Platform Project

THE PARTIALITY OF PRIMARY CARE INTELLIGENCE AND STRUCTURE

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The Platform Project is a collaboration between the Universities of Aberdeen, Dundee, Edinburgh and Glasgow, with ISDScotland and the Royal College of General Practitioners working under the auspices of the Scottish School of Primary Care.

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Executive Summary

Introduction

Primary care is an increasingly important part of the Scottish Executive Health Department's strategy to improve health and reduce health inequalities.

Primary care developments in the last decade include enhanced information systems, new funding arrangements, quality initiatives and developments in postgraduate training. This report describes how participation in these initiatives varied across general practices serving ten equally-sized groups of the Scottish population, ranging from the most affluent to the most deprived.

The report also considers how several structural characteristics that may affect the ability of practices to offer good quality care varies across these groups, including average list size, single-handed practices, the average age of general practitioners and the availability of a female general practitioner.

Findings

Our findings show that, as at the end of 2002, the coverage of a wide range of initiatives and features of general practice varied by the level of deprivation:

- Practices working in deprived areas were less likely to participate in the enhanced data collection systems that offered crucial intelligence on patterns of disease, consultation patterns and standards of care.

- The distribution of Personal Medical Services (PMS) pilots was uneven, with the fewest number of such schemes being based in the most deprived areas. This was despite the explicit policy intention that practices in deprived areas would benefit most from investment in this new approach to the organisation and funding of primary care.

- The most affluent third of the population was twice as likely to be served by General Practitioners who have been approved for the training of GP registrars than the population in the most deprived third of areas.

- In contrast, general practices run by young general practitioners (average age less than 38 years) served twice as many people from the most deprived third of the population compared to the most affluent third.

- Single-handed general practitioners and practices with more than 1,900 registered patients per general practitioner were more prevalent in deprived than in affluent areas.

- In 2002, about one third of Scottish practices had received an accreditation from the Royal College of General Practitioners indicating that they had in place “the essential elements to provide good general practice”. The prevalence of practice accreditation was lowest in practices serving the most deprived 30% of the population.

Implications

Practices in deprived areas were less likely to contribute to intelligence-gathering, to participate in policy initiatives and to have structural characteristics conducive to offering good quality care. Therefore, practices serving the most deprived patients in Scotland appear less able to contribute to the Government’s strategy for improving Scotland’s health.

In the short-term, research and evaluation findings should be interpreted with caution and adjusted to reflect the partiality of the evidence base. We suggest a method for approaching this in the full report.

In the longer-term, policy-makers and researchers should do more to ensure participation from deprived practices. Steps will need to be taken to ensure a level playing-field if primary care is to contribute to the Executive’s objective of reducing inequalities in health.

THE PARTIALITY OF PRIMARY CARE INTELLIGENCE AND STRUCTURE

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On behalf of the Platform Project Study Team

Summary

Recent developments in care management and technology suggest that the contribution of primary care to population health is set to increase. Yet little is known about how primary care is delivered in deprived areas, what works, and how the delivery of primary care exacerbates or ameliorates health inequalities. We sought to summarise the extent to which general practices serving deprived areas are represented in 'national' datasets and policy initiatives. We assess the extent to which practices serving deprived areas contribute to a wide range of datasets and policy initiatives using two measures of concentration - (i) the Robin Hood Index and (ii) the Kakwani index. We find that deprived practices are less likely to participate in dedicated data collection systems, receive accreditation from the Royal College and to offer extended services under the Personal Medical Services scheme. In contrast, they are more likely to have too many patients per General Practitioner and to be single-handed. They are also less likely to offer training but are more likely to be staffed by young GPs. Practices in deprived areas can therefore contribute to our understanding of what happens when general practice resources are stretched but tend to be underrepresented in the datasets and samples used for research and for assessing innovative ways of delivering primary care.

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Introduction

The recent Scottish White Paper highlighted the importance of primary care:

> "For most people contact with the NHS begins and ends in primary care. The professionals who provide these services…manage 90% of patient contacts with the health service, co-ordinating diagnosis, treatment and care and ensuring that more of these services are provided as close to home as possible." (Scottish Executive, 2003, p.33).

It also confirmed the conditions required to enable primary care to deliver change:

> "Radical service improvements can happen when people at the frontline are given the opportunity, skills and resources to do a better job. This requires:
> • the right number and mix of staff with the right education, training and skills;
> • premises which are flexible enough to support a broad range of community services and a better environment for care teams;
> • clinical and care information systems which support the primary care team; and
> • quicker access to a wider range of services." (*op.cit.*)

These quotes suggest that intelligence on, and the structure of, primary care are both important for the Scottish NHS. Yet a recent commentator has suggested that intelligence on '*what happens?*' and '*what works?*' may be particularly deficient for deprived areas (Watt, 2002). Given the potential contribution of primary care to health outcomes (Jarman et al, 1999; Shi et al, 2002; Bunker, 2001; Watt, 2002; Macinko et al, 2003), this may be a serious impediment to the NHS achieving its stated aim "to improve Scotland's health and reduce the health inequalities within our society" (Scottish Executive, 2003, p.11).

In this report we consider this issue of 'partiality' with respect to deprivation in the intelligence and structure of primary care in Scotland. Intelligence in this context may take the form of detailed data sets or pilot policy initiatives. We also consider partiality in terms of structural characteristics that may influence the delivery of care.

There are five reasons why partiality may be an important issue for primary care research and policy, which are generally appreciated to lesser or greater degrees. The first is perhaps most obvious. If there is partiality, cross-sectional analysis may be biased unless the potentially confounding effects of deprivation are considered. For example, in comparing single-handed with multi-partner practices, it is important to take account of the differences in the characteristics of the population served (Hippisley-Cox et al, 2001).

Second, partiality in some characteristics may indicate systematic variations in service quality between affluent and deprived areas. In a series of papers in the late-1980s and early-1990s, for example, Bosanquet and Leese demonstrated deprivation-related inequalities in practice innovation (Leese and Bosanquet, 1995). Some of the characteristics that we consider in this paper may be proxies for quality or an indicator of practices' ability to judge the quality of care that they deliver.

Third, partiality may lead to evaluation results that lack generalisability. If pilot policy initiatives are tried preferentially in affluent areas, and the effects of these changes (would) have different effects in deprived areas, then the results may not be generalisable. For example, one policy initiative about which there was considerable interest in partiality was fundholding. Early studies seemed to show that fundholding practices were atypical (Baines and Whynes, 1996; Gosden et al, 1997) and highlighted the issues that this raised about evaluation of the effects of this policy. However, later work indicated few links with deprivation (Asthana et al, 1999) and more recent work suggests that participation in fundholding was more to do with local policy drives than the characteristics of practices or the areas that they served (Moon et al, 2002). We are not aware of any studies that considered whether the effects of fundholding varied between different types of area, but the wave of fundholding seems to be important (Gravelle et al, 2002) and earlier waves did seem to be a partial set of practices (Baines and Whynes, 1996).

Fourth, partiality may generate inequity because many policy initiatives are associated with increased investment. Resources may be diverted to an initiative at the expense of other practices perhaps in greater need of increased resources. A suitable example here would be Personal Medical Services pilots, who received higher rates of increase in investment than their GMS counterparts (Lewis and Gillam, 2002). The drive for innovation and change in the NHS will generate inequity in health care delivery if additional resources flow preferentially to practices in certain types of areas. This will thwart attempts to achieve equity in health care financing through the use of resource allocation formulae for mainstream funding.

Finally, certain types of partiality have implications for studies of the epidemiology of primary care. Partiality of data can lead to misleading national correlations or averages. Partiality may be random or non-random (i.e. systematically related to one or more of the variables of interest). Random partiality is primarily an issue of statistical power – we are less likely to be able to draw reliable conclusions based on a small sample of the true data. Non-random partiality has more serious consequences as it results in an uneven representation of a characteristic of particular interest. For example, consider a study of GP contact rates that uses data from a sample of practices. The sample obtained may have an unusually low representation from deprived areas. Since deprivation is one of the known determinants of GP contact rates (Carr-Hill et al, 1996), average contact rates in the sample are likely to under-represent the average contact rate for the Scottish population.

Partiality may also affect relationships within the datasets, such as correlations or differences between groups. If the sampled practices do not have typical behaviour or care delivery for their 'types', then conclusions arising from any analysis may be misleading. For example, if the deprived practices in the sample have relatively high prescribing compared to other deprived practices, whereas the prescribing behaviour of affluent practices in the sample is typical of affluent practices, then the correlation between deprivation and prescribing in the sample is an upwardly-biased estimate of the true relationship.

For the purpose of this paper, we focus on partiality with respect to deprivation. We do not seek to explain *why* we observe partiality in some characteristics (Spooner et al, 2001) or consider the statistical consequences for study design (Adams et al, 2003). Nor do we consider other aspects of partiality. First we consider how well several data sets and practice characteristics represent the underlying deprivation distribution within Scotland. We find that partiality with respect to deprivation is a problem within many of the facets of primary care that we examine and demonstrate that this can have consequences for any analysis conducted using primary care data.

Data

We draw on a number of data sets for our analysis. The Royal College of General Practitioners (RCGP) kindly supplied lists of practices that had received Practice Accreditation or the Quality Practice Award by the end of 2002.

A list of all practices that returned Continuous Morbidity Recording (CMR) data to ISD in December 2002 was provided by ISD. Among these 84 practices are the 70 practices that returned complete data for 2002 and are used for the published statistics on the ISD website.[2] A further subset of these 70 practices will form the basis of a 'national sample', purposefully chosen to be "broadly representative of the Scottish population in terms of age, sex, deprivation and urban/rural mix". We have decided to use the full list of practices that returned data to reflect the tendency of different types of practices to participate in dedicated data collection systems.

The information on practices participating in SPICE was provided by the Primary Care Clinical Informatics Unit at Aberdeen University. Practice consent to be included was sought by the RCGP. Three out of 160 practices declined.

We also obtained a set of practice characteristics from the General Medical Practitioner (GMP) Database for October 2002 held at *ISDScotland*. These included Personal Medical Services (PMS) practices, training practices (defined as those practices with at least one GP who is an approved trainer) and dispensing practices as at April 2003 (defined as those practices where at least one GP was licensed to dispense drugs to at least one of their patients).

We also derived four structural variables from the same GMP Database. These included whether (a) each practice had just one partner (single-handed) and (b) at least one female GP. We also considered whether each practice had "young" GPs. Our definition of "young" was based on the distribution of average GP age across practices. We defined those practices having an average GP age less than or equal to thirty-eight years as "young". This represents approximately 10% of practices. The final structural variable of interest was average list size per whole-time equivalent GP. After an inspection of the distribution we categorised all practices with more than 1,900 patients per WTE as large list size practices. Again, this represents approximately 10% of practices.

While fundholding has now been abolished, we included this variable because of historical interest in the partiality of participation. Fundholding practices as of April 1999 were identified from the GMP database. We defined fundholding practices as those practices that were involved in a total purchasing pilot, standard fundholding or a primary care purchasing pilot. Given that most of the analysis throughout this paper is undertaken for 2002, we restrict our analysis of this variable to practices open in April 1999 and still open in September 2002.

These lists of practices were linked to population counts derived from the Community Health Index as at September 2002. These population counts were stratified by practice and 1991 postcode sector, so that practice characteristics could be matched by practice, and Carstairs

[2] http://www.show.scot.nhs.uk

index scores (Carstairs and Morris, 1991) from the 1991 Census (McLoone, 1994) could be matched by geographical area. It was not possible to match practice codes for a small number of SPICE (n=5) and PA (n=3) practices to the list of practices open in September 2002. These cases have been omitted.

We also consider angiography rates for those aged 45-74 years of age. The data were obtained from an SMR1 extract held by *ISDScotland* and relate to discharges in the 2002 calendar year. We count the number of discharges that involved an angiography using OPCS4 codes (K63 and K65). As some discharges may involve more than one angiography, these counts *under*-estimate the total number of *procedures* undertaken. However, as some individuals may have more than one discharge involving an angiography during the year, these counts *over*-estimate the number of *individuals* who had an angiography in 2002.

Analysis

Differential coverage by deprivation decile

We calculated (population-weighted) deprivation deciles and aggregated the population files to calculate coverage rates for each practice characteristic. We compared the coverage rate in each decile, comprising some 500,000 of the Scottish population, with the national coverage rate.

Summary measures of partiality

Some of the decile charts show systematic variation across deprivation deciles while others are more erratic. We derived two summary measures of partiality based on the extent of concentration.

The first is similar to the Robin Hood Index (Kennedy et al, 1996). It is defined as:

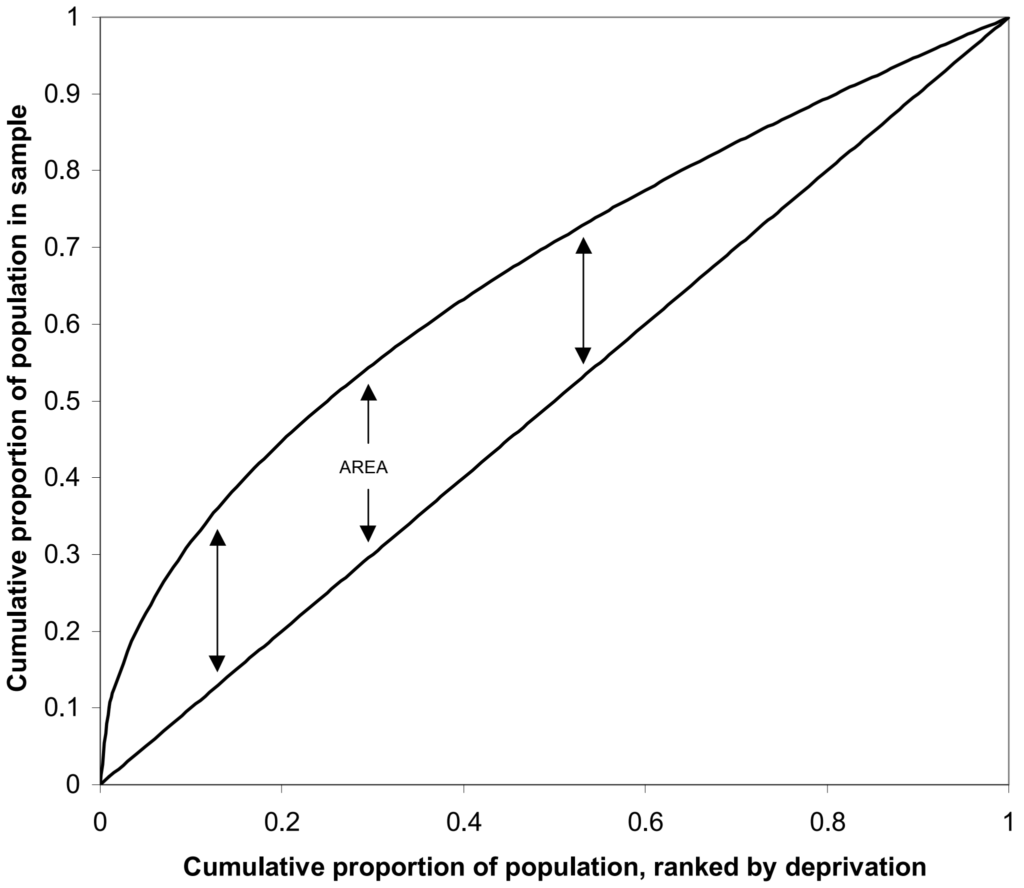
> *"the proportion of the population in the sample from deprivation deciles 6-10 (the five most deprived deciles) "*

Since the proportions of the Scottish population in deciles 6-10 and 1-5 are the same by construction, we hope to find that 50% of the population in the sample are from deciles 6-10. The minimum value of this measure is zero and the maximum value is one. A basic definition of no partiality in the sample of interest is that it is draws equal proportions from the most deprived and the least deprived halves of the population. However, if we find that there are unequal proportions of the most deprived and least deprived then we can say that there is partiality and, more importantly, we are able to quantify its extent.

However, the Robin Hood Index can be criticised for not taking account of the whole distribution of deprivation. For example, this measure equals 0.5 if 10% of the sample is drawn from each of the deciles or if 50% of the sample comes from decile 1 and the other 50% from decile 6. The sample is drawn equally from the two halves of the deprivation distribution in both cases but the latter distribution is clearly more partial. For this reason it would be preferable to take account of the full distribution of deprivation. We therefore use the concentration curve and the closely related concentration coefficient (Kakwani et al, 1997).

In this application, the concentration curve is a plot of the cumulative proportion of the population in the sample against the cumulative proportion of the total population, ranked in ascending order of the Carstairs deprivation score. If the series lies along the 45^{o}-line then the cumulative proportion of the population in the sample equals the cumulative proportion of the entire population. Systematic deviations from the 45^{o}-line represent cumulative concentrations at particular levels of affluence/deprivation. The extent of concentration can be measured by calculating twice the area between the curve and the 45^{o}-line as illustrated in Figure 1.

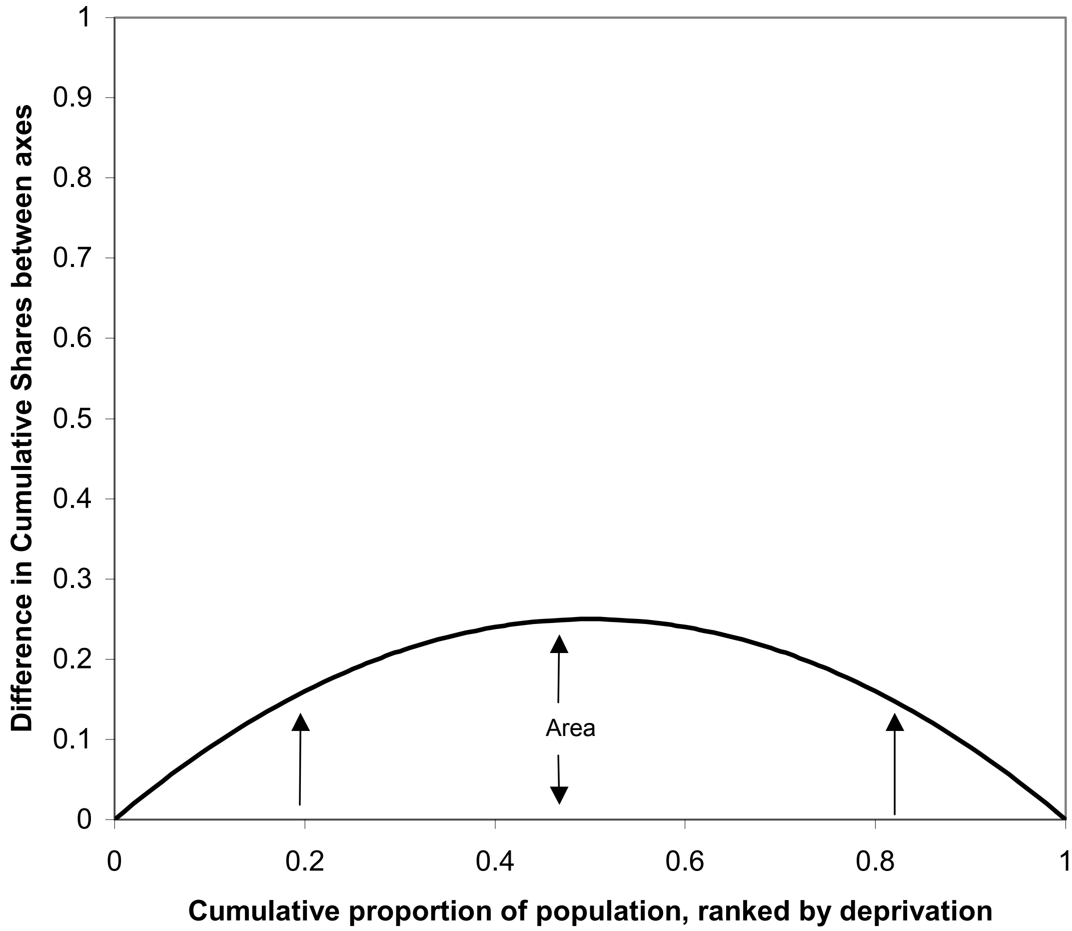
Figure 1 Illustration of Concentration Curve



If the curve lies above the 45^{o}-line then the concentration coefficient is negative and the sample preferentially represents affluent areas. If the curve lies below the 45^{o}-line then the concentration coefficient is positive and the sample preferentially represents deprived areas. The concentration coefficient has a maximum value of +1, indicating that the sample is drawn exclusively from the most deprived area. The minimum value of –1 represents the case where the sample is exclusively drawn from the most affluent area. The concentration coefficient can be most readily calculated by means of regression analysis (Kakwani et al, 1997). We use a Newey-West correction for autocorrelation of degree one to generate 95% confidence intervals around the point estimate (Newey and West, 1987).

For clarity, we present the concentration curves using a modified version of the above figure. Instead of the cumulative proportion of the population in the sample being plotted on the *Y* axis we plot the *difference* between the cumulative proportion of the population in the sample and the cumulative proportion of the population. If there was no partiality in the sample then we would expect the difference to be zero between the two cumulative measures. Thus the line of no partiality would lie horizontally on the *X* axis. If the line (curve) is above zero then the sample preferentially represents affluent areas, as shown in figure 2 below, and if the curve is below the *X* axis then it preferentially represents deprived areas.

Figure 2 Modified Concentration Curve



Demonstrating the consequences of, and correcting for, partiality

Partiality implies that there is a bias that arises because the sample under consideration is not representative of the total population which it purports to represent. The consequence is that summary statistics (such as the mean and variance) may be incorrect. The relationships between variables within the sample may also be affected.

Two potential solutions are available. First, one could sample more practices until the partiality has been eliminated from the data. However, this is a time consuming and potentially expensive exercise and will probably not be feasible in the vast majority of cases. Second, one could weight the analysis to make it representative of the population distribution of deprivation.

To illustrate the consequences of partiality we consider the (artificial) situation where we have data for all Scottish practices but consider the implications of using data from a subset of practices. We illustrate the consequences of partiality using data on angiography procedures for the 45-74 year-old age-group. We calculated the number of angiographies per capita for combinations of practices and deprivation deciles. We then compared the *mean* angiography rate overall for each sample characteristic under consideration with that of the national population. We further examined these differences in each decile. Finally, we calculated a mean value corrected for partiality, using the ratio of the national coverage rate to the sample coverage rate as the relative weight for each decile.

Algebraically, these latter stages of the analysis can be described as follows. We estimate the true mean ($\bar{y}$) as:

$$\bar{y} = \sum_j p_j y_j \qquad [1]$$

in which y_j represents the mean angiography rate per capita in the jth decile, where j runs from 1 to J, and $J = 10$. p_j is the proportion of the population in decile j and should be equal to 0.1. However, because the population base is restricted to 45-74 year olds p_j is not exactly equal 0.1 for all j.

We compare this with the mean from the sample ($\bar{y}^s$), estimated as:

$$\bar{y}^s = \sum_j \pi_j y_j^s \qquad [2]$$

in which π_j represents the proportion of the sample in decile j and y_j^s is the mean angiography rate for the populations registered with the sampled practices in decile j.

The sample bias can then be expressed as:

$$\bar{y}^s - \bar{y} = \sum_j (\pi_j y_j^s - p_j y_j) \qquad [3]$$

which is a function of both the partiality of the sample (given by the extent to which the π_j's differ from the p_j's) and the representativeness of the activity data in the sample within each decile (the extent to which the y_j^s are good estimates of the y_j).

There are two simple scenarios:

1. *No partiality* ($\pi_j = p_j \;\forall\; j$). In this case the sample bias depends only on the y_j^s and y_j because $\bar{y}^s - \bar{y} = \sum_j p_j (y_j^s - y_j)$.

2. *Representative activity estimates* ($y_j^s = y_j \ \forall \ j$). In this case the sample bias is a weighted average of the extent of partiality, where the weights are the activity rates in each decile because $\bar{y}^s - \bar{y} = \sum_j \bar{y}_j(\pi_j - p_j)$

Under scenario 2, where we have representative sample estimates, the partiality is correctable using $\bar{y} = \sum_j p_j \bar{y}_j^s$. However, with real data the bias is likely to be a complex interaction between the extent of partiality and the unrepresentativeness of sample estimates for each decile. Most problematically, the data will not be available to test for unrepresentativeness within deciles.

Weighting only improves the estimate of the population average if the sampled practices are representative of the areas from which they drawn. Otherwise, the problem may be exacerbated rather than mitigated. This is because weighting assumes that, conditional on the observed characteristics, 'missing' practices have similar rates to the included practices. We weight to control for the fact that some observations are under represented to increase their influence in any calculations.

Results

Our results are presented in three main parts. First we consider the coverage rate across deprivation deciles. Second we present our summary measures of partiality based on the Robin Hood Index and the concentration coefficient. We then show what happens when corrective action is applied to the data in an attempt to mitigate the effects of partial data coverage.

Coverage rates by deprivation deciles

Appendix 1 shows the coverage rates by deprivation decile of the twelve characteristics of interest. The figures are also shown graphically. The proportions of the national population registered with various types of practices are plotted on the *Y* axis. On the *X* axis is the Carstairs deprivation decile and the horizontal line shows the national average coverage rates. For dispensing practices, we can see that there is a fairly marked degree of partiality. Deciles 1-5 are over represented (especially decile 4) whilst deciles 9 and 10 are very poorly represented.

Around 9% of the national population were registered with the practices that returned CMR data in December 2002. However, this is drawn unequally from the deprivation spectrum. Again, the most deprived deciles are under-represented, especially decile 10. The least deprived are over-represented. Young general practitioners are also more likely to be serving people from the more deprived part of the population. On the other hand the graphs for single handed practices and for practices with more than 1,900 registered patients per general practitioner show the opposite scenario - in these graphs the most deprived deciles are over-represented.

Summary measures of partiality

The figure in appendix 2 and the coefficients in table 1 below, show the extent of partiality, as defined by the Robin Hood Index, within the various primary care data sets and policy initiatives we consider in this paper. Forty-nine percent of the population that were registered with practices that had at least one female GP were from the more deprived half of the population. This also implies that 51% of the population that were registered with any-female GP practices were from the least deprived half of the population. Thus, any-female GP practices serve the least deprived and most deprived in approximately equal measure. Thus, there is no partiality of any-female GP practices with respect to deprivation.

Dispensing practices, however, draw only 25.0% of their population from the most deprived half of the population, implying a significant amount of partiality. At the opposite extreme, 64.3% of the population registered with single-handed practices are from the most deprived half of the population.

In terms of policy initiatives, there would appear to be a certain amount of partiality associated with PMS and PA practices. These practices tend to have an under-representation of the most deprived in the population. Primary care data sets such as SPICE and CMR also have a degree of partiality, with CMR less partial than SPICE. Both datasets have an under-representation of the most deprived practices.

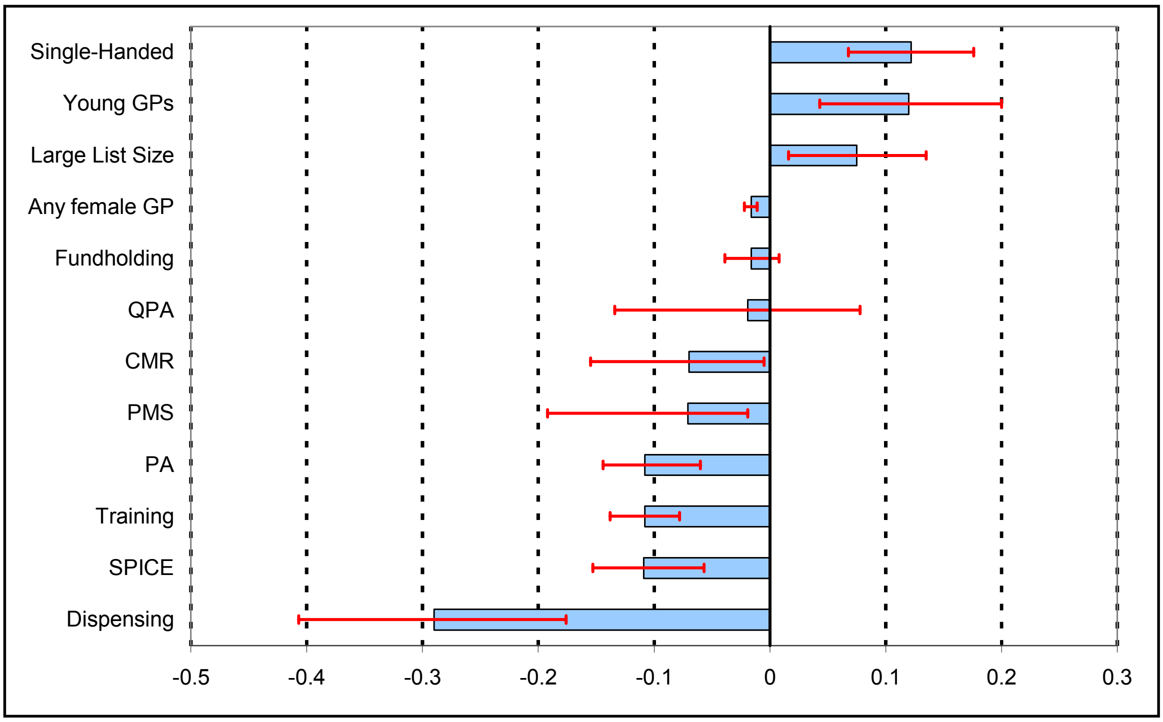
Table 1 also shows the value of the concentration coefficient with 95% confidence intervals for the various characteristics we consider in this paper.

Table 1 Measures of Partiality

Variable	Robin Hood Index	Concentration Coefficient and Confidence Intervals	
Dispensing	0.250	-0.290	(-0.407, -0.176)
PA	0.415	-0.108	(-0.144, -0.060)
SPICE	0.416	-0.109	(-0.153, -0.057)
Training Practices	0.419	-0.108	(-0.138, -0.078)
PMS	0.430	-0.071	(-0.192, -0.019)
CMR	0.438	-0.070	(-0.155, -0.005)
Fundholding	0.480	-0.016	(-0.039, 0.008)
QPA	0.483	-0.019	(-0.134, 0.078)
Any female GP	0.490	-0.016	(-0.022, -0.011)
Young GPs	0.574	0.120	(0.043, 0.200)
Large List Size	0.586	0.075	(0.016, 0.135)
Single Handed Practices	0.643	0.122	(0.068, 0.176)

Partiality is greatest for dispensing practices whose population is concentrated in relatively well-off areas, and single-handed practices whose populations are concentrated in the worst-off areas. Practices with at least one female GP appear to be the most 'equitable', although the narrow confidence interval indicates that the small degree of pro-affluent partiality is significantly different from zero.

Figure 3 Concentration Coefficients and 95% Confidence Intervals



The confidence intervals for other concentration coefficients are, in some cases, rather wider (Figure 3). The cause of the wide variations in the confidence intervals can be seen by inspection of the concentration curves shown in Appendix 3. For practices with at least one female GP at an *x*-axis value of 0.4 (the upper bound of the 4th decile) the difference between the cumulative populations is approximately 0.01. This means that the 40% of the population in the most affluent areas contributes 41% of the population registered with practices with at least one female GP. This suggests negligible partiality.

However, comparing this result with that of CMR reveals a different picture. In this instance, the series touches the x-axis at 0.18, implying that the 18% of the population in the most affluent areas account for 18% of the population in CMR practices. However, at the 50% point the series equals 0.05, implying that the 50% of the population in the most affluent areas contributes 55% of the population in CMR practices. The erratic nature of this series causes the confidence intervals to be wider than other series. If coverage was more systematically related to deprivation then the confidence intervals would be narrower, as they are for any female GP, training and fund-holding practices.

Consequences of Partiality

SPICE, training and PA practices are all more concentrated in affluent areas. Table 2 shows the mean angiographies per capita (per 1000) and their respective confidence intervals[3] within the three samples for an age range of 45-74 year olds. PA and training practices have mean values below the national average, and SPICE practices above, even though all three characteristics have similar partiality.

Table 2 Angiographies per 1000 population (45-74 year olds)

Sample	Population Mean (45-74 year olds)	Partiality-Corrected Mean	Number of practices
PA	5.19 (4.97,5.41)	5.35	215
SPICE	5.45 (5.18,5.73)	5.64	152
Training	5.27 (5.09,5.45)	5.47	277
National Average	5.38 (5.27,5.49)		1052

The fact that these sample means are biased illustrates the need to attempt to control for partiality. Weighting the data should, in theory, result in the sample means converging to that of the population mean. The partiality-corrected mean column of table 2 shows the effect of weighting the data by the ratio of the population coverage rate to the sample coverage rate for each decile.

Only in the case of PA practices does the sample mean converge to the population mean. For training practices a downwardly biased mean now becomes upwardly biased, overshooting the population mean. For SPICE practices there is an increase in the mean taking the sample mean even further away from the population average. The reasons for this can be seen by examining the detailed tables of figures by deprivation decile (Tables 3-5).

Columns 2 and 3 of Table 3 show the population and sample mean rates of angiographies per capita for each of the deciles. Angiography rates are higher in SPICE practices in six of the ten deciles and lower in only two deciles. Columns 4 and 5 compare the population and sample proportions by decile. As found previously, the sample proportions are higher in the lower deciles in the SPICE sample. Column 6 shows how the population mean can be

[3] The confidence intervals shown are "exact" confidence intervals calculated using the poisson distribution.

obtained from these figures. First, we multiply the population rate by the population proportion for each decile and then calculate the sum across deciles (shown in the final row). Column 7 shows how the same calculation can be obtained for the SPICE sample. If the population and sample rates were the same for each decile, and the population and sample proportions were the same for each decile, then the population and sample means would be identical. Column 8 shows the effect of multiplying the sample rates by population proportions to obtain a sample mean that has been corrected for partiality.

Table 3 shows that the contribution of decile 1 to the SPICE sample mean is higher than it should be, since the column 7 figure (0.66) is higher than the column 6 figure (0.46). This is because within this decile the population within the SPICE sample is over represented (14.6%), compared to the population proportion (10.7%). Use of the population proportion (column 8) reduces the contribution of decile 1 from 0.66 to 0.48, but it remains above its target value (0.46) because SPICE practices in decile 1 have higher angiography rates than all practices in decile 1. Because angiography rates in SPICE practices are above the population rates in seven of the ten deciles, the partiality-corrected contributions of these deciles are also above their target values and the overall corrected-mean is upwardly biased.

These findings demonstrate that attempts to correct for partiality, using weights that measure the under/over representation of some groups, will not prove successful in generating more representative estimates if the sampled practices are not representative of their groups. Therefore, we recommend that in future research national data be used to assess, not only whether samples of practices are partial with respect to deprivation, but also whether the sampled practices are typical in some relevant dimension of activity or structure as other practices of their type. If one is interested in patterns of prescribing for CHD, for example, then national data on dispensed prescriptions could be used to check the representativeness of the sampled practices.

Table 3 Weighted Mean Calculations SPICE Practices

Decile (j)	Population Mean ($\overline{y}_j$ *1000)	Sample Mean ($\overline{y}_j^s$ *1000)	Population proportion (p_j)	Sample proportion (π_j)	Population proportion* population mean (p_j * $\overline{y}_j$)*1000	Sample proportion * sample mean (π_j * $\overline{y}_j^s$)*1000	Population proportion * sample mean (p_j * $\overline{y}_j^s$)*1000
1	4.2607	4.4995	0.1071	0.1457	0.4564	0.6554	0.4820
2	4.7323	5.0624	0.1047	0.1267	0.4961	0.6412	0.5307
3	4.4230	4.4135	0.1037	0.0969	0.4587	0.4275	0.4578
4	5.0795	4.8541	0.1088	0.1145	0.5527	0.5557	0.5282
5	4.8935	5.0644	0.1034	0.1259	0.5060	0.6376	0.5237
6	5.1203	5.7715	0.0998	0.1074	0.5107	0.6198	0.5756
7	5.5201	5.5137	0.0969	0.0846	0.5346	0.4666	0.5340
8	5.9230	7.0262	0.0966	0.0781	0.5720	0.5486	0.6785
9	6.6883	7.3492	0.0943	0.0693	0.6303	0.5094	0.6926
10	7.8469	7.5408	0.0847	0.0510	0.6648	0.3847	0.6388
Total Σ_j			1.000	1.000	5.3823	5.4465	5.6419

Table 4 Weighted Mean Calculations Training Practices

Decile (j)	Population Mean ($\overline{y}_j$ *1000)	Sample Mean ($\overline{y}_j^s$ *1000)	Population proportion (p_j)	Sample proportion (π_j)	Population proportion* population mean (p_j * $\overline{y}_j$)*1000	Sample proportion * sample mean (π_j * $\overline{y}_j^s$)*1000	Population proportion * sample mean (p_j * $\overline{y}_j^s$)*1000
1	4.2607	4.4875	0.1071	0.1325	0.4564	0.5945	0.4807
2	4.7323	4.7138	0.1047	0.1143	0.4961	0.5386	0.4942
3	4.4230	4.4393	0.1037	0.1375	0.4587	0.6105	0.4604
4	5.0795	5.2890	0.1088	0.1302	0.5527	0.6888	0.5755
5	4.8935	4.5144	0.1034	0.0956	0.5060	0.4315	0.4668
6	5.1203	4.8465	0.0998	0.1019	0.5107	0.4938	0.4834
7	5.5201	5.6967	0.0969	0.0861	0.5346	0.4906	0.5517
8	5.9230	6.3961	0.0966	0.0760	0.5720	0.4858	0.6177
9	6.6883	6.6632	0.0943	0.0715	0.6303	0.4762	0.6280
10	7.8469	8.4475	0.0847	0.0545	0.6648	0.4603	0.7156
Total Σ_j			1.000	1.000	5.3823	5.2706	5.474

Table 5 Weighted Mean Calculations PA Practices

Decile (j)	Population Mean ($\overline{y}_j$ *1000)	Sample Mean ($\overline{y}_j^s$ *1000)	Population proportion (p_j)	Sample proportion (π_j)	Population proportion* population mean (p_j * $\overline{y}_j$)*1000	Sample proportion * sample mean (π_j * $\overline{y}_j^s$)*1000	Population proportion * sample mean (p_j * $\overline{y}_j^s$)*1000
1	4.2607	3.8263	0.1071	0.1274	0.4564	0.4876	0.4100
2	4.7323	4.7598	0.1047	0.1412	0.4961	0.6720	0.4982
3	4.4230	4.6954	0.1037	0.1178	0.4587	0.5530	0.4870
4	5.0795	5.2481	0.1088	0.1134	0.5527	0.5950	0.5712
5	4.8935	5.0624	0.1034	0.1161	0.5060	0.5880	0.5234
6	5.1203	5.6130	0.0998	0.0736	0.5107	0.4130	0.5600
7	5.5201	5.4856	0.0969	0.1178	0.5346	0.6463	0.5314
8	5.9230	5.9314	0.0966	0.0736	0.5720	0.4363	0.5729
9	6.6883	6.2125	0.0943	0.0653	0.6303	0.4060	0.5856
10	7.8469	7.2429	0.0847	0.0538	0.6648	0.3896	0.6137
Total Σ_j			1.000	1.000	5.3823	5.1868	5.3534

Conclusions

Using two summary measures, we have shown that partiality is a problem in a wide variety of indicators of intelligence and structure. It is unsurprising that some practice characteristics show partiality. The observation that the population in the most deprived areas in Scotland is under-represented within dispensing practices reflects the fact that dispensing practices tend to be located in sparsely populated rural areas. It is well known that the Carstairs index, which is the deprivation measure that we use, is lower in rural areas.

Some of our results have also been found in other parts of the UK. For example, we find a preponderance of single-handed practices in deprived areas, mainly reflecting the large number of single-handed practices in deprived parts of Glasgow. This has previously been shown to occur in England and Wales (Lunt et al, 1997; Hippisley-Cox et al, 2001)

In other cases our findings are more surprising. PMS practices were intended to contribute to the problem of delivering GMS in deprived areas. Despite the targeting of resources for PMS at deprived areas, our results suggest that PMS practices are more likely to be found in affluent areas. We also find that training practices are more likely to be found in affluent areas. This may be unfortunate for GP Registrars, as we find they are more likely to start as principals in deprived areas, which are quite different from where they trained. We have also shown that practices with large lists are more likely to be found in deprived areas. Since we have not adjusted the practice populations for the effects of deprivation on need, this finding gives some cause for concern.

We also find evidence to confirm Watt's (2002) claim there is lack of 'intelligence' in primary care within deprived areas in that practices participating in primary care datasets are more likely to be located in *affluent* areas. We have illustrated what the consequences of partial data are for the simple mean of a sample. We also explored a number of potential solutions to the problem but pointed out some caveats, especially with regard to the solution of weighting data. Weighting should not be applied without some investigation of other indicators of sample representativeness.

We propose that researchers working with sample datasets proceed with two tests. The first, which is often already done, is to ensure or check the representativeness of the sample in terms of patient and practice characteristics. The second is to obtain national data that are as close as possible to the outcome(s) of interest. Only once it has been established that the sampled practices are likely to be representative of their 'types' can conclusions then be generalised to the population as a whole. If the sample is found to be partial, corrected statistics should be presented so that national conclusions can be safely drawn.

We conclude with a note of caution about the findings in this paper. The data that we have used are typically from 2002 and, in some cases (notably CMR, SPICE and Practice Accreditation), we are aware of important developments since these data were obtained. This is an inevitable feature of the sort of research that we have undertaken and we hope that any follow-up analysis using more recent data will demonstrate that the situation has changed for the better.

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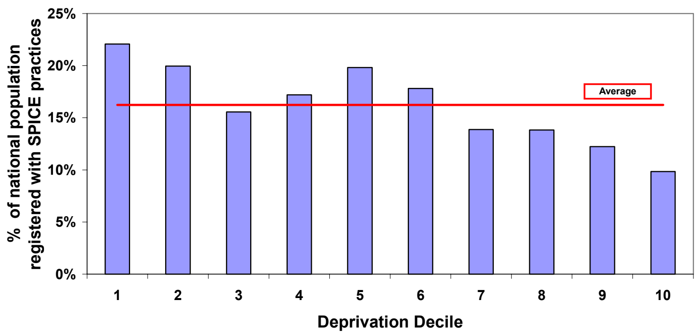
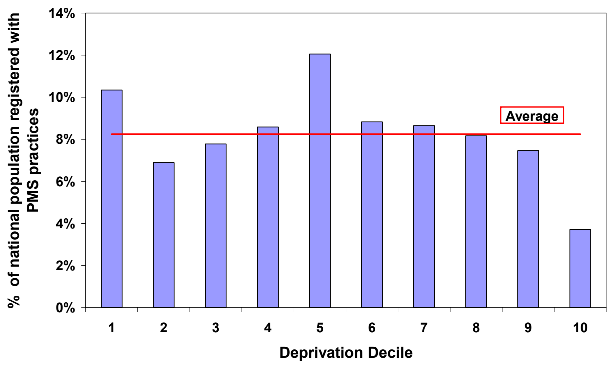
Decile Charts

APPENDIX 1 DECILE CHARTS

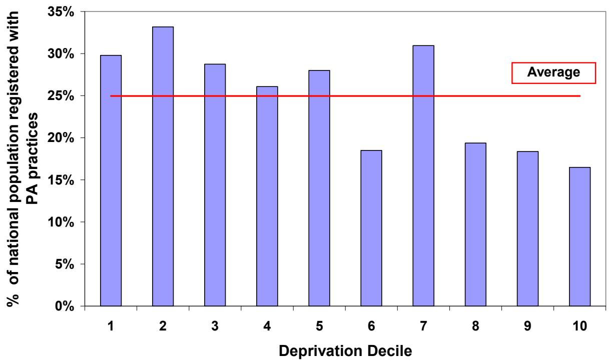
SPICE



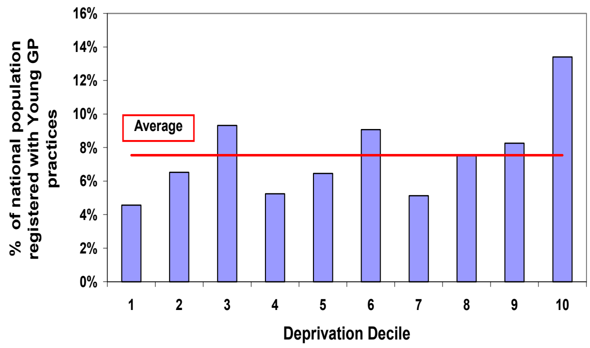
PMS Practices



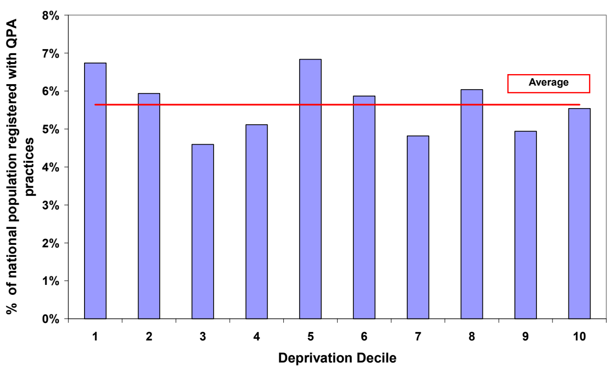
PA Practices



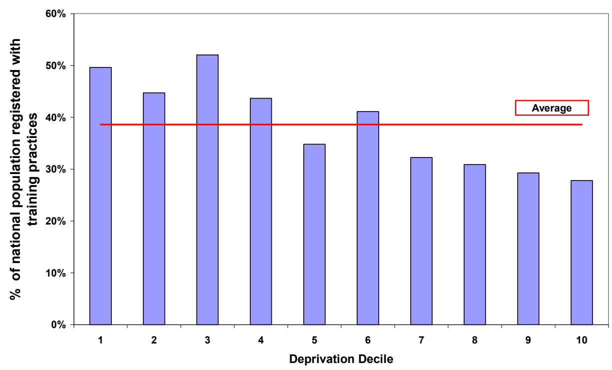
Young GP practices



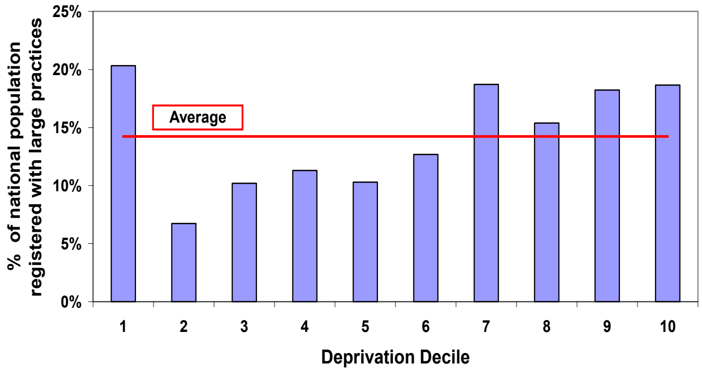
QPA



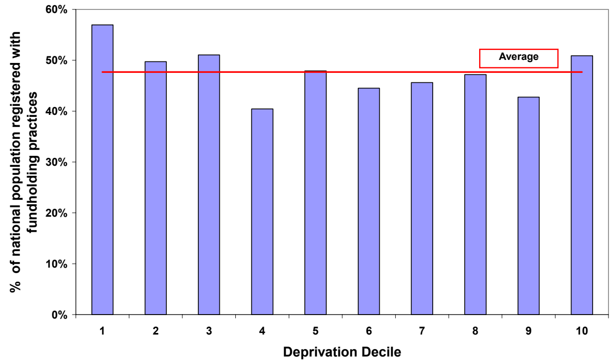
Training practices



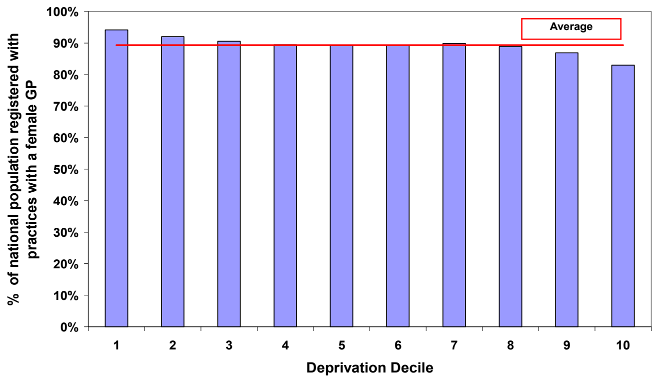
Large list practices



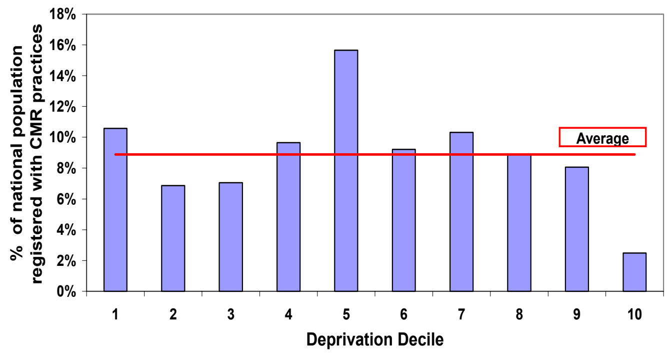
Fundholding practices



Female GP practices

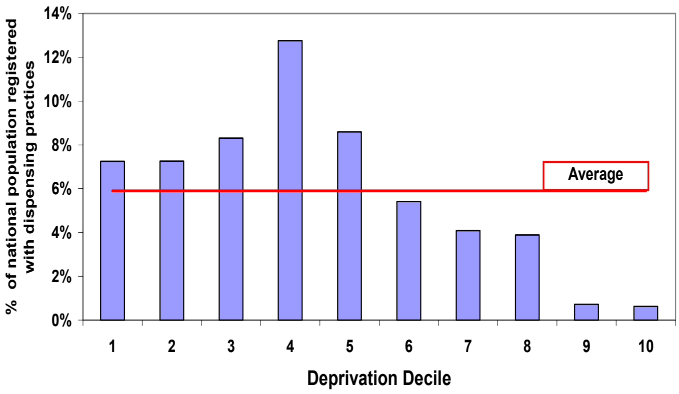


CMR practices

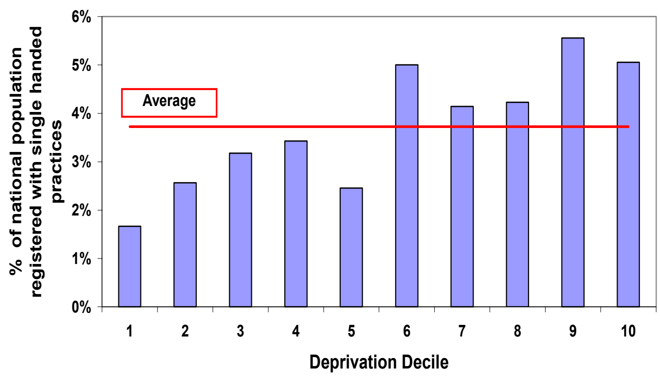


NOTE: This is not 'national' sample- see data section

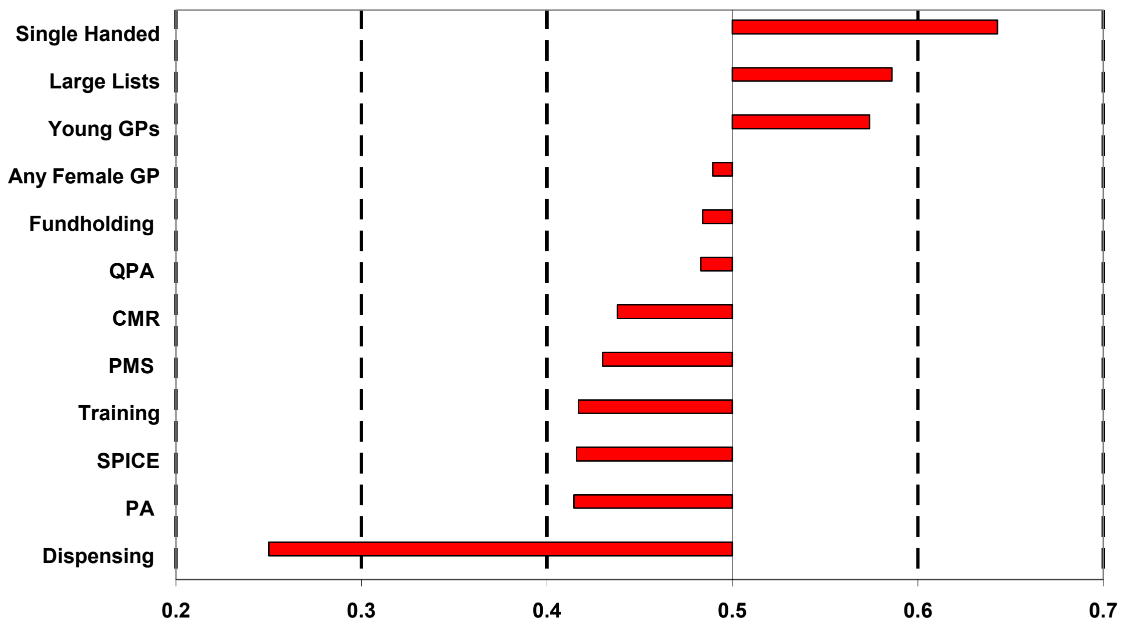
Dispensing practices



Single handed practices



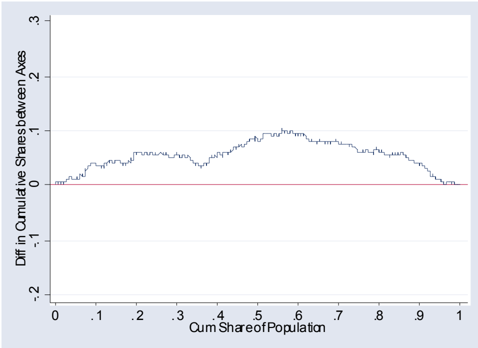
APPENDIX 2 ROBIN HOOD INDEX VALUES



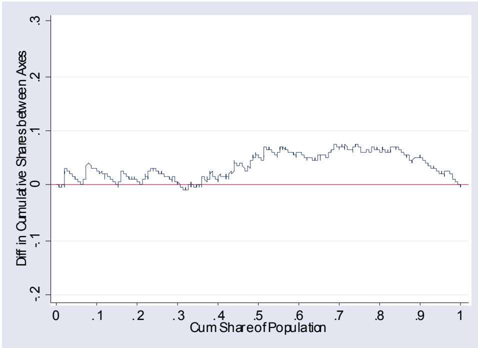
Concentration Curves

APPENDIX 3 CONCENTRATION CURVES

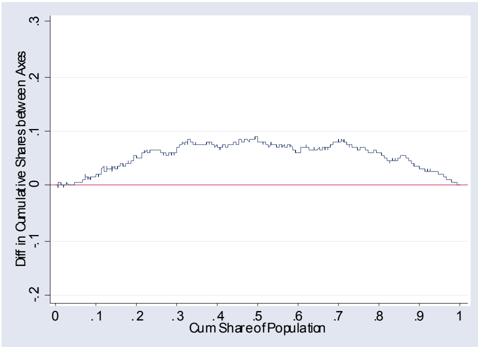
SPICE



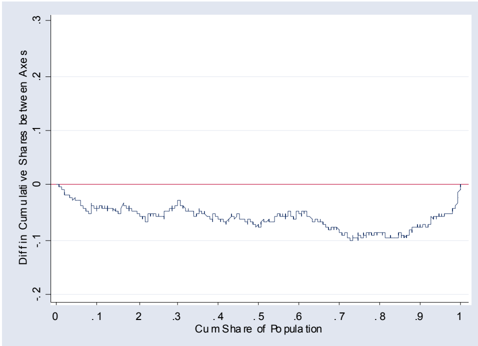
PMS Practices



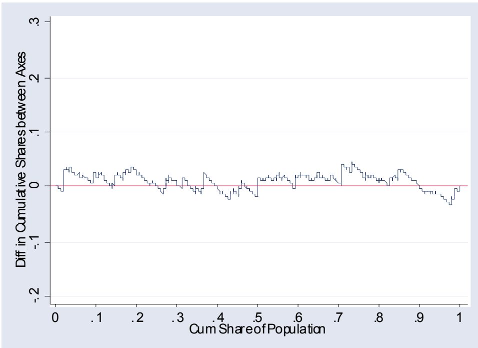
PA Practices



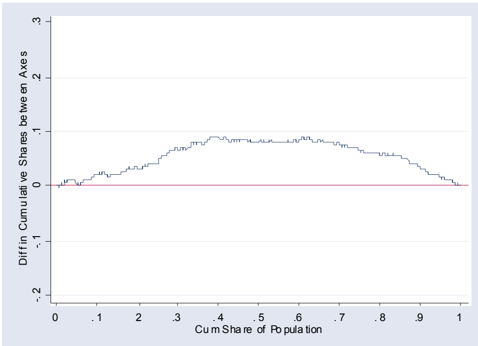
Young GP Practices



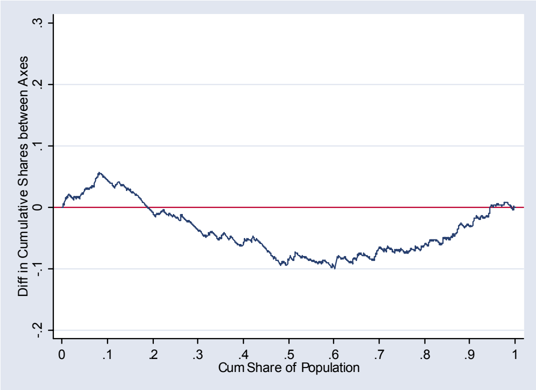
QPA



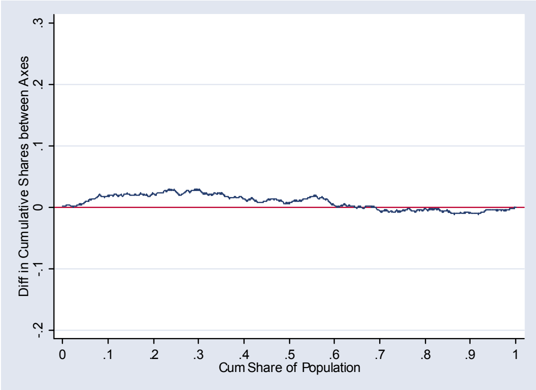
Training practices



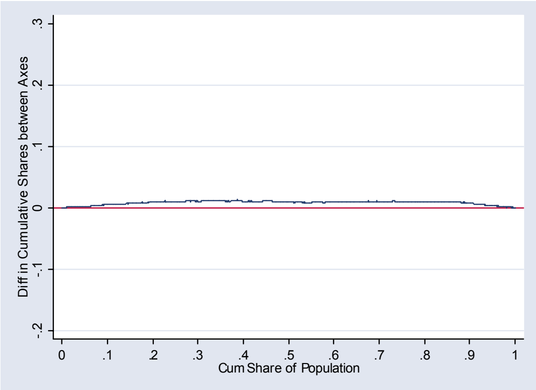
Large list practices



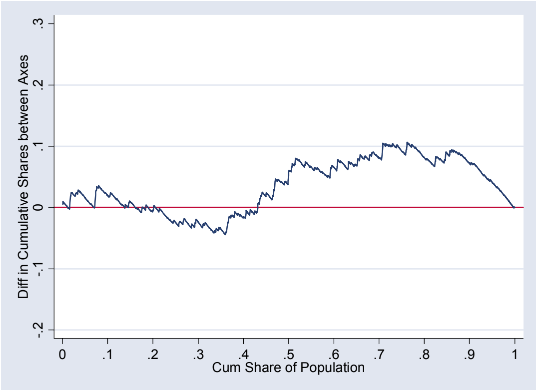
Fundholding practices



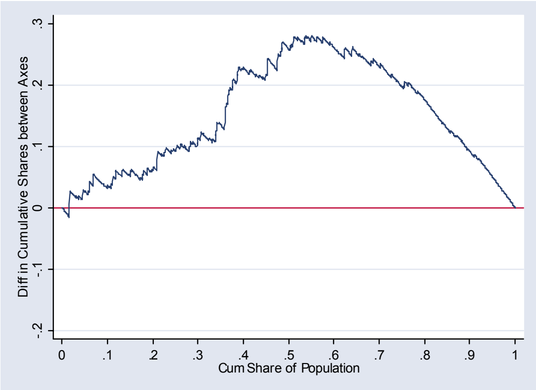
Female GP practices



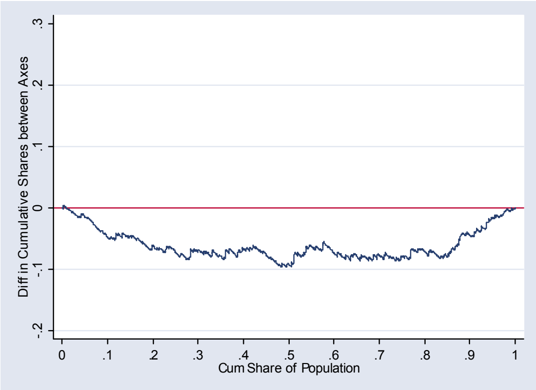
CMR Practices



Dispensing practices



Single handed practices



APPENDIX 4 2002 PRACTICE POPULATIONS BY DATA SET AND CARSTAIRS DECILE ('000s)

Decile	ALL	CMR	SPICE	PA	QPA	PMS	Dispensing	Fund Holder	Training	Single Hand	Any Female	Large Lists	Young GPs
1	529.1	56.0	116.8	157.6	35.5	54.5	38.4	301.3	247.2	14.1	498.3	107.6	24.1
2	530.0	36.5	106.0	176.1	31.3	36.3	38.5	263.8	216.3	23.7	488.2	35.8	34.6
3	523.8	37.0	83.7	150.5	24.1	40.9	43.5	267.4	251.1	25.3	474.4	53.4	48.8
4	532.4	51.4	84.6	138.8	27.1	45.6	67.9	215.2	219.3	27.9	475.9	60.2	27.9
5	526.3	82.4	109.1	147.4	35.9	63.4	45.3	252.1	177.8	20.0	469.3	54.2	34.0
6	529.2	48.8	94.2	97.9	31.1	46.7	28.6	235.6	206.3	32.4	472.6	67.1	48.0
7	525.3	54.2	73.3	162.6	25.5	45.7	21.5	239.6	161.2	25.9	472.0	98.2	27.0
8	527.5	46.8	72.5	102.2	31.9	43.1	20.5	248.8	153.2	29.0	468.8	81.1	39.6
9	527.8	42.6	64.5	96.9	26.1	39.4	3.8	225.5	145.8	34.4	458.6	96.2	43.6
10	523.1	13.0	51.5	86.3	29.2	19.6	3.3	266.1	133.8	39.5	434.2	97.6	70.1
Number of Practices	**1052**	**84**	**152**	**215**	**40**	**90**	**153**	**451**	**277**	**195**	**799**	**128**	**99**
Total population	**5274.5**	**468.7**	**856.2**	**1316.3**	**297.7**	**435.2**	**311.3**	**2515.5**	**1912.0**	**272.2**	**4712.3**	**751.4**	**397.7**
Proportion of total Population	**1**	**0.09**	**0.16**	**0.25**	**0.06**	**0.08**	**0.06**	**0.51***	**0.36**	**0.05**	**0.89**	**0.14**	**0.08**
Proportion of Practices	**1**	**0.08**	**0.14**	**0.20**	**0.04**	**0.09**	**0.145**	**0.46***	**0.26**	**0.19**	**0.76**	**0.12**	**0.09**

* Based on a smaller number of practices and population - practices open in April 1999 and still open in September 2002.

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