# The Development of Population-Based Need Indicators from Self-Reported Health Care Utilisation Data

## Discussion Paper 7



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# EXECUTIVE SUMMARY

## INTRODUCTION

There is considerable interest in establishing how the 1991 Census data can be used to improve the estimates of weighted capitation to achieve an equitable distribution of purchasing power in the new NHS. One possibility is to build on the small area analysis developed for the 1988 review of RAWP. While this approach has a number of strengths it also has limitations. Given these the DoH has decided to investigate other possible methodologies. Against this background, the King's Fund Institute was commissioned to explore the development of weighted capitation formulae from household survey data about individuals for both hospital and GP services.

## DATA AND METHODS

The aim of this paper is to develop statistical models which explain the utilisation of health care services and which can also subsequently be linked to the 1991 Census data to calculate weighted population estimates for areas based on their implied need for health care.

The analysis is based on the assumption that the utilisation of health services is determined by four key groups of factors:

* demographic characteristics;
* health status;
* socio-economic circumstances;
* local availability of services.

### *Data*

The dataset available for analysis is based on information collected by the Office of Population Censuses and Surveys as part of its monthly Omnibus Survey and administrative data from the DoH performance indicator package.

The OPCS Omnibus Survey is a monthly random sample of approximately 2,000 adults who are representative of the British population. The paper is based on the English sub-sample of 7 months of Omnibus data; a total sample of 12,729 people. The Omnibus Survey contains a core set of questions which overlap with large parts of the Census questionnaire. In addition, the Institute requested the insertion of the Census health question - and three health care utilisation questions.

Hospital and primary care supply side data was included in individual models of utilisation at GHS regional level. This regional categorisation splits standard regions into metropolitan and non-metropolitan areas. These are characterised by substantial variation in the availability of NHS resources. The hypothesis to be tested is that all other things being equal such variation influences utilisation.

### *Methods*

The variable of interest - whether or not individuals utilised health services - is a dichotomous one; it takes the value 0 or 1. The most appropriate statistical technique to use, therefore, is logistic regression. Models were developed which best explained the variation in utilisation for three population groups: all adults; adults under pensionable age and adults over pensionable age.

## RESULTS

For each of the three types of utilisation in all of the models, the single most important factor is health status: the Census health question about limiting long-standing illness. In addition, where applicable, being permanently unable to work due to illness is also consistently significant.

Having controlled for health status, a number of different age/sex groups had additional utilisation. This was particularly true for young women and women with children and almost certainly reflected child birth. However, middle aged men tended to have lower utilisation levels and very old men higher utilisation.

Over and above health and demographic characteristics there were some significant socio-economic variables which both reduce and increase utilisation in different circumstances. For example, individuals without access to a car are more likely to use hospital services than others. However, self-employed or part-time individuals are less likely to have had an in-patient stay or to have consulted their GP.

Finally, having controlled for health status, demographic characteristics and socio-economic circumstances, utilisation of in-patient and out-patient services is positively associated with living in metropolitan areas. This may reflect either supplier-induced demand or the extra needs of urban areas. In addition, a number of different supply side factors are significant in several models.

## SYNTHETIC ESTIMATIONS

The odds ratios from the statistical models of utilisation can be combined with Census data about the characteristics of the population in an area to produce weighted population estimates. Detailed estimates for areas are not presented in this report, however, we do show how they should be calculated.

## DATA LIMITATIONS AND FURTHER WORK

The main weaknesses of the analysis set out in this paper are associated with the dataset available to the Institute. These include:

* the exclusion of children;
* the exclusion of individuals living in institutions;
* no information on frequency or intensity of use;
* the inclusion of maternity cases in in-patient utilisation;
* poor supply side data;
* only cross-sectional data.

The imaginative use of a number of existing data sources such as GHS or BHPS could overcome many of the problems encountered in this analysis. However, household surveys cannot by their very nature address issues about individuals who live in institutions and without a change in the confidentiality rules it is difficult to see how the measurement of supply can be improved on.

# *1.* INTRODUCTION

There is considerable interest in establishing how the 1991 Census data can improve estimates of weighted capitation for the distribution of purchasing power for hospital and community health services. The Department of Health (DoH) has reiterated that 'people at equal risk of ill health should have equal opportunity of access to health care' (Taylor, 1992) and confirmed that the availability of data from the 1991 Census 'offers an obvious opportunity to review NHS weighted capitation formula in the light of this objective' (Taylor, 1992).

Existing estimates of weighted capitation have been based on small area analyses. The 1988 review of RAWP derived its empirical estimates by first identifying from NHS patient records the total level of hospital utilisation for electoral wards. Second, the relationships between the aggregate level of utilisation, standardised mortality rates, service availability measures and other indicators of the socio-economic characteristics of the ward were investigated.

Current indications suggest that the DoH favours using the Census data to modify the methodology developed for the 1988 review of RAWP. At the same time, there is a recognition that 'it is important to gain expert opinions on alternative methods that could realistically be used to ascertain the geographic distribution of health needs for resource allocation purposes' (Taylor, 1992).

A number of problems and possibilities for further work have been acknowledged by the DoH. These include possible ways of dealing with ecological fallacy, and taking account of the relationships between one form of service utilisation (e.g. hospitals) and others (e.g. general practice or social care). The problem of ecological fallacy occurs when, for example, the average properties of an area or a group are attributed to each of its individual components or individuals. The difficultie associated with investigating utilisation in a particular service vacuum is that complementary and substitute relationships with other services cannot easily be taken into account.

The purpose of this paper, therefore, is to respond to these kinds of concerns and to suggest an alternative method of estimating the health care needs of purchasing authorities. This methodology is based on individual data which overcomes the problems of ecological fallacy and allows different types of utilisation to be compared with each other.

The remainder of this paper has five main sections. First, it outlines the reasons for favouring an approach to estimating weights for resource allocation purposes based on the experience of individual people rather than small areas. Second, it describes the dataset and methods employed to develop statistical models of utilisation. Third, it sets out the results of the models for each type of utilisation for a number of different population groups. Fourth, it explains how the results from these models can be used to derive weighted capitation estimates for different areas. Finally, it sets out the limitations of the dataset available to the Institute and areas of further work which are required to develop the methodology.

# 2. Background

In 1948 the National Health Service was established to provide comprehensive health care to all regardless of ability to pay. Equal access for equal need became a fundamental principle of the NHS, and in the 1970s a new resource allocation policy was introduced to achieve this.

The measurement of need is fundamental to the achievement of an equitable regional distribution of resources. This has lead to a search for health service research's own holy grail - a health care need indicator. There are two schools of thought. The Department of Health (DoH) has favoured a reliance on data about the utilisation of health care, while others advocate the use of measures of, or proxies for, morbidity. Neither is perfect.

Utilisation is determined by the interaction of demand and supply. However, numerous studies which examine variations in utilisation rates have found that the level of supply is the most significant explanatory factor (Morgan *et al.*, 1987).

Measures of morbidity and health status are equally problematic. First, they are difficult to measure on a systematic basis. Second, health services are not always the most appropriate form of intervention, other services may better prevent and alleviate the affects of ill health. Finally, there may not be effective health care treatments available.

Without a direct measure of health care needs, policy makers have to identify the second best alternative. The key question, therefore, is whether available information about either utilisation or health status can be adjusted to better measure the need for health services. It is difficult to see how this can be done with morbidity without a great deal more information about the effectiveness of all kinds of interventions. However, a new approach to weighting populations on the basis of individual data may overcome some of the problems generally associated with the use of utilisation data.

To date, the analytical basis for the resource allocation formula - area level analysis of administrative data - has a number of limitations. Such data may show relationships which do not exist at an individual level, for artifactual reasons or because associations are masked by the aggregation process. This is know as the ecological fallacy. There are two main causes of bias - aggregation and specification (van Doorslaer and van Vliet, 1989). Aggregation bias occurs because of the reduction in variation between individuals within regions in macro studies. Specification bias occurs when important variables are omitted from aggregated models because of their lack of availability at macro level.

In addition, analysing the relationship between supply and utilisation at an individual level avoids the problem of simultaneous determination. It is improbable that an individual's utilisation will influence supply. Thus we can be more sure of the direction of causation in analysis of individual data. Similarly, individual data are unlikely to contain large numbers of patients of particular physicians which will reduce the importance of professional characteristics and uncertainty on use.

## INDIVIDUAL DETERMINANTS OF UTILISATION

There have been relatively few studies which examine the determinants of utilisation at an individual level in Britain. Haynes (1991) demonstrated the importance of self-reported health status in predicting the utilisation of health services using the 1982 General Household Survey (GHS). Respondents who reported either a short or long-term illness were three times as likely to have attended out-patients and twice as likely to have been an in-patient, as those who reported neither (Table 4, p.366). After controlling for health status, other factors such as region and socio-economic status were generally insignificant. Balarajan *et al.* (1987) combined five years of GHS and showed the significance of socio-economic factors such as car ownership, class and tenure. However, this study did not include health status and neither paper attempted to measure the importance of supply. Fortunately, there is a much more sophisticated international literature in this area.

In the USA and the Netherlands, for example, researchers have been using individual based insurance and survey data to develop new ways of preventing risk selection and facilitating equal access to health care. In the USA, there is growing interest in developing a more sophisticated mechanism for Medicare reimbursement of HMOs on the basis of capitation payments. In the

Netherlands, the Government is proposing to pay all health insurance organisations on a capitation basis (van Vliet and van de Ven, 1992). The debate in both countries has focused on the relative merits of using past utilisation or a variety of measures of health status to improve the basis on which need indicators or weighted capitation formulae are established.

In the USA, Newhouse *et al.* (1989) modelled medical expenditure data from the RAND health insurance study to investigate variations in utilisation. The conclusion was that both health status and prior utilisation were highly correlated with observed variations in service use. A recent Dutch study came to similar conclusions (Van Vliet and van de Ven, 1992).

It is not surprising that health status should prove to be closely related to utilisation when analyses are conducted at the individual level. But a key issue in British health service research concerns whether or not health status is more or less important than the local availability of health care resources in determining levels of utilisation.

There are two key international papers (Pauly, 1980; van Doorslaer and van Vliet, 1989) which model in-patient use on both health status and supply factors at an individual level. Pauly (1980) analysed the Health Interview Survey of 1970 and found that the admission rate, number of surgical hospital episodes and length of stay were not consistently associated with the availability of beds or doctors.

*These results...do suggest, however, that the primary determinant of use is the health status of individuals, not the availability of beds or physicians (p.101).*

This finding contradicts Fuchs (1978) who analysed the same data at an aggregate level and found a significant relationship between the number of surgeons and the rate of surgery. Pauly suggests the reason for making false inferences from this analysis is the failure 'to account adequately for the health status of the patient' (p.115-116).

Van Doorslaer and van Vliet (1989) investigated the relationship between macro and micro analyses further by using insurance data for 230,000 Dutch individuals at both the individual and two different regional levels. They modelled both the probability of hospital admission and length of stay against regional supply, health status and other individual characteristics. Two of their key findings are relevant for this study. First, health status is a very important predictor of hospitalisation and length of stay. When included in both macro and micro models it dramatically increased the goodness of fit and reduced the significance of the supply factors. Second, bed supply data were not positively associated with hospital admissions but were significant for length of stay at both levels of analysis.

The detailed empirical analysis of individual data highlighted in this section identifies an important new direction for the debate about resource allocation in England. The international literature suggests that the most logical means of estimating the weights for capitation payments is on the basis of individual data. This avoids some of the problems identified above. For example, it allows the inclusion of more direct measures of morbidity, which have consistently been found to be the most important determinant of health care use. Once such measures are included the significance of supply factors is greatly reduced and in a number of examples becomes non-existent.

# 3. Data and Methods

This section of the report describes the dataset and methods employed for statistical modelling. The models themselves aim to explain the utilisation of health care services - in-patient, out-patient and GP. The coefficients from the models can be subsequently linked to the 1991 Census data to calculate weighted population estimates for areas on the basis of their need for health care.

It is hypothesised that the utilisation of health care services is determined by a wide range of different factors, including:

* demographic characteristics;
* morbidity;
* socio-economic circumstances;
* availability of local services.

The objective is to identify what combination of Census variables best predicts the usage of services. The logic of this approach can perhaps be best illustrated as follows:

*if utilisation = f (illness + socio-economic and demographic characteristics + supply side factors),*

*and health care needs = f (utilisation adjusted for supplier-induced demand and inappropriate demand factors),*

*then health care needs = f (illness + socio-economic and demographic factors).*

What this means in practice is that the odds ratios derived from robust statistical models which are good predictors of health care utilisation can be used to estimate weighted populations.

Two key assumptions should be emphasized. First, the determinants of utilisation are constrained to the set of variables available in the decennial census. Second, a judgement has to be made as to whether or not a statistically-significant determinant of utilisation can be regarded as an appropriate need indicator. We return to this point later in the paper.

## DATA

The dataset used for this analysis is based on information collected by the Office of Population Censuses and Surveys (OPCS) as part of its monthly Omnibus Survey, and administrative data about the availability of health care services from the Department of Health's performance indicator package.

### *OPCS Omnibus Survey*

The Omnibus Survey is a relatively new survey service for government departments and public bodies. It aims to provide a fast, effective and reliable way of obtaining information about the characteristics, behaviour and attitudes of the general population or of particular groups of people. The survey is conducted monthly for approximately 2,000 adults, the average response rate is approximately 80 per cent. Fieldwork takes place over a two week period and the results are made available to clients in the form of a report and computer file about one month later.

The Omnibus Survey is based on a random sample of the general British population (OPCS, 1991). The sample addresses for the OPCS Omnibus Survey come from the Postcode Address File, an up-to-date sampling frame of the addresses of private households in Great Britain. Each month a random sample of 100 sampling areas (postcode sectors) in England, Wales and Scotland (excluding the Scottish Islands) is selected, stratified to ensure that all regions are included and that, within each region, the basic tenure and occupation types are correctly represented.

In each area, 30 addresses are selected at random for visit by interviewers. About 12 per cent of the addresses visited each month will not be eligible for the survey in that they will not contain a resident private household. At the remaining addresses the interviewers establish what households live at the address, and, if necessary, randomly select one household for the survey. They then list all adult members of that household in age order and select one of them, at random, as the informant.

No substitutes are taken, either for addresses or households or informants. Interviewing is carried out face-to-face with the designated informant. No proxy interviewing takes place, because of the large opinion component in Omnibus questions, although questions may be asked about other people in the household.

Since only one household member is interviewed, people in households containing few adults have a greater chance of selection than those in households with many. Responses are weighted to correct for this unequal probability of selection. First, responses are weighted by the number of adults in the household, to correct the proportions, and then adjusted to give a total sample size equal to the number of informants actually interviewed.

The King's Fund Institute purchased the collection of health and health care utilisation data in seven different months: April, August, November 1991; February, May, November 1992 and February 1993. The achieved sample size for Great Britain is 14,847 from 18,523 eligible addresses - a response rate of 80 per cent. The analyses in this report are limited to the English sub-sample only - a total of 12,729 respondents.

The representativeness of the survey can be assessed by comparing it to the 1991 Census (OPCS, 1992). It should be noted, however, that the Omnibus Survey includes people over the age of 16 only, whereas the Census includes children and young people. In addition, information on car ownership and tenure are not strictly comparable, since the 1991 Census is based on household data and the Omnibus Survey on individual responses. As can be seen in Table 1 the Omnibus Survey has a slightly higher proportion of women respondents, owner occupiers and households with 2 or more cars. It has fewer individuals from minority ethnic groups, those aged over 75 and households with no car. Otherwise the regional and age distributions of the populations are similar.

One of the key features of the Omnibus Survey is that each month a set of basic classificatory data is collected in addition to any questions requested by clients. These data cover many of the characteristics of individual respondents and their household circumstances which were included in the 1991 Census. Table 2 shows the items of information collected in the 1991 Census and their availability in the Omnibus Survey. As can be seen from Table 2 the only relevant omissions from the Omnibus Survey are: type of accommodation; country of birth; daily journey to work; qualifications; and household amenities.

In addition to the basic module, the King's Fund Institute requested the insertion of the Census health question, and three utilisation questions - for accident & emergency and out-patient attendance, in-patient stays and general practitioner consultations. The exact wording of the questions is shown in Box 1. All of the questions, except that about GP consultations, were identical to those asked in the General Household Survey (GHS). On the advice of OPCS, the GP consultation question had to be modified slightly to simplify it from a series of questions in the GHS to a single question in the Omnibus Survey.

It is important to bear in mind that the in-patient - but not the out-patient - question includes use of maternity services, which complicates the analysis of hospital utilisation (Balarajan, 1991; Garfinkel *et al.*, 1988). Unfortunately, it is only possible to identify women attending hospital to give birth by examining women with children under 4. Although this is extremely unsatisfactory, we have no alternative other than to use this variable as a crude proxy for identifying maternity cases for the in-patient models.

Table 3 compares some of the results from the 1991/1992 Omnibus Surveys with similar questions asked in the 1990 GHS (Smyth and Browne, 1992). There are a number of differences worthy of note. The Census question on limiting long-term illness has a lower prevalence rate in the Omnibus Survey, although this may reflect the alterations made to the question for the Census (see Benzeval and Judge, 1993). The utilisation rates reported in the Omnibus Survey are all slightly higher than in the GHS, but it is known that reported health care use varies from year to year and sample to sample.

### *Service Availability*

Service availability factors were obtained from the DoH performance indicator package for 1990/91 (DoH, 1992). We considered the utility of a wide range of indicators. For the hospital sector, physical and human resources are clearly of importance and vary substantially between different areas. These are shown in Table 4.

Primary care data were less clear cut. The number of GPs per capita is clearly an important supply variable in this sector. But as a result of efforts by the Medical Practices Committee since 1948 to equalise the number of GPs per head between areas there is very little variation in this variable. However, it is widely believed that the quality of primary care varies considerably between areas and this may impact on individual access to services and utilisation in the same way as physical resources. We, therefore, included a number of 'quality' indicators for the primary care sector which are shown in Table 4.

The OPCS Omnibus Survey data contain Regional Health Authority (RHA) codes for England. However, it is well known that the variation in the availability of resources at the regional level is much smaller than at lower levels of aggregation and hence the impact of service availability may not be picked by the RHA level data.

For confidentiality reasons OPCS will not allow the local authority or district health authority of an individual to be identified. However, the survey does include GHS region codes which divide regions between metropolitan and non-metropolitan areas as shown in Table 5. Although there are a similar number of regions to RHAs, the metropolitan split should enable the identification of more extreme areas of high supply than RHA data allows.

Table 6 shows the mean, standard deviation and coefficient of variation for the hospital availability variables for both RHAs and GHS regions. As can be seen both the standard deviation and coefficient of variations are much greater amongst GHS regions than RHAs. Intuitively this is very plausible. GHS regions explicitly identify metropolitan areas, the high levels of services in these areas are well documented (Boyle and Smaje, 1992), hence the fact that there is more variation amongst these areas is predictable.

The data on primary care show a similar trend, although the differences are not as wide. As can be seen in Table 7 there is very little variation in the supply of GPs between areas. However, there are substantial variations in the more qualitative indicators such as the number of single handed GPs or the proportion of practices which fall below the minimum standards. Again, the variation between GHS regions is greater than that between RHAs.

Overall, GHS regions appear to exhibit greater variation in service availability than RHAs. We believe, therefore, that including the actual mean value of resource measures at GHS regional level in models of utilisation is the best way of picking up service availability effects, given the data constraints.

## METHODS

The purpose of this paper is to explore the relationships between health care utilisation, the Census health question, other demographic, social and economic variables available in the 1991 Census and regional measures of resource availability, using the multivariate statistical technique logistic regression. This is the most appropriate method when the dependent variable is dichotomous, i.e. takes the value 0 or 1 (Hosmer and Lemshow, 1989). It estimates the probability of an individual using health care services based on the set of statistically significant explanatory variables included in the model. This is expressed algebraically as:

$$\text{Probability of } (y=1) = \frac{e^{(BX)}}{1+e^{(BX)}}$$

where y is the dependent variable, e is the natural log and BX is the linear combination of coefficients and explanatory variables.

The explanatory variables used in the modelling covered the four groups of factors identified earlier as important determinants of health care utilisation. A detailed list of the precise variables which were included is shown in Table 8. All the demographic, morbidity and socio-economic variables are available in the 1991 Census dataset. However, the exact specification of some variables differs slightly between the Omnibus Survey and the SAS tabulations which are available. Table A 1.1 shows which variables match precisely and which are problematic. Table A 1.2 sets out the method we employed to deal with each problematic variable.

To improve our understanding of the complex determinants of health care utilisation, we modelled the data in a number of different ways. The aim being to ensure that all the variables have every chance of entering the model if they were important despite the high level of multicollinearity which exists between them.

A consistent approach to modelling was followed for each type of utilisation - in-patient, out-patient and GP consultations. First, we modelled utilisation on the four groups of factors separately. Second, we included all possible variables in one model, using both forward and backward stepwise logistic regression techniques.

Both of these approaches were employed for different population groups from the survey: all adults; adults under pensionable age and adults over pensionable age. After preliminary investigation these appeared to provide the most intuitively appealing categories which are consistent with the classification used in the SAS tabulations in the 1991 Census.

Any variable which was either significant in any of the models identified above or of special interest from a policy or theoretical perspective was then included in a second modelling stage. Again models were developed by both forward and backward stepwise logistic regression.

Final models were chosen on the basis of statistical significance, a priori reasoning and parsimony. Statistical significance was established at 95 per cent by comparing the change in scaled deviance for the model as a whole to a chi-square distribution to test the null hypothesis that the coefficients for all the terms in the model, except the constant, are zero. The significance of individual variables was tested by comparing the Wald statistic (square of the ratio of the coefficient to standard error) to the chi-square distribution. At this stage variables were included if they were significant at 90 per cent.

# 4. Results

The purpose of this section is to present the results of the statistical modelling of each type of utilisation - in-patient, out-patient and GP consultations.

Before presenting the final models it is worth highlighting the relative importance of the different groups of factors in determining utilisation. This can be done by comparing the change in scaled deviance calculated from five separate models for each of the groups of factors for each type of utilisation. As can be seen from Table 9, all of the models are significantly different to the constant only model.

The larger the change in scaled deviance the better the model is in explaining utilisation. In this respect a consistent pattern emerges across each type of utilisation. Morbidity factors are clearly the most important group. Demographic and socio-economic factors each account for less than one-third of the change in scaled deviance of the morbidity variables. However, it is impossible to ascertain at this stage whether these factors are independent of health status or merely confounding. Supply factors have a very low change in scaled deviance in comparison to the other three groups. This may or may not be a consequence of their relative imprecision.

## IN-PATIENT UTILISATION

### *All Adults*

Table 10 shows the final explanatory model for in-patient utilisation for all adults. The first thing to note is that it contains variables from each of the four groups of factors hypothesised as important. The single most important factor is having a limiting long-standing illness. Such people are nearly three times as likely to use in-patient services as others. The second most significant factor is women who have a child under 4. Such women are twice as likely to have used in-patient services in the last year as other population groups. Age and gender are also important factors. Using men aged under 30 as the reference group, men aged 30-44 are significantly less likely to use in-patient services. In addition, men over 75 are 1.3 times more likely to have had an in-patient stay in the last year. Women aged 60-74 are also significantly more likely to use hospital services than the reference group of men.

There are three significant socio-economic variables. Individuals without access to a car are more likely to use in-patient services, whilst respondents who are self-employed or in part-time employment have lower utilisation, ceteris paribus, than other groups.

Supply factors also appear to be significant in the models. Utilisation of in-patient services decreases with the proportion of GPs in the region who are single-handed. In addition, the model suggests that, having controlled for health, demographic and socio-economic factors, individuals who live in metropolitan areas are more likely to use in-patient services. This may reflect either some aspect of urban need which has not been picked up by the other factors or the high level of hospital resources which are known to exist in these areas (Boyle and Smaje, 1992).

### *Adults under Pensionable Age*

The model for adults under pensionable age is shown in Table 11. Limiting long-standing illness, permanent inability to work due to illness and women with children under 4 are the most significant variables. In addition, men aged 30-44 and the self-employed are less likely to use in-patient services.

### *Adults over Pensionable Age*

The model for adults over pensionable age is very similar to that for the whole sample. Table 12 shows that limiting long-standing illness is the most important factor. In addition, pensioners who live in metropolitan areas or do not have access to a car are more likely to use in-patient services than other individuals over pensionable age.

## OUT-PATIENT UTILISATION

### *All Adults*

Table 13 shows the final model which best explains out-patient utilisation for all adults. The two measures of morbidity are the most important factors. Individuals with limiting long-standing illness are three times, and those permanently unable to work are one and a half times, as likely to have used out-patient services in the last three months.

Having controlled for morbidity, men aged 30 to 64 are less likely to use out-patient services than other age and gender groups. Individuals who fall into the other inactive category as defined by the Census tabulations as looking after the home and 'other' are also less likely to use out-patient services. Married people, on the other hand, have a slightly increased risk of utilisation.

Once all of the factors above have been controlled for, living in metropolitan areas increases the probability that an individual will use out-patient services. Once again, it is impossible to determine whether this reflects the extra needs of urban areas or supply side effects, either due to the high levels of hospital resources or poor primary care.

### *Adults under pensionable age*

The final equation for adults under pensionable age is shown in Table 14 and reflects many of the features of the all adult model. The two most important factors in determining out-patient utilisation are limiting long-standing illness and being permanently unable to work. Men aged 30 to 64 and individuals who look after the home or are categorised as 'other' inactive are less likely to use out-patient services. Again, having controlled for these factors, individuals living in metropolitan areas have a higher probability of utilisation than others.

In addition to these factors, there are three significant variables relating to the supply of primary care in the individual's area. As the number of GPs per 1,000 population in the area increases so does the probability of an individual using out-patient services. However, there is a negative association between out-patient utilisation and the proportion of GPs with small list sizes and the proportion over 65. This makes intuitive sense since both of these factors probably reflect part-time GPs who are less accessible to their patients and hence less likely to refer them to out-patient clinics. Together, these three factors suggest that there may be a complementary relationship between GP and out-patient services.

### *Adults over pensionable age*

The model for adults over pensionable age is very simple and contains only three variables. As can be seen from Table 15, the most important determinant of utilisation for this group is having a limiting long-standing illness. Having controlled for this factor, men over 75 are 35 per cent more likely to use out-patient services than other pensioners.

Finally, utilisation of out-patient services amongst pensioners increases with the number of beds per resident population in the respondent's area. However, this demonstrates the problem of interpreting area based variables in these models. Table A 2.1 shows a very similar model for out-patient utilisation amongst pensioners except the beds variable has been replaced by a dummy variable for metropolitan areas. Although the presence of a beds variable in the equation implies that supplier-induced demand is a problem, it is impossible to rule out the possibility that this may reflect extra urban need as the two factors are clearly closely related.

## GP CONSULTATION UTILISATION

### *All adults*

The final model for GP consultations for all adults is shown in Table 16. Once again it contains variables from all four groups of factors hypothesised as being determinants of utilisation. Limiting long-standing illness is the single most important factor. Also important is being permanently unable to work due to illness.

Having controlled for health status, there are a large number of significant demographic factors. For women under 60 there is a reverse j-shaped relationship with GP utilisation, with the highest probability being amongst women under 29 which then declines and increases again towards retirement age. In addition, there is raised utilisation amongst women with young children. Over retirement age there is little difference between the genders in utilisation but there are higher consultation rates, particularly amongst the over 75s.

Individuals who classified themselves as Asian are 30 per cent more likely to consult their GP, *ceteris paribus*, than other ethnic groups.

There are a number of significant socio-economic factors. Being an owner-occupier, in part or full-time employment, reduces the probability that an individual will consult their GP. On the other hand, being married increases the probability of utilisation.

Finally, having controlled for all of these individual level factors, areas with GPs with large list sizes have higher consultation rates.

### Adults under pensionable age

As Table 17 shows, the model for adults under pensionable age is similar to that for all adults. The groups who are most likely to consult their GP are those with limiting long-standing illness or permanently unable to work due to illness; women, particularly the young or those with children; and individuals who classified themselves as Asian.

In terms of socio-economic status, owner occupiers and those in part-time employment are less likely, while single parents and married individuals are more likely, to consult their GP.

In this model the number of GPs per resident population has a negative effect on utilisation. This may reflect the inverse care law which suggests that areas with the most need have the least resources.

### Adults over pensionable age

The model for individuals over pensionable age is very simple containing, as is shown in Table 18, only three variables. As has consistently been found in all of the models reported in this paper, the single most important factor is whether or not the individual has a limiting long-standing illness.

Perhaps counter-intuitively at first, the next significant variable - living alone - is negatively associated with GP consultation. However, this may reflect a 'healthy survivor' effect suggesting that only relatively healthy elderly people remain living alone with more morbid individuals moving in with relatives or to residential care.

Finally, individuals living in metropolitan areas are nearly 30 per cent more likely to consult their GP than others. Once again, it is impossible to say whether this reflects extra urban need or supply effects.

# 5. Synthetic Estimations

The purpose of this section is to describe how the results of logistic regression models reported in Section 4 can be used to estimate weighted populations.

The methodology employed to calculate weighted population estimates has been adapted from the work of Balarajan and his colleagues and involves four distinct stages. First, judgements must be made about which of the significant explanatory variables are 'legitimate' need factors and hence should be included in the calculation of weighted population estimates. Second, weighting factors for each selected explanatory factor are calculated. These combine the odds ratios for each factor with the characteristics of area populations. Third, a need indicator is calculated which is the product of the weighting factor for each characteristic. Finally, the need indicator is applied to the number of people living in the area to calculate the area's weighted population.

## CHOOSING 'LEGITIMATE' NEED FACTORS

The purpose of calculating weighted populations is to estimate each area's relative need for health care services. The utilisation models presented earlier in the report include some variables which clearly represent an individual's need for health care services such as morbidity or age and gender. These should be included in the estimate of weighted populations. However, some of the significant variables are supply side factors or represent higher or lower utilisation amongst specific sub-groups of the population which may not be considered legitimate. Such factors should not be included in the calculation of the need indicators. A judgement has to be made about the underlying associations that such variables are picking up and whether or not they should be excluded. For example, if poorly educated people living in council housing were discovered, *ceteris paribus*, to consult health services less frequently than might be expected this could be an example of the inverse care law at work and should be ignored for resource allocation purposes.

## WEIGHTING FACTORS

Once a decision has been made about which variables to include in the need indicator, a weighting factor is calculated for each variable which combines the odds ratios derived from the models with the population characteristics. The odds ratio indicates how much more likely an individual with a given characteristic is to use health care services than someone without the characteristic. This is applied to the proportion of the population with the characteristic in the area and added to the proportion of the population without the characteristic to give the weighting factor.

For example, if the odds ratio for limiting long-standing illness is 3 and its prevalence in an area is 20 per cent, then the weighting factor is 1.4, i.e. (3 X 0.2) + 0.8.

## NEED INDICATOR AND WEIGHTED POPULATIONS

The need indicator for each area is the product of weighting factors for each of the significant and 'legitimate' characteristics. Once calculated it is applied to the actual number of people resident in the area to estimate the weighted population based on the need for health care services.

Using the full results of the 1991 Census it is possible to produce weighted populations for each health authority in England. Box 2 shows a simple hypothetical example for two contrasting areas. It illustrates how both the value of the odds ratio and the characteristics of the area are important in calculating the final weighted population estimates which reflect the area's relative need for health care services.

# 6. Data Limitations and Further Work

The main weaknesses of the approach set out in this paper are associated with the nature of the dataset available to the Institute rather than the methodology itself. The work is limited because the dataset:

* excludes children;
* excludes individuals living in institutions;
* takes no account of the frequency or intensity of utilisation;
* cannot distinguish in-patient utilisation for maternity services;
* has very aggregated supply data;
* is cross-sectional.

## CHILDREN

The exclusion of children from the dataset has particular problems for estimating the need for health care in an area, as their pattern of utilisation does not necessarily reflect that of adults. However, the GHS does contain health status and utilisation information for children and hence this shortfall could easily be overcome by using an alternative dataset.

## INDIVIDUALS LIVING IN INSTITUTIONS

By their very nature, household surveys will be unable to capture information about the health and health care utilisation of individuals living in institutions.

Judgement needs to be made about how serious a limitation this is and what, if any, adjustments can be made to weighted capitation estimates to take account of the extra needs for resources of areas with institutions. It might be sufficient, for example, simply to apply the odds ratio for limiting long-standing illness derived from these analyses to people living in institutions.

## FREQUENCY AND INTENSITY OF UTILISATION

The dataset used for the analysis in this document simply asks whether the respondent has used in-patient, out-patient or GP services within a specified time period (12 months, 3 months or 2 weeks respectively). It takes no account of the number of times the service has been used within that time frame and it treats each unit of utilisation as equal. Both of these points clearly limit the value of the information. However, the latter is a particularly invalid assumption for in-patient utilisation. For example, the average length of stay is known to vary by age and gender. In Wales individuals over 75 have average lengths of stay more than three times that of people aged 15 to 64 (Boyle and Harrison, 1992). Insofar as utilisation is used as a proxy for the demand for resources, therefore, any failure to take account of the intensity of hospital use will bias any estimates of need in a way which is prejudicial to those areas which have an excess of elderly people. One way of overcoming this problem would be to estimate weighted populations on the basis of episode of utilisation as set out in this paper and then to adjust them further to take account of variations in intensity. Longer term, these problems may be overcome by more detailed data collection efforts. GHS already collects information on the frequency of health care utilisation. Special data collections could be made to investigate the length of stay for in-patient episodes. For example, the British Household Panel Study (BHPS) asks respondents about the number of days they were an in-patient. However, the quality of such data may be questionable because of the problem of recall bias.

## MATERNITY SERVICES

The inclusion of maternity services in the measure of in-patient utilisation is clearly problematic. Ideally, one would want to model hospital utilisation without maternity cases since they do not necessarily relate to measures of health status or other conventional indicators of health care need. Separate need indicators should be used for maternity care based on historic births, as now, or fertility rates. In this respect, this dataset is severely hampered by only being able to identify such cases very crudely by reference to women with children under 4. The GHS asks the same in-patient question, but it also collects data which make it possible to ascertain when the last child in the household was born and hence more accurately identify maternity cases. It clearly would be possible in special data collections to specifically ask women whether their in-patient stay was for maternity care as is done in the BHPS.

## SUPPLY SIDE DATA

As indicated in Section 3, for confidentiality reasons, OPCS will not allow the local authority or district health authority of an individual to be identified. This meant that we had to include supply side information at a very aggregated level which obscured considerable variation and, therefore, may have reduced its importance in the models. Obviously the models and our analysis would be much more robust if the problem could be overcome. Unfortunately, we have not to date found a satisfactory way of doing so.

## CROSS-SECTIONAL DATA

A slightly different problem arises as a result 'of using measures of current health to explain past utilisation behaviour?' (Manning *et. al.*, 1982). Most empirical studies of the demand for health care 'have asked individuals about their current health and their past utilisation of health services ... health status measures at the time of the interview are then used to explain past utilisation ... (however) the observed health status variables do not really predict utilisation; they 'postdict' it' (Manning *et. al.*, 1982).

These problems, which tend to exaggerate the causal significance of health status measures, are clearly relevant to the analysis presented in this paper. For example, in Manning and colleagues' analysis of data from the USA, the use of a subjective health status measure in a postdictive model increases the explanatory power by 10 per cent compared with the same measure in a predictive model. Such problems can be overcome by the use of longitudinal datasets where the time sequence of events can be established.

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BOX 1

## KING'S FUND INSTITUTE QUESTIONS INCLUDED IN OPCS OMNIBUS SURVEY

1. CENSUS HEALTH QUESTION ON LONG-TERM ILLNESS

Do you have any long-term illness, health problems or handicap which limits your daily activities or the work you can do?

Yes, have a health problem which limits activities (1)

Have no such health problem (2)

*Include problems which are due to old age.*

2. DOCTOR CONSULTATIONS

During the 2 weeks ending yesterday, apart from any visit to a hospital, did you talk to a doctor for any reason to do with your own health (or that of another adult member of your household)?

Yes (1)

No (2)

*Include talking on telephone as well as in person.*

3. OUT-PATIENT ATTENDANCES

During the months of [name last 3 months] did you attend as a patient in the casualty or out-patient department of a hospital (apart from straightforward ante- or post-natal visits)?

Yes (1)

No (2)

4. IN-PATIENT STAYS

During the last year, that is, since [name appropriate month in preceding year] have you been in hospital as an in-patient, overnight or longer?

Yes (1)

No (2)

BOX 2

## CALCULATING WEIGHTED POPULATIONS

In this example there are two hypothetical areas: District A and District B. District A has a high level of morbidity and poor socio-economic status. District B, on the other hand, has a low level of morbidity and is relatively affluent. Assuming there were only two significant variables in our model of utilisation, limiting long-standing illness (odds ratio = 3) and owning two or more cars (odds ratio = 0.5), then the weighted populations for the two areas would be calculated as follows:

***District A***

| | |
|---|---|
| Population | 100,000 |
| Proportion with limiting long-standing illness | 0.2 |
| Weighting factor | 3 x 0.2 + 0.8 = 1.4 |
| Proportion with two or more cars | 0.1 |
| Weighting factor | 0.5 x 0.1 + 0.9 = 0.95 |
| Need indicator | 1.4 x 0.95 = 1.33 |
| Weighted population | 100,000 x 1.33 = 133,000 |

***District B***

| | |
|---|---|
| Population | 100,000 |
| Proportion with limiting long-standing illness | 0.1 |
| Weighting factor | 3 x 0.1 + 0.9 = 1.2 |
| Proportion with two or more cars | 0.5 x 0.3 + 0.7 = 0.85 |
| Need indicator | 12 x 0.85 = 1.02 |
| Weighted population | 100,000 x 1.02 = 102,000 |

Thus it can be seen that District A - the area with high morbidity and poor socio-economic status - would have a larger weighted population than District B, and should, therefore, receive proportionately more health care resources.

TABLE 1

REPRESENTATIVENESS OF OMNIBUS SURVEY
IN COMPARISON TO 1991 CENSUS
ENGLAND

| | 1991 Census | Omnibus Survey 1991/92 |
|---|---|---|
| | % | % |
| ***Women*** | 51.6 | 53.1 |
| Aged | | |
| - 16-30 | 26.0 | 24.4 |
| - 30-44 | 26.7 | 26.7 |
| - 44 - pensionable age | 24.0 | 25.8 |
| - Pensionable age - 74 | 14.5 | 16.2 |
| - 75+ | 8.9 | 7.1 |
| ***Ethnic Group*** | | |
| - White | 93.8 | 95.2 |
| - Afro-Caribbean | 1.9 | 1.2 |
| - Asian | 3.1 | 2.1 |
| - Other | 1.3 | 1.4 |
| ***Tenure*** | | |
| - Owner occupier | 67.6 | 73.2 |
| - Local authority rent | 19.8 | 19.7 |
| ***Car Ownership*** | | |
| - 0 | 32.4 | 20.7 |
| - 2+ | 23.9 | 34.6 |
| ***Region*** | | |
| - North | 6.5 | 6.6 |
| - Yorkshire & Humberside | 10.3 | 10.7 |
| - East Midlands | 8.4 | 9.2 |
| - East Anglia | 4.3 | 4.2 |
| - Greater London | 13.8 | 13.0 |
| - South East | 22.4 | 22.7 |
| - South West | 9.9 | 10.3 |
| - West Midlands | 11.0 | 10.7 |
| - North West | 13.3 | 12.6 |

TABLE 2

### 1991 CENSUS VARIABLES AVAILABLE IN THE OPCS OMNIBUS SURVEY

| | 1991 Census | Omnibus Survey |
|---|---|---|
| H1 | Number of rooms | 4 months only |
| H2 | Type of accommodation | No |
| 1 | Name | No |
| 2 | Gender | Yes |
| 3 | Date of birth | No (age - yes) |
| | Number of adults in household | Yes |
| | Number of children in household | Yes |
| | Type of household | Yes |
| 4 | Marital status | Yes (slightly different categories) |
| 5 | Relationship in household | Yes |
| 6 | Location on night of 21/22 April | No |
| 7 | Usual address | No |
| 8 | Term address of students | No |
| 9 | At address a year ago | 4 months only |
| 10 | Country of birth | No |
| 11 | Ethnic Group | Yes (identical groups) |
| 12 | Long-term illness | Yes (identical) |
| 13 | Employment status | Yes (slightly different categories) |
| 14 | Hours worked per week | Under & over 10 & 30 hours only |
| 15 | Occupation | Yes |
| 16 | Industry | Yes |
| 17 | Address of place of work | No |
| 18 | Daily journey to work | No |
| 19 | Qualifications | No |
| H3 | Tenure | Yes (same categories) |
| H4 | Amenities | No |
| H5 | Cars and vans | Yes |

TABLE 3

OMNIBUS SURVEY RESPONSES
COMPARED WITH THE GENERAL HOUSEHOLD SURVEY 1990+
GREAT BRITAIN

| Variables | GHS 1990 | Omnibus Survey |
|---|---|---|
| | % | % |
| *Health* | | |
| - Limiting long-standing illness | 24.4 | 20.3 |
| - Acute sickness | 14.2 | 13.9 |
| - Subjective health assessment | | |
| Good | 60.0 | 62.4 |
| Fairly good | 28.0 | 28.0 |
| Not good | 12.0 | 9.5 |
| *Utilisation* | | |
| - GP consultation | 15.8 | 19.2 |
| - Out-patient | 14.5 | 16.4 |
| - In-patient | 10.8 | 14.1 |

+ all persons aged 16+

TABLE 4

## HEALTH SERVICE INDICATORS

*Hospital*

Acute beds per 1,000 resident population
Wte medical and dental staff per 1,000 resident population
Wte nurse and midwives per 1,000 resident population
Wte consultants per 1,000 resident population

*Primary Care*

GMPs per 10,000 resident population
Per cent of GPs with list size < 1,000
Per cent of GPs with list size > 2,500
Per cent of GPs in single handed practices
Per cent of GPs over the age of 65
Per cent of practices without a practice nurse
Per cent of practices which fall below the minimum standard

TABLE 5

## GHS STANDARD REGIONS

| | |
|---|---|
| North | |
| | metropolitan |
| | non-metropolitan |
| Yorkshire and Humberside | |
| | metropolitan |
| | non-metropolitan |
| North West | |
| | metropolitan |
| | non-metropolitan |
| East Midlands | |
| West Midlands | |
| | metropolitan |
| | non-metropolitan |
| East Anglia | |
| London | |
| | inner |
| | outer |
| South East | |
| South West | |

TABLE 6

HOSPITAL RESOURCE DATA, 1990/91

| Indicator | Regional Health Authority | | | GHS Standard Regions | | |
|---|---|---|---|---|---|---|
| | mean | standard deviation | coefficient of variation | mean | standard deviation | coefficient of variation |
| Acute beds 1,000 population | 2.39 | 0.31 | 13.0 | 2.56 | 0.54 | 21.1 |
| Wte medical & dental staff per 1,000 population | 0.66 | 0.18 | 27.3 | 0.70 | 0.41 | 58.6 |
| Wte nurse & midwives per 1,000 population | 8.50 | 0.60 | 7.1 | 8.87 | 1.47 | 16.6 |
| Wte consultants per 1,000 population | 0.12 | 0.06 | 50.0 | 0.13 | 0.08 | 61.5 |

TABLE 7

PRIMARY CARE DATA, 1990/91

| Indicator | Regional Health Authority | | | GHS Standard Regions | | |
|---|---|---|---|---|---|---|
| | mean | standard deviation | coefficient of variation | mean | standard deviation | coefficient of variation |
| GMPs per 10,000 population | 5.37 | 0.25 | 4.7 | 5.36 | 0.25 | 4.7 |
| Percent GPs with lists <1,000 | 0.89 | 0.44 | 49.4 | 0.93 | 0.54 | 58.1 |
| Percent GPs with lists >2,500 | 3.57 | 2.06 | 57.7 | 4.11 | 3.04 | 74.0 |
| Percent GPs single handed | 4.22 | 2.59 | 61.4 | 4.73 | 3.67 | 77.6 |
| Percent GPs over 65 | 1.00 | 0.58 | 58.0 | 1.11 | 1.00 | 90.1 |
| Percent practices out nurse | 12.23 | 6.07 | 49.6 | 13.32 | 9.66 | 72.5 |
| Percent practice premises below minimum standard | 4.22 | 4.51 | 106.9 | 4.85 | 7.49 | 154.4 |

**TABLE 8**

## VARIABLES TESTED IN UTILISATION MODELS

***Demography***

Men under 30

Men 30-44

Men 45-64

Men 65-74

Men 75+

Women under 30

Women 30-44

Women 45-59

Women 60-74

Women 75+

Women with children under 4

Non-white

Afro-Caribbean

Asian

"Other" ethnic group

***Morbidity***

Limiting long-standing illness

Permanently unable to work due to illness

***Social-economic factors***

Unemployed

Looks after home

Still at school

Part-time employment

Full-time employment

Self-employed

Owner occupier

Rents from local authority/housing association

Does not own a car or van

Has more than 1 car

Single parent

Lives alone

Married

Pensioner living alone

Social class I and II

Social class IV and V

***Area/Service Availability Factors***

Metropolitan areas

Non-London metropolitan areas

Inner London

Outer London

Beds per 1,000 resident population

Wte medical and dental staff per 1,000 resident population

Wte nurses and midwives per 1,000 resident population

Wte consultants per 1,000 resident population

Percentage of GPs with lists <1,000

Percentage of GPs with lists >2,500

Percentage of GPs over 65

Percentage of GPs single-handed

Percentage of practices without a nurse

Percentage of practices below minimum standards

GPs per 1,000 resident population

TABLE 9

CHANGE IN SCALED DEVIANCE, ALL ADULT MODELS

| Groups of Independent Variables * | Utilisation Models | | |
|---|---|---|---|
| | In-Patient | Out-Patient | GP Consultations |
| | $\chi^2$ (a) | $\chi^2$(a) | $\chi^2$ (a) |
| Demographic characteristics | 100 (6) | 92 (5) | 124 (9) |
| Women with children under 4 | 35 (1) | 6 (1) | 30 (1) |
| Morbidity | 386 (2) | 507 (2) | 357 (2) |
| Socio-economic circumstances | 122 (7) | 101 (5) | 112 (7) |
| Service availability | 21 (2) | 17 (1) | 18 (2) |

* See Table 8 for definition of variables included in each group.

(a) Number of significant variables at 95 per cent included in each group's model.

TABLE 10

IN-PATIENT MODEL - ALL ADULTS

| VARIABLE | COEFFICIENT | WALD | SIGNIFICANCE LEVEL | ODDS RATIO |
|---|---|---|---|---|
| Constant | -2.11 | 668.2 | *** | - |
| Limiting long-standing illness | 1.04 | 266.6 | *** | 2.83 |
| Men aged 30-44 | -0.31 | 9.8 | *** | 0.73 |
| Men aged 75+ | 0.27 | 3.7 | * | 1.30 |
| Women with children under 4 | 0.69 | 55.6 | *** | 1.98 |
| Women aged 60-74 | 0.16 | 3.4 | * | 1.17 |
| Permanently unable to work due to illness | 0.37 | 7.8 | *** | 1.45 |
| No car or van | 0.14 | 4.7 | ** | 1.15 |
| Self-employed | -0.21 | 4.8 | ** | 0.81 |
| Part-time employment | -0.14 | 2.8 | * | 0.87 |
| Metropolitan area | 0.29 | 9.8 | *** | 1.34 |
| Proportion of GPs who are single-handed | -0.02 | 3.3 | * | 0.99 |

$\chi^2$ = 487 with 11 degrees of freedom

N = 12,115

*** Significant at 99 per cent level
** Significant at 95 per cent level
* Significant at 90 per cent level

TABLE 11

IN-PATIENT MODEL - ADULTS UNDER PENSIONABLE AGE

| VARIABLE | COEFFICIENT | WALD | SIGNIFICANCE LEVEL | ODDS RATIO |
|---|---|---|---|---|
| Constant | -2.20 | 2544.5 | *** | - |
| Limiting long-standing illness | 1.15 | 182.0 | *** | 3.17 |
| Women with children under 4 | 0.70 | 56.9 | *** | 2.01 |
| Man aged 30-44 | -0.27 | 7.2 | *** | 0.76 |
| Self-employed | -0.33 | 8.6 | *** | 0.72 |
| Permanently unable to work due to illness | 0.40 | 7.0 | *** | 1.49 |

$\chi^2$ = 316 with 5 degrees of freedom

N = 8,632

*** Significant at 99 per cent level

TABLE 12

IN-PATIENT MODEL - ADULTS OVER PENSIONABLE AGE

| VARIABLE | COEFFICIENT | WALD | SIGNIFICANCE LEVEL | ODDS RATIO |
|---|---|---|---|---|
| Constant | -2.13 | 550.1 | *** | - |
| Limiting long-standing illness | 0.85 | 74.0 | *** | 2.34 |
| No car or van | 0.17 | 3.0 | * | 1.19 |
| Metropolitan areas | 0.41 | 17.2 | *** | 1.51 |

$\chi^2 = 106$ with 3 degrees of freedom

N = 3,643

*** Significant at 99 per cent level
* Significant at 90 per cent level

TABLE 13

## OUT-PATIENT MODEL - ALL ADULTS

| VARIABLE | COEFFICIENT | WALD | SIGNIFICANCE LEVEL | ODDS RATIO |
|---|---|---|---|---|
| Constant | -1.98 | 1630.9 | *** | - |
| Limiting long-standing illness | 1.11 | 375.8 | *** | 3.02 |
| Permanently unable to work due to illness | 0.52 | 16.3 | *** | 1.68 |
| Men aged 30-44 | -0.34 | 15.1 | *** | 0.71 |
| Men aged 45-64 | -0.22 | 8.1 | *** | 0.80 |
| Men aged 75+ | 0.27 | 4.5 | ** | 1.31 |
| Other inactive | -0.25 | 9.8 | *** | 0.78 |
| Married | 0.08 | 2.9 | * | 1.08 |
| Metropolitan areas | 0.19 | 14.3 | *** | 1.21 |

$\chi^2$ = 546 with 8 degrees of freedom

N = 12,466

*** Significant at 99 per cent level
** Significant at 95 per cent level
* Significant at 90 per cent level

TABLE 14

OUT-PATIENT MODEL - ADULTS UNDER PENSIONABLE AGE

| VARIABLE | COEFFICIENT | WALD | SIGNIFICANCE LEVEL | ODDS RATIO |
|---|---|---|---|---|
| Constant | 3.28 | 13.8 | *** | - |
| Limiting long-standing illness | 1.25 | 238.7 | *** | 3.49 |
| Permanently unable to work due to illness | 0.47 | 10.5 | *** | 1.60 |
| Men aged 30-44 | -0.32 | 12.4 | *** | 0.73 |
| Men aged 45-64 | -0.22 | 7.4 | *** | 0.80 |
| Other inactive | -0.29 | 9.1 | *** | 0.75 |
| Metropolitan areas | 0.35 | 10.6 | *** | 1.42 |
| Proportion of GPs over 65 | -0.06 | 5.4 | ** | 0.94 |
| Proportion of practices with list sizes <1,000 | -0.05 | 3.1 | * | 0.95 |
| GP per 1,000 resident population | 0.29 | 2.7 | * | 1.33 |

$\chi^2$ = 367 with 9 degrees of freedom

N = 8,842

*** Significant at 99 per cent level
** Significant at 95 per cent level
* Significant at 90 per cent level

TABLE 15

OUT-PATIENT MODEL - ADULTS OVER PENSIONABLE AGE

| VARIABLE | COEFFICIENT | WALD | SIGNIFICANCE LEVEL | ODDS RATIO |
|---|---|---|---|---|
| Constant | -2.69 | 110.2 | *** | - |
| Limiting long-standing illness | 0.85 | 85.7 | *** | 2.34 |
| Men aged over 75 | 0.30 | 5.4 | ** | 1.35 |
| Beds per 1,000 resident population | 0.41 | 15.4 | *** | 1.50 |

$\chi^2$ = 114 with 3 degrees of freedom

N = 3,645

*** Significant at 99 per cent level
** Significant at 95 per cent level

TABLE 16

GP CONSULTATION MODEL - ALL ADULTS

| VARIABLE | COEFFICIENT | WALD | SIGNIFICANCE LEVEL | ODDS RATIO |
|---|---|---|---|---|
| Constant | 2.02 | 486.2 | *** | - |
| Limiting long-standing illness | 0.87 | 200.6 | *** | 2.39 |
| Permanently unable to work due to illness | 0.58 | 16.3 | *** | 1.70 |
| Women aged under 29 | 0.63 | 58.6 | *** | 1.88 |
| Women aged 30-44 | 0.35 | 19.0 | *** | 1.42 |
| Women aged 45-59 | 0.43 | 28.0 | *** | 1.53 |
| Adults aged 60-74 | 0.22 | 6.1 | ** | 1.24 |
| Adults aged 75+ | 0.27 | 7.4 | *** | 1.31 |
| Women with children under 4 | 0.27 | 8.2 | *** | 1.31 |
| Asian | 0.39 | 7.1 | *** | 1.48 |
| Owner occupier | -0.14 | 6.7 | *** | 0.87 |
| Married | 0.16 | 12.3 | *** | 1.18 |
| Full-time employment | -0.12 | 3.2 | * | 0.89 |
| Part-time employment | -0.29 | 11.9 | *** | 0.75 |
| Percentage of GPs with lists >2,500 | 0.01 | 8.7 | *** | 1.01 |

$\chi^2 = 508$ with 14 degrees of freedom

N = 12,349

*** Significant at 99 per cent level
** Significant at 95 per cent level
* Significant at 90 per cent level

TABLE 17

## GP CONSULTATION MODEL - ADULTS UNDER PENSIONABLE AGE

| VARIABLE | COEFFICIENT | WALD | SIGNIFICANCE LEVEL | ODDS RATIO |
|---|---|---|---|---|
| Constant | 0.07 | 0.01 | - | - |
| Limiting long-standing illness | 0.85 | 110.3 | *** | 2.33 |
| Permanently unable to work due to illness | 0.68 | 22.3 | *** | 1.98 |
| Women aged under 29 | 0.69 | 64.4 | *** | 1.99 |
| Women aged 30-44 | 0.37 | 20.0 | *** | 1.45 |
| Women aged 45-59 | 0.43 | 27.8 | *** | 1.54 |
| Women with children under 4 | 0.26 | 7.5 | *** | 1.30 |
| Asian | 0.47 | 9.3 | *** | 1.60 |
| Owner occupier | -0.23 | 12.3 | *** | 0.80 |
| Single parent | 0.27 | 4.2 | ** | 1.31 |
| Married | 0.27 | 18.6 | *** | 1.32 |
| Part-time employment | -0.22 | 7.3 | *** | 0.80 |
| GPs per 1,000 resident population | -0.39 | 13.2 | *** | 0.69 |

$\chi^2 = 393$ with 13 degrees of freedom

N = 8,749

*** Significant at 99 per cent level
** Significant at 95 per cent level

TABLE 18

GP CONSULTATION MODEL - ADULTS OVER PENSIONABLE AGE

| VARIABLE | COEFFICIENT | WALD | SIGNIFICANCE LEVEL | ODDS RATIO |
|---|---|---|---|---|
| Constant | -1.74 | 466.0 | *** | - |
| Limiting long-standing illness | 0.95 | 106.8 | *** | 2.59 |
| Lives alone | -0.21 | 4.5 | ** | 0.81 |
| Metropolitan areas | 0.24 | 6.6 | ** | 1.27 |

$\chi^2$ = 120 with 3 degrees of freedom

N = 3,646

*** Significant at 99 per cent level
** Significant at 95 per cent level

# Appendix 1

TABLE A 1.1

AVAILABILITY OF OMNIBUS SURVEY VARIABLES IN CENSUS TABULATIONS

| VARIABLE | ALL ADULTS AGED 16+ | ADULTS 16-PENSIONABLE AGE | ADULTS OF PENSIONABLE AGE |
|---|---|---|---|
| Men under 30 | Yes | Yes | - |
| Men 30-44 | Yes | Yes | - |
| Men 45-64 | Yes | Yes | - |
| Men 65-74 | Yes | - | Yes |
| Men 75+ | Yes | - | Yes |
| Women under 30 | Yes | Yes | - |
| Women 30-44 | Yes | Yes | - |
| Women 45-49 | Yes | Yes | - |
| Women 60-74 | Yes | - | Yes |
| Women 75+ | Yes | - | Yes |
| Women with children under 4 years | Problem | Problem | - |
| Non-white | Yes | Yes | Yes |
| Afro-caribbean | Yes | Yes | Yes |
| Asian | Yes | Yes | Yes |
| Other Ethnic Group | Yes | Yes | Yes |
| Long-term illness | Yes | Yes | Yes |
| Permanently unable to work due to illness | Yes | Yes | Yes |
| Unemployed | Yes | Yes | - |
| Looks after home | Problem | Problem | Problem |
| Still at school | Yes | Yes | - |
| Part-time employment | Problem | Problem | Problem |

TABLE A 1.1 (CONT'D)

| VARIABLE | ALL ADULTS AGED 16+ | ADULTS 16-PENSIONABLE AGE | ADULTS OF PENSIONABLE AGE |
|---|---|---|---|
| Full-time employment | Problem | Problem | Problem |
| Self-employment | Yes | Yes | Yes |
| Owner occupier | Yes | Yes | Yes |
| Rents from local authority/housing association | Yes | Yes | Yes |
| Does not own a car or van | Yes | Yes | Yes |
| Has more than one car | Yes | No | No |
| Single parent | Yes | Problem | - |
| Lives alone | Yes | Yes | Yes |
| Married or cohabiting | Problem | Problem | Problem |
| Pensioner living alone | Yes | - | Yes |
| Social class I & II | Problem | Yes | Problem |
| Social class IV & V | Problem | Yes | Problem |
| Moved in last year | Yes | Yes | Yes |
| Overcrowding | Yes | No | No |

NB: Variables which are identified as problems are explained in full in Table A 1.2.

TABLE A 1.2

## PROBLEMATIC VARIABLES

**Variable: Women with child under 4**

*Problem:* The Census table which highlights dependent children in different types of households identifies whether the adults are male or female except in two categories - two adults same sex and three or more adults same sex. These categories represent about 4 per cent of all households, and it is not possible to identify whether any or all of these adults are women.

*Solution:* Assume such households do contain at least one woman and include them in the count of women with child under 4.

**Variable: Looks after home**

*Problem:* Although the Census questionnaire separately identifies 'people who look after the home', the Census tabulations merge this category with 'other - including people of independent means'.

*Solution:* The Omnibus Survey also has an 'other' category which is very small, representing only about 1 per cent of the Omnibus sample. We should, therefore, model on the merged category in the Omnibus Survey making the two variables identical.

**Variable: Full and Part-time employment**

*Problem:* The Census employment information explicitly excluded both the self-employed and individuals on government employment or training schemes. The Omnibus Survey, however, included both of these groups of individuals in the part-time and full-time work categories of its employment classification.

*Solution:* For the self-employed we can use the answers to other questions in the Omnibus Survey to exclude them from the full-time and part-time employment variables. However, there is no way of excluding individuals on government schemes. The Omnibus and Census data will, therefore, have to be incompatible on these variables.

**Variable: Single Parent**

*Problem:* For the Adult 16 to Pensionable Age population group, the available Census data on single parents splits for women at 64 and not at 59.

*Solution:* We should use these data, as the number of cases of women aged 59-64 who have dependent children will be minimal.

**Variable: Married/Cohabiting**

Problem: The Census does not identify cohabiting couples. There are two different Census tables which cover this subject. The first is the marital status table but this identifies people who are legally married only, cohabitors are categorised by their previous legal marital status i.e. single/divorced etc. The second relevant table identifies individuals who are living in 'couple households' whether married or not. However, this table excludes any married or cohabiting couples who live with other adults, e.g. grown-up children or 'granny'.

*Solution:* We can use legally married as the explanatory variable in the modelling of Omnibus Survey Data.

**Variable: Social Class**

*Problem:* The Census questionnaire only asks individuals who are not currently working for their occupation if they have worked in the last ten years. This means that anyone who has been retired, or a housewife etc., for at least ten years will not have recorded an occupation. The Census tabulation sets out the social class of the economically active and then has two separate counts for the economically inactive - retired and 'other' - without

TABLE A 1.2 (CONT'D)

any occupational information. However, any retired or inactive person who has provided occupational information, e.g. they have only been retired for five years, may have been included in the economically active social class distribution. The Omnibus Survey, on the other hand, asks for occupational data from all respondents and this is included in the social class measure.

***Solution:*** The Census economically active social class table does separately identify individuals of pensionable age. We will, therefore, be able to include social class in the utilisation models for respondents under pensionable age. However, given the inconsistent treatment of pensioners, we will not be able to use social class in the 'all adult' models or the models for adults over pensionable age.

# APPENDIX 2

TABLE A 2.1

OUT-PATIENT MODEL, ADULTS OVER PENSIONABLE AGE

| VARIABLE | COEFFICIENT | WALD | SIGNIFICANCE LEVEL | ODDS RATIO |
|---|---|---|---|---|
| Constant | -1.85 | 548.4 | *** | - |
| Limiting long-standing illness | 0.86 | 86.8 | *** | 2.35 |
| Men aged >75 | 0.29 | 5.2 | ** | 1.34 |
| Metropolitan area | 0.33 | 12.1 | *** | 1.38 |

$\chi^2$ = 111 with 3 degrees of freedom

N = 3,645

*** Significant at 99 per cent level
** Significant at 95 per cent level

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