

Appendix A – Methods

GP supply

GP types

We used the Department of Health definitions of GP type.¹² An unrestricted principal is a GP contracted to provide the full range of general medical services (minor surgery, child health surveillance, maternity medical services, contraceptive services, chronic disease management, vaccination and immunisation programmes, cervical cytology) and whose list is not limited to any particular group of persons. A restricted principal provides the full range of services to a limited list of patients or provides maternity medical services and contraceptive services only. An assistant is a GP who assists a GP principal. A registrar is a GP in training for general practice. A retainer is a GP who provides service sessions in general practice. A non-PMS salaried doctor is employed by an unrestricted principal under the practice staff scheme, whereas, if the doctor has PMS status, they are employed by the PMS contractor/ PMS contracted doctor (and provide the full range of services and have a patient list).

Assigning Geography

Postcodes from the yearly address files in the annual GP census undertaken by the Department of Health were assigned to Health Authorities using the Organisation Codes Service Postcode Directory. Although electronic files of the GP census were available from 1991, comprehensive address files were only available for 1994 onwards.

Not all GP records had a postcode, and not all postcodes had been assigned to a particular Health Authority. Using data from 1994, we estimated that approximately 2% of the (on average 29,000) GP records annually would be without a postcode. In such cases we attempted to impute a Health Authority. If other GPs from the same practice had been assigned to a Health Authority, then this Health Authority was also assigned to the incomplete GP record(s). If no GP within the practice had been assigned to a Health Authority we used the first two or three characters of the unique practice identifier (which, post 1998, were changed to match the HA code) to assign the most likely Health Authority. For example, practice codes beginning with 'BAA' were most likely to be in Barnsley Health Authority, 'BD' Bedfordshire Health Authority, etc. When two or more Health Authorities had the same two or three-character code – for example 'DE' identified both North and Southern Derbyshire Health Authorities – it was necessary to consult subsequent yearly address data or previous Postcode Directories to assign a Health Authority. Where this failed, no Health Authority was assigned, and the GP excluded from the analysis. On average, only four whole-time-equivalent GPs per year were lost in this way.

No address data was available for GPs other than principals. Health Authorities were assigned on the basis of the GP's practice code. In 1994, 899 of 1,563 GP registrars had no practice code; in 1995, 903 of 1,508 registrars had no practice code; in 1996, 286 of 868 GP assistants had no practice code. They were excluded from the analyses. Given that registrars are doctors-in-training, and their 'placement' unlikely to be regulated, the

level of mal-distribution for all doctors will most probably be under-estimated in 1994 and 1995. (This does appear to be the case. Figure 1 shows a large 'jump' in the level of mal-distribution of all GPs between 1994/5 and 1996.) The loss of 300 GP assistants is unlikely to affect the level of mal-distribution greatly.

Time Commitment

GPs designated as job sharing were assumed to be 0.5 time commitment, as were those designated as half-time. Three-quarter time was assumed to be 0.75 time commitment. For GP retainers, time commitment was assumed to be 0.12 per session provided; the maximum number of sessions allowed being four.¹² Data on time commitment was missing for GP assistants and salaried GPs in 1999. It was imputed at Health Authority level (in terms of whole-time-equivalents) based on the median of the other nine years data.

Need Adjustment

In order to calculate HA-specific need-adjusted populations, the number in each age (and sex) band was multiplied by the respective payment or rate in that band: a sum was then taken over all bands. This was not necessary for the mortality adjustment as we did not use age/ sex-specific data.

Age-related capitation payments

These payments are, in part, intended to reflect workload. HA populations were weighted by age-related capitation payments for April 2001: £18.60 for patients aged up to and including 64, £24.50 for patients aged 65 – 74, and £47.50 for patients aged 75 and over. Although payments increased over the study period, they did so at the same rate within each age-band.

National age- and sex-specific consultation rates

These were intended to reflect age- and sex-specific population need. HA populations were weighted by GP consultation rates per person per year from the 2000 General Household Survey (GHS).¹³

National age- and sex-specific limiting long-term illness rates

Populations were weighted by the proportion of the population, in each age/sex group, reporting a limiting long-term illness from the 2000 GHS.¹³ As with the consultation rates, it was thought that the annual variation from 1995 to 2002 was not significant enough to affect the results. In absolute terms, the results from this period were not comparable with those of Gravelle and Sutton,³ as they used area-specific rates from the 1991 Census, which are more sensitive, and, therefore, likely to show increased levels of mal-distribution.

Health Authority-specific mortality

Data on all-cause mortality was only available at Health Authority level from 1998 to 2001. For 1994 to 1997 we used 1998 mortality weights, and for 2002 and 2003 we used 2001 weights. These adjustments, unlike the others, were at area level rather than national level, and will be more sensitive.

Mal-distribution measures

Decile Ratio

HAs were ranked from highest to lowest by their GP to population ratios. The decile ratio is the ratio of the Health Authority 10% from the top of the rankings to the Health Authority 10% from the bottom of the rankings (90th centile / 10th centile).

Gini Coefficient

Ordering Health Authorities by GPs per head of population, the cumulative proportion of the total number of GPs is plotted against the cumulative proportion of the total population. The Gini coefficient is twice the area between this cumulative curve and the curve of complete equality (which is a 45° line). The coefficient can range from zero (equality of distribution) to one (one Health Authority has all GPs). To put the results in the paper in context: Gravelle and Sutton³ calculated 1994/5 Gini coefficients of 0.3165 for practice nurses and 0.1089 for GPs using a limiting long-term illness need adjustment. They reported a Gini for HCHS expenditure in 1997/8 of 0.0149 using the HCHS formula need adjusters.

Atkinson Index¹⁴

The index is based on the assumption that an increase in the number of GPs per head (y_i) in any given area i increases the social value per capita ($v(y_i)$) at a decreasing rate: additional GPs become less valuable. The national per capita social value is given by $\sum_i s_i v(y_i)$, where s_i is the proportion of the population in area i . The same social value could be produced by all areas having the same number, y_e , of GPs per capita, where $v(y_e) = \sum_i (s_i v(y_i))$. The Atkinson index is the proportionate difference between the average per capita provision and y_e . The social value function is conventionally specified as $v = y^{1-a} / (1-a)$, where a is a parameter measuring aversion to mal-distribution: greater values of a corresponding to greater aversion. We fixed $a = 2$, but the value of a has little effect on the results.³ Gravelle and Sutton³ reported Atkinson indices of 0.38 for practice nurses and 0.0388 for GPs for 1994/5 with a long-term limiting illness adjustment and an Atkinson index of 0.0007 for HCHS expenditure in 1997/8 using the HCHS formula need adjusters.