Accepted Manuscript

British Journal of General Practice

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DOI: https://doi.org/10.3399/BJGP.2020.0737

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Received 30 July 2020
Revised 25 October 2020
Accepted 27 October 2020

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Are more GPs associated with a reduction in emergency hospital admissions?

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Background Recent studies have found an association between access to primary care and accident and emergency attendances, with better access associated with fewer attendances. Analyses of an association with emergency admissions however have produced conflicting findings.

Aim: We investigate whether emergency admission rates in an area are associated with (i) the number of GPs, and (ii) mean size of GP practice.

Design and Setting: Analysis was conducted utilising Hospital Episode Statistics, the numbers of GPs and GP practices, ONS population data, Quality and Outcomes Framework (QoF) prevalence data, and Index of Multiple Deprivation data, from 2004/5 to 2011/12, for all practices in England.

Method: Regression analysis of panel data with fixed effects to address (i) a potential two-way relationship between the numbers of GPs and emergency admissions, and (ii) unobservable characteristics of GP practices.

Results: There is not a statistically significant relationship between the number of GPs in a PCT area and the number of emergency admissions when analysing all areas. However, in deprived areas, a higher number of GPs is associated with lower emergency admissions. There is also a lower emergency admission rate in areas in which practices are on average larger, holding constant GP supply.

Conclusions In deprived areas an increase in GPs was found to reduce emergency admissions, but not elsewhere. Areas in which GPs are concentrated into larger practices showed reduced levels of emergency admissions, all else equal.

Keywords: Emergency admissions, GP practices, Instrumental Variable, GP number, Deprivation

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How this fits in

Previous studies have produced mixed findings on the relationship between the number of GPs in an area, and rate of emergency hospital admissions. This study presents new evidence on this issue using a large national panel data set that links a range of data on primary and secondary care. It uses statistical techniques that take into account the potential two-way relationship between numbers of GPs and of emergency admissions.

Introduction

Recent Department of Health and Social Care (DHSC) policy goals include "a measurable reduction in age standardised emergency admission rates and emergency inpatient bed-day rates" by 2020 [1], while the DHSC 2016 Shared Delivery Plan [2] comments that "Improved care in out-of-hospital settings is expected to lead to reduced need for emergency admissions to hospital".

Emergency hospital admissions are urgent and unplanned admissions initiated by referral from A&E, GPs, or ambulatory clinics, and have increased steadily in England from 4.4 million in 2004/5 to 5.2 million in 2012/13, an average annual rate of increase of 2.1%. [3] Explanations for this growth, include higher demand due to (i) increases in illness, and (ii) the frailty of the aging population [4]; and changes in primary care, such as access to out of hours GP services, [5]-[6]. An emergency admission is occurred when a patient is admitted to hospital urgently and unexpectedly (unplanned). Emergency admissions can occur via A&E, via GPs or consultants in ambulatory clinics.

GPs could influence the emergency admissions in several ways. Various recent UK studies have found, for example, that better access to primary care is associated with fewer accident and emergency attendances [7], [8], [9], [10]. These studies suggest that a higher provision of GPs per 1,000 population may be associated with fewer visits to emergency care, but do not analyse whether more GPs reduce the number of emergency admissions, with their implications for costs and patient care. Gulliford [11], in a study of ninety-nine English health authorities, found that an increased supply of GPs is associated with lower hospital admissions for chronic and acute conditions. Harris et al [12], in a study of sixty-eight practices, found that access to primary health care does not explain differences between GP practices in potentially avoidable emergency attendances. Bankart el at [13] found, in their study of 145 general practices, that practice characteristics as well as various patient characteristics were associated with higher emergency admission rates. Gunther et al [14] in a similar study in Northamptonshire reached similar conclusions. In the US, it has been found that spending on health care in markets is lower in markets with a large proportion of primary care physicians [15] [16].

In this paper we investigate whether variations between areas in emergency admission rates are associated with variations of (i) the number of GPs per head, and (ii) the average size of GP practices in an area, after allowing for various confounding factors.. More GPs per head may enable practices to extend opening hours, diagnose illness before an emergency occurs, and offer patients rapid unplanned

GP appointments, Clustering GPs into larger practices may attract patients away from emergency care by increasing timely access, and providing in the practice a wider range of specialist GPwER services; but areas with more (smaller) practices may be located closer to patient homes, and achieve greater continuity of care, both of which encourage primary care use.

Although these issues are straightforward, the existing literature is conflicting and has methodological shortcomings. Specific area level health care policies may confound estimating the relationship between GP supply and emergency admissions, as may any responsiveness of GP supply to evidence of high patient demand, which undermines treating GP supply as an exogenous explanatory variable. We use two statistical techniques to address these two obstacles: a panel data approach to capture unobserved local area differences with 'fixed effects', and an instrumental variables analysis to control for endogeneity. We use a unique dataset covering all registered patients in England for a relatively long time period (2004-2011) that includes data for population characteristics (index deprivation, expenditure per capita, etc.) and demand/need (QOF). Since we also control for the number of GPs, estimates of the effect of a larger mean size of practice on area admissions captures the implicit effect of having proportionately fewer such practices. Other data sets like CPRD, QResearch, etc. cannot take into account where the practice is located and the characteristics of the practices. Another possible design study to estimate this type of problem is a structural equation model, however, as we have so many parameters and a longitudinal data, attempt to estimate as structural equation model could increase the difficult to estimate precisely the parameters.

The changing supply of NHS GPs to areas of England, 2004 to 2011, is used to provide panel data estimates of their effect on emergency admissions, in a way which allows for the endogeneity of GP location choice. This longitudinal approach, which is more 'efficient' than pooling cross-sections, helps to control for the impact of omitted variables, and generates more accurate predictions for area outcomes.

Methods

Data

A unique database was constructed for England linking several data sources at area level, for years between 2004 and 2011 (equivalent data for individual GPs are unavailable after 2012). The data are used in a longitudinal way, and all the variables must have values in each year selected otherwise our models cannot be estimated.

We combine the Hospital Episode Statistics (HES) on emergency hospital admissions for each at Lower Super Output Area (LSOA); data on population by age, gender and ethnicity at Primary Care Trust (PCT) level produced by ONS (these variables are available for all the years selected only at PCT level); the Index of Multiple Deprivation (IMD) and the index of rurality at LSOA level; NHS Digital data on the number of FTE GPs in each PCT; the number and the location of the practices; the number and the location of Walk-in Centres (WiC) and Out-of-Hours Services (OOH); data on NHS expenditure per capita at PCT level; and Quality and Outcomes Framework (QOF) data on prevalence of specific diseases form each practice and aggregate at PCT level. There were 151 PCTs and 32,482 LSOAs (average population 1,500) in England in 2011. The variables and their sources are set out in Table 1. To measure the supply of GP services we link HES data with the 'General Medical Practices Exeter Payments' data, and the 'Practitioners of NHS Connecting for Health' data. These databases contain information on current GPs and GP practices and give both GP headcount and full-time equivalent (FTE) information. We present in the main text the analysis and results for FTE GPs and in the supplementary file the results for headcount GPs. We have considered headcount as a robustness check on our main analysis.

To take into account both traditional and new primary care delivery models, practice density at PCT level is measured using two variables: (i) the number of traditional GP practices per 1000 population (density of practices), and (ii) the total number of WICs and OOHs per 1000 population at PCT level. We construct these variables at PCT level and not at LSOA level because many LSOAs have no practices, and this could bias the estimation. Undertaking the analysis at PCT level allows us to also control for the spatial correlation among LSOAs.

HES provides information on all patients admitted to NHS hospitals and NHS patients admitted to independent Treatment Centres, in England. We have extracted the total number of emergency admissions for each LSOA.

QOF is a system used to remunerate GPs for providing good quality care to their patients. The system, which covers almost all GP practices in England, includes prevalence rates for just eleven clinical conditions that are presented for all seven years of our analysis: Coronary Heart Disease, Left Ventricular Dysfunction, Stroke and Transient Ischaemic Attack, Hypertension, Diabetes Mellitus, Chronic Obstructive Pulmonary Disease, Epilepsy, Hypothyroidism, Cancer, Mental Health and Asthma. A QOF prevalence rate is the total number of patients on the register who has reported in the QOF data the health condition listed above, expressed as a proportion of the total number of patients registered with a practice at one point in time. The rate is calculated by grouping the prevalence of the eleven conditions at PCT level and divided by the PCT population. To avoid endogenous recording of conditions following hospital admission we use prevalence data for the year prior to that for the year of study for hospital admissions. The IMD combines information from seven domain indices to produce an overall relative measure of deprivation (we have excluded the health domain to avoid correlation with the other explicative variables), and gives each LSOA a rank from 1 (least deprived) to 10 (most deprived).

The descriptive statistics for the variables used below are given in Table 2. Figure 1 illustrates the simple relationship in the data between the percentage change in GPs in each LSOA and changes in LSOA emergency admissions, between 2004-11. This shows that there does not exist a simple relationship in which areas with greater growth in GPs per head have less growth in emergency admissions, prior to analysis of controls for confounding factors.

Empirical strategy.

We estimate regression models at LSOA level to investigate how far rates of emergency hospital admission per 1,000 population are associated with the number of GPs and the number of GP practices in the PCT, controlling for characteristics of the local population and for local disease prevalence rates. The model is as follows:

$$F_{jt} = \beta X_{jt} + \alpha GP_{pt} + \rho GR_{pt} + Z_{jt} + d_{jt} + \omega_{jt} + \sigma_j + \mu_t + \varepsilon_{jt} \quad (1)$$

F_{jt} represents the number of emergency admissions per 1,000 population at each LSOA (j) in each year. The use of LSOA as the unit of observation has the advantage that it allows us to capture the effects of variation of the explanatory variables across areas.

Xjt is a vector of socio-economic characteristics that are time-varying at area j in time t. It includes the proportion of the PCT population in gender, age and ethnicity groups and NHS expenditure per capita. GPjt is the number of GPs FTE per 1,000 population of LSOA *j* in PCT *p* at time *t*. GRpt is the number of GP practices per 1,000 population at time t in PCT *p*. Z_{jt} and d_{jt} are dummy variables capturing respectively the urban/rural nature of the local area and local deprivation.ω_{jt} is a vector of the local prevalence of the 11 QOF diseases. μ_t and σ_j are time and LSOA fixed effects respectively. ε_{jt} is a random error term which is assumed to be normally distributed. Areas fixed effect is an important factor here because we control for time invariant characteristics that are not observed at area level.

We considered two versions of the variable for the number of GPs in an area: headcount number of GPs and FTE GPs. We present in this paper results using the number of FTE GPs: results using headcount are presented in the Appendix 2, Table S1.

As well as estimating the parameters of the model using Ordinary Least Squares (OLS) we estimate the equation above using a Two Stage Least Square (2SLS) or instrumental variables model. This technique is an extension of the OLS method to circumstances where the dependent variable’s error terms are correlated with an explanatory variable. In this study it is reasonable to be concerned that the measures of GP supply - the headcount number of GPs, and the level of FTE GPs – may be partly determined by observed levels of the use of emergency care. For example, a greater number of GPs (FTEs) could lead to an increase in the number of emergency admissions in an area, because GPs may discover more cases given emergency admission. Also, if the emergency admissions increase in an area, the NHS could invest more resources in that area, attracting more GPs. In either case the number of GPs, and the hours each supplies, are not randomly assigned ‘doses’ across geographic areas, as in a randomised clinical trial: unobservable factors could bias regression estimates. For these reasons OLS gives biased estimates, and an instrumental variable approach is preferred. (A readable textbook account of IV estimation is given in [20]).

An important criterion in choosing a good instrument to replace an endogenous regressor is that it is correlated with the endogenous regressor, but is only correlated with the dependent variable indirectly through its influence on the endogenous regressor. We use two instruments; for FTE GPs we use the number of female GPs. This is the first time that this instrument has been used, to the best of our knowledge. The intuition behind this instrument is that female GPs are more likely to work part-time in comparison to male GPs. The decision to work part-time will affect the number of hours supplied, but the individual decision to work full time or part-time is unlikely to be influenced by the level of emergency admissions in the area. As we want to be sure that we capture the effect of GPs on emergency admissions, we use another variable to capture GP supply: the GP headcount. Again, this variable may be endogenous, and for that reason we use an instrumental variable. In this case we use the proportion of GPs who practiced in each area of England in 1980. This approach was originally developed by Card 2001. The main idea is to impute the number of GPs in an area based on the share of GPs in that area in the past to eliminate the recent, possibly endogenous movements of GP headcount. In the Supplementary file we present more detail on the IV methods used.

Results

The findings are set out in Tables 3 and 4. The main explanatory variables are the number of GPs (FTE) and the number of places of primary care provision per 1,000 population.

Estimates of four models are reported in Table 3, two OLS (M1 and M2, one with and one without control for practice size and treatment centres), and two 2SLS (M3 and M4) with and without equivalent controls. The analyses suggest that areas with more GP FTEs per head of population, all else equal, do not have emergency admissions significantly different to areas with fewer GPs. This is consistent with Harris et al. 2011 [12]. The coefficient on the number of GPs when we account for endogeneity is larger and negative (M4), although not statistically significant. Increasing the number of GPs in an area is not found to influence the level of emergency admissions in the area.

A positive association is found between areas with a larger number of GP practices per head and those with a higher number of emergency admissions (holding constant the number of GPs), albeit only at a 10% significance level, (model M4). This implies that, holding constant the number of FTE GPs, there are more emergency admissions in areas with a larger number of smaller practices than in areas with a lower number of larger practices: an Increase in the mean number of practices of one standard deviation (SD) of the distribution of the number of GP practices across LSOAs will increase the number of emergency admissions by about 1.4%.

An increase in the proportion of the population who are female by one SD of the distribution of this proportion across LSOAs is associated with an increased rate of emergency admission of 1.2%, An increase in the proportion of the population who are females (males) aged 60 and over of the over by one SD of the distribution of this proportion across LSOAs increases the rates of emergency admission by 8,3% (5,3%). Similarly, an increase in the proportion of the population who are black by one SD of the variation across LSOAs increases the rate of emergency admissions by 5.3%. The proportion who are Asian has no significant influence on emergency admissions.

As there is evidence that both health state and use of health services vary with deprivation, we consider that there are good a priori reasons for hypothesising that the relationship between number of GPs and the number of emergency admissions in an area might vary with deprivation. For example, even within disease categories, patient use of emergency care tends to be greater in less deprived areas suggesting that primary care may work differently in deprived areas [19]. We select two samples of deprived areas, using the IMD ranking of LSO, based on a narrower and broader definition of deprived area. Similarly, we construct two measures of relatively prosperous LSOAs. In Table 4 we present the estimation for the broad and narrow deprived LSOA area samples in columns 1 and 2, and for the broad and narrow more prosperous LSOA area samples in columns 3 and 4. (See footnotes to Table 4 for further details.)

We find that under both definitions of more prosperous areas (columns 3 and 4) neither the number of GPs nor the mean size of practice significantly affects the number of emergency admissions. However, in the two deprived area samples, the coefficient on the number of GPs is negative at 10% level of significance (column 1), and in the case of the smaller group of most deprived LSOAs the level of significance increases to 5% (column 2). This suggests that, under both definitions of deprived areas, a higher number of GPs (FTE) leads to a lower emergency admission rate: an increase in FTE GPs of one SD of the distribution of FTE per head of population across LSOAs will decrease the emergency admission rate by about 10% in both columns 1 and 2. The analysis also shows that in these areas patients of smaller practices have more emergency admissions on average than patients of larger practices: the number of emergency admissions is about 25% higher if the mean size of practice is decreased by one standard deviate of the distribution of practice size across PCTs).

Discussion

Summary

Our study contains two main findings. First, an increase in the local level of GP FTEs per head of population, contrary to the common assumption, by itself is not overall associated with a reduction in emergency hospital admissions of patients resident in that local area, when other factors are held constant. In deprived areas, however, a higher number of GPs per head is associated with a lower emergency admission rate. Secondly, local areas in which a given number of GPs are concentrated into fewer (larger by FTEs) practices, have lower emergency admissions per head than otherwise similar areas with more (smaller) practices.

Strengths and weaknesses of the study

We study panel data for all registered patients in England, for seven years from 2004/5. We address possible reverse causality (endogeneity) of GP location choice, variation in the prevalence of several diseases, and demographic variables. While omitted variables due to lack of data could be relevant, we address this by estimating fixed effects for each area and year. We have not conducted separate analyses for admissions for different health conditions, which would have raised issues of small numbers at LSOA level. We believe that the data, drawn from 2004/5 to 20011/12, and findings, remain applicable to the situation now where the number of GPs has declined, and the population disease burden has increased. Our analysis uses the number of GPs at PCT level, rather than at a local area level. As a consequence, we may not fully capture the associations between GP numbers and emergency admissions.

We did not account in the study for practice nurses and other non-GP clinical staff. Nurses and other staff do have a role in detecting some health conditions, as well as in chronic disease management, and larger practices may well employ more nurses. We also do not consider the performance of GPs: high quality of care would be expected to reduce the number of emergency admissions. Furthermore, although we control for the prevalence rates of health conditions using QOF data as well as for the structure of the population (age, gender, deprivation, rurality and ethnicity) plus fixed effects at LSOA level, the QOF prevalence rates may be an under-estimate of the rates of some conditions.

Comparison with existing literature

Our findings are consistent with those of Harris et al (2011), albeit they examined emergency department (self-referral, potentially avoidable) attendances in 2007/8 and 2008/9 rather than emergency admissions. They found that 'avoidable emergency department attendance appears to be mostly driven by underlying deprivation rather than by the degree of access to primary care' (Harris et al. 2011, page 1). Our findings differ however from those of Gulliford (2002) who examined the relationship between GP supply and indicators of population health in 1999. He found that each unit increase in GP supply was associated with a decrease in hospital admission rates for acute conditions and chronic conditions. We used more recent data than Harris et al or Gulliford; and we looked at all areas of England and all emergency admissions.

Implications for clinicians and policy-makers

Our findings suggest that increasing the number of FTE GPs in *deprived* areas could lead to fewer emergency hospital admissions of residents of these areas. In other areas we find little connection between the number of GP FTEs and emergency admissions. The areas in which the available GPs became increasingly employed in large practices also appear to be areas with fewer emergency admissions. These findings may have helpful implications for policy towards fiscal incentives to encourage GPs to locate in deprived areas and for addressing unmet demand for primary care.

Authors ‘contribution:

CN and BM produced the concept, conducted the analysis and prepared the first draft. RW and FDRH reviewed the analyses and revised the paper. All authors helped to complete the final draft.CN is responsible for the overall content as guarantor.

The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Role of the funding source: This project was funded by the National Institute for Health Research, Health Services and Delivery Research 11/1022: Demand management for planned care. The views and opinions expressed therein are those of the authors and do not necessarily reflect those of the NIHR Health Services and Delivery Research, NIHR, NHS or Department of Health and Social Care.

Declaration of interests: No competing interests. All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work. FDRH acknowledges his part-funding from the National Institute for Health Research (NIHR) School for Primary Care Research, the NIHR Collaboration for Leadership in Health Research and Care (CLARHC) Oxford, the NIHR Oxford Biomedical Research Centre (BRC3 UHT), and the NIHR Oxford Medtech and In-Vitro Diagnostics Co-operative (MIC).

Ethics: This study did not require research ethics committee approval since it comprised analysis of secondary data and did not involve collection of new data

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Figure 1: Correlation between % Change in FTE GPs Density and Emergency Admisisons

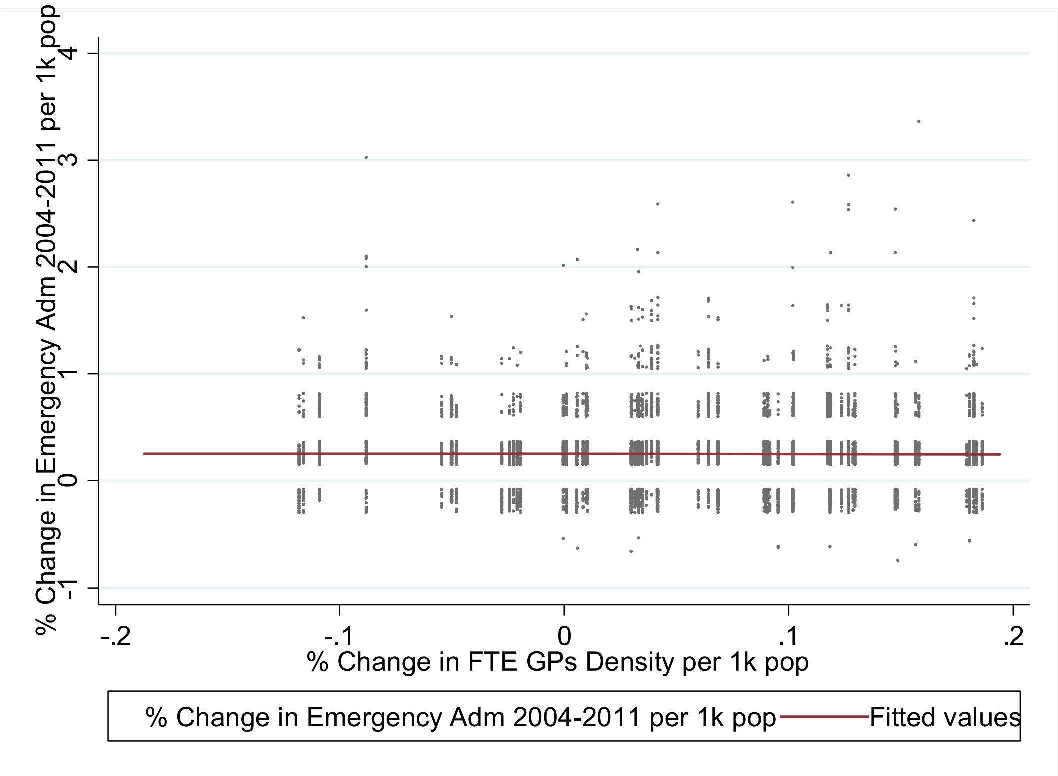

Table 1 Description of Variables and Data Sources

*HES: Hospital Episode Statistical Data. **ONS: Office for National Statistics. ***DH: Department of Health

Name of Variable	Description	Data source
Emergency	Total emergency admissions per 1k pop at LSOA level in the financial year	**HES***
Female pop (%)	Percentage of population female at LSOA level	**ONS****
Female population +60 (%)	Percentage of female population aged 60+ at LSOA level	**ONS**
Male pop. +65 (%)	Percentage of male population aged 65+ at LSOA level	**ONS**
Black ethnicity (%)	Percentage of black ethnicity at PCT level	**ONS**
Asian ethnicity (%)	Percentage of Asian ethnicity at PCT level	**ONS**
Headcount GPs Density at PCT 1kpop	Number of GPs per 1k pop at PCT level	**NHS Digital**
Ratio of practices at PCT 1k pop	Number of GP Practices at PCT per 1k pop	**NHS Digital**
FTE GPs Density at PCT 1kpop	Number of GPs FTE per 1k pop at PCT level	**NHS Digital**
G. Practice Density at PCT 1k pop	Number of GP Practices per 1k pop at PCT level	**NHS Digital**
WIC and OOH Density at PCT 1kpop	WIC and OOH Centres per 1k pop at PCT level	**NHS Digital**
Revenue per head	HS Expenditure per capita at PCT level	**DH*****
Deprivation Areas	Index of deprivation at LSOAs in 10 deciles	**ONS**
Prevalence Diseases	Prevalence of specific diseases per 1k pop at PCT level from QOF	**NHS Digital**

Table 2: Descriptive Statistics at LSOA level, 2004-2011

	2004	2005	2006	2007	2008	2009	2010	2011	Total
Emergency admissions per 1k pop	116.33	122.70	123.18	124.16	132.20	138.33	141.30	140.47	129.83
	(44.20)	(45.66)	(46.92)	(48.17)	(49.41)	(51.59)	(52.73)	(52.04)	(49.73)
Female pop (%)	51.04	51.01	50.98	50.95	50.92	50.90	50.87	50.97	50.96
	(2.30)	(2.31)	(2.36)	(2.48)	(2.67)	(2.85)	(3.11)	(2.28)	(2.56)
Female pop +60 (%)	11.78	11.83	11.90	12.10	12.28	12.43	12.38	12.56	12.16
	(4.59)	(4.61)	(4.65)	(4.73)	(4.82)	(4.88)	(4.82)	(4.94)	(4.77)
Male pop +65 (%)	6.87	6.92	6.96	7.02	7.14	7.28	7.42	7.27	7.11
	(2.71)	(2.75)	(2.80)	(2.86)	(2.94)	(3.04)	(3.15)	(3.06)	(2.92)
Black ethnicity (%)	2.60	2.67	2.72	2.78	2.84	2.88	2.93	2.91	2.79
	(4.40)	(4.26)	(4.12)	(3.99)	(3.87)	(3.75)	(3.64)	(3.29)	(3.93)
Asian ethnicity (%)	5.65	5.88	6.11	6.37	6.58	6.78	7.01	7.12	6.44
	(6.89)	(6.80)	(6.71)	(6.66)	(6.57)	(6.50)	(6.46)	(6.08)	(6.61)
PCT expenditure per head	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00
	(0.69)	(0.69)	(0.68)	(0.68)	(0.13)	(0.13)	(0.14)	(0.14)	(0.49)
Headcount GPs Density at PCT per 1k pop	0.83	0.87	0.89	0.93	0.96	1.00	1.04	1.06	0.95
	(0.10)	(0.10)	(0.11)	(0.12)	(0.13)	(0.13)	(0.17)	(0.18)	(0.15)
FTE GPs Density at PCT per 1k pop	0.61	0.62	0.65	0.64	0.66	0.68	0.68	0.67	0.65
	(0.07)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.10)	(0.09)	(0.09)
General Practices Density at PCT per 1k pop*	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
WIC and OOH Density at PCT per 1k pop**	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
N obs.	**32482**	**32482**	**32482**	**32482**	**32482**	**32482**	**32482**	**32482**	**259856**

* This includes conventional partnership practices, ** This includes: Walk-in Centres, Out Of Hours Centres, other Prescribing Cost Centres which include addiction services. Standard Deviation in parenthesis.

Table 3 The influence of the number of GPs (FTE) and of GP practices on Emergency Hospital Admissions: OLS and 2SLS estimation

	OLS						2SLS					
	M1			M2			M3			M4		
	Coef	95% CI	P-value	Coef	95% CI	P-value	Coef	95% CI	P-value	Coef	95% CI	P-value
Female pop (%)	0.465***	0.334,0.593	<0.001	0.465***	0.334,0.593	<0.001	0.467***	0.327,0.583	<0.001	0.466***	0.337,0.595	<0.001
% change	1.19				1.19			1.2			1.19	
Female pop +60 (%)	1.778***	1.593,1.988	<0.001	1.770***	1.5547,1.969	<0.001	1.782***	1.587,1.979	<0.001	1.774***	1.554,1.983	<0.001
% change		8.36			8.32			8.38			8.34	
Male pop +65 (%)	1.868***	1.523,2.064	<0.001	1.858***	1.525,2.064	<0.001	1.867***	1.523,2.064	<0.001	1.854***	1.515,2.055	<0.001
% change		5.42			5.39			5.41			5.38	
Black ethnicity (%)	1.378***	1.024,1.836	<0.001	1.350***	1.014,1.854	<0.001	1.392***	1.045,1.912	<0.001	1.353***	1.016,1.7566	<0.001
% change		5.37			5.27			5.43			5.28	
Asian ethnicity (%)	0.753*	0.253,1.253	<0.01	0.66	0.143,0.520	0.08	0.80*	0.354,1.276	<0.01	0.68	0.153,0.620	0.09
% change		4.97			na			5.28			na	
Revenue per head	-0.138	-1.073,0.519	0.494	-0.228	-1.073,0.519	0.398	-0.139	-0.986,0.715	0.423	-0.246	-1.068,0.515	0.786
% change		na			na			na			na	
GPs Density PCT 1k pop	1.685	-18.136,35.388	0.188	-0.344	-12.672,64.289	0.127	-1.682	-13.573,57.256	0.681	-5.363	-8.842,2.837	0.314
% change		na			na			na			na	
General Practices Density PCT 1k pop		No		34.28	-11.672,44.378	0.563		No		45.535*	0.365,76.589	<0.01
% change				na			na			1.37		
WIC-OOH Density PCT 1k pop		No			Yes			No			Yes	
N obs	253376						253376					

. Robust and cluster standard errors at PCT. Fixed effects are included for the Year, LSOA, whether urban/rural, Index of deprivation, and prevalence of disease. The row '% change' gives the % change in emergency hospital admissions from a change in the indicated explanatory variable equal to 1 standard deviation of the distribution of the explanatory variable acro

Table 4 The influence of the number of GPs (FTE) and of GP practices on Emergency Hospital Admissions in Deprived and relatively prosperous Ar

	Deprived LSOAs IMD Ranks 8,9, and 10 2SLS			Most deprived LSOAs IMD Ranks 9 and 10 2SLS			Less deprived LSOAs IMD Ranks 1,2 and 3 2SLS			Least deprived LSOAs IMD Ranks 1 and 2 2SLS		
	Coef	95% CI	P-value	Coef	95% CI	P-value	Coef	95% CI	P-value	Coef	95% CI	P-value
Female pop (%)	0.764***	0.438,0.939	<0.001	0.805***	0.480,1.131	<0.001	0.617***	0.348,0.792	<0.001	0.613***	0.333,0.894	<0.001
% change		2.03			2.16			1.65			1.65	
Female pop +60 (%)	2.107***	1.762,2.561	<0.001	2.188***	1.679,2.698	<0.001	1.576***	1.234,1.815	<0.001	1.479***	1.143,1.814	<0.001
% change		9.98			10.33			7.46			6.97	
Male pop +65 (%)	2.705***	1.762,2.861	<0.001	2.889***	2.249,3.528	<0.001	1.547***	1.077,1.798	<0.001	1.406***	0.939,1.874	<0.001
% change		7.97			8.12			4.54			4.06	
Black ethnicity (%)	1.962***	1.049,2.407	<0.001	1.522***	0.691,2.353	<0.001	0.056	-2.135,0.941	0.446	-0.286	2.422,1.850	0.793
% change		8.57			4.95			na			na	
Asian ethnicity (%)	1.039	1.595.407	0.08	1.906***	1.087,2.725	<0.001	-1.885***	-2.742,-0.974	<0.001	-1.765***	2.913,-0.617	<0.001
% change		na			12.58			-11.84			-11.22	
PCT revenue per head	-0.093	-1.368,0.959	0.73	0.349	-0.995,1.693	0.611	-0.761	-1.874,0.915	0.014	-1.096*	2.253,0.061	<0.01
% change		na			na			na			-0.436	
GPs Density PCT per 1k pop	-12.812*	-18.526,-0.054	<0.01	-12.678**	-23.529,-1.827	<0.05	3.663	-4.003,9.832	0.409	-2.564	-10.880,5.753	0.546
% change		-10.76			-10.24			na			na	
General Practices Density PCT per 1k pop	68.401*	-2.924,111.850	0.063	62.903*	-3.949,129.755	<0.01	-8.965	-34.961,40.889	0.878	-13.25	-59.872,33.372	0.578
% change		25.99			24.34			na			na	
N obs.		89762			50160			89762			50160	

Robust and cluster standard errors at PCT. Year, LSOA, urban/rural, deprivation and prevalence disease fixed effects are included. The row '% change' gives the % change in emergency hospital admissions from a change in the indicated explanatory variable equal to 1 standard deviation of the distribution of the explanatory variable across LSOAs. This Table studies two samples of deprived LSOAs, and two samples of less deprived LSOAs. All LSOAs are ranked by the Office for National Statistics on the IMD criterion from 1 to 10 (most deprived). Column I studies the LSOAs with IMD rank 8, 9, and 10. Column 2 studies LSOA's IMD ranked 9 and 10. Column 3 studies LSOAs IMD ranked 1,2, and 3. Column 4 studies the LSOAs IMD ranked 1 and 2.