Centre for
Health Service Economics
& Organisation

Are patients more likely to require emergency admission if they are registered with a single-handed practice? Analysis of three acute conditions

Barry McCormick | Peter-Sam Hill

Working Paper No. 3, August 2012

Are patients more likely to require emergency admission if they are registered with a single-handed practice? Analysis of three acute conditions

Barry McCormick and Peter-Sam Hill

Working Paper No. 3

Published by:
Centre for Health Service Economics & Organisation (CHSEO)
5th Floor Zone B, Skipton House, 80 London Road, London SE1 6LH
Nuffield College, New Road, Oxford OX1 1NF

Corresponding author(s):

Barry McCormick
Director, Centre for Health Service Economics & Organisation
barry.mccormick@chseo.org.uk

Peter-Sam Hill
Project Lead, Centre for Health Service Economics & Organisation
peter-sam.hill@chseo.org.uk

Table of contents

1. Introduction

There have been longstanding concerns about the quality of care provided by single-handed general practices in England. This study uses a new approach to test the hypothesis that single-handed practices, unable to access scale economies available to larger practices, reduce either patient access or the quality of care, thereby reducing the likelihood that patients are 'managed', perhaps into elective care, rather than being admitted for emergency care.

The NHS plan (DH, 2000) and the Shipman Inquiry (2004) both expressed concern about clinical isolation in single-handed practices resulting in poor quality care. For decades, government policy has acted on these concerns by encouraging group practice. For example, the Group Practice Allowance paid from 1966 to 1990 offered a direct financial incentive and the General Medical Services contract introduced in 2004 requires lists of patients to be attached to practices rather than doctors, thereby making it more difficult to establish single-handed practices because doctors can no longer take their list from their previous practice.

Single-handed practices are particularly concentrated in deprived areas (as defined by the index of multiple deprivation), so that their quality is important in determining health inequalities. Of all the practices in the most deprived quintile of PCTs, 32 percent are single-handed, whilst the equivalent figure for the least deprived quintile is 11 percent.

The literature on single-handed practices suggests that differences in quality depend on the measure used. The Quality and Outcomes Framework (QOF) provides a relatively reliable dataset with which to assess quality even if its use for this purpose is not without issue. During the first few years after the QOF was introduced, single-handed practices achieved fewer points than group practices, although the gap narrowed over time (Doran et al., 2010; Ashworth and Armstrong, 2006). Among the domains, single-handed practices fared particularly poorly for organisation (Wang et al., 2006).

Small practices persistently exhibited wider variation in QOF attainment than larger practices; the poorest performing practices are single-handed (Doran et al., 2010). Ashworth et al. (2007) provide evidence to suggest that single-handed practices in deprived areas are poorer on average than those in the rest of the country. Single-handedness may, therefore, be more of an issue in these areas.

There is evidence that diabetes care is slightly poorer in single-handed practices than in group practices (Millett et al., 2007) and that single-handed practices are less likely to take part in a number of optional activities (Mackay and Watt, 2010).

Gulliford et al. (2004) found that single-handed practices had higher standardised mortality ratios (SMR) for all causes and acute myocardial infarction (aged 35-64) when GP supply, deprivation (Townsend score) and demographic variables (age, ethnicity, social class, rural) were controlled for. They found no significant difference in avoidable mortality SMR. Much of the differences between single-handed and group practices in were explained by the independent variables in the multivariate model and it is likely that differences in need that were not included within these variables could explain some of the remaining variation.

In a study assessing the performance of single-handed practices using admission rates, Bankart et al. (2011) found that smaller practices generate more emergency admissions. However, the implications for single-handed practices are not clear since they also found that practices where patients could see a particular GP generated fewer emergency admissions. A study of London practices excluded a ‘single-handed’ variable from the model because there was no significant relationship between single-handed practice and emergency admissions (Congdon, 2006).

Studies of admission rates for individual conditions provide evidence that single-handed practices generate more emergency admissions for asthma and epilepsy, but not for COPD, coronary heart disease or diabetes (Purdy et al., 2011a; Purdy et al., 2011b; Hippisley-Cox et al., 2001; Gulliford et al., 2004). Although Gulliford et al. found that single-handed practices generated significantly more emergency admissions for ear, nose and throat infections, urinary tract infections and congestive heart failure, Hippisley-Cox et al. found no such relationship using a similar method.

The literature provides some evidence about the advantages and disadvantages of single-handed practice that influence the probability that a patient with symptoms visits a GP and has their condition managed. The inability to benefit from scale economies may limit patients access, through shorter opening hours (Ashworth et al., 2007), and result in poorer quality care or patient experience. GPs practicing alone may have less interaction with professional peers and may be less likely to keep up-to-date with best practice (Shipman Inquiry, 2004). Quality could be reduced further practical difficulties faced by single-handed practices in maintaining and investing in high quality premises, computerisation and general management (van den Hombergh, 2005).

An important structural advantage of small practices over larger practices is their ability to provide better continuity of care because the patient sees the same doctor each time providing more opportunity to build a better relationship and understanding between them. This may explain why doctors in single-handed practices are less likely to “depersonalise” their patients (Orton et al., 2012) and their patients report higher levels of satisfaction (Kontopantelis et al, 2010).

The concerns regarding single-handed practices are primarily associated with the conventional definition of single-handedness on being practices with one registered principal. This may be viewed as inadequate because some practices employ salaried GPs in addition to the principal and therefore share some characteristics with group practices and some with solo practices. In the absence of information about salaried GPs, we address this issue by considering alternative definitions of single-handed practice that treat separately practices with large list sizes, which are therefore likely to employ salaried GPs.

The method, econometric model and data used to test the central hypothesis are outlined in section 2. Section 3 discusses the regression results and conclusions are highlighted in section 4.

2. Methods

The main difficulty faced when trying to estimate the relationship between single-handed practice and emergency admissions is controlling for the effects of differing patient needs. Single-handed practices generating more emergency admissions could indicate that they are less effective, but it could equally indicate that their patients have more medical need. Studies in the literature have mainly used either deprivation (see, for example, Hippisley-Cox et al., 2001 and Gulliford et al., 2004) or prevalence data (see, for example, Purdy et al., 2011a and Purdy et al., 2011b) to control for need[1].

Area-level deprivation provides a national dataset that is correlated with morbidity, but it might be regarded as an insufficiently granular control of individual patient need.

[1] A third method is to use survey data to control for need, but this has not been applied to analysing the performance of single-handed practices. Propper et al. (1998) reviewed a number of studies that use this method in assessing the equity of use. The method can provide detailed need variables, but is limited in the sample sizes it can produce, the reliability and extent of information about healthcare use and the conditions that it covers.

QOF registers provide prevalence data for the whole country, which can be used to control for need. Although this method provides the best available estimate of need, it can only be used for a small number of conditions and is vulnerable to unwanted correlation between the level of undiagnosed need and practice characteristics. For example, if single-handed practices have more undiagnosed cases, as Connolly et al. (2011) suggest is the case for dementia, the estimated coefficient for this variable would be positively biased.

The approach used here to control for the high levels of need when estimating the effectiveness of single-handed practice is to focus on the nature of care given to patients with specific conditions.

This study shows how, under certain plausible assumptions, the nature of patient admission (emergency or elective) can identify whether condition management is less effective in single-handed practices than in group practices holding constant other explanatory factors. Unlike the volume of emergency admissions, the method of admission is not affected by differences in prevalence because, all other things being equal, this would increase both emergency and elective admissions at the same rate. Section 2.1 describes a framework of how admissions are generated in order to clarify how the method of admission can be interpreted and which assumptions are required.

Three acute conditions (identified by ICD10 code) are included in this study; acute tonsillitis (J039), inguinal hernia (K40) and gallstones (K802). For each, the volume of elective admissions is largely beyond the influence of GPs, whilst some emergency admissions may be prevented by effective general practice. The method of admission therefore provides information about the effectiveness of primary care. Each condition also generates large volumes of admissions and the method of admission varies so that regression analysis can provide significant results.

2.1. A model of hospital admissions

A simple model describing how emergency and elective admissions are generated shows the influence of GPs and clarifies the assumptions under which the probability of emergency treatment for patients admitted to hospital can be interpreted as a quality measure. The disease is understood to begin with the onset of initial symptoms, which may differ in nature and intensity between patients. When these occur, patients make a choice to visit a GP or not. This decision depends partly on the severity and symptoms of the condition. It also depends on patient characteristics and healthcare supply factors that influence the propensity to visit a GP rather than contact an A&E department or be passive. This probability can be expressed as:

$$p_i = p(\theta_i, z_i, g_i, h_i) \tag{1}$$

where θ_i is a vector of condition characteristics such as pain;

z_i is a vector of patient characteristics such as age and gender;

g_i is a vector of GP supply factors such as proximity and access to a practice;

and h_i is a vector of hospital care supply factors such as proximity to an A&E department.

Following a GP consultation, the condition may or may not be "managed", where this is expressed as a binary outcome. Management consists of the correct combination of monitoring, diagnostics, pharmaceuticals and referral to secondary care given the information that is obtainable by the GP with reasonable effort and skill. In order for a GP to manage the condition, they must garner all relevant information from the patient and use it to assess risks before making good decisions based on this assessment. Furthermore, the patient must be persuaded to adhere to the GP's advice. A better GP (or one with a smaller workload) would adopt best practice and be more effective at diagnosis and imbuing patient trust. Some patient characteristics (such as communication skills) may aid or hinder the process. Similarly, the nature of a patient's condition, such as masked symptoms can make the GPs job more difficult. The probability that a patient's condition is managed once they have visited a GP is expressed as:

$$q_i = q(\theta_i, z_i, g_i) \tag{2}$$

The probability that patient i's condition is managed is the product of probabilities p_i and q_i.

If a patient's condition is managed, they have probability e_i of having an elective admission. If it is not managed, they have a probability m_i of having an emergency admission where e_i and m_i can be expressed as:

$$e_i = e(\theta_i, z_i, h_i) \tag{3}$$

and $m_i = m(\theta_i, z_i, h_i)$ (4)

Both e and m depend on the condition and patient characteristics (θ_i and z_i) in a condition-specific manner. For example, most elective admissions for tonsillitis are for tonsillectomy, which is only recommended for patients with repeat infections. The patient and condition factors relevant to e would therefore relate to risk factors for repeat infection. Emergency admissions for the same condition are mostly initiated by complications, such as abscesses spreading pus or causing difficulty in breathing that are unique to the bacterial form of the disease. Factors relevant to m would therefore relate to risk factors for complications, such as the condition being bacterial rather than viral. Both probabilities could depend on secondary care supply factors (h_i) if these alter admission thresholds. However, there do not appear to be reasons to suggest that GP level characteristics will influence e, the probability of an elective admissions for those being managed; or m, the probability of emergency admissions for those not being managed.

The probability that patient i has an emergency admission is:

$$prob(M_i) = m_i(1 - p_i q_i) \quad (5)$$

where M_i is an emergency admission.

The probability that patient i has an elective admission is:

$$prob(L_i) = e_i p_i q_i \quad (6)$$

where L_i is an elective admission.

This framework is summarised in figure 1.

Figure 1 about here

2.2. Econometric application

The main hypothesis is tested by estimating models of the probability that a patient admitted to hospital with an acute condition is admitted as an emergency. The main independent variable of interest is a binary variable indicating whether the practice with which the patient is registered is single-handed or not. Socio-demographic, GP supply and hospital supply variables are also included as controls.

In the model outlined in section 2.1, the ratio of the probability that a patient has an emergency admission to the probability that they have an elective admission can be expressed as:

$$y_i = \frac{prob(M_i)}{prob(L_i)} = \frac{m_i(1-p_i q_i)}{e_i p_i q_i} \qquad (7)$$

This term is increasing in m_i and decreasing in e_i, p_i and q_i.

Inference about the probability of a patient with symptoms becoming 'managed', $p_i q_i$ can therefore be made for independent variables that are uncorrelated with m_i and e_i. Under the assumption that single-handed practice is unrelated to the probabilities that unmanaged patients require emergency admission and managed patients require elective admission (m_i and e_i), if being registered with a single-handed practice increases a patients y_i, a lower $p_i q_i$ is implied. The degree to which this is caused by patients being less likely to visit the GP (lower p) or the GP providing poorer quality care (lower q) cannot be determined.

Although the assumption that single-handed practices are unrelated to m_i is uncontroversial, the assumption that they are unrelated to e_i may be contested. Over-referral to secondary care could increase the probability that a 'managed' patient has an elective admission. Under-referral represents mismanagement so is included within the probability q_i. The degree of the problem posed by the possibility that GPs can over-refer depends on how the flow of patients from outpatient clinics to inpatient spells is determined. If, as should theoretically be the case, hospital doctors maintain a constant threshold for admission, GP referral patterns will have no effect. If, on the other hand, inappropriately referred patients have a probability of being admitted that is greater than zero, doctors who over-refer would reduce the ratio y_i. Some GPs might want to over-refer to transfer the patient, and the workload, to someone else, but this is in tension with the incentive to save on hospital costs. Both incentives are minimised by the choice to include only acute conditions in this study so over-referral should not have a large impact.

The econometric analysis gives logit estimation of y where the dependent variable is one if the patient was admitted as an emergency and zero if they were admitted electively. In the model, individuals with symptoms may enter hospital as emergency or elective patients or remain in the community, managed or not. Data is only available for those entering hospital so it is not possible to jointly estimate models of the probability of each of the four outcomes. As a consequence, we must assume that the relative probability of emergency to elective hospital admission is independent of the relative probability of the other two outcomes (staying in the community, managed or not) to either mode of hospital entry. This assumption suggests a logit model, rather than other econometric specifications, is suitable for estimating y.

Failure to observe some condition characteristics creates the risk of an omitted variable bias. The rate at which the condition develops and severity of symptoms, θ_i, are not observed so cannot be included in an econometric model. This omission will bias the coefficient estimators for any explanatory variables that are correlated with θ_i. This is likely to include age, sex and ethnicity since biological differences interact with each condition, but the coefficients on these variables are not of primary interest for this study. If θ_i is related to any other explanatory factors then the estimated coefficients for these variables will be biased.

Differences between the doctors who practice in single-handed practices and those in group practices may also bias results. Compared to GPs in group practices, GPs in single-handed practices tend to be older and a larger proportion are male and were trained in South Asia (Wang et al., 2006). These characteristics may in turn relate to the quality of care provided. The inclusion of QOF scores in the model may control for some differences in GP quality, but it does not separate the effects of individual doctors from those of the practice. Differences between the patients that choose single-handed practices may also influence the method of admission in a manner that is not caused by the single-handed practice.

The definition of q_i can be broadened to allow condition management to vary in quality rather than simply being a binary outcome. The quality of management can be defined as a continuous variable ranging from zero (no management) to one (perfect management). A patient's expected management quality depends on the same factors as when it was defined as a binary outcome, but can now be increased by quality improvements anywhere on the spectrum.

The assumption in the framework that no emergency admission can occur when a patient's condition is being managed is included for neatness of notation only; the conclusions from the model are not affected if it is relaxed. This can be demonstrated by allowing managed patients to have emergency admissions with probability $m_i - \delta_i$, where $0 \le \delta_i \le m$, so that managed patients are less likely to be admitted as an emergency than unmanaged patients. The ratio of the probability of emergency admission to that of elective admission then becomes:

$$y = \frac{prob(M_i)}{prob(L_i)} = \frac{m_i(1 - p_i q_i) + (m_i - \delta_i)p_i q_i}{e_i p_i q_i} = \frac{m_i - \delta_i p_i q_i}{e_i p_i q_i} \qquad (8)$$

which has the same interpretation under the same assumptions as before.

2.3. Data and explanatory variables

The care dataset is Hospital Episode Statistics (HES) data on all admissions in the two years from April 2007 to March 2009. GP practice- and small area-level (Lower Super Output Area or LSOA) data are added to patient records using the "practice of the patient's registered GP" (NHS Information Centre, 2012) and the LSOA of residence fields.

The main explanatory variable is the type of practice with which a patient is registered; single-handed or group. Single-handed practices are primarily defined as those with only one principal. Caps on list size (mostly 3,000 patients) are also imposed to treat separately practices that employ salaried GPs in addition to the principal. Connecting for Health's organisational database provided all necessary data.

In order to isolate the effect of single-handed practise on $p_i q_i$, socioeconomic, demographic, hospital supply and GP supply factors are included as control variables in the regression model.

Deprivation is measured at the LSOA level using a variant of the Index of Multiple Deprivation (IMD, see Communities and Local Government, 2007) with the health domain removed. The "Non-Health IMD" or NHIMD rankings are used to assign each LSOA into a deprivation decile, the most deprived of which is divided into two vintiles. These categories are assigned to the record data using the LSOA of residence field in HES.

Age, sex and ethnicity are recorded at patient level in HES.

The LSOA of residence is used to map ONS urban/rural classification and two hospital supply measures to patient records: the straight-line distance to the nearest hospital and an index of the number of hospital beds nearby. The latter takes a form consistent with the methodology in Morris et al. (2007) and Carr-Hill et al. (1994). The index incorporates the capacity of hospitals, their proximity to the population in the LSOA of residence and to other populations competing for use of the same services in the following way.

$$A_j^H = \sum_i \left(\frac{C_i \left(D_{ij} + 10\right)^{-2}}{\sum_j P_j \left(D_{ij} + 10\right)^{-2}} \right) \quad (9)$$

where A_j^H is the accessibility of LSOA j to hospital beds

C_i is the capacity of hospital site i in terms of the number of available beds

D_{ij} is the straight line distance between the population-weighted centroid of LSOA j and hospital i in kilometres

P_j is the population size of LSOA j.

Broadly, this index is higher when there are more beds, the beds are nearer to the LSOA of residence or local competing population is smaller. The 10km buffer is included to avoid populations near hospitals from having too much weight given the inverse square function used.

A similar index is applied to the number of GPs working near an LSOA. In this index, i's represent practices rather than hospitals and C_i denotes the number of GP principals rather than beds. The 10km buffer is also shortened to 3km to reflect the more localised nature of general practice. All supply-side data for these indices comes from Connecting for Health.

The Quality and Outcomes Framework (2008/09) and the GP patient survey (2007/08) provide measures of the quality of, and access to GP care. These are mapped to records using the practice with which the patient is registered. The total QOF score is expressed as a percentage of all available points. The survey questions included concern patients' ability to reach the practice on the telephone, their ability to see a doctor within 48 hours, their ability to see a specific GP of their choice and their knowledge of how to access care out of hours. They are expressed in terms of the percentage of respondents from each practice who stated that they were able (or that they knew in the case of the out of hour's question[2].

The framework presented in section 2.1 can provide intuition as to how each control variable might influence the method of admission for patients in this study. Each could alter any combination of the three probabilities described in the framework: that the patient's condition is managed by a GP (pq), that a 'managed' patient is admitted electively (e) and that an 'unmanaged' patient is admitted as an emergency (m).

The probability that a patient's condition is managed well depends on condition characteristics, patients' preferences, the quality of GP care and barriers to accessing GP care. Each of these factors relate in turn to control variables included in the econometric model.

If the condition produces particularly uncomfortable symptoms then the likelihood that the patient visits a GP might be expected to be higher. Some condition characteristics may also influence the ease with which a GP can diagnose and manage the condition.

The decision to visit a GP or not depends partly on the patient's preferences – between time periods, between health and consumption or leisure, and between different characteristics of care. If a patient 'lives for today' and places little value on future utility they will be less likely to invest time visiting the GP so that they might be better off, through improved health, in the future. Similarly, if health is a lower priority than consumption and leisure the patient is more likely to spend their time working or enjoying leisure time than visiting the doctor to improve their health. The final category of patient preferences that are relevant here relate to the characteristics of general practice compared with those of alternative care providers, particularly the A&E department. Whilst GPs provide continuity of care and the ability to book an appointment at a convenient time with short waiting times in the surgery, A&E departments offer access to hospital doctors and facilities at short notice. The relative importance of these characteristics to a patient can be expected to influence their decision to visit a GP or an A&E department.

Deprivation, age, sex and ethnicity variables are likely to control for a significant proportion of differences in condition characteristics and patient preferences.

[2] More information about the survey is available at www.gp-patient.co.uk/

Better GP care, if correctly perceived by patients, can be expected to encourage greater use of their services. Once the patient presents to a GP, better care should make a correct diagnosis and effective condition management more likely.

The effectiveness of using QOF scores to measure GP practice quality is arguable (see for example Downing et al., 2007), but it provides a reliable, universal dataset that may provide an indication of the quality of care provided by a practice. The ONS' urban/rural classification and deprivation deciles may also be correlated with the quality of primary care.

Goddard (2009) outlines two concepts with which to understand barriers to access; candidacy and permeability. The former describes a view on the eligibility of a patient for care, which is negotiated between the patient and the provider. The most permeable provision "requires[s] the fewest qualifications for candidacy and demand[s] the least work from citizens". Patients who do not view themselves as eligible for GP care will not visit a GP. If when a patient sees a GP their eligibility is not correctly defined during the consultation, their condition will not be managed properly. This view of barriers to access encompasses patient factors as well as GP quality and other more obvious obstacles such as difficulty getting an appointment or getting to the surgery.

The patient-level aspects of barriers to access are likely to be correlated with deprivation, age, sex and ethnicity variables. The relationships between variables included in the model and GP quality have already been discussed. Difficulty in getting an appointment is indicated by the four GP patient survey variables and the GP access index. The importance of these factors to a patient depends partly on the alternative to GP care; namely, emergency hospital care. The difficulty of accessing emergency hospital care is therefore also controlled for in the model using the hospital access index and the distance between the LSOA of residence and the nearest hospital.

The probabilities of a 'managed' patient having an elective admission (e) and an 'unmanaged' patient having an emergency admission (m) are dependent only on condition characteristics that determine how the condition develops and what risks it carries. These relate to the demographic variables included in the model.

PCT fixed effects are also included in the model to allow for variation in resources, management and need at this geographic level.

2.4. Data exclusions and summary

Some admissions are excluded from the dataset to reduce variation in the nature of conditions that may influence the method of admission independently of the main independent variables. All patients with comorbidities (indicated in HES by secondary diagnoses being recorded) are excluded because they are likely to carry different risks. For similar reasons, patients under the age of 16 or over 74 are also excluded.

Patients with recent previous admissions for the same condition may be more likely to be admitted electively because their condition is known to the NHS. To avoid these influencing results patients who were discharged from hospital for the same condition within the three months prior to admission are also excluded.

Together with data requirements, these data restrictions limit the data set and affect its profile. 6308, 6389 and 3955 admissions were excluded from the data set for gallstones, inguinal hernia and tonsillitis respectively (representing 22, 9 and 13 per cent of admissions). The majority of these are excluded because of the requirement that patients had not been admitted to hospital during the preceding three months. The exclusions were skewed towards deprived areas and emergency admissions.

Table I about here

Table I shows summary statistics for group practices, small single-handed practices (up to 3,000 patients) and large single-handed practices (more than 3,000 patients). They show that emergency admissions constituted a larger proportion of all admissions for patients registered with single-handed practices than for those registered with group practices for two of the three conditions included (hernia and tonsillitis).

The relative prevalence of single-handed practices in deprived urban areas is reflected in the demographic characteristics of their patients as well as their NHIMD deciles and ONS urban/rural classification. Compared to those registered with group practices, patients registered with single-handed practices were younger and a larger proportion were black or Asian.

The hospital supply variables also reflect the urban location of single-handed practices as their patients live closer to hospital and have higher hospital supply index scores.

From this patient-level dataset, large single-handed practices appear to be more similar to group practices than small single-handed practices in two respects: their patients were less satisfied with phone access and were less able to see a specific GP.

Table I also shows differences between the three conditions. For example, patients admitted with tonsillitis were predominantly aged under 45 years and patients admitted for inguinal hernia were predominantly male, whilst those admitted for the other two conditions were mostly female.

3. Results and discussion

Table II about here

Table III about here

Table IV about here

Tables II-IV show the results of regressions on three models for each of the three conditions. The first model includes deprivation and demographic variables. The second adds two single-handed dummy variables; one for patients living in the most deprived decile of the country and the other patients living in the rest of the country. The third includes the same variables plus controls for hospital and GP supply as well as other GP practice characteristics.

The results presented provide no strong evidence that patients of single-handed practices systematically access care differently. Patients in deprived areas who were registered with a single-handed practice were more likely to be admitted as an emergency than those registered with group practices, but this relationship was not statistically significant for any condition.

Single-handed practices appear to increase the probability of emergency admission more for patients living in deprived areas than for those living in the rest of the country. However, this result is also weak and only significant in the case of tonsillitis. It is possible that the single-handed practices are different in deprived areas to in the rest of the country: They could attract poorer quality GPs who are unable to establish practices in more affluent areas. Alternatively, the nature of patients in deprived areas may make them more vulnerable to single-handed practice's short-comings, pushing them towards emergency, rather than elective channels.

For patients living in NHIMD deciles one to nine, registering with a single-handed practice increases the probability of emergency admission for hernia (significant at the ten percent level). The effect on the probability of emergency admission for the other two conditions appears to be insignificantly negative.

For all three conditions, patients from deprived areas were more likely to be admitted as an emergency than those from more affluent areas. This trend is not monotonic across all levels of deprivation, but always applies particularly strongly to the most deprived five percent of the country.

This trend could be caused by any combination of condition, patient and supply side factors. The addition of supply-side factors in models two and three appear to have minimal effect on these odds ratios, which suggests that either they measure the wrong aspects of supply, they are not effective measures or supply-side factors are not important drivers of differences.

All four of the demographic variables are significant predictors of the method of admission, although not in a uniform manner. Younger patients were more likely to be admitted as an emergency for gallstones and inguinal hernia, but less likely for tonsillitis. Women were more likely to be admitted as an emergency for hernia, but less likely for gallstones and tonsillitis.

Black and Asian patients were more likely to be admitted as an emergency, but these relationships were not significant for all conditions. The positive relationship between black ethnicity and emergency admission was significant for hernia and tonsillitis, whilst that for Asian ethnicity was only significant for hernia.

Demographic factors can influence admission method through biological differences and risk factors and through differences in behaviour. Section 2.3 discusses how biological differences influence the probabilities e and m as well as p and q. The nature of these effects depends on the condition. Differences in behaviour, on the other hand, influence the method of admission by altering the probabilities p and q in a manner that is similar for all conditions. For example, women may have a greater tendency to visit the GP for any given level of symptoms because they develop a better relationship with the GP whilst raising children. The inconsistency of coefficients between conditions suggests that inference about patient behaviour is not possible because biological factors are also important.

Patients living in villages were more likely to be admitted as an emergency than those in densely populated urban areas, whilst those in towns were less likely. These relationships combine the effects of differing health supply with cultural and lifestyle factors.

A particularly important supply-side factor in rural areas is the need for patients to travel further to get to hospitals, which are usually situated in urban areas. The coefficients on the 'distance to hospital' variable in model three show that patients living further from hospital were less likely to be admitted as an emergency although the relationship is not significant for hernia. This is likely to be a result of the healthcare seeking and self-management behaviours that are incentivised by the greater cost of travelling to hospital. An event that necessitates emergency admission is of greater inconvenience to someone who lives further from hospital than to someone who lives closer so the former may be more willing to act to avoid such incidences than the latter.

When supply-side factors are controlled for in model three, patients from villages appear to have been more likely to access hospital care via emergency routes. This is significant for gallstones and tonsillitis at the 10 percent level.

Only one patient survey measure is a statistically significant predictor (for tonsillitis only) of the method of admission. Patients registered with practices for which a larger proportion of respondents know how to access out of hours care were less likely to be admitted as an emergency.

Interestingly, although the number of QOF scores achieved by a practice does not affect their patients' method of admission for gallstones or hernia, it is significantly associated with emergency admission for tonsillitis at the 10 percent level. One possible explanation for this would be that achieving QOF points diverts attention and resources away from other important aspects of general practice resulting in poorer quality care for the dimensions that are not observed.

The GP access index was not a significant predictor of the method of admission of any of the conditions in this study.

3.1. Sensitivity tests

There are three potential weaknesses with the econometric model; misclassification of the model, poor definition of single-handed practices and GP supply index and the imposition of a single model for all areas.

The large number of insignificant regressors in the model could spuriously influence the estimates generated.

The definition of single-handed practices may not isolate the practices of interest. Some practices with one principal GP employ other GPs on a salaried basis. These practices may be more similar to group practices than to single-handed practices with no salaried GPs because larger patient lists would enable them to exploit economies of scale and the additional medical staff makes clinical isolation less likely and continuity of care more difficult.

Results may also be dependent on the arbitrary parameters used in the healthcare supply indices described in section 2.3.

The econometric model imposes that deprivation acts separately to all variables apart from single-handed practice. It is possible that the relative importance of other variables are different in deprived areas to in the rest of the country.

Alternative model specifications were estimated to identify the sensitivity of results to these issues. The first were parsimonious versions of the models removing insignificant variables and grouping variable categories (e.g. deprivation deciles) with similar coefficients. Some models divided group practices into two groups and redefined the distance to hospital as a binary categorical variable. A model with one single-handed variable for the whole of the country was estimated to increase the number of records for each category.

The practice list size was used to indicate which practices were likely to employ salaried GPs. It was considered likely that practices with one principal GP and more than 3000 patients were likely to be employing additional GPs on a salaried basis. These were therefore classified as group practices. A threshold of 2000 patients was also tested.

Models were tested using alternative GP supply index parameters. 1.5km, 5km and 10km buffers were used in place of the 3km in the initial regressions.

Finally, models for decile 10 and the rest of the country were estimated separately.

Table V about here

Table VI about here

Tables V and VI show four alternative model specifications estimating the method of admission for hernia. These provide an example of combining the two single-handed practice variables, changing the definition of single-handed practice and using a parsimonious version of the model. In the case of hernia, including one single-handed variable for all parts of the country results in an estimated odds ratio of 1.20 that is significant at the five percent level. This is unsurprising because both single-handed practice coefficients in table III were positive and close to significance. This result holds for both full and parsimonious versions of the model, but loses significance again when the alternative definition of single-handed practice is used. Practices with one principal GP and additional salaried GPs may therefore be more similar to single-handed practices than to group practices.

The alternative model specifications do not change conclusions about the effect of single-handed practice on the method of admission for gallstones; all correlation remains weak.

The negative coefficient on single-handed practice for tonsillitis patients living in LSOAs in NHIMD deciles 1-9 becomes significant when the alternative definition is used. This holds for either list size cap and for the large and parsimonious versions of the model. The positive correlation for single-handed practices in deprived areas remains very small and insignificant. Therefore, the advantages of single-handed practice may relate to better use of secondary care in some instances, but these benefits do not appear to materialise in deprived areas.

When separate models were estimated for deprived areas and the rest of the country, coefficients for control variables were remarkably similar, whilst conclusions about single-handed practices were not altered.

4. Conclusion

The analysis in this study suggests that being registered with a single-handed general practice has limited, if any influence on a patient's method of admission for the three conditions included.

In the case of inguinal hernia the correlation is significant at the 15% level. However, the effect is small, particularly in NHIMD deciles 1 to 9. Holding other things constant, the proportion of admissions from single-handed practices in decile 10 that were emergencies was about 6.6 per cent compared with 5.3 per cent for group practices in the same areas. In the rest of the country, 4.0 per cent of admissions from single-handed practices were emergencies compared with 3.5 per cent of admissions from group practices.

Irrespective of the type of practice that a patient is registered with, patients living in deprived areas were significantly more likely to be admitted as an emergency than those living in more affluent areas. Controlling for demographic factors reduces the scale of the difference, but the addition of supply variables into the model has relatively little effect.

Patients living close to a hospital were more likely to be admitted as an emergency than those living further away. This correlation was significant for gallstones and acute tonsillitis.

GP patient survey measures were largely uncorrelated with the method of admission. The main exception was that patients from practices with greater awareness of how to access care out of hours were less likely to be admitted as an emergency for acute tonsillitis.

Although there are other dimensions to GP effectiveness, the results in this study provide little reason to seek to reduce the number of single-handed practices. Doing so is likely to reduce the number of emergency admissions minimally, if at all.

5. Acknowledgements

We are grateful to Professor Richard Hobbs and Dr Dan Lasserman of the Primary Care Department, University of Oxford, and Professor José Valderas of the University of Exeter for their helpful comments.

6. References

Ashworth M, Armstrong D. 2006. The relationship between general practice characteristics and quality of care: a national survey of quality indicators used in the UK Quality and Outcomes Framework, 2004-5. *BMC Family Practice* 7:68.

Ashworth M, Seed P, Armstrong D, Durbaba S, Jones R. 2007. The relationship between social deprivation and the quality of primary care: a national survey using indicators from the UK Quality and Outcomes Framework. *British Journal of General Practice* 57: 441-448.

Audit Commission. 2000. *A focus on General Practice in England*. Audit Commission: London. Available through: www.audit-commission.gov.uk (accessed 18 April 2012).

Bankart M, Baker R, Rashid A, Habiba M, Banerjee J, Hsu R, Conroy S, Agarwal S, Wilson A. 2011. Characteristics of general practices associated with emergency admission rates to hospital: a cross-sectional study. *Emergency Medicine Journal* 28(7): 669-563.

Carr-Hill R, Hardman G, Martin S, Peacock S, Sheldon T, Smith P. 1994. *A formula for distributing NHS revenues based on small area use of hospital beds.* University of York: York. Available through: www.york.ac.uk (accessed 18 April 2012).

Communities and Local Government. 2007. *The English Indices of Deprivation 2007.* Communities and Local Government Publications.
Available through: www.communities.gov.uk (accessed 18 April 2012).

Congdon P. 2006. Modelling multiple hospital outcomes: the impact of small area and primary care practice variation. *International Journal of Health Geographics* 5:50.

Connolly A, Gaehl E, Martin H, Morris J, Purandare N. 2011. Under diagnosis of dementia in primary care: Variations in the observed prevalence and comparisons to the expected prevalence. *Aging & Mental Health* 15(8): 978-984.

Department of Health. 2000. *The NHS Plan: a plan for investment, a plan for reform*. DoH: London. Available through: www.dh.gov.uk (Accessed 18 April 2012).

Doran T, Campbell S, Fullwood C, Kontopantelis E, Roland M. 2010. Performance of small general practices under the UK's Quality and Outcomes Framework. *British Journal of General Practice* 60(578): 335-344.

Downing A, Rudge G, Cheng Y, Tu YK, Keen J, Gilthorpe M. 2007. Do the UK government's new Quality and Outcomes Framework (QOF) scores adequately measure primary care performance? A cross-sectional survey of routine healthcare data. *BMC Health Services Research* 7:166.

Feron JM, Gerexhe F, Pestiaux D, Roland M, Giet D, Montrieux C, Paulus D. 2003. GPs working in solo practice: obstacles and motivations for working in a group? A qualitative study. *Family Practice* 20(2): 167-172.

Goddard M. 2009. Access to health care services – an English policy perspective. *Health Economics, Policy and Law* 4: 195-208.

Gulliford M, Jack R, Adams G, Ukoumunne O. 2004. Availability and structure of primary medical care services and population health and health care indicators in England. *BMC Health Services Research* 4:12.

Hippisley-Cox J, Pringle M, Coupland C, Hammersley V, Wilson A. 2001. Do single handed practices offer poorer care? Cross sectional survey of processes and outcomes. *BMJ* 323: 320-323.

Kontopantelis E, Roland M, Reeves D. 2101. Patient experience of access to primary care: identification of predictors in a national patient survey. *BMC Family Practice* 11:61.

Mackay D, Watt G. 2010. General practice size determines participation in optional activities: cross sectional analysis of a national primary care system. *Primary Health Care Research & Development* 11(3): 271-279.

Majeed A. 2005. The future of singlehanded general practices, *BMJ* 330: 1460-1461

Morris S, Carr-Hill R, Dixon P, Law M, Rice N, Sutton M, Vallejo-Torres L. 2007. *Combining Age Related and Additional Needs (Caran) Report: 2007 Review of the Needs Formulae for Hospital Services and Prescribing Activity in England.* Department of Health: London. Available through: www.dh.gov.uk (accessed 18 April 2012).

Millett C, Car J, Eldred D, Khunti K, Mainous Ill A, Majeed A. 2007. Diabetes prevalence, process of care and outcomes in relation to practice size, caseload and deprivation: national cross-sectional study in primary care. *Journal of the Royal Society of Medicine* 100: 275-283.

NHS Information Centre (2012) HES Data Dictionary. Available through: www.hesonline.nhs.uk (accessed 18 April 2012)

Propper C. 1998. *Who pays for and who gets health care: equity in the finance and delivery of health care in the UK.* Nuffield Occasional Paper. Health Economics Series, paper 5. London: The Nuffield Trust.

Purdy S, Griffin T, Salisbury C, Sharp D. 2011a. Emergency admissions for coronary heart disease: a cross-sectional study of general practice, population and hospital factors in England, *Public Health* 125(1): 46-54.

Purdy S, Griffin T, Salisbury C, Sharp D. 2011b. Emergency respiratory admissions: influence of practice, population and hospital factors, *Journal of Health Services Research & Policy* 16(3): 133-140.

The Shipman Inquiry. 2004. *Fifth Report. Safeguarding patients: lessons from the past – proposals for the future.* The Shipman Inquiry. Available through: www. shipman-inquiry.org.uk (Accessed 18 April 2012).

van den Hombergh P, Engels Y, van den Hoogen H, van Doremalen J, van den Bosch W, Grol R. 2005. Saying 'goodbye' to single-handed practices; what do patients and staff lose or gain? *Family Practice* 22(1): 20-27.

Wang Y, O'Donnell C, Mackay D, Watt G. 2006. Practice size and quality attainment under the new GMS contract: a cross-sectional analysis, *British Journal of General Practice* 56: 830-835.

7. Tables

Table I: Summary statistics of patient characteristics by GP practice type

	Gallstones			Inguinal hernia			Acute tonsillitis		
	Group	small SHP	large SHP	Group	small SHP	large SHP	Group	small SHP	large SHP
% elective	74.7%	74.1%	76.5%	96.4%	95.4%	95.2%	60.3%	59.9%	56.1%
% emergency	25.3%	25.9%	23.5%	3.6%	4.6%	4.8%	39.7%	40.1%	43.9%
% NHIMD vint. 20	5.4%	12.5%	13.7%	3.5%	9.5%	7.7%	6.1%	13.2%	11.2%
% NHIMD vint. 19	5.5%	10.0%	10.8%	4.0%	8.3%	9.5%	5.6%	9.2%	8.4%
% age 16-44	48.3%	51.9%	54.9%	32.6%	38.3%	38.5%	96.4%	96.4%	96.3%
% age 45-54	21.4%	20.2%	21.6%	19.2%	18.7%	19.2%	2.6%	2.8%	2.9%
% age 55-64	18.7%	17.0%	12.0%	27.1%	24.8%	24.1%	0.7%	0.6%	0.6%
% age 65-74	11.7%	10.9%	11.5%	21.1%	18.1%	18.2%	0.2%	0.2%	0.2%
% gender male	20.1%	19.9%	20.4%	93.8%	94.5%	93.1%	33.5%	38.7%	33.3%
% gender female	79.9%	80.1%	79.6%	6.2%	5.5%	6.9%	66.5%	61.3%	66.7%
% Eth. White	79.3%	72.6%	67.1%	72.7%	64.2%	60.3%	73.8%	66.3%	63.4%
% Eth. Mixed	0.7%	0.6%	1.0%	0.5%	0.7%	1.1%	1.2%	1.3%	1.4%
% Eth. Asian	3.9%	8.9%	9.8%	2.3%	5.6%	7.0%	3.7%	8.4%	8.7%
% Eth. Black	2.0%	3.4%	5.5%	1.4%	2.6%	3.5%	2.3%	4.7%	5.3%
% Eth. Chinese	0.3%	0.1%	0.2%	0.2%	0.5%	0.3%	0.1%	0.1%	0.2%
% Eth. Other	1.3%	2.4%	3.1%	0.9%	2.3%	1.8%	1.2%	2.4%	3.7%
% Eth. Not known	12.6%	12.0%	13.2%	22.0%	24.0%	25.9%	17.6%	16.8%	17.4%
% Urban	81.3%	93.3%	94.7%	76.9%	88.5%	94.0%	83.8%	92.3%	92.1%
% Town	10.0%	4.1%	2.6%	11.4%	6.3%	3.4%	8.9%	3.8%	4.0%
% Village	8.7%	2.7%	2.6%	11.8%	5.2%	2.6%	7.3%	3.9%	3.9%
Hospital access index - mean (sd)	1.74	1.99	1.99	1.69	1.98	2.03	1.78	2	1.98
	(0.62)	(0.55)	(0.6)	(0.62)	(0.59)	(0.6)	(0.61)	(0.58)	(0.59)
Km to hospital - mean (sd)	5.33	3.68	3.57	5.85	3.94	3.78	4.98	3.49	3.79
	(5.41)	(3.75)	(3.69)	(5.89)	(4.09)	(3.89)	(5.01)	(3.08)	(3.85)
QOF total - mean (sd)	0.96	0.95	0.94	0.96	0.94	0.94	0.96	0.94	0.94
	(0.03)	(0.06)	(0.07)	(0.03)	(0.07)	(0.06)	(0.03)	(0.07)	(0.07)
GP phone access - mean (sd)	0.85	0.92	0.86	0.86	0.92	0.86	0.85	0.91	0.86
	(0.12)	(0.09)	(0.13)	(0.12)	(0.1)	(0.12)	(0.13)	(0.11)	(0.12)
GP 48hr access - mean (sd)	0.86	0.89	0.83	0.86	0.89	0.83	0.86	0.88	0.83
	(0.1)	(0.1)	(0.13)	(0.1)	(0.1)	(0.13)	(0.1)	(0.11)	(0.13)
Out of hours know - mean (sd)	0.67	0.68	0.63	0.68	0.67	0.62	0.67	0.67	0.63
	(0.08)	(0.09)	(0.1)	(0.08)	(0.09)	(0.1)	(0.08)	(0.09)	(0.1)
GP specific - mean (sd)	0.86	0.9	0.86	0.87	0.9	0.86	0.86	0.9	0.85
	(0.09)	(0.08)	(0.1)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.1)
GP access index - mean (sd)	0.75	0.8	0.81	0.74	0.79	0.83	0.77	0.79	0.8
	(0.21)	(0.21)	(0.23)	(0.22)	(0.22)	(0.25)	(0.22)	(0.2)	(0.24)
Total observations	21,510	861	417	61,586	2,326	1,321	25,379	973	645

Table II: Results from logit regression with PCT fixed effects for gallstones (K802)

	1			2			3		
	Coef.	Std. Err.	OR	Coef.	Std. Err.	OR	Coef.	Std. Err.	OR
Vint. 20	0.359 ***	0.094	1.43	0.350 ***	0.096	1.42	0.329 ***	0.098	1.39
Vint. 19	0.324 ***	0.094	1.38	0.316 ***	0.095	1.37	0.296 ***	0.096	1.34
Dec. 9	0.283 ***	0.081	1.33	0.284 ***	0.081	1.33	0.266 ***	0.082	1.30
Dec. 8	0.203 **	0.081	1.22	0.204 **	0.081	1.23	0.190 **	0.082	1.21
Dec. 7	0.112	0.081	1.12	0.113	0.081	1.12	0.106	0.082	1.11
Dec. 6	0.093	0.082	1.10	0.094	0.082	1.10	0.090	0.082	1.09
Dec. 5	0.199 **	0.080	1.22	0.199 **	0.080	1.22	0.195 **	0.081	1.22
Dec. 4	0.203 **	0.081	1.23	0.203 **	0.081	1.23	0.198 **	0.081	1.22
Dec. 3	0.151 *	0.080	1.16	0.151 *	0.080	1.16	0.139 *	0.080	1.15
Dec. 2	0.123	0.080	1.13	0.123	0.080	1.13	0.118	0.080	1.13
Aged 45-54	-0.345 ***	0.042	0.71	-0.345 ***	0.042	0.71	-0.349 ***	0.042	0.71
Aged 55-64	-0.580 ***	0.047	.056	-0.581 ***	0.047	0.56	-0.582 ***	0.047	0.56
Aged 65-74	-0.492 ***	0.055	0.61	-0.492 ***	0.055	0.61	-0.490 ***	0.055	0.61
Gender (fem.)	-0.343 ***	0.039	0.71	-0.342 ***	0.039	0.71	-0.343 ***	0.039	0.71
Eth. Mixed	0.187	0.184	1.21	0.188	0.184	1.21	0.151	0.186	1.16
Eth. Asian	0.046	0.082	1.05	0.047	0.082	1.05	0.026	0.083	1.03
Eth. Black	0.119	0.114	1.13	0.119	0.114	1.13	0.116	0.114	1.12
Eth. Chinese	-0.595	0.373	0.55	-0.593	0.373	0.55	-0.591	0.374	0.55
Eth. Other	0.208	0.137	1.23	0.208	0.137	1.23	0.204	0.137	1.23
Eth. Not known	-0.284 ***	0.052	0.75	-0.284 ***	0.052	0.75	-0.284 ***	0.052	0.75
Town	-0.145 **	0.061	0.87	-0.146 **	0.061	0.86	-0.084	0.065	0.92
Village	0.067	0.064	1.07	0.066	0.064	1.07	0.147 **	0.075	1.16
Single-handed (D10)				0.052	0.142	1.05	0.078	0.143	1.08
Single-handed (D1-9)				-0.059	0.082	0.94	-0.045	0.083	0.96
Hospital access index							-12.35	56.40	NA
Distance to hospital							-0.012 ***	0.005	NA
QOF total							0.073	0.516	NA
GP phone access							-0.217	0.200	NA
GP 48hr access							0.039	0.204	NA
Out of hours know							-0.156	0.297	NA
GP specific							0.054	0.246	NA
GP access index							40.57	211.4	NA

Wald test	χ^2	$P>\|\chi^2\|$	χ^2	$P>\|\chi^2\|$	χ^2	$P>\|\chi^2\|$
All additional vars	47.13	0.000	0.66	0.721	11.20	0.191

Table III: Results from logit regression with PCT fixed effects for inguinal hernia (K40)

	1			2			3		
	Coef.	Std. Err.	OR	Coef.	Std. Err.	OR	Coef.	Std. Err.	OR
Vint. 20	0.778 ***	0.125	2.18	0.757 ***	0.128	2.13	0.736 ***	0.130	2.09
Vint. 19	0.503 ***	0.127	1.65	0.483 ***	0.129	1.62	0.463 ***	0.131	1.59
Dec. 9	0.591 ***	0.107	1.81	0.585 ***	0.107	1.80	0.569 ***	0.108	1.77
Dec. 8	0.482 ***	0.105	1.62	0.478 ***	0.105	1.61	0.462 ***	0.106	1.59
Dec. 7	0.172	0.107	1.19	0.169	0.107	1.18	0.155	0.108	1.17
Dec. 6	0.367 ***	0.103	1.44	0.365 ***	0.103	1.44	0.349 ***	0.104	1.42
Dec. 5	0.180 *	0.104	1.20	0.177 *	0.104	1.19	0.168	0.105	1.18
Dec. 4	0.178 *	0.104	1.20	0.177 *	0.104	1.19	0.172 *	0.104	1.19
Dec. 3	0.067	0.106	1.07	0.067	0.106	1.07	0.062	0.106	1.06
Dec. 2	0.127	0.103	1.14	0.127	0.103	1.14	0.119	0.103	1.13
Aged 45-54	-0.318 ***	0.061	0.73	-0.318 ***	0.061	0.73	-0.316 ***	0.061	0.73
Aged 55-64	-0.391 ***	0.057	0.68	-0.391 ***	0.057	0.68	-0.387 ***	0.057	0.68
Aged 65-74	-0.197 ***	0.058	0.82	-0.197 ***	0.058	0.82	-0.198 ***	0.058	0.82
Gender (fem.)	0.373 ***	0.060	1.45	0.374 ***	0.060	1.45	0.371 ***	0.060	1.45
Eth. Mixed	-0.225	0.298	0.80	-0.228	0.298	0.80	-0.233	0.298	0.79
Eth. Asian	0.457 ***	0.108	1.58	0.448 ***	0.108	1.57	0.427 ***	0.109	1.53
Eth. Black	0.405 ***	0.143	1.50	0.402 ***	0.143	1.49	0.396 ***	0.143	1.49
Eth. Chinese	0.519	0.373	1.68	0.513	0.373	1.67	0.505	0.373	1.66
Eth. Other	0.402 **	0.168	1.49	0.396 **	0.168	1.49	0.390 **	0.169	1.48
Eth. Not known	-0.442 ***	0.060	0.64	-0.444 ***	0.060	0.64	-0.447 ***	0.060	0.64
Town	-0.102	0.081	0.90	-0.102	0.081	0.90	-0.077	0.088	0.93
Village	0.007	0.079	1.01	0.007	0.079	1.01	0.046	0.095	1.05
Single-handed (D10)				0.238	0.174	1.27	0.229	0.177	1.26
Single-handed (D1-9)				0.163 *	0.098	1.18	0.161	0.100	1.17
Hospital access index							-90.61	76.65	NA
Distance to hospital							-0.005	0.006	NA
QOF total							-0.252	0.624	NA
GP phone access							-0.104	0.269	NA
GP 48hr access							-0.120	0.267	NA
Out of hours know							-0.323	0.384	NA
GP specific							0.116	0.329	NA
GP access index							122.2	269.9	NA
Wald test	χ^2		$P>\|\chi^2\|$	χ^2		$P>\|\chi^2\|$	χ^2		$P>\|\chi^2\|$
All additional vars	104.97		0.000	4.56		0.102	4.13		0.845

Table IV: Results from logit regression with PCT fixed effects for acute tonsillitis (J039)

	1				2				3			
	Coef.		**Std. Err.**	**OR**	**Coef.**		**Std. Err.**	**OR**	**Coef.**		**Std. Err.**	**OR**
Vint. 20	0.315	***	0.077	1.37	0.299	***	0.078	1.35	0.291	***	0.079	1.34
Vint. 19	0.262	***	0.077	1.30	0.248	***	0.077	1.28	0.234	***	0.078	1.26
Dec. 9	0.169	**	0.066	1.18	0.172	***	0.066	1.19	0.161	**	0.067	1.17
Dec. 8	0.081		0.065	1.08	0.083		0.065	1.09	0.075		0.065	1.08
Dec. 7	0.110	*	0.065	1.12	0.112	*	0.065	1.12	0.105		0.065	1.11
Dec. 6	0.038		0.065	1.04	0.040		0.065	1.04	0.032		0.065	1.03
Dec. 5	0.005		0.065	1.01	0.007		0.065	1.01	-0.004		0.066	1.00
Dec. 4	-0.042		0.066	0.96	-0.042		0.066	0.96	-0.052		0.066	0.95
Dec. 3	0.030		0.065	1.03	0.030		0.065	1.03	0.027		0.065	1.03
Dec. 2	0.003		0.065	1.00	0.004		0.065	1.00	0.004		0.066	1.00
Aged 45-54	0.662	***	0.081	1.94	0.663	***	0.081	1.94	0.668	***	0.081	1.95
Aged 55-64	0.771	***	0.152	2.16	0.770	***	0.152	2.16	0.777	***	0.153	2.17
Aged 65-74	0.292		0.256	1.34	0.293		0.256	1.34	0.259		0.259	1.30
Gender (fem.)	-0.806	***	0.027	0.45	-0.807	***	0.027	0.45	-0.807	***	0.027	0.45
Eth. Mixed	0.163		0.121	1.18	0.162		0.121	1.18	0.148		0.121	1.16
Eth. Asian	0.010		0.070	1.01	0.011		0.070	1.01	-0.010		0.071	0.99
Eth. Black	0.640	***	0.090	1.90	0.643	***	0.091	1.90	0.618	***	0.091	1.86
Eth. Chinese	0.436		0.350	1.55	0.438		0.350	1.55	0.394		0.351	1.48
Eth. Other	0.395	***	0.115	1.48	0.398	***	0.115	1.49	0.370	***	0.115	1.45
Eth. Not known	-0.242	***	0.036	0.78	-0.242	***	0.036	0.79	-0.246	***	0.037	0.78
Town	-0.004		0.051	1.00	-0.004		0.051	1.00	0.075		0.056	1.08
Village	0.030		0.056	1.03	0.030		0.056	1.03	0.130	**	0.064	1.14
Single-handed (D10)					0.089		0.122	1.09	0.104		0.122	1.11
Single-handed (D1-9)					-0.103		0.065	0.90	-0.089		0.066	0.91
Hospital access index									10.07		45.26	NA
Distance to hospital									-0.013	***	0.004	NA
QOF total									0.787	*	0.412	NA
GP phone access									0.239		0.165	NA
GP 48hr access									-0.215		0.166	NA
Out of hours know									-1.003	***	0.225	NA
GP specific									-0.196		0.206	NA
GP access index									10.18		168.9	NA
Wald test	χ^2			**P>|χ^2|**	χ^2|			**P>|χ^2|**	χ^2			**P>|χ^2|**
All additional vars	45.81			0.000	3.11			0.211	41.23			0.000

Table V: Results from logit regressions with PCT fixed effects for inguinal hernia (K40) with all single-handed practices grouped together, under two definitions of single-handed practices

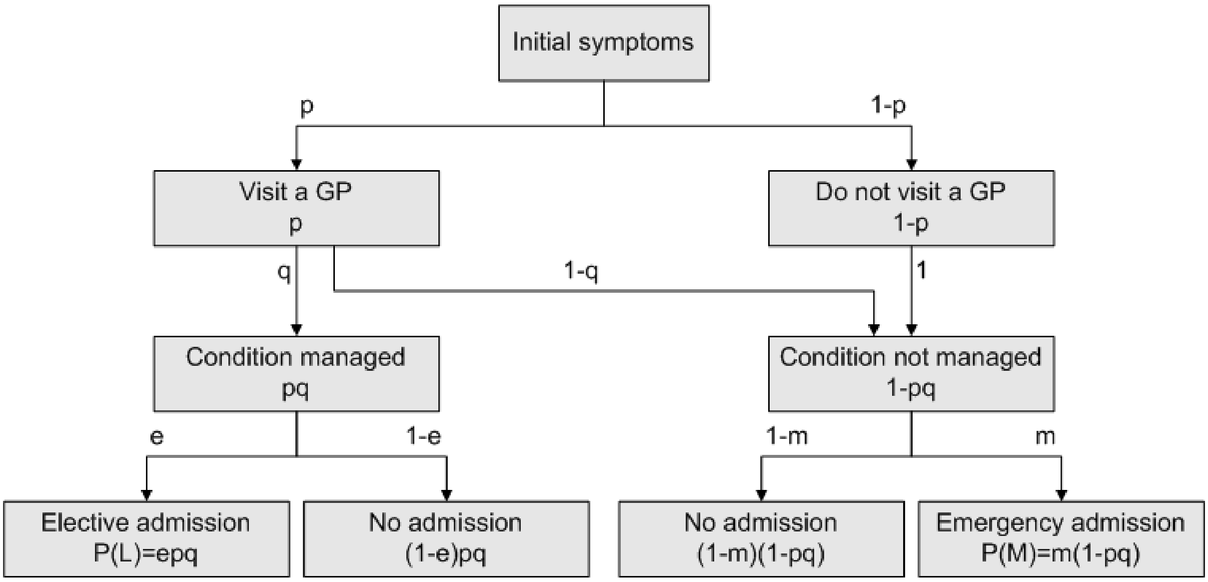
	SH practice not constrained by list size			SH practice have <=3000 patients		
	Coef.	Std. Err.	OR	Coef.	Std. Err.	OR
NHIMD vintile 20	0.766 ***	0.125	2.15	0.770 ***	0.125	2.16
NHIMD vintile 19	0.492 ***	0.127	1.64	0.497 ***	0.127	1.64
NHIMD decile 9	0.584 ***	0.107	1.79	0.587 ***	0.107	1.80
NHIMD decile 8	0.477 ***	0.105	1.61	0.479 ***	0.105	1.61
NHIMD decile 7	0.168	0.107	1.18	0.169	0.107	1.18
NHIMD decile 6	0.365 ***	0.103	1.44	0.365 ***	0.103	1.44
NHIMD decile 5	0.177 *	0.104	1.19	0.178 *	0.104	1.20
NHIMD decile 4	0.177 *	0.104	1.19	0.177 *	0.104	1.19
NHIMD decile 3	0.067	0.106	1.07	0.067	0.106	1.07
NHIMD decile 2	0.127	0.103	1.14	0.127	0.103	1.14
Aged 45-54	-0.318 ***	0.061	0.73	-0.318 ***	0.061	0.73
Aged 55-64	-0.391 ***	0.057	0.68	-0.391 ***	0.057	0.68
Aged 65-74	-0.197 ***	0.058	0.82	-0.197 ***	0.058	0.82
Gender (female)	0.374 ***	0.060	1.45	0.374 ***	0.060	1.45
Eth. Mixed	-0.229	0.298	0.80	-0.226	0.298	0.80
Eth. Asian	0.449 ***	0.108	1.57	0.453 ***	0.108	1.57
Eth. Black	0.402 ***	0.143	1.49	0.403 ***	0.143	1.50
Eth. Chinese	0.512	0.373	1.67	0.512	0.373	1.67
Eth. other	0.396 **	0.168	1.49	0.396 **	0.168	1.49
Eth. not known	-0.444 ***	0.060	0.64	-0.443 ***	0.060	0.64
Town	-0.102	0.081	0.90	-0.102	0.081	0.90
Village	0.007	0.079	1.01	0.007	0.079	1.01
Single-handed	0.180 **	0.086	1.20	0.161	0.104	1.17

Table VI: Results from parsimonious logit regressions with PCT fixed effects for inguinal hernia (K40) with all single-handed practices grouped together under two definitions of single-handed practice

	SH practice not constrained by list size			SH practice have <=3000 patients		
	Coef.	Std. Err.	OR	Coef.	Std. Err.	OR
NHIMD vintile 20	0.757 ***	0.124	2.13	0.761 ***	0.124	2.14
NHIMD vintile 15-19	0.518 ***	0.094	1.68	0.521 ***	0.093	1.68
NHIMD vintile 3-14	0.181 **	0.083	1.20	0.181 **	0.083	1.20
Aged 45-54	-0.317 ***	0.060	0.73	-0.317 ***	0.060	0.73
Aged 55-64	-0.392 ***	0.056	0.68	-0.392 ***	0.056	0.68
Aged 65-74	-0.200 ***	0.058	0.82	-0.200 ***	0.058	0.82
Gender (female)	0.373 ***	0.060	1.45	0.373 ***	0.060	1.45
Eth. Asian, Black or	0.432 ***	0.083	1.54	0.435 ***	0.083	1.54
Eth. Not known	-0.444 ***	0.060	0.64	-0.443 ***	0.060	0.64
Single-handed	0.184 **	0.086	1.20	0.165	0.104	1.18

8. Figures

Figure 1: Conceptual framework outlining how emergency and elective admissions are generated



Centre for
Health Service Economics
& Organisation

Skipton House
80 London Road, London SE1 6LH
Nuffield College
New Road, Oxford OX1 1NF
Tel. 020 7972 5219, www.chseo.org.uk
A Centre of the Department
of Economics, University of Oxford