 2010) than those that existed in both 2004 and 2010 (4.3 FTE GPs in 2010), but larger than those that had exited (1.7 FTE GPs in 2004). Taken together with the results in Figures 2.4 and 2.5, this suggests that the increase in the average practice size was driven by both:

- changes in the composition of practices, with practices entering the market being larger than those exiting;
- a growth in practice size among existing practices.

To decompose the relative importance of these changes, we compared the change in average practice size for those practices that existed in both 2004 and 2010 (where there is no entry and exit) to the changes in the average practice size for

Figure 2.6. Percentage of patients registered with a GP practice in England, by practice size, 2004–10



Source: Authors' calculations using NHAIS GP data.

all practices (which would also include the effects of entry and exit). The average growth in practice size for all practices over this period was 0.63 FTE GPs, relative to 0.57 for practices that existed in both years. Hence, entry and exit contributed 0.06 (or around 10%) of the overall change.

This section has thus far focused on changes to the number of GPs per practice. However, changes in the number and sizes of practices also carry implications for the distribution of patients across practices. Figure 2.6 shows the percentage of patients registered with practices in each size category in each year between 2004 and 2010. In 2004, the greatest proportion of patients were registered with medium-large practices, but from 2008, more patients were registered with large practices (with more than six FTE GPs) than with any of the smaller-sized practices. The share of patients in small and small-medium practices fell throughout the period. By 2010, over three-quarters of patients were registered in practices with more than three FTE GPs, compared with 69% in 2004.

2.2 Changes in GP practice characteristics

Individual GP characteristics are not the main focus of this report, primarily because most information about GP behaviour is only available at the practice level, rather than being observed for each individual GP.[5] However, for the

[5] The Health and Social Care Information Centre publishes detailed summary statistics on GP characteristics on an annual basis. For details, see www.hscic.gov.uk/catalogue/PUB13849.

purpose of this report, it is important to provide some context for trends that might lie behind the changes in practice size described in the previous section.

Table 2.2 shows changes in the composition of GPs in the annual NHS workforce census over time, from 2004 to 2010. The percentages in the table are not weighted by FTE status because the focus here is on the composition of GPs who provide care, which may in turn be related to working hours (through, for example, age or sex). The table reveals three secular trends in GP composition:

- there was a continuous rise in the percentage of female GPs, from 41.2% in 2004 to 46.9% in 2010;
- the share of salaried GPs increased from just over one in 16 in 2004 to almost one in five in 2010, with a particularly large rise between 2005 and 2006;
- there was a modest fall in the percentage of GPs trained within the United Kingdom (UK) or the European Economic Area (EEA), from 85.1% to 81.3%.

Table 2.2. Changes in the composition of GPs over time, 2004–10

	% of GPs (headcount)					
	Female	**Part-time**	**Under 40**	**Salaried**	**Registrar**	**UK/EEA trained**
2004	41.2	25.9	31.4	6.1	7.3	85.1
2005	42.0	26.7	30.6	7.3	7.1	84.5
2006	43.0	17.9	30.5	13.6	6.4	83.2
2007	43.4	19.1	29.5	15.6	4.7	83.0
2008	44.9	23.4	31.7	17.1	8.1	82.4
2009	45.9	25.0	33.5	19.0	9.2	79.5
2010	46.9	32.8	34.3	20.7	9.7	81.3

Note: All figures are percentages of the headcount of GPs in each year (irrespective of FTE status). Part time refers to GPs who work less than one FTE.
Source: Authors' calculations using NHAIS GP data.

Trends in the shares of GPs who work part-time (i.e. less than one FTE), who are under the age of 40 or who are registrars, follow a different pattern. The shares of GPs with these characteristics fell between 2004 and 2006 or 2007, before rising thereafter and eventually exceeding their 2004 levels. For example, the percentage of registrar GPs fell from 7.3% in 2004 to 4.7% in 2007, before rising to 9.7% in 2010. There is also a clear relationship between the share of GPs aged under 40 and the share of registrars, because most trainees are young doctors.

It is interesting to note that the increasing proportion of female GPs provides only a partial explanation for the change in the share of GPs who work part-time. The proportion of female GPs has been increasing for decades, but part-time work only started rising after 2006. Moreover, although women continue to form the majority of part-time workers, their share has fallen over time: women accounted for 76% of all part-time GPs in 2004 but just 67% in 2010.

2.3 Practice size and population, practice and local area characteristics

The previous two sections have illustrated substantive changes in the size of GP practices and the composition of GPs over time. In this section, we examine the extent to which practices of different sizes vary in terms of their population, practice and local area characteristics. This is important in order to understand why the outcomes that are examined in Chapters 3–5 may vary by practice size, through either differences in the characteristics of the patients and areas that the practices serve or variation in the composition of GPs. As the outcomes examined were measured in 2010, the focus here is on characteristics in that year, unless otherwise specified.

Table 2.3 shows the average characteristics of GP practices in each size category in 2010. The mean number of patients per GP declined with practice size, but was particularly high for single-handed practices.[6] The number of patients per GP also had much more variation for single-handed practices, as indicated by the higher standard deviation (in brackets). The number of other GP practices nearby also declined with practice size: on average, single-handed practices had 4.2 other GP practices located within one kilometre (km) of them, compared with 2.1 for large practices.

Table 2.3. Mean GP practice characteristics, by practice size, 2010

Practice size	No. of patients per FTE GPs	No. of GP practices within 1 km	% of patients aged 65+	% of patients <15 years old	% of practices opting out of out-of-hours care	% of practices dispensing
Single-handed	2,577 (1191)	4.2 (3.6)	14.3	18.9	45.2	5.6
Small-medium	1,846 (690)	3.3 (3.3)	15.0	18.8	46.4	13.0
Medium-large	1,627 (458)	2.4 (2.7)	16.2	18.0	41.8	16.3
Large	1,396 (342)	2.1 (2.5)	16.5	17.7	48.1	19.0
All	1,779 (762)	2.9 (3.1)	15.6	18.3	45.2	14.4

Note: GP practices were excluded from patients per FTE GP calculations if they had a total of FTE GPs of 0.5 or fewer. This affected just 62 of the 1,330 single-handed practices in 2010.
Source: Authors' calculations using NHAIS GP data.

[6] This was not driven by very small or very large practice lists, as results for the median number of patients per GP looked very similar.

Table 2.4. Mean local area and nearest trust characteristics, by practice size, 2010

Practice size	*Local area characteristics*		
	Deprivation (IMD)	Population density	% white
Single-handed	32.4	44.8	0.76
Small-medium	29.4	38.1	0.79
Medium-large	24.7	33.0	0.85
Large	22.8	31.6	0.87
All	26.9	36.1	0.82

Practice size	*Nearest acute trust (hospital) characteristics*		
	Average wait (days)	% teaching hospital	% early foundation trust
Single-handed	87.3	23.2	13.7
Small-medium	86.7	20.3	15.9
Medium-large	88.1	21.2	16.5
Large	89.8	21.8	18.5
All	87.9	21.3	16.3

Note: Local area is defined as the MSOA of the practice headquarters. Population density shows 100s of individuals per square km. IMD denotes Index of Multiple Deprivation.
Source: Authors' calculations using NHAIS GP data.

Despite quite large differences in the number of patients per GP and the geographical concentration of practices, there was no clear relationship between practice size and the age of patients registered with the practices or the percentage of practices that opted out of out-of-hours care in 2006/07.[7] However, larger practices were more likely to be dispensing practices: just 5.6% of single-handed practices were dispensing practices, compared with 19.0% of large practices. For all characteristics except for opting out of out-of-hours care, the differences between single-handed and large practices were statistically significant at the 5% level.

The upper panel of Table 2.4 summarises the characteristics of the local area in which GP practices were located in 2010.[8] On average, the smaller the practice, the more deprived, ethnically diverse and densely populated the area it served. All differences shown between the single-handed and the largest practices were statistically significant. This suggests that it may be important to take these factors into account when drawing conclusions about the relationships between practice size and the quality of health care services provided.

[7] We use 2006/07 as the last year of available data at the time of writing.

[8] For this, the Middle Layer Super Output Area (MSOA) of the practice headquarters was used. There were 6,791 MSOAs in England in 2010, with an average population of 7,200.

The lower panel of Table 2.4 shows the mean characteristics of the nearest trust:

- average waiting times (in days) in 2002–04;[9]
- whether the nearest acute trust was a teaching hospital;
- whether the nearest acute trust was given early foundation trust status (by 2006/07).

Each of these characteristics is an indicator of quality. Although this is not a comprehensive list of quality indicators, the results do not indicate large differences by GP practice size. There were no significant differences in whether the nearest acute trust was a teaching hospital. Differences in average waiting times were statistically significant but there was no clear pattern: the shortest waiting times were for small-medium practices, while the longest were for large practices. However, there was a clear and statistically significant gradient in whether the nearest acute trust was given foundation trust status early on.

Finally, Table 2.5 considers the relationship between GP practice size and the composition of GPs who work in the practice. Larger practices had a greater share of female GPs than smaller practices: just 34.2% of single-handed practices had a female GP, while 58% of GPs working in large practices were female. In part this is explained by the age distribution of GPs in larger practices: GPs in larger practices are more likely to be under the age of 40 and to be GP registrars, groups among which 60% of GPs are female.

The share of GPs under the age of 40 rose from just 9.3% for single-handed practices to 41.0% for large practices. A portion of this difference is explained by

Table 2.5. Composition of GPs, by practice size, 2010 (weighted by FTE)

Practice size	**Mean % of GPs**					
	FTE weighted					***All***
	Female	**Under age 40**	**Trained UK/EEA**	**Salaried**	**Registrar**	**Part-time**
Single-handed	34.2	9.3	44.9	9.5	0.0	16.1
Small-medium	47.2	22.3	61.8	21.6	1.1	31.9
Medium-large	55.5	31.3	83.5	19.1	6.8	32.2
Large	58.0	41.0	87.3	18.8	16.2	30.4
All	50.2	27.4	71.6	18.4	6.1	29.2

Source: Authors' calculations using NHAIS GP data.

[9] Average inpatient waiting times (the time between referral and admission) for the period 2002–04 were used. These included times for patients waiting for all elective procedures. Trusts exhibited considerable variation in waiting times during this period, which provided an indication of trust quality. This variation was reduced in later periods as a result of strict targets, resulting in only small differences between trusts of different quality.

higher proportions of registrar or trainee GPs in larger practices, because almost all these GPs are under the age of 40. GP registrars cannot run single-handed practices, and were almost absent from small-medium practices, but formed 6.8% of FTE GPs in medium-large practices and 16.2% of FTE GPs in the largest practices. Salaried GPs made up an average of 20% of GPs in all practices with more than one FTE GP. This compares with an average of 9.5% for single-handed practices. The share of GPs trained in the UK/EEA rose from 44.9% for the smallest practices to 87.3% for the largest practices, which in part reflects the result in Table 2.4 that single-handed practices operate in areas that are more densely populated and ethnically diverse.

For all the characteristics we considered, the composition of GPs in single-handed practices was significantly different from that in the largest practices at the 5% level.

Taken together, Tables 2.3–2.5 indicate that, in 2010, GP practices of different sizes varied in terms of both the populations they served and the composition of GPs who worked in them. The composition of the population served by the practice could have strong implications for underlying health and therefore the prevalence of ACS conditions and the nature of referrals to secondary care. It will, therefore, be very important to take these characteristics into account when considering the relationship between practice size and GP practice quality and behaviour in Chapters 3–5.

2.4 Summary

- Between 2004 and 2010, the number of GPs in England grew faster than the population that was registered with a GP practice. This led to a 10% increase in the number of GPs per registered patient.
- At the same time, the number of GP practices fell slightly and the average number of FTE GPs per practice grew from 3.6 to 4.2 (or by 17.6%).
- The majority of the rise in GP practice size, as measured by the number of FTE GPs, is explained by existing practices getting larger. However, new practices entering the market were also larger, on average, than those that exited, with single-handed practices being particularly likely to have exited between 2004 and 2010.
- By 2010, 42% of those registered at GP practices in England were patients of practices with more than six FTE GPs; this had increased from 32% in 2004.
- Over the same period, there was a gradual increase in the share of GPs who were female and a rapid increase in the share who were salaried rather than partners (from 6% in 2004 to 19% in 2010). After 2006, there was also a rise in the numbers of GPs who were registrars and aged under 40.

- Single-handed GP practices had higher numbers of patients per GP practice, and treated patients in more deprived and more densely populated areas than larger practices.
- GPs in single-handed practices were less likely to be female or aged under 40 and were more likely to have trained outside the UK/EEA.

3. Practice Size and Quality and Outcomes Framework Scores

Chapter 2 indicated that there have been substantial changes in the composition of GP practices by practice size, and an accompanying change in the GP practice-registered population towards large practices. Given these substantive changes, the rest of the report concentrates on the extent to which practice size matters for GP practice quality and therefore both patient health and NHS costs.

The first outcome or set of outcomes we consider is the QOF scores. The QOF is a voluntary scheme that provides incentives for GP practices to improve the quality of care that they provide to patients. Practices can score points for achieving a set of targets against a wide set of indicators. Payments are then provided based on the number of points earned by practices.

In 2010/11, practices could achieve up to 1,000 points, and were judged on a set of 134 indicators.[10] These indicators were grouped into four domains, as follows.

- Clinical – consisting of 86 indicators across 20 clinical areas. Indicators were based on clinical outcomes and related to a range of conditions. This domain accounted for a potential 697 points (69.7% of the available QOF total).
- Organisational – consisting of 36 indicators. These were further divided into five subcategories:
    - records and information;
    - information for patients;
    - education and training;
    - practice management;
    - management of medicines.

  This domain accounted for a potential 167.5 points (16.75% of the available QOF total).
- Additional services – consisting of nine indicators. Practices could achieve points for providing four additional services. In 2010/11, these were:
    - cervical screening;
    - child health surveillance;

[10] For detailed guidance on the 2010/11 QOF indicators and scores, see The NHS Information Centre (2011).

- maternity services;
- contraception (sexual health).

This domain accounted for a potential 44 points (4.4% of the available QOF total).

- Patient experience – consisting of three indicators based on the length of patient consultations and patient-reported access to GPs. This domain accounted for a potential 91.5 points (9.15% of the available QOF total).

In this chapter, we examine the relationship between practice size and QOF scores. It should be noted that despite the primary intention of QOF scores as an incentive payment scheme and not as an explicit indicator of the provision of quality care (The NHS Information Centre, 2011), it has become common practice to use them as an indicator of quality of care in the medical literature.[11]

3.1 Differences in QOF scores, by practice size

Table 3.1 shows the relationship between GP practice size and mean QOF scores in 2010/11. It gives the means of the overall QOF score for the different practice sizes and the percentage of potential points attained in each of the four QOF domains. Focusing first on total practice scores, we observe that they increased with practice size category. Practices with more than six FTE GPs had a mean score of 956. In comparison, the mean score for single-handed practices was 932.

We can further break down QOF scores into the four domains: clinical, organisational, additional services and patient experience. This is to explore whether differences are driven by domains where it may be harder for smaller

Table 3.1. QOF scores, by practice size, 2010/11

Practice size	Mean QOF score	*% of potential points achieved in domain*			
		Clinical	Organisational	Additional services	Patient experience
Single-handed	932	94.4	95.8	94.1	78.5
Small-medium	943	96.1	97.0	96.5	74.8
Medium-large	952	97.6	98.0	98.1	70.7
Large	956	98.2	98.4	98.7	68.6
Total (100%)	947	96.8	97.4	97.1	72.6

Note: GP practice size is defined by the number of FTE GPs in 2010.
Source: Authors' calculations using NHAIS GP data.

[11] For an example, see Santos, Gravelle and Propper (2013).

practices to maximise points, such as additional services. The remaining columns show the mean percentage of available points achieved within each domain by practices of different sizes. The size gradient persisted across three domains: clinical, organisational and additional services. The gradient was reversed for patient experience. Single-handed practices achieved an average of 78.5% of the available points. Large practices gained the smallest share of available points, with an average achievement of 68.6%. This may reflect patient preferences for seeing the same GP across visits. This is most likely for patients registered at single-handed practices.

3.2 Practice size and QOF scores: multivariate analysis

Table 3.1 indicates that QOF scores increase with practice size. However, practice size is also associated with other practice characteristics, such as the local population that is served and the composition of GPs in the practice, which may explain the differences in average quality. Adjusting for these other factors is therefore very important in order to establish whether there is, or could be, a size gradient in quality.

We use two sets of models to adjust for factors that might explain the relationship between practice size and mean QOF scores. The first set of models, which we term the 'multivariate baseline' model, controls or adjusts for:

- characteristics of the MSOA (specifically, levels of deprivation, population density and the percentage of the population that is white);
- characteristics of the patients registered at the practice (percentage of the practice list who are aged 75 and over or 15 and under);
- characteristics of doctors in the practice (percentage of FTE GPs under the age of 40, female and trained outside the UK/EEA);
- characteristics of the local health economy,[12] such as waiting lists, complaints per bed, teaching trust status of the nearest trust, distances to the nearest two NHS acute trusts and distances to the nearest two independent sector providers (ISPs);[13]

[12] There may be a link between the quality of primary and secondary care services in particular areas. This may be due to underlying management practices in the area, or better coordination between different parts of the health service. Better-quality secondary care may also reduce the demand for primary care. It is therefore important to control for the characteristics of the health economy in which the GP practice is located.

[13] ISPs are private, secondary care providers who treat NHS-funded patients for elective procedures. For more information on these providers, see Arora et al. (2013).

- other practice characteristics (whether the practice opted out of providing out-of-hours care (in 2006/07) and indicators for whether the practice was a dispensing practice and had branch surgeries).[14]

The second set of models, which we term the 'PCT fixed effects' model, introduces fixed effects at the primary care trust (PCT) level.[15] The fixed effects act to control for all factors that are constant at the PCT level over time, which might include certain aspects of population composition, such as a high population density, or the policies of the PCT administration. This model therefore compares GP practices with headquarters in the same local area.[16] The advantage of this specification is that it controls more precisely for differences in local populations and their associated needs than in the multivariate baseline model.[17] Full results of the PCT fixed effects specification are provided in Appendix B.

The effects of practice size on quality in both models are displayed in Table 3.2. All effects are relative to large practices. Shaded cells indicate that practices in that size category had QOF scores that were significantly different from those in large practices at the 5% significance level.

For both sets of models, there was a statistically significant size gradient in QOF scores, even after controlling for other characteristics of the GPs, patients and the local area. That is, even comparing GP practices in the same PCT, and therefore serving similar populations, large practices had slightly better QOF scores than single-handed and small-medium practices. The multivariate baseline results indicate that single-handed practices achieved, on average, scores that were 0.68 percentage points smaller than large practices. Small-medium practices also achieved a smaller percentage of available points (0.33 percentage points fewer). The PCT fixed effects model yielded similar results. Differences for medium-large practices were statistically insignificant in both models.

The bottom four panels of Table 3.2 break down the QOF scores into the four domains. We might expect different effects across the domains if it is harder for smaller practices to maximise points in certain areas. Again, the size gradient persisted across the clinical, organisational and additional services domains. The gradient was steepest for additional services, which suggests that smaller

[14] All of the data are at GP practice level and we cannot differentiate between the behaviour of GPs at different branches of the same practice.

[15] PCTs were administrative bodies responsible for commissioning primary, secondary and community NHS-funded health care within a given area. They were also responsible for providing administrative and management guidance to providers within these areas. Practices within the same PCT may therefore have had similar outcomes due to sharing similar management practices, in addition to serving similar geographical areas and local populations.

[16] We clustered standard errors at the PCT level.

[17] We can also conduct this analysis at the MSOA level. This captures differences across small areas in even greater detail. The direction and magnitude of results were similar to those reported in the PCT model. However, the precision of results was severely reduced because fewer than half of GP practices were located within the same MSOA as another practice.

Table 3.2. Models of the relationship between practice size and QOF scores, relative to large practices (2010/11)

Practice size	*Multivariate baseline*		*PCT fixed effects*	
	Estimate	**95% CI**	**Estimate**	**95% CI**
All				
Single-handed	–0.68	[–1.22, –0.15]	–0.62	[–1.11, –0.13]
Small-medium	–0.33	[–0.59, –0.07]	–0.30	[–0.58, –0.01]
Medium-large	–0.08	[–0.27, – 0.11]	–0.07	[–0.27, –0.13]
Clinical				
Single-handed	–2.14	[–2.70, –1.57]	–2.20	[–2.73, –1.67]
Small-medium	–1.28	[–1.55, –1.01]	–1.33	[–1.61, –1.05]
Medium-large	–0.35	[–0.54, –0.17]	–0.40	[–0.59, –0.21]
Organisational				
Single-handed	–1.59	[–2.24, –0.93]	–1.44	[–2.04, –0.84]
Small-medium	–0.94	[–1.25, –0.62]	–0.82	[–1.16, –0.48]
Medium-large	–0.25	[–0.47, –0.03]	–0.16	[–0.41, 0.09]
Additional services				
Single-handed	–2.97	[–3.69, –2.25]	–2.87	[–3.71, –2.03]
Small-medium	–1.26	[–1.59, –0.92]	–1.14	[–1.48, –0.80]
Medium-large	–0.32	[–0.54, –0.09]	–0.27	[–0.48, –0.06]
Patient experience				
Single-handed	13.13	[11.49, 14.77]	13.95	[12.22, 15.68]
Small-medium	8.44	[7.24, 9.64]	8.92	[7.63, 10.21]
Medium-large	2.46	[1.36, 3.56]	2.64	[1.47, 3.80]

Note: CI denotes confidence interval. Shaded cells indicate that the estimated difference between the coefficient on practice size estimated in the model was statistically significant at the 5% significance level (p-value < 0.05).
Source: Authors' calculations using NHAIS GP data.

practices find it more difficult to provide such services than large practices. In contrast, a large, negative size gradient remained in the patient experience domain. The fixed effects specification suggests that single-handed practices scored 13.95% more points in this domain than comparable large practices.

The results in this chapter are suggestive of a small, positive overall QOF–practice size gradient. However, marked differences were observed when different domains were examined, with a much larger and negative gradient being observed in the patient experience domain than in the others. This suggests that patients at smaller practices are more satisfied with the care that they receive than patients at large practices. However, this particular domain accounts for less than 10% of the overall QOF score. As a result, the larger negative effects of practice size on QOF points in this domain did not outweigh the positive size gradient observed in the other domains. This would indicate that large practices are associated with better overall outcomes, despite lower patient satisfaction.

It is also important to note that these estimates should still be interpreted with caution as there may have been unobserved factors, even at the local level, that explain the results. For example, sicker or poorer patients may be more likely (for whatever reason) to register with smaller practices than healthier or richer patients, which might make it harder to achieve maximum QOF scores

3.3 Summary

- There is a small, positive relationship between practice size and average QOF scores. In 2010/11, large practices with more than six FTE GPs achieved, on average, an additional 24 points compared with single-handed practices.
- Large practices achieved higher mean scores for three of the four domains that contribute to QOF scores: clinical, organisational and additional services. These domains made up more than 90% of the total scores.
- In contrast, single-handed GP practices achieved greater scores in the patient experience domain. In 2010/11, these practices achieved an average of 78.5% of available patient experience points. This compares with an average of 68.6% for large practices.
- These relationships remained after controlling for differences in the practice population, the local area and the characteristics of GP practices across practices of different sizes. When controlling for PCT fixed effects, single-handed GPs achieved scores that were 0.62% lower than those achieved by large practices.
- This is despite achieving scores that were 13.95% higher in the patient experience domain. Patients of single-handed practices therefore appear to be more satisfied with the care that they received, even if the overall QOF scores indicate that the care was of slightly lower quality.

4. Emergency Inpatient Admissions Related to Ambulatory Care Sensitive Conditions

Emergency inpatient admissions for ACS conditions are potentially avoidable with the appropriate use of preventative and primary care services (Billings et al., 1993). Under the assumption that better-quality care reduces hospital use for such conditions, ACS admissions are regularly used as a measure of the quality of primary health care in the UK and in other countries (Blunt, 2013). Moreover, the Department of Health itself now uses related measures when judging improvements in health outcomes, and includes indicators based on these admissions in its NHS Outcomes Framework. This chapter examines the relationship between GP practice size and the number of emergency inpatient admissions for ACS conditions among the population registered with each practice in England.

Billings et al. (1993) note that the reduction in hospitalisation risk from effective primary care operates through three distinct channels. This provides three broad categories of condition types:

- acute conditions – these include episodic illnesses that occur infrequently;
- chronic conditions – these include long-term conditions that require long-term management;
- vaccine-preventable and other preventable conditions – these include conditions that can, in general, be avoided through the use of vaccines and other preventative medicines.

The total number of ACS admissions among a practice's population may be largely determined by the size and demographic composition of its registered patients. In order to account for this variation, we used data from the inpatient Hospital Episode Statistics (HES) to calculate age- and sex-standardised ACS admissions ratios in 2010/11. These compare the observed level of admissions at each GP practice to the number of admissions that would be expected given the size and demographic composition of the population registered with the practice. Ratios were created for total admissions, and separately for acute, chronic and vaccine-preventable conditions.[18] Full details are available in Appendix A.

[18] We refer to admissions ratios throughout this chapter. In all cases, these ratios have been standardised for age and sex.

4.1 Differences in ACS admissions, by practice size

Table 4.1 shows the mean ACS admissions ratios in 2010/11, by practice size. Ratios are presented for all ACS admissions, and separately for acute, chronic and vaccine-preventable conditions. Standard deviations are displayed in brackets.

We first focus on admissions for all conditions. There were clear differences in average ratios across practice size, with the mean ratio falling with the number of FTE GPs. The mean ratio for single-handed practices was 1.26. This means that these practices had, on average, an additional 26% of annual admissions above what would be expected given the size and demographic composition of their practice list. Small-medium practices also had higher than expected admissions (an additional 17%). Medium-large practices had a ratio closer to one, while large practices (with more than six FTE GPs) had a ratio below one. Ratios also varied more for smaller practices, as shown by the larger standard deviations for these practices.

Similar patterns emerge if we separately examine admissions related to acute, chronic and vaccine-preventable conditions. The steepest gradient with practice size was observed for admissions related to chronic conditions. Single-handed practices had an additional 30% of inpatient admissions related to chronic conditions, over and above the admissions that would be expected given the size and demographic composition of their practice lists. This compared with the largest practices, with 5% fewer admissions than would be expected.

We saw in Chapter 2 that smaller practices have a greater number of registered patients per FTE GP than larger practices. The difference in mean admissions ratios across different-sized practices may therefore reflect differences in the ability of patients to obtain appointments with their GP and choosing to go to

Table 4.1. Mean age- and sex-standardised admissions ratios for ACS conditions, by practice size, 2010/11

Practice size	*Admission for ACS condition type*			
	All ASC conditions	**Acute**	**Chronic**	**Vaccine-preventable**
Single-handed	1.26 (0.62)	1.26 (0.71)	1.30 (0.73)	1.31 (0.95)
Small-medium	1.17 (0.57)	1.17 (0.60)	1.21 (0.69)	1.21 (0.81)
Medium-large	1.02 (0.46)	1.00 (0.49)	1.04 (0.54)	1.05 (0.63)
Large	0.94 (0.41)	0.95 (0.43)	0.95 (0.46)	0.99 (0.56)

Note: Includes all 8,127 practices that provided information on the age/sex composition of the population registered in the practice in 2010/11. Ratios are at the practice level. Standard deviations are displayed in brackets.
Source: Authors' calculations using NHAIS GP data.

A&E instead. In all cases, fewer FTE GPs were associated with higher than expected admissions.

The results in Table 4.1 show the relationship between practice size and admissions ratios on average. However, there are at least two reasons why the mean might not be the appropriate metric for assessing relationships with practice size. First, as documented in Chapter 2, there is substantial variation in the characteristics and quality of GP practices within size categories, particularly for single-handed practices. Second, if we are concerned about patient health, we may be more interested in examining the determinants of 'poor' GP behaviour, rather than the determinants of the mean where most practices may be performing quite well.

For these reasons, Table 4.2 examines the relationship between practice size and the probability that the practice falls into the 20% of practices where actual admissions most exceed expected admissions (i.e. the fifth of practices with ratios that most exceed one).[19] If practice size is unrelated to admissions, the share of practices falling into the worst-performing quintile will be 20% in each size category (in other words, we would expect to see a share of 0.2 in each cell of Table 4.2).[20]

Table 4.2. Share of GP practices falling into the poorest-performing age- and sex-standardised ACS admissions ratio quintile, by practice size, 2010/11

Practice size	*ACS admission type*			
	All	**Acute**	**Chronic**	**Vaccine-preventable**
Single-handed	0.27	0.28	0.29	0.28
Small-medium	0.25	0.24	0.25	0.24
Medium-large	0.15	0.15	0.16	0.16
Large	0.10	0.11	0.11	0.12

Note: Includes all 8,127 practices that provided information on the age/sex composition of the population registered in the practice in 2010/11. The poorest-performing quintile is defined within each financial year as the 20% of practices with the greatest age- and sex-adjusted admissions ratios. Quintiles are defined separately for each type of ACS condition.
Source: Authors' calculations using NHAIS GP data.

[19] We observe very similar results when examining deciles (the greatest 10% of ratios) and quartiles (the greatest 25%).

[20] Given that single-handed practices have, on average, smaller practice list sizes, they may display a greater degree of natural variation than larger practices. If this were the case, then we would also expect to see single-handed practices over-represented in the best-performing quintile. We did not observe this in the data. Instead, the share of single-handed practices increased linearly as we moved from the best- to worst-performing quintiles.

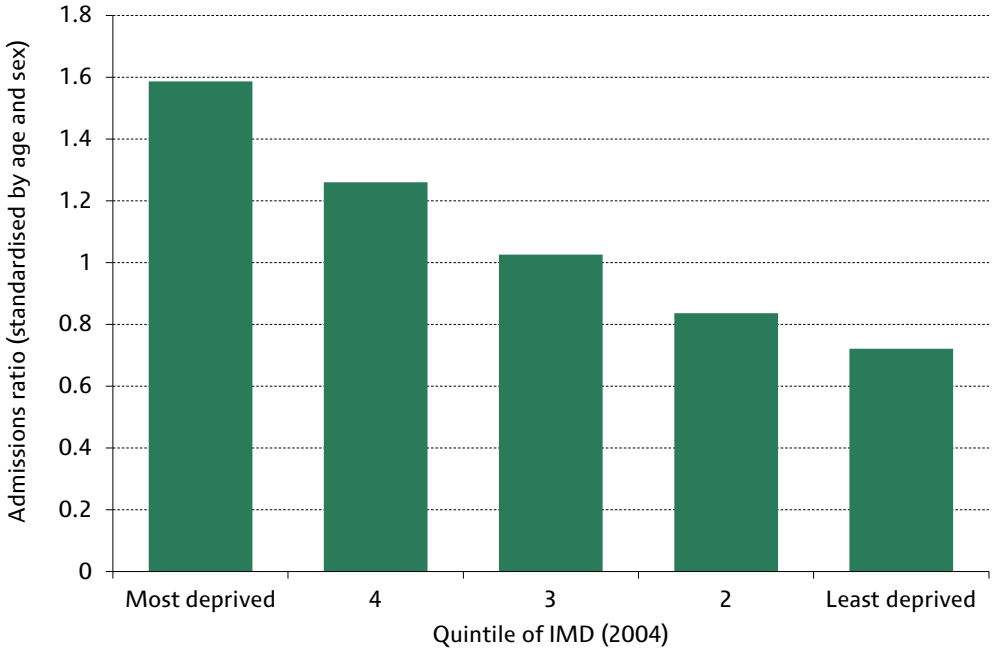
The results indicate that smaller practices are in fact more likely to be in this quintile. Single-handed GPs are more than three times as likely to fall into this group as practices with more than six FTE GPs. The differences between the two groups were broadly similar across all admissions types.

4.2 Multivariate analysis: ACS admissions

Although the analysis presented in the previous section controlled for differences in the age and sex of patients registered at different practices, practices of different sizes also differ in some other respects, as shown in Chapter 2. These differences might also affect admission rates. To illustrate this, Figure 4.1 shows the mean ACS admissions ratios, by quintile of IMD. Richer areas were associated with lower admissions ratios, with the average ratio falling linearly with deprivation. Practices located in the 20% most deprived areas had a mean ratio of just under 1.6. This compares with just over 0.7 in the richest quintile.

Average practice size also varied with deprivation level. Regarding single-handed practices, 10% were located in the least deprived areas, while 30% were located in the most deprived areas. In contrast, 28% of large practices were located in the least deprived areas, while only 12% were located in the most deprived areas. As a result, differences between the admissions ratios of practices in different areas,

Figure 4.1. ACS admissions ratios, by local area deprivation level, 2010/11



Note: Deprivation was measured by the 2004 IMD. Practices were assigned to MSOAs based on practice (headquarters) postcode in 2010/11. Differences between the ratio and one represented additional (fewer) procedures above (below) the expected level (given patient list size and composition) in percentage-point terms.
Source: Authors' calculations using NHAIS GP data.

which arise as a result of differences in local deprivation levels, may be falsely attributed to differences in practice size.

To address the concerns over such confounding factors, we now consider the two models set out in Chapter 3, which control for the differences in other characteristics of GP practices of different sizes. Detailed results for the PCT fixed effects specification can be found in Appendix B.

Table 4.3 presents the results relating to the effects of practice size on mean admissions ratios. Results are presented for all conditions, and by each of the three subcategories. All effects are relative to large practices. Shaded cells indicate that practices in that size category had admissions ratios that were significantly different from those of large practices at the 5% significance level.

Taken together, the multivariate baseline results suggest that smaller practices had, on average, higher ACS admissions ratios than large practices, even after controlling for differences in the practice population, the local area and the characteristics of the GPs. These estimates were linear in the case of acute conditions, with the mean ratio increasing as practice size fell. However, for chronic conditions, the greatest difference was between the largest practices and

Table 4.3. Models of the relationship between GP practice size and ACS admissions ratios (2010/11)

Practice size	*Multivariate baseline*		*PCT fixed effects*	
	Estimate	95% CI	Estimate	95% CI
All				
Small	0.048	[0.011, 0.085]	0.024	[–0.011, 0.060]
Small-medium	0.052	[0.028, 0.077]	0.017	[–0.003, 0.037]
Medium-large	0.033	[0.013, 0.053]	0.015	[–0.002, 0.031]
Acute				
Small	0.066	[0.021, 0.110]	0.024	[–0.017, 0.064]
Small-medium	0.053	[0.025, 0.082]	0.008	[–0.014, 0.030]
Medium-large	0.042	[0.019, 0.065]	0.015	[–0.004, 0.034]
Chronic				
Small	0.051	[0.005, 0.096]	0.034	[–0.012, 0.081]
Small-medium	0.061	[0.032, 0.091]	0.030	[0.004, 0.056]
Medium-large	0.035	[0.012, 0.059]	0.018	[–0.003, 0.039]
Vaccine-preventable				
Small	0.022	[–0.038, 0.082]	0.015	[–0.040, 0.071]
Small-medium	0.032	[–0.006, 0.070]	0.009	[–0.026, 0.043]
Medium-large	0.010	[–0.021, 0.041]	0.009	[–0.016, 0.035]

Note: CI denotes confidence interval. Shaded cells indicate that the coefficient estimated in the model was statistically significant at the 5% significance level (p-value < 0.05). A coefficient of 0.05 means that actual admissions were five percentage points greater than the expected level, given practice list size and composition.
Source: Authors' calculations using NHAIS GP data.

small-medium practices. We did not observe any statistically significant differences for vaccine-preventable admissions.

The multivariate baseline results indicate that single-handed and small-medium practices had mean admissions ratios that were approximately five percentage points higher than large comparable large practices. The mean admission ratios of single-handed practices and medium-large practices were greater than for the largest practices, but the differences were smaller in magnitude.

The pattern changed, however, when the fixed effects model was used. Focusing first on total ACS admissions, we see that the average ratios for smaller practices remained larger than for large practices, but these differences were no longer statistically significant.

If we examine the results separately by condition type, we observe no statistically significant differences for acute and vaccine-preventable conditions. There were significant differences in the case of chronic conditions, with small-medium practices having, on average, higher admissions ratios than large practices. The difference between small and large practices was the greatest in magnitude, but was not statistically significant.

Table 4.4 presents estimates of the effect of GP practice size on the likelihood of falling into the poorest-performing admissions ratio quintile (those with the 20% greatest ratios). Shaded cells indicate that practices in that size category were significantly (at the 5% significance level) more likely to fall into the poorest admissions ratio quintile than large practices. Taken together, the results indicate that smaller practices were more likely to be in the poorest-performing quintile than larger practices, although the precise relationship varied across the different specifications.

When examining overall admissions ratios, the multivariate baseline results suggest that the smallest practices were not significantly more likely to appear in the poorest-performing quintiles than large practices. In contrast, practices with between one and six FTEs were significantly more likely to be in the poorest-performing quintile.

When each condition type was examined separately, the multivariate baseline results varied considerably. Relative to the largest practices, single-handed practices were more than five percentage points more likely to appear in the poorest-performing quintile for acute admissions. Small-medium practices were also more likely to appear in this group. This pattern was repeated for vaccine-preventable conditions, with both small and small-medium practices most likely to appear in the worst-performing quintile. In the case of chronic admissions, all practices with six or fewer FTE GPs were more likely to fall into this group than large practices.

The pattern again changed when controlling for PCT effects. Small-medium practices were more likely to appear in the worst-performing quintile than large practices, when looking at admissions ratios for all ACS conditions. Results again

Table 4.4. Models of the relationship between GP practice size and the likelihood of falling into the poorest-performing admissions ratio quintile (2010/11)

Practice size	*Multivariate baseline*		*PCT fixed effects*	
	Estimate	95% CI	Estimate	95% CI
All				
Small	0.028	[–0.004, 0.060]	0.018	[–0.016, 0.052]
Small-medium	0.049	[0.028, 0.070]	0.027	[0.006, 0.050]
Medium-large	0.019	[0.001, 0.037]	0.009	[–0.008, 0.026]
Acute				
Small	0.051	[0.018, 0.084]	0.023	[–0.012, 0.059]
Small-medium	0.043	[0.021, 0.065]	0.01	[–0.012, 0.033]
Medium-large	0.015	[–0.004, 0.034]	–0.003	[–0.022, 0.015]
Chronic				
Small	0.040	[0.008, 0.072]	0.037	[0.002, 0.072]
Small-medium	0.048	[0.027, 0.070]	0.031	[0.010, 0.053]
Medium-large	0.020	[0.002, 0.038]	0.012	[–0.006, 0.030]
Vaccine-preventable				
Small	0.042	[0.008, 0.076]	0.039	[–0.002, 0.080]
Small-medium	0.042	[0.019, 0.065]	0.032	[0.007, 0.056]
Medium-large	0.015	[–0.005, 0.034]	0.015	[–0.004, 0.034]

Note: CI denotes confidence interval. Shaded cells indicate that the coefficient estimated in the model were statistically significant at the 5% significance level (p-value < 0.05). A coefficient of 0.05 means that practices of a given size were five percentage points more likely to fall into the worst-performing quintile, after controlling for practice list size and composition.
Source: Authors' calculations using NHAIS GP data.

varied by condition type. Small-medium practices were more likely than large practices to appear in the worst-performing quintile for chronic and vaccine-preventable admissions, while single-handed practices were most likely to appear in this group for chronic conditions. In the case of acute conditions, there were no significant differences between practices of any size.

Taken together, the results in Tables 4.3 and 4.4 contain two key findings. First, the estimates suggest that large practices are generally associated with lower standardised admissions ratios for ACS conditions. This relationship holds both on average and in the worst-performing quintile of practices in the multivariate models. The addition of PCT fixed effects weakens this relationship, but statistically significant differences remain across practice size in the probability of appearing in the worst-performing quintile for a number of condition types.

Second, the exact nature of the relationship changes depending on the types of admissions that are examined. The results from each specification indicate that practice size plays a role, both at the mean and in the probability of appearing in the worst-performing group, for chronic admissions. Table 4.3 suggests that medium-sized practices perform worse, on average, than large practices. Table

4.4 indicates that the greatest differences in extreme outcomes are found between single-handed practices and large practices. These differences are likely to reflect the difficulties that smaller practices face, relative to large practices, in regularly monitoring chronic conditions of their patients. As we observed in Table 2.3, large practices typically treat fewer patients per FTE GP. GPs at large practices may be able to spend a greater amount of time with patients as a result, and therefore actively manage chronic conditions. This would have an important role in preventing admissions related to ACS chronic conditions.

4.3 Summary

- Small practices with three or fewer FTE GPs had a larger number of emergency hospital admissions in 2010/11 than would be expected given the size, age and sex composition of their registered population. In contrast, large practices with more than six FTEs had fewer admissions than would be expected.

- Smaller practices were also more likely to appear in the worst-performing fifth of practices. In this group, there were 27% of single-handed practices, compared with 10% of large practices.

- Many of the raw differences were driven by the characteristics of the population and the local area that small practices serve. When controlling for these characteristics and including PCT fixed effects, the differences in standardised admissions ratios fell across practice size.

- On average, medium-large practices had worse admissions ratios than large practices.

- Differences in outcomes for chronic and vaccine-preventable conditions persisted across size in both the multivariate and PCT fixed effects specifications. Medium-sized practices had worse outcomes on average, while single-handed and small-medium practices were more likely to appear in the worst-performing quintile for chronic and vaccine-preventable conditions.

5. Referrals

In addition to providing primary health care services to patients registered at their practice, GPs also act as gatekeepers to secondary or specialist NHS-funded care. Appropriate referrals are important to ensure that patients receive the additional health care that they need, but these referrals also generate significant costs in terms of subsequent consultations and treatment (Imison and Naylor, 2010).

Rates of referral per patient have been rising for many years (BMA, 2009; Imison and Naylor, 2010). In 2006/07, the total number of first outpatient referrals by GPs stood at 9.6 million. By 2010/11, this had risen to 13.7 million.[21] Some of this rise is explained by increases in the number of consultations per patient and an ageing population (BMA, 2009). However, there is significant variation across GP practices that is not readily explained by population need (BMA, 2009; Imison and Naylor, 2010; McBride et al., 2010).

In this chapter we examine the relationship between practice size and how frequently and where patients are referred by their GPs for their first outpatient appointment. Data on outpatient referrals come from the outpatient HES from the financial year 2010/11. The National Institute for Health and Care Excellence (NICE) has produced a range of guidelines for referrals for specific conditions. However, the outpatient data contain very little information about the diagnoses or treatments that patients receive, and we have no data at the primary care level. As such, we cannot construct measures based on those guidelines, or draw any strong conclusions about whether appropriate referral rates differ across GP practices. Instead, we construct measures of overall referral patterns, and discuss how and why these measures might be related to practice size. Full details on the data are available in Appendix A.

Using the outpatient HES data, we constructed two measures of referral behaviour in 2010/11, as follows.

- The age/sex standardised referral ratio (SRR)[22] – a ratio of one indicates that a practice is referring at the same rate as the England-wide average, given the age and sex composition of the practice list. A ratio above one indicates a higher referral rate and a ratio below one indicates a lower referral rate.

- The percentage of patients referred to an ISP – this indicator aims to capture whether GP practices have offered their patients the opportunity to receive

[21] Authors' calculations using the outpatient HES data.

[22] Referral ratios are indirectly standardised by age and sex, using the England-wide rate of referrals per patient for each five-year age and sex band. See Appendix A for further details.

treatment at ISPs, and potentially indicates the willingness or ability of GPs to offer a full range of treatment options to patients.

These measures are designed to provide indicators for GP practice referral behaviour. However, we are aware that many reasons related to the local health economy or patient need may explain why these measures could vary. These factors are in part addressed by multivariate analysis later in this chapter.

5.1 Mean differences in referral behaviour, by practice size

Table 5.1 shows the average (mean) values of each indicator, by practice size. For both indicators, the relationships do not appear strong and there is not a clear gradient. However, there are several reasons why the mean might not be the appropriate metric for assessing relationships with practice size. First, as documented in Chapter 2, there is substantial variation in the characteristics and quality of GP practices within size categories, particularly for single-handed practices. Second, we have no information about patient diagnoses or conditions, and so we cannot ascertain whether referrals are appropriate or not. Hence, variation around the mean might reflect differences in underlying need. It might, of course, also be the case that particularly low or high referrals are appropriate, given patient need, but the concern is somewhat reduced. Third, if we are concerned about patient health, we may be more interested in examining the determinants of unusual referral practices, rather than the determinants of the mean where practices of all sizes may be performing similarly. Finally, for the SRR, the optimal rates of referrals are likely to be closer to one, with higher than average or lower than average referrals more likely to signify poor practice.

Table 5.2 therefore considers potential measures of unusual or outlying referral behaviour, by examining the probability that GP practices fall into the 20% of practices with outcomes that deviate most from 1. If practice size is unrelated to each of these indicators, then the share of practices falling into these groups will be 20% in each size category.

'Outlier' referring outcomes are defined as follows:

- practices that fall into the highest fifth in terms of SRRs;
- practices that fall into the lowest fifth in terms of SRRs;
- practices that fall into the lowest fifth in terms of share of referrals to ISPs.

In contrast to Table 5.1, Table 5.2 shows a clear relationship between practice size and referral behaviour. For both the two SRR indicators and ISP referrals, the probability of being in the bottom quintile fell linearly with practice size, while the probability of being in the highest quintile also fell linearly.

Table 5.1. Referral indicators, by practice size, 2010/11

Practice size	SSR	% of ISP referrals
Single-handed	1.009	3.19
Small-medium	1.021	3.59
Medium-large	1.002	3.66
Large	0.965	3.60

Source: Authors' calculations using NHAIS GP data.

Table 5.2. GP practices in the lowest quintile, 2010/11

Practice size	High SRR	Low SRR	Low ISP referrals
Single-handed	0.236	0.269	0.273
Small-medium	0.220	0.209	0.166
Medium-large	0.196	0.169	0.103
Large	0.155	0.188	0.089

Source: Authors' calculations using NHAIS GP data.

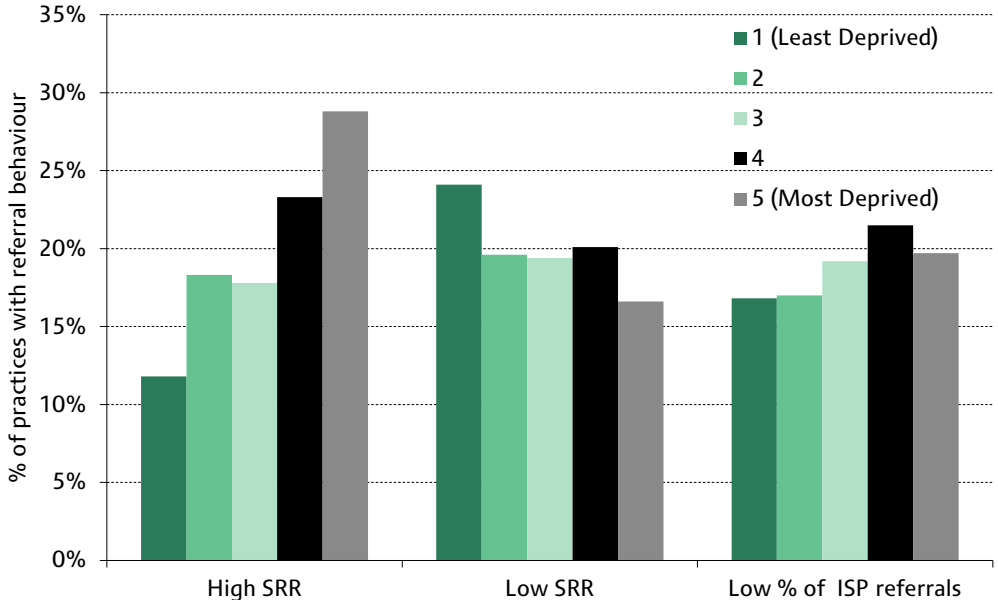
5.2 Practice size and referral behaviour: multivariate analysis

As described in Chapter 2, practices of different sizes also differ in other respects, which might affect referral behaviour. To further illustrate this point, Figure 5.1 shows the rate of outlier referral behaviour by level of deprivation in the MSOA of the GP practice headquarters. Practices in the least deprived areas had lower proportions of high SRRs, higher proportions of low SRRs and lower proportions of low ISP referrals. Smaller practices are located in areas with higher average deprivation. It is therefore important to adjust for the needs of the local population when considering the relationship between practice size and GP referral behaviour.

As in Chapters 3 and 4, we have adjusted for factors at the population, local health economy and GP practice levels using two models: baseline multivariate analysis and PCT fixed effects.[23] Table 5.3 summarises the relationship between practice size and the rates of outlier referring behaviour. All effects of practice size were measured relative to large practices (which have more than six FTE GPs). Shaded cells indicate that GP practices in that category were significantly more or less likely to demonstrate unusual referring behaviour.

[23] For the SRR outcomes, we did not adjust for population composition, because this was accounted for in the ratio.

Figure 5.1. Prevalence of outlier referral behaviour, by local area deprivation level, 2010/11



Note: Deprivation is measured by the 2004 IMD. Practices are assigned to MSOAs based on practice (headquarters) postcode in 2010/11.
Source: Authors' calculations using NHAIS GP data.

Table 5.3. Models of the relationship between GP practice size and the likelihood of falling into the highest/lowest referral quintile, 2010/11

Practice size	*Multivariate baseline*		*PCT fixed effects*	
	Estimate	95% CI	Estimate	95% CI
High SRR				
Single-handed	0.042	[0.004, 0.079]	–0.004	[–0.048, 0.039]
Small-medium	0.038	[0.011, 0.064]	0.015	[–0.011, 0.042]
Medium-large	0.035	[0.012, 0.058]	0.021	[–0.002, 0.044]
Low SRR				
Single-handed	0.095	[0.057, 0.132]	0.120	[0.086, 0.154]
Small-medium	0.044	[0.017, 0.070]	0.053	[0.032, 0.075]
Medium-large	–0.011	[–0.034, 0.013]	0.001	[–0.021, 0.023]
Low % of ISP referrals				
Single-handed	0.025	[–0.016, 0.066]	0.056	[0.019, 0.092]
Small-medium	–0.026	[–0.056, 0.003]	0.011	[–0.017, 0.040]
Medium-large	–0.028	[–0.049, –0.007]	–0.006	[–0.024, 0.013]

Note: CI denotes confidence interval. Shaded cells indicate that the coefficient estimated for the difference between the practice size group and large practices in the model is statistically significant at the 5% significance level (p-value < 0.05). A positive (negative) coefficient indicates that practices within the size category are more (less) likely to fall into this group than large practices.
Source: Authors' calculations using NHAIS GP data.

Results for the multivariate baseline specifications in the left-hand panel of the table indicate that single-handed and small-medium practices were more likely to appear in lowest and highest SRR quintiles than large practices. This effect was greatest in the case of low SRRs, where single-handed practices were 9.5% more likely to appear in this group than comparable large practices. The results indicated no statistically significant relationship for practice size and the percentage of ISP referrals for single-handed and small-medium practices. However, medium-large practices were slightly less likely to appear in the low ISP referral group than large practices.

Moving on to the right-hand panel of Table 5.3, PCT fixed effects control for all characteristics that are constant at the PCT level, including average PCT population composition and the nature of the local health economy. Controlling for these factors removes the relationship between high SRRs and practice size. This indicates that the effects in Table 5.2 and the multivariate baseline specifications reflect differences in the populations served by different types of GP practice and/or differences in the health economies where different types of GP practices are located. By contrast, adding PCT fixed effects strengthens the relationship between low SRRs and practice size.

Single-handed practices are also more likely to refer a low proportion of patients to ISPs. This may be because single-handed practices are more likely to be located in areas with more limited access to ISPs. However, this appears not to be the entire explanation, as these practices remain more likely to have low ISP referral rates even once this factor is controlled for through the use of PCT fixed effects. In fact, if anything, the relationship is strengthened by including PCT fixed effects.

Comparing the magnitudes of the effects of practice size and deprivation using the PCT fixed effects estimates, for low SRRs and a low percentage of ISP referrals, the difference between single-handed and large practices was double the size of the difference between the least and most deprived 20% of areas. GPs in the most deprived fifth of areas were more likely to have higher referral concentrations and higher SRRs. In the case of high SRRs, there was a gradient by deprivation, but not by practice size.

Taken together, the results in Table 5.3 indicate that single-handed practices are more likely than large practices to have low SRRs and a low percentage of referrals to ISPs. However, the limited information we have about potential differences in the health and socio-economic composition of the practice list means that it is important to be careful when attempting to claim that single-handed practices in and of themselves cause outlying or unusual referral behaviour.

5.3 Summary

- No obvious practice size gradient exists for average referral behaviour.
- Smaller practices are disproportionately found in the fifth of practices with the lowest referral rates. For the SRR indicator and ISP referrals, the probability of being in the lowest referring quintile falls linearly with practice size.
- Outlier referral behaviour is strongly correlated with deprivation levels of the local area. Small practices are also disproportionately located in more deprived areas. It is therefore important to control for differences in the characteristics of areas when examining the relationship between practice size and practice referral behaviour.
- Practices with three or fewer FTE GPs are significantly more likely to appear in the lowest fifth of practices when ranked by SRR. Single-handed practices were 12.0%, and small-medium practices 5.3%, more likely to appear in this group than large practices.
- Single-handed practices were 5.6% more likely to appear in the quintile of practices with a low proportion of referrals to ISPs. This in itself does not mean that the referral behaviour of small practices is worse than large practices. However, it suggests that small practices are less likely to make use of new providers, and therefore may provide a more limited choice of providers to their patients.

6. Summary and Conclusions

There has been a consolidation of GP practices over the last decade, with an increase in the numbers of FTE GPs per practice and (at least in part as a direct result of this) a shift of registered patients towards larger practices. This has been driven by both the growth of existing practices and the exit of single-handed practices over this period.

Data from 2010/11 suggest that, in general, smaller practices provide poorer-quality primary care services. They achieve lower QOF scores on average and have higher rates of hospital admissions among their patients for ACS conditions. The one dimension of QOF on which smaller practices perform better, on average, than larger practices is patient experience. Smaller practices are also less likely to refer their patients for secondary care or to make use of ISPs.

However, it should be noted that there is considerable variation in GP practice quality within size categories. This is particularly the case for single-handed practices. Hence, although single-handed practices have higher rates of poor performance, a substantial proportion of such practices provide high-quality care.

It is also important to carefully consider the interpretation of the results presented in this report. Although the models adjust for observable local area, health care economy and practice characteristics, the relationships between practice size and GP behaviour are still not necessarily causal. There are a large number of factors that we cannot observe, including the underlying health of the practice population, which may explain why smaller practices tend to perform worse.

With this in mind, the findings of the report have potentially important policy implications and suggest two natural avenues for future research. First, larger practice sizes are associated with better clinical outcomes for patients. However, practice size is likely to be only one of several important factors that determine the quality of primary care provided to patients. There are a number of other factors that relate to the quality of GP services, and future research should focus on examining these in more detail. This would help us to understand the relative importance of practice size compared to these other factors, and to direct policy in improving other areas of primary care.

Second, much of the recent public debate surrounding primary care has focused on patients' access to GPs, both in terms of waiting times and in the ability to see the doctor of their choice. Our results suggest that, while larger practices achieve higher overall QOF scores on average, they achieve lower scores for patient experience – indicating that patients of large practices are less satisfied with the care that they receive than patients who are registered at smaller practices. This raises important questions over the negative aspects of increasing practice size and whether there is a trade-off between patients' perceived quality of

experience with their GP and the quality of clinical care they receive. Future research into the determinants of patient experience, and the effect of practice size on access to particular GPs, would add significant value to this discussion.

Appendix A. Data

Data

We used HES data to create outcomes relating to the quality of care received in NHS hospitals. HES contain the records of all NHS-funded hospital care in England and provide information on both inpatient and outpatient treatment.

HES admitted patient care or inpatient data provide information on all NHS-funded hospital admissions in England. Observations are at the episode level.[24] Inpatient data contain detailed information on patient age, sex, registered GP practice and a range of details concerning patient health. This includes up to 20 diagnoses and specific procedure codes undertaken during the episode.[25]

HES outpatient data provide information on all outpatient appointments funded by the NHS. Observations are at the appointment level, and contain information on both the characteristics of the patient and the location of the treatment. Patient information includes age, sex and the GP practice with which they are registered. Appointment information includes the location of the appointment (at both site and trust levels), the date of the appointment and the treatment specialty.

Outcomes

Emergency inpatient admissions for ACS conditions

Emergency inpatient admissions for ACS conditions are indirectly standardised by age and sex. Indirect standardisation applies common age- and sex-specific admission rates to different populations to calculate expected admissions (Naing, 2000). We calculated national age- and sex-specific admissions rates in 2010/11 for the total population registered with GP practices in England, and applied these rates to the registered populations of each practice. Practice populations were taken from Health and Social Care Information Centre extracts from the Exeter GP payments system.

We used inpatient HES data to calculate overall inpatient admissions for ACS conditions, by age and sex band, for the entire GP-registered population in

[24] An episode is defined as a period of care under a single consultant.

[25] Diagnoses are classified by the World Health Organization's *International Statistical Classification of Diseases and Related Health Problems 10th Revision* (ICD-10) codes. Procedures are described by the Office of Population Censuses and Surveys (OPCS) *Classification of Interventions and Procedures Codes* (4th edition).

Table A.1. Specific ACS conditions, by condition type

Category of ACS condition		
Acute	**Chronic**	**Vaccine-preventable and other preventable conditions**
Cellulitis	Angina	Influenza
Dehydration	Asthma	Pneumonia
Dental conditions	Chronic obstructive pulmonary disease	Tuberculosis
Ear, nose and throat infections	Congestive heart failure	Other vaccine-preventable conditions
Gangrene	Convulsions and epilepsy	
Gastroenteritis	Diabetic complications	
Nutritional deficiencies	Hypertension	
Pelvic inflammatory disease	Iron deficiency anaemia	
Perforated or bleeding ulcer		
Urinary tract infection or pyelonephritis		

Note: ACS conditions are defined by the primary ICD-10 code. We also included cases where secondary diagnoses indicate gangrene, diabetic complications, influenza, pneumonia or other vaccine-preventable conditions.
Source: Authors' calculations using NHAIS GP data.

England in 2010/11. We restricted our sample to cases where admissions were made directly through A&E departments.[26]

We divided the population into seven age bands: 0–4, 5–14, 15–44, 45–64, 65–74, 75–84 and 85 and older. The national rate of admissions for each age/sex group was calculated by dividing admissions by the appropriate population. We calculated total expected admissions for each practice by multiplying these national rates by the number of patients registered with the practice in each appropriate age/sex band. We computed age- and sex-standardised ratios by dividing total admissions by total expected admissions.

We produced ratios for total ACS admissions, and for three broad categories of condition: acute, chronic and vaccine-preventable. We used ICD-10 diagnosis codes to classify admissions into each group. Blunt (2013) provides guidance for the categorisation of conditions. Table A.1 shows specific ACS conditions, by condition type.

Age- and sex-standardised referral ratios

Referral ratios were calculated in a similar manner. We combined outpatient HES data and total practice population to calculate the national rate of referrals per

[26] Select GPs have the power to admit patients directly to hospital. We exclude GP admissions from the analysis.

patient for each age band in 2010/11. The expected number of referrals, if GPs were referring at the same rate as the England-wide average, was calculated by multiplying these rates by the number of patients registered with the practice in each age/sex group. We then calculated the practice-level age and sex SRRs by dividing total referrals by the expected total.

Independent sector provider referral rates

ISPs are privately owned providers of secondary care for NHS-funded patients. They were introduced in 2003 and focus on providing routine diagnostic and elective operations. By 2010/11, 161 ISPs were in operation across England, and were responsible for 475,000 outpatient attendances (Kelly and Tetlow, 2012).

The outpatient HES data contain site-level provider codes. These indicate whether the provider operates as an ISP. We calculated ISP referral rates by dividing practice-level outpatient referrals to ISPs by total outpatient referrals. We restricted our attention to referrals within the Orthopaedics and Trauma treatment specialty. This restriction was made for two reasons. First, Orthopaedics and Trauma was the largest treatment specialty in terms of the number of outpatient referrals in 2010/11. Second, ISPs have a larger presence in this treatment specialty than in others. In so far as the measure was used to reflect the referral of patients to new providers by GPs, it is sensible to restrict attention to an area where ISPs have a non-negligible presence.

Table A.2. Variables used in the analysis

Variable	Source	Description
Quality outcomes		
QOF scores	Health and Social Care Information Centre (HSCIC)	QOF scores in 2010/11 (total, clinical, organisational, additional services and patient experience domains)
Inpatient admissions for ACS conditions	HES	Standardised by age and sex of registered practice population
Outpatient referrals	HES	Standardised by age and sex of registered practice population
Area characteristics		
IMD (2004)	Department for Communities and Local Government	Multidimensional measure of deprivation (Lower Layer Super Output Area – LSOA – level)
Population density	Office for National Statistics	100s of individuals per square km (LSOA level)
Ethnicity	Office for National Statistics	Percentage of white ethnicity (LSOA level)
Local health economy		
Nearest trust waiting lists (elective procedures)	HES	Derived period between referral and admission date
Nearest trust teaching status	Department of Health	Dummy indicator of whether the nearest NHS trust had teaching hospital status
Nearest trust foundation trust status	Department of Health	Dummy indicator of whether the nearest NHS trust had achieved foundation trust status by 2006/07
Distance to NHS hospitals	National Postcode Database	Distances between NHS hospitals and GP practices calculated using postcodes and GPS coordinates of treatment sites
Distance to ISPs	National Postcode Database	Distances between ISPs and GP practices calculated using postcodes and GPS coordinates of treatment sites
Nearest trust official complaints per total beds	NHS Estates Return and Information Centre (ERIC)	A derived variable that shows the number of official complaints per total trust beds

Practice list characteristics		
Practice list population details	Exeter GP payment system (HSCIC extract)	Information on the age and sex composition of registered populations at practice level
Percentage of list aged 75 and over	Exeter GP payment system (HSCIC extract)	
Percentage of list aged 15 and under	Exeter GP payment system (HSCIC extract)	
GP characteristics		
Number of FTE GPs	Exeter GP payment system (HSCIC extract)	
Percentage of FTE GPs aged 40 and under	Exeter GP payment system (HSCIC extract)	
Percentage of FTE GPs who are female	Exeter GP payment system (HSCIC extract)	
Percentage of FTE GPs trained outside of the EEA	Exeter GP payment system (HSCIC extract)	
Practice characteristics		
Out-of-hours service opt-out status	HSCIC	Dummy indicator of whether the practice had opted out of providing out-of-hours services in 2006/07
Dispensing practice status	HSCIC	Dummy indicator of whether the practice was a dispensing practice in 2006/07
Branch surgeries indicator	HSCIC	Dummy indicator of whether the practice ran multiple branches (information generally pertains to practice headquarters)

Source: Authors' calculations using NHAIS GP data.

Appendix B. Specifications

Table B.1. PCT fixed effects model of the relationship between practice size and practice-level QOF scores, 2010/11

Omitted comparator	Variable	*QOF domain*				
		Total	**Clinical**	**Organisational**	**Additional services**	**Patient experience**
	Practice size					
Large GP practice (more than six FTE GPs)	Single-handed practice (≤1 FTE GP)	–0.621** (0.249)	–2.199*** (0.267)	–1.438*** (0.305)	–2.870*** (0.425)	13.95*** (0.876)
	Small-medium practice (>1 and ≤3 FTE GPs)	–0.299** (0.144)	–1.334*** (0.141)	–0.818*** (0.171)	–1.138*** (0.172)	8.920*** (0.652)
	Medium-large practice (>3 and ≤6 FTE GPs)	–0.0734 (0.101)	–0.395*** (0.0960)	–0.162 (0.127)	–0.271** (0.105)	2.639*** (0.589)
	Local area characteristics					
	Population density	0.000888 (0.00470)	0.00398 (0.00504)	0.00368 (0.00483)	–1.05e–05 (0.00560)	–0.0273** (0.0130)
IMD, quintile 1	IMD, quintile 2	–0.201 (0.132)	0.0265 (0.152)	0.177 (0.179)	0.178 (0.179)	–2.813*** (0.666)
	IMD, quintile 3	–0.621*** (0.172)	–0.310* (0.187)	–0.114 (0.224)	0.0141 (0.256)	–4.219*** (0.700)
	IMD, quintile 4	–1.069*** (0.190)	–0.522** (0.211)	–0.390* (0.229)	–0.380 (0.250)	–6.823*** (0.837)
	IMD, quintile 5	–1.343*** (0.257)	–0.885*** (0.268)	–0.604** (0.260)	–1.075*** (0.308)	–6.302*** (1.046)
	% white ethnicity for LSOA of GP practice	3.014*** (0.620)	1.547*** (0.569)	0.890 (0.669)	2.838*** (0.829)	18.20*** (2.927)
	Local health economy					
	Number of GP practices within 1 km	–0.00658 (0.0407)	–0.0437 (0.0418)	0.000618 (0.0511)	–0.0516 (0.0543)	0.285** (0.111)

	Mean nearest trust waiting times in 2004	–0.00286 (0.00459)	0.00194 (0.00486)	0.00673 (0.00564)	0.00420 (0.00612)	–0.0596** (0.0241)
	Nearest trust complaints per bed in 2004	–0.252 (0.442)	–0.106 (0.464)	0.427 (0.399)	0.0238 (0.591)	–2.671 (1.794)
	Achieved foundation trust status in 2006/07	–0.0621 (0.198)	–0.154 (0.222)	0.273 (0.217)	0.123 (0.254)	–0.0679 (0.809)
	Achieved teaching hospital status in 2010/11	–0.184 (0.211)	–0.271 (0.210)	–0.398 (0.305)	–0.528 (0.441)	1.055 (0.892)
	Practice characteristics					
	% GPs aged 40 years or younger	0.876** (0.339)	0.885** (0.359)	0.901** (0.347)	1.155*** (0.411)	0.591 (0.983)
	% non-EEA trained FTE GPs	–0.535** (0.221)	–0.798*** (0.232)	–0.285 (0.289)	–1.090*** (0.373)	1.282* (0.754)
	% female FTE GPs	0.225 (0.142)	0.259 (0.161)	0.221 (0.137)	0.317* (0.180)	–0.0739 (0.185)
	Did not provide out-of-hours care in 2006/07	0.159 (0.136)	0.119 (0.143)	0.236 (0.157)	0.566*** (0.186)	0.108 (0.538)
	Dispensing practice in 2006/07	0.606*** (0.146)	0.0513 (0.149)	0.158 (0.185)	0.0357 (0.177)	5.898*** (0.737)
	Practice operates multiple branches	–0.283** (0.126)	0.0244 (0.123)	–0.0787 (0.153)	–0.0171 (0.154)	–3.111*** (0.571)
	% of list aged 75+	0.0349 (0.0623)	0.0788 (0.0692)	0.0431 (0.0447)	–0.130 (0.105)	–0.238* (0.122)
	% of list aged 15 or younger	0.0573* (0.0299)	0.125*** (0.0340)	0.107*** (0.0322)	0.166*** (0.0435)	–0.600*** (0.0710)
	Observations	8,161	8,161	8,161	8,161	8,161
	R^2	0.069	0.100	0.028	0.068	0.126
	Number of PCTs	152	152	152	152	152

Note: Robust standard errors are given in parentheses. *** indicates a *p*-value of less than 0.01, ** indicates a *p*-value of less than 0.05 and * indicates a *p*-value of less than 0.1. Reported effects are relative to omitted categories in the case of categorical variables.
Source: Authors' calculations using NHAIS GP data.

Table B.2. PCT fixed effects model of the relationship between practice size and practice-level admissions ratios for ACS conditions, 2010/11

Omitted comparator	Variable	*Type of ACS admission*			
		All	**Acute**	**Chronic**	**Vaccine-preventable**
	Practice size				
Large GP practice (more than six FTE GPs)	Single-handed practice (≤1 FTE GP)	0.0243 (0.0178)	0.0236 (0.0205)	0.0344 (0.0234)	0.0153 (0.0282)
	Small-medium practice (>1 and ≤3 FTE GPs)	0.0172* (0.0101)	0.00783 (0.0112)	0.0295** (0.0132)	0.00863 (0.0175)
	Medium-large practice (>3 and ≤6 FTE GPs)	0.0147* (0.00829)	0.0150 (0.00940)	0.0178* (0.0107)	0.00933 (0.0129)
	Local area characteristics				
	Population density	–3.41e–05 (0.000308)	9.47e–05 (0.000324)	7.77e–05 (0.000366)	–0.000698 (0.000475)
IMD, quintile 1	IMD, quintile 2	0.112*** (0.0116)	0.0866*** (0.0134)	0.122*** (0.0146)	0.144*** (0.0173)
	IMD, quintile 3	0.236*** (0.0170)	0.174*** (0.0185)	0.281*** (0.0201)	0.267*** (0.0272)
	IMD, quintile 4	0.384*** (0.0236)	0.285*** (0.0219)	0.463*** (0.0299)	0.401*** (0.0368)
	IMD, quintile 5	0.596*** (0.0339)	0.445*** (0.0321)	0.725*** (0.0433)	0.620*** (0.0472)
	% white ethnicity for LSOA of GP practice	–0.119** (0.0538)	–0.0258 (0.0588)	–0.213*** (0.0763)	–0.135 (0.108)

	Local health economy				
0 GP practices within 1 km of practice	1–2 GP practices within 1 km of practice	–0.000476 (0.00949)	0.00137 (0.0116)	0.000832 (0.0126)	–0.00338 (0.0175)
	3–5 GP practices within 1 km of practice	–0.0285** (0.0137)	–0.00977 (0.0155)	–0.0430** (0.0177)	–0.0372 (0.0234)
	6 or more GP practices within 1 km of practice	–0.0398** (0.0187)	–0.0140 (0.0213)	–0.0640** (0.0267)	–0.0252 (0.0339)
	Mean nearest trust waiting times in 2004	0.000541 (0.000622)	7.58e–06 (0.000726)	0.00120* (0.000661)	–0.000424 (0.00123)
	Nearest trust complaints per bed in 2004	–0.0318 (0.0465)	–0.0141 (0.0532)	–0.00877 (0.0508)	–0.126 (0.0990)
	Achieved foundation trust status in 2006/07	0.00598 (0.0283)	–0.0171 (0.0326)	0.0378 (0.0314)	–0.0397 (0.0513)
	Achieved teaching hospital status in 2010/11	0.0124 (0.0298)	–0.0198 (0.0343)	–0.0236 (0.0327)	0.193*** (0.0595)
	Practice has a private hospital closer than the nearest NHS trust	–0.0239 (0.0155)	–0.0178 (0.0168)	–0.0285 (0.0182)	–0.0263 (0.0219)
	Distance to nearest trust headquarters (km)	–0.00313 (0.00210)	–0.00345 (0.00232)	–0.00357 (0.00262)	–0.00189 (0.00194)
	Distance to second nearest trust headquarters (km)	–0.000839 (0.00181)	–0.00132 (0.00203)	–0.000651 (0.00191)	–0.000345 (0.00240)
	Distance to nearest ISP (km)	0.00114 (0.00159)	0.00129 (0.00196)	0.00184 (0.00222)	–0.000463 (0.00183)
	Distance to second nearest ISP (km)	–0.00194 (0.00131)	–0.00214 (0.00155)	–0.00170 (0.00145)	–0.00240 (0.00201)

	Practice characteristics				
2010/11 QOF score, quintile 1	QOF score, quintile 2	–0.0164 (0.0137)	–0.0105 (0.0167)	–0.0203 (0.0180)	–0.0182 (0.0227)
	QOF score, quintile 3	–0.0452*** (0.0143)	–0.0367** (0.0165)	–0.0483** (0.0185)	–0.0605*** (0.0203)
	QOF score, quintile 4	–0.0502*** (0.0135)	–0.0322** (0.0154)	–0.0511*** (0.0192)	–0.0792*** (0.0211)
	QOF score, quintile 5	–0.0571*** (0.0146)	–0.0308* (0.0166)	–0.0760*** (0.0200)	–0.0567** (0.0227)
	% GPs aged 40 or younger	0.0584*** (0.0173)	0.0745*** (0.0212)	0.0572*** (0.0216)	0.0241 (0.0305)
	% non-EEA trained FTE GPs	0.100*** (0.0139)	0.0755*** (0.0162)	0.119*** (0.0178)	0.118*** (0.0226)
	% female FTE GPs	0.0123 (0.00878)	0.00987 (0.00816)	0.00183 (0.00820)	0.0488*** (0.0155)
	Did not provide out-of-hours care in 2006/07	0.00733 (0.0113)	–0.00251 (0.0105)	0.0204 (0.0146)	–0.00773 (0.0171)
	Dispensing practice in 2006/07	–0.0718*** (0.0122)	–0.0687*** (0.0134)	–0.0860*** (0.0159)	–0.0460** (0.0226)
	Practice operates multiple branches	0.00737 (0.00864)	0.0108 (0.00879)	0.00581 (0.0115)	0.00860 (0.0135)
	Observations	7,964	7,964	7,964	7,964
	R^2	0.247	0.122	0.225	0.108
	Number of PCTs	152	152	152	152

Note: Robust standard errors are given in parentheses. *** indicates a *p*-value of less than 0.01, ** indicates a *p*-value of less than 0.05 and * indicates a *p*-value of less than 0.1. Reported effects are relative to omitted categories in the case of categorical variables.
Source: Authors' calculations using NHAIS GP data.

Table B.3. PCT fixed effects model of the relationship between practice size and the likelihood of falling into the poorest-performing admissions ratio quintile, 2010/11

Omitted comparator	Variable	*Type of ACS admission*			
		All	**Acute**	**Chronic**	**Vaccine-preventable**
	Practice size				
Large GP practice (more than six FTE GPs)	Single-handed practice (≤1 FTE GP)	0.0178 (0.0172)	0.0234 (0.0179)	0.0372** (0.0176)	0.0389* (0.0208)
	Small-medium practice (>1 and ≤3 FTE GPs)	0.0272** (0.0105)	0.0102 (0.0115)	0.0314*** (0.0110)	0.0316** (0.0122)
	Medium-large practice (>3 and ≤6 FTE GPs)	0.00897 (0.00882)	–0.00312 (0.00940)	0.0121 (0.00923)	0.0149 (0.00958)
	Local area characteristics				
	Population density	–0.000354 (0.000279)	–3.29e–05 (0.000251)	–0.000106 (0.000254)	–0.000447* (0.000227)
IMD, quintile 1	IMD, quintile 2	0.0287*** (0.00863)	0.0221** (0.0102)	0.0218*** (0.00828)	0.0520*** (0.00989)
	IMD, quintile 3	0.0643*** (0.0139)	0.0535*** (0.0145)	0.0835*** (0.0142)	0.0898*** (0.0146)
	IMD, quintile 4	0.175*** (0.0234)	0.124*** (0.0205)	0.185*** (0.0215)	0.157*** (0.0198)
	IMD, quintile 5	0.321*** (0.0328)	0.216*** (0.0300)	0.366*** (0.0306)	0.280*** (0.0289)
	% white ethnicity for LSOA of GP practice	–0.165*** (0.0499)	–0.0808 (0.0498)	–0.154*** (0.0568)	–0.0872 (0.0599)

	Local health economy				
0 GP practices within 1 km of practice	1–2 GP practices within 1 km of practice	–0.0123 (0.00853)	–0.0127 (0.00906)	–0.00797 (0.00980)	–0.00444 (0.0110)
	3–5 GP practices within 1 km of practice	–0.0226* (0.0119)	–0.0280** (0.0133)	–0.0205 (0.0134)	–0.0209 (0.0140)
	6 or more GP practices within 1 km of practice	–0.0314 (0.0193)	–0.0280 (0.0185)	–0.0300 (0.0215)	–0.0323 (0.0214)
	Mean nearest trust waiting times in 2004	0.000215 (0.000413)	0.000643 (0.000442)	0.000300 (0.000399)	–0.000342 (0.000580)
	Nearest trust complaints per bed in 2004	–0.00334 (0.0394)	0.00717 (0.0471)	–0.0101 (0.0281)	–0.0478 (0.0582)
	Achieved foundation trust status in 2006/07	–0.0210 (0.0148)	–0.0110 (0.0203)	0.0101 (0.0151)	–0.0244 (0.0233)
	Achieved teaching hospital status in 2010/11	–0.00904 (0.0220)	–0.0256 (0.0246)	–0.0130 (0.0159)	0.0637** (0.0312)
	Practice has a private hospital closer than the nearest NHS trust	–0.0219* (0.0113)	–0.0199 (0.0126)	–0.00720 (0.0115)	–0.000603 (0.0123)
	Distance to nearest trust headquarters (km)	–0.000578 (0.000807)	–0.00131 (0.000947)	–0.00108 (0.00131)	–0.000888 (0.000772)
	Distance to second nearest trust headquarters (km)	–0.000711 (0.000893)	–0.00113 (0.00104)	4.82e–05 (0.000796)	–0.000163 (0.00110)
	Distance to nearest ISP (km)	–0.000144 (0.000666)	0.000183 (0.000810)	0.00109 (0.00129)	–0.000625 (0.000622)
	Distance to second nearest ISP (km)	–0.000799 (0.000526)	–2.19e–05 (0.000659)	–0.00110 (0.000683)	–0.000928 (0.000862)

	Practice characteristics				
2010/11 QOF score, quintile 1	QOF score, quintile 2	–0.00540 (0.0134)	–0.00378 (0.0123)	–0.0157 (0.0135)	–0.0113 (0.0148)
	QOF score, quintile 3	–0.0242* (0.0124)	–0.0144 (0.0111)	–0.0295** (0.0134)	–0.0288** (0.0141)
	QOF score, quintile 4	–0.0213* (0.0127)	–0.0115 (0.0116)	–0.0317** (0.0138)	–0.0261* (0.0152)
	QOF score, quintile 5	–0.0330** (0.0127)	–0.00116 (0.0115)	–0.0519*** (0.0141)	–0.0258* (0.0141)
	% GPs aged 40 or younger	0.0314* (0.0169)	0.0306** (0.0151)	0.0354** (0.0154)	0.0339* (0.0194)
	% non-EEA trained FTE GPs	0.0499*** (0.0150)	0.0393*** (0.0130)	0.0608*** (0.0152)	0.0647*** (0.0140)
	% female FTE GPs	0.00484 (0.00449)	0.00670 (0.00442)	0.00722 (0.00513)	0.0151*** (0.00372)
	Did not provide out-of-hours care in 2006/07	0.00201 (0.00819)	–0.0109 (0.00850)	0.00680 (0.0103)	–0.0106 (0.00944)
	Dispensing practice in 2006/07	0.00209 (0.00926)	–0.00389 (0.00844)	–0.00890 (0.0126)	–0.00376 (0.0119)
	Practice operates multiple branches	0.00384 (0.00793)	0.00402 (0.00736)	0.0107 (0.0102)	0.00231 (0.00828)
	Observations	7,964	7,964	7,964	7,964
	R^2	0.105	0.050	0.120	0.062
	Number of PCTs	152	152	152	152

Note: Robust standard errors in parentheses. *** indicates a *p*-value of less than 0.01, ** indicates a *p*-value of less than 0.05 and * indicates a *p*-value of less than 0.1. Reported effects are relative to omitted categories in the case of categorical variables.
Source: Authors' calculations using NHAIS GP data.

Table B.4. PCT fixed effects model of the relationship between practice size and the likelihood of falling into the highest/lowest admissions quintile of referral behaviours, 2010/11

Omitted comparator	Variables	*Performance indicator*		
		High SRR	**Low SRR**	**Low ISP referrals**
	Practice size			
Large GP practice (more than six FTE GPs)	Single-handed practice (≤1 FTE GP)	–0.00441 (0.0220)	0.120*** (0.0173)	0.0555*** (0.0187)
	Small-medium practice (>1 and ≤3 FTE GPs)	0.0151 (0.0134)	0.0532*** (0.0109)	0.0113 (0.0145)
	Medium-large practice (>3 and ≤6 FTE GPs)	0.0212* (0.0116)	0.00145 (0.0111)	–0.00565 (0.00921)
	Local area characteristics			
IMD, quintile 1	IMD, quintile 2	0.0286** (0.0122)	–0.0158 (0.0153)	0.00207 (0.00726)
	IMD, quintile 3	0.0188 (0.0149)	–0.0258 (0.0163)	0.00343 (0.0118)
	IMD, quintile 4	0.0630*** (0.0185)	–0.0253 (0.0178)	0.0150 (0.0144)
	IMD, quintile 5	0.0712*** (0.0237)	–0.0618*** (0.0209)	0.0281* (0.0157)
	% white ethnicity for LSOA of GP practice	–0.0811 (0.0515)	0.0456 (0.0429)	–0.0290 (0.0486)

	Local health economy			
	Number of GP practices within 1 km	0.00139 (0.00273)	0.00299 (0.00209)	0.00461* (0.00235)
	Mean nearest trust waiting times in 2004	0.000991 (0.000895)	–0.000208 (0.000647)	–0.00128*** (0.000474)
	Nearest trust complaints per bed in 2004	–0.0626 (0.0707)	0.0434 (0.0408)	–0.0413 (0.0399)
	Achieved foundation trust status in 2006/07	–0.0346 (0.0297)	–0.0296 (0.0307)	0.0163 (0.0209)
	Achieved teaching hospital status in 2010/11	–0.0455 (0.0357)	–0.0194 (0.0279)	0.0335* (0.0187)
	Practice has a private hospital closer than the nearest NHS trust	–0.0106 (0.0153)	–0.0163 (0.0128)	–0.00137 (0.0104)
	Distance to nearest trust headquarters (km)	0.000510 (0.00116)	0.000905 (0.00139)	–0.00125 (0.00130)
	Distance to second nearest trust headquarters (km)	0.00371 (0.00225)	0.000308 (0.00131)	–0.000424 (0.00173)
	Distance to nearest ISP (km)	–0.00130 (0.00230)	–0.000384 (0.00137)	0.000977 (0.00163)
	Distance to second nearest ISP (km)	–0.000866 (0.00224)	0.000675 (0.00110)	0.00251 (0.00176)
	Practice characteristics			
2010/11 QOF score, quintile 1	QOF score, quintile 2	0.00485 (0.0138)	0.00470 (0.0126)	–0.0267*** (0.0100)
	QOF score, quintile 3	–0.00319 (0.0129)	0.0189 (0.0141)	–0.0278*** (0.0103)
	QOF score, quintile 4	–0.0254* (0.0141)	0.0161 (0.0137)	–0.0370*** (0.0113)
	QOF score, quintile 5	–0.0302** (0.0140)	0.0298* (0.0165)	–0.0372*** (0.0110)

	% GPs aged 40 or younger	0.0809***	–0.0386**	–0.00904
		(0.0189)	(0.0189)	(0.0141)
	% non-EEA trained FTE GPs	–0.0110	0.0145	0.0198
		(0.0136)	(0.0144)	(0.0132)
	% female FTE GPs	0.0196***	–0.0123	–0.00376
		(0.00731)	(0.00770)	(0.00318)
	Did not provide out-of-hours care in 2006/07	–0.00619	0.0130	0.00206
		(0.0125)	(0.0112)	(0.00931)
	Dispensing practice in 2006/07	–0.0138	0.0308	–0.0200
		(0.0161)	(0.0187)	(0.0144)
	Practice operates multiple branches	–0.00908	–0.00110	0.000197
		(0.00824)	(0.0104)	(0.00772)
	Practice list size			–0.00382***
				(0.00121)
	% of list aged 75+			0.00161
				(0.00144)
	% of list aged 15 or younger			0.000334
				(0.00153)
	Observations	7,663	7,663	7,710
	R^2	0.020	0.022	0.041
	Number of PCTs	152	152	152

Note: Robust standard errors in parentheses. *** indicates a *p*-value of less than 0.01, ** indicates a *p*-value of less than 0.05 and * indicates a *p*-value of less than 0.1. Reported effects are relative to omitted categories in the case of categorical variables. Source: Authors' calculations using NHAIS GP data.

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