The representativeness of sentinel practice networks†

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ABSTRACT

Background The representativeness of practice networks is important when using the information obtained to guide health policy.

Aim To develop a model for examining the representativeness of practice networks.

Methods Comparison of surveyed population, practice structure and prescribing characteristics with the national data using the Weekly Returns Service (WRS) for 2006 as an example of practice network. The population monitored was compared with the national PCT population. The practice postcode was linked to the Index of Multiple Deprivation and the distribution compared with the national equivalents. Doctor and practice-specific structural data (obtained by questionnaire) and practice-prescribing data were compared with the national equivalents. The significance of differences was evaluated using non-parametric tests.

Results The WRS population was closely matched with the national data by age, gender and deprivation index. Compared with the national equivalents, WRS practices, included more younger GPs, had a larger average list per GP and fewer practices with a list of less than 1499 per GP. Prescribing patterns were similar to their PCT equivalents excepting for small reductions of antibacterial prescribing (items 7% and cost 5%).

Conclusion We demonstrate a low-cost model methodology for examining the representativeness of practice networks using independent data with minimum practice input.

Keywords epidemiology, health impact assessment, primary care

Introduction

Widespread use of electronic medical records has encouraged the development of general practice network databases. In the UK, the introduction of the diagnostic index and age–sex register 50 years ago paved the way for obtaining data capable of use for epidemiological purposes such as morbidity surveys, infectious disease surveillance or defining risk populations for interventions such as vaccination.

To be of value in the determination of health policy and evaluating change, information from practice networks needs to be reliable and captured consistently. The information obtained needs to be related to the situation in the underlying population. Whilst the network does not itself need to be fully representative of the underlying population, sufficient information must be collected to allow comparison with the relevant national data. Practice databases describe firstly what the registered population is presenting for health care and secondly, the activities and interventions of the doctors. In the British National Health Service, the introduction of the Quality and Outcomes framework programme has facilitated the extraction of information from almost the entire population for the selected pieces of information.1 For other purposes (for example, the surveillance of influenza), the involvement of the general practitioners (GPs) is voluntary and much more limited.

The Weekly Returns Service

The Weekly Returns Service (WRS) was established in 1964 in the Records and Statistical Unit of the College of General

†A model study of practice representativeness based on the Weekly Returns Service of the Royal College of General Practitioners.
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Practitioners. Initially, the participant GPs used simple score grids tallying new episodes of selected diseases that were analysed each week at the College Unit in Birmingham. From 1971 onwards, the weekly counts were taken from new entries made in the diagnostic index. The population of the practice was defined from practice-maintained age-sex registers. The system was boosted by the second national morbidity survey (NMS2) that was based on practice age-sex registers and morbidity registration in practice maintained diagnostic indexes. The monitored population was compared with the national population by age, gender and socio-economic composition. The practice structure and partnership size were compared with the national equivalent data. Although best known for its publication for the years 1971–72, this survey continued to provide prevalence data until 1976.

There were further National Morbidity Surveys in 1981–82 (NMS3) and 1991–92 (MSGP4). The second and third studies used broadly similar methods. The fourth study involved radical changes in methods of data capture. Population denominators were obtained from Family Practitioner Committee listings of registered patients (as opposed to practice maintained registers used previously), and the diagnostic information was based on Read code entries in individual electronic patient records. The study involved the first major use of the Read code system at a national level, though the use of Read codes had been pioneered in more limited projects. Socio-economic data were gathered in personal interviews and comparisons with nationally equivalent data reported. The study included assessments of recording quality and coding accuracy. There has always been a considerable overlap of contributing practices in the morbidity surveys and the WRS. There was substantial recruitment of new practices to the fourth study and many continued in the WRS. The WRS now provides annual prevalence data routinely in addition to the annual report of disease incidence (www.rcgp.org.uk/bru).

During the early 1970s the WRS was particularly important in providing data about influenza which, in the aftermath of the pandemic in the winter of 1969–70, was much more severe than in recent years. These data have been used to model strategies for managing an influenza pandemic. Examples of more recent use include estimation of the population targeted to receive influenza vaccination, to consider the age-specific impact of herpes zoster, to examine trends in the seasonality of asthma and of gout and to study the relationship between antibiotic prescribing and disease incidence. They have also been used to validate recording quality in other practice networks.

In 1984, we published a study of the prescribing representativeness of the practices participating in NMS2 for which practice-specific data were provided by the Prescription Pricing Authority. These were compared with the distribution of equivalent data from all practices nationally. In 2002, Harcourt et al. examined the postcodes of approximately 75% of persons registered in the WRS and compared these with the national postcode distribution according to deprivation status. This study identified selection bias in the North and South of the country, which exaggerated the known socio-economic gradient and prompted the recruitment of further practices.

In its current form, the WRS data extraction and analytical routines are all fully automated and are based on a population of 950,000 persons. During 2006 (the year of this study) data extraction took place twice weekly and an annual extract at the end of the year.

Objectives
We studied the representativeness of the practice network known as the WRS of the Royal College of General Practitioners using freely available practice and national data concerning the registered population; the structural characteristics of the practices and the dispensed prescriptions of the doctors. We aimed to establish a model method for evaluating the representativeness of practice networks.

Material and methods
At the end of 2006, there were 100 practices in England who reported to the WRS, including 28 recruited since 2003. The practices are not restricted to a single software provider. Since 1998 data capture from the practices has been based exclusively on electronic medical records and the process has been fully automated. Practices provide a twice weekly report to the administrative centre, which specifies the registered population and the numbers of new episodes of illness reported in disease-specific Read codes. The weekly populations were averaged to provide annual populations in gender and age groups (0–4, 5–14, 15–24, 25–44, 45–64, 65–74 and 75+ years). In turn these were assembled into the 10 Strategic Health Authorities. Population comparisons were made with the mid-year population estimate for 2006 published by the Office of National Statistics (ONS), and with the combined Primary Care Trust (PCT) registered population for 2006 obtained from the Prescription Pricing Authority.

The practice postcodes were matched with the Super Output Area defined Index of Multiple Deprivation (IMD) for 2004 using the National Statistics Postcode Directory supplied by the ONS. In England, there are 32,482 Super
Output Areas that we ranked high to low into deciles according to the IMD. The WRS practice distribution was then compared with these national equivalent data using the Kolmogorov–Smirnov test.27

The distribution of the GPs by age group and gender and the number of principals in the practice partnerships were obtained from questionnaires to the practices, and the practice registered population per GP principal was calculated from the routinely reported population. The results were compared with the national equivalent data available from the Department of Health.28

Prescribing data reported by the Prescription Pricing Authority were obtained through the use of the Freedom of Information Act. The data included the number of items, the total net ingredient cost and the proportion of generically prescribed items for all prescriptions in each of the seven major prescribing categories (gastro-intestinal system, cardiovascular system, respiratory system, central nervous system, endocrine system, nutrition and blood and other) plus antibacterials as a subset of the ‘Infections’ prescribing category. Each practice-based prescribing rate is standardized to the national population according to the ASTRO-prescribing unit formula (which is an adjustment factor incorporating age and prescribing for persons receiving treatment as temporary residents) and presented as a percentage score relative to the PCT equivalent.29 This percentage relationship to the PCT equivalent was investigated using the Wilcoxon matched-pairs signed-ranks test examining the ranking of differences between the practice score and the PCT equivalent.27

Results

This study included 95 of the 100 practices, five declined to provide practice and personal physician data.

Regional- and population-based characteristics

The distribution of the monitored population (886 628) by age is similar to the national census population estimate for England for 2006 (50 763 000) and to the national practice PCT registered population (50 006 837) (Table 1). The network covers 1.8% of the national population and between 1.3 and 2.3% of the population in the 10 Strategic Health Authority populations. Outliers include Yorkshire and Humber (0.8%) and East Midlands (2.7%).

The distribution of the 95 practices by their matching Super Output Area IMD rank disclosed practices were well distributed across this index with no significant differences at the 5% level in a test of cumulative frequency distribution. There were 10 of 95 practices in the lowest decile of the IMD and 11 in the highest. The distribution was also examined in three large regional areas (North, Central and South, derived by grouping adjacent health authority areas) and again disclosed no differences.

Practice-structural characteristics

In the WRS, the average list per GP principal was 12% more than the national average (1598). The WRS included fewer practices with an average list per GP of less than 1499 ($P < 0.01$). The distribution of principals by age group shows a bias towards younger doctors and a relative reduction in small and very large practices (Table 2). The WRS included 44% female GP principals, very similar to the 42% nationally.

Practice-prescribing characteristics

Table 3 gives the distribution of WRS practices in 5% interval bands relative to their PCT equivalents for the three

### Table 1 Percentage distribution of WRS population, census population and PCT registered population by age and gender

<table>
<thead>
<tr>
<th>Age Group</th>
<th>WRS Male</th>
<th>Census Male</th>
<th>PCT Male</th>
<th>WRS Female</th>
<th>Census Female</th>
<th>PCT Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–4</td>
<td>2.9</td>
<td>3.0</td>
<td>2.8</td>
<td>2.7</td>
<td>2.8</td>
<td>2.7</td>
</tr>
<tr>
<td>5–14</td>
<td>6.2</td>
<td>6.1</td>
<td>6.1</td>
<td>5.9</td>
<td>6.4</td>
<td>6.5</td>
</tr>
<tr>
<td>15–24</td>
<td>5.9</td>
<td>6.8</td>
<td>6.6</td>
<td>6.2</td>
<td>6.4</td>
<td>6.5</td>
</tr>
<tr>
<td>25–44</td>
<td>14.9</td>
<td>14.2</td>
<td>15.6</td>
<td>14.7</td>
<td>14.3</td>
<td>14.7</td>
</tr>
<tr>
<td>45–64</td>
<td>12.8</td>
<td>12.1</td>
<td>12.3</td>
<td>12.7</td>
<td>12.4</td>
<td>11.7</td>
</tr>
<tr>
<td>65–74</td>
<td>3.8</td>
<td>3.9</td>
<td>3.8</td>
<td>4.2</td>
<td>4.3</td>
<td>4.1</td>
</tr>
<tr>
<td>75+</td>
<td>2.9</td>
<td>3.0</td>
<td>2.8</td>
<td>4.6</td>
<td>4.7</td>
<td>4.5</td>
</tr>
<tr>
<td>All ages</td>
<td>49.3</td>
<td>49.1</td>
<td>50.0</td>
<td>50.7</td>
<td>50.9</td>
<td>50.0</td>
</tr>
</tbody>
</table>

### Table 2 Percentage distribution of GP principals ($n = 497$) by average list per principal, by age group and number of principals in partnership compared with national equivalent

<table>
<thead>
<tr>
<th>Average list per principal</th>
<th>Age group of principals</th>
<th>Principals in partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRS</td>
<td>National</td>
<td>WRS</td>
</tr>
<tr>
<td>&lt;1499</td>
<td>23</td>
<td>43</td>
</tr>
<tr>
<td>1750–1999</td>
<td>31</td>
<td>16</td>
</tr>
<tr>
<td>2000–2249</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>2250+</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>
main total prescribing indicators (number of items; net ingredient cost; proportion of items prescribed generically) and the mean of the signed percentage differences from the PCT equivalents. Practice differences from the PCT equivalents were examined in the Wilcoxon test and no significant difference found ($P < 0.05$).

Similar analyses were undertaken for prescribed items and net ingredient cost in each of the seven major prescribing categories plus the antibacterials. Distributions are presented in 10% interval bands (Table 4). The significant differences disclosed by the Wilcoxon test include highly significant ($P < 0.01$) reductions of antibacterial items (mean 7%) and net ingredient cost (mean 5%); a small but significant increase ($P < 0.05$) of net ingredient cost for cardiovascular (mean 3%).

Additional data were available for the five WRS practices (who did not supply GP/practice-specific data) covering the population monitored, the IMD and in four of them the prescribing statistics. Reanalysis of all the data incorporating the material from these practices disclosed no material differences in the interpretation of data presented in Tables 1, 3 and 4 and no change in the statistical significance of the findings.

### Table 3
Distribution of WRS practices relative to PCT equivalents for total prescribed items, net ingredient cost (NIC) and generic proportion of prescribed items

<table>
<thead>
<tr>
<th>Lower band</th>
<th>% Less than PCT</th>
<th>Equal to PCT</th>
<th>% More than PCT</th>
<th>Mean % difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Items</td>
<td>12</td>
<td>7</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>NIC</td>
<td>6</td>
<td>8</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Generic</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>18</td>
</tr>
</tbody>
</table>

### Table 4
Distribution of WRS practices relative to PCT equivalents for prescribed items and net ingredient cost by prescribing category

<table>
<thead>
<tr>
<th>Lower band</th>
<th>% Less than PCT</th>
<th>Equal to PCT</th>
<th>% More than PCT</th>
<th>Mean % difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Items</td>
<td>1.76</td>
<td>1.75</td>
<td>1.12</td>
<td>1.75</td>
</tr>
<tr>
<td>NIC</td>
<td>1.66</td>
<td>1.66</td>
<td>1.66</td>
<td>1.66</td>
</tr>
<tr>
<td>Generic</td>
<td>1.53</td>
<td>1.52</td>
<td>1.53</td>
<td>1.53</td>
</tr>
</tbody>
</table>
Discussion

Main findings
This study presents a comprehensive set of enquiries in which the representativeness of practice networks can be examined. The main findings are discussed as they applied to the WRS.

Region and population representativeness
The total population of England as defined by the PCT registered patient list is similar to the national census population (50 million), but there are some small absolute differences in the age distribution. The census population is derived from the national census for 2001, adjusted by the census validation exercise and updated annually using a small sample. The WRS population distribution is similar to both but it is particularly important to be representative of persons for whom health care is provided (i.e. the PCT population). The WRS sample size in some Strategic Health Authorities (Yorkshire and Humber) was lower than elsewhere because resources to recruit additional practices have not been forthcoming. Intuitively the WRS has aimed to achieve a minimum 2% population sample in each area in order to obtain reliable information at this level. However, this bias is unlikely to disturb estimates at a broader regional level.

Practice representativeness
WRS practices were well distributed by region across England, although there are some anomalies in distribution based on the Strategic Health Authorities. These will influence the recruitment policies of the WRS as resources become available. The representativeness of the WRS across the IMD is particularly welcomed. This deprivation score is built up from several indicators: income, employment, health and disability, education, skills and training, barriers to housing and services, living environment and crime. Socio-economic data are not available to study at individual patient or postcode level within the WRS data set. Practice location provides a proxy measurement for the patient location and demographic characteristics and has been used in other studies.

Average list per GP was higher in the WRS than in the national equivalent data. The calculation of average list can be confusing when a strict interpretation of Principal partner is used as this excludes part-time assistants and GP registrars. There were small differences between the WRS and national GPs in age and gender distribution. Practice partnership size in the WRS is concentrated in the range of 4–8 GPs with fewer than the national equivalent in the very small and very large practices. Larger partnerships were a feature of practices recruited to the National Morbidity Surveys and hence to the WRS, because the clerical support and computer facilities needed were more available and financially justifiable in large practices. Notwithstanding these small differences, the representativeness of the population suggests that the pattern of consultations and the range of diseases presented by patients in the WRS is indicative of the national picture.

Representativeness according to prescribing
There are four measures of practice prescribing: prescriptions issued, prescriptions recorded and issued, prescriptions dispensed and reported to the Prescription Pricing Authority and prescriptions for medication that is taken. In this study, we consider prescriptions dispensed and reported by the Prescription Pricing Authority. These are the most valuable measures when considering the activities of doctors, since they are independent of the recording diligence of the doctor. The reliability of the prescription capture mechanism is high because it is fundamental to the reimbursement of pharmacists.

The representativeness of the WRS across a wide range of prescribing indices provides reassurance that what is described in the WRS accurately reflects the situation in England. The only important differences (antibacterial prescriptions) were also apparent in the previous prescribing comparison. These differences might almost be expected in a network committed to accurate reporting of common infections and including many GPs involved in a respiratory virology swabbing programme.

Limitations of this study
The major enquiries undertaken in this study involved comparing practice-specific data with the equivalent national published information. Data acquisition required no input from the practices, and were collected independently. The prescription analysis is based on prescribing data collected nationally and is not biased by practice recording. For these reasons, the study is particularly robust and has few limitations. A minor enquiry in this study concerned the age of the GPs and the partnership size. Only five practices chose not to provide these personal data but any possible bias from their loss has minimal bearing on the overall conclusions.

Whilst additional comparisons (for example morbidity diagnoses) would be desirable, there are limited sources of comparable data except for conditions now reported in the Quality and Outcomes Framework. Statistical data in this
framework are mostly concerned with period prevalence, which is not the most appropriate comparison when considering surveillance data. Further work in this direction is being planned. Such comparisons that have been made between networks have used the WRS or National Morbidity Surveys as reference standards and have generally reported lower rates. Direct comparison can be difficult since few networks report specifically on disease episodes as opposed to consultations, which are greater because many episodes of illness are managed in a series of consultations.33

Patient postcode has been used as a proxy to examine socio-economic representativeness in practice networks and though this is a step forward, it does not address the individuality of patients as represented, for example, by their ethnic origin or smoking habit. In this study we have used practice postcode that is less specific than patient postcode but it is used solely in relation to aspects of the practice; this study is concerned primarily with aspects of the practice, though these need to be considered alongside patient-based characteristics.

What is already known
Most practice-based information networks have investigated the representativeness of the surveyed population. In particular, there has been a concentration on geographical and socio-economic demography, but the means whereby this can be done without the need for individual patient consent are increasingly limited by the advance of computer technology and the potential for deductive disclosure. These studies have mostly involved linking patient postcodes to national statistical data available by postcode.

What this study adds
This study incorporates a set of enquiries that extends the concept of representativeness to include the practice structure and practice-prescribing characteristics, a key element of practice behaviour, which is independent of the practice-derived data. The population data are as described by the PCTs and are the basis for remunerating practices; the prescribing data are available through the operation of the Freedom of Information Act; the practice-structural data are available in established national sources. The only data provided by the practices were obtained in a short questionnaire and covered the age and gender of the GPs in the partnership.

In the context of the WRS, the study has demonstrated the representativeness of the population monitored, the distribution of practices by the IMD and in all major prescribing areas.

Conclusion
This examination of representativeness has embraced aspects of population demography, socio-economic factors, practice structure and physician performance. No other investigation of representativeness has examined the issues across such a wide range of parameters. The use of information published as a result of the Freedom of Information Act has enabled this to be undertaken at a minimum cost. We commend this research package as a cost-effective analysis of a problem important to all concerned with the use of routine data from primary care for informing public health policy.

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References


