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Equity in health care use among older people in the United Kingdom: an analysis of panel data

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Abstract

This paper uses panel data to investigate the extent of income-related inequity in the likelihood of visiting a GP, specialist, dentist and hospital among individuals aged 65 and over in the United Kingdom. The probability of accessing health care is predicted with separate random effects probit panel models using data from the British Household Panel Survey for the period 1998-2006. We use well-established methods based on the concept of the concentration curve to compare the cumulative distribution of health care utilisation with the cumulative distribution of the population ranked by income. The results find evidence of inequity in specialist and dental care, but only slight inequity for GP care and not significant inequity in hospital admissions. Levels of inequity are highest for specialist and dental care, even when users of the private sector are excluded from analyses. The mobility index is also used to compare short- and lung-run estimates of inequities and show that upwardly income mobile individuals contribute to inequity in the long run.

I. INTRODUCTION

Health systems with universal health care coverage aspire to align the distribution of health services according to need. Policy documents in the United Kingdom (UK) consistently endorse such equity goals in health care (Department of Health, 2000, 2002, 2006a; Oliver, 2005). This paper draws on panel data from the UK to measure equity in the use of health care services in the older population during the period 1998-2006, a period that has been characterized by increased policy interest in equity goals in the NHS alongside a significant increase in spending on health care.

International comparisons of equity in utilisation of health services in the general population reveal that the UK is relatively equitable (van Doorslaer, Masseria, & the OECD Health Equity Research Group Members, 2004). However recent reviews of the literature and empirical studies find little or no evidence of inequity in general practitioner (GP) and inpatient service use, whereas low income individuals appear to make less use of secondary and dental care than would be predicted based on need (Dixon, Le Grand, Henderson, Murray, & Poteliakhoff, 2007; Goddard & Smith, 2001; Morris, Sutton, & Gravelle, 2005). Contradictory results have been obtained: one study that used 2001 British Household Panel Survey (BHPS) did not find significant inequity in GP or specialist visit probability (van Doorslaer, Koolman, & Jones, 2004), while another study based on the 1996 European Community Household Panel (ECHP) found a modest but significant pro-rich inequity in the probability of contacting both a GP and specialist (van Doorslaer, Masseria, & the OECD Health Equity Research Group Members, 2004). Inpatient care has generally shown to be equitable (Masseria, Koolman, & van Doorslaer, 2008), although as noted by Dixon *et al* (2007), by measuring inpatient care at an aggregated level, inequity in the treatment of specific diseases and in elective procedures may be masked (Dixon, Shaw, Ebrahim, & Dieppe, 2004; Morris, Whincup, Papacosta, Walker, & Thomson, 2005; Neal & Allgar, 2005). Though inconclusive, the international

population-level studies point to a fairly equitable distribution of health service use by income in the general population relative to other industrialized countries, although service-specific studies reveal inequity in certain preventive and specialized services.

In the context of a universal health system that provides the majority of services free at the point of delivery, inequitable utilisation could be due to individuals' knowledge of available services and their need for services, characteristics of the doctor-patient relationship, and the existence of barriers to access that disproportionately affect the lower socioeconomic groups (Dixon, Le Grand, Henderson et al., 2007). In other words, higher socioeconomic groups have a louder 'voice' allowing them better to navigate the health system than those with less socioeconomic advantage; they may be better able to acknowledge their needs, identify the services available, and make demands on their GPs such as for specialist referrals (Dixon, Le Grand, Henderson et al., 2007). The presence of a parallel private sector may also give rise to inequitable utilisation whereby individuals with private insurance coverage, who are drawn from the higher socioeconomic groups (King & Mossialos, 2005), are afforded easier access in particular in the form of lower waiting times for specialty and surgical interventions. Analyses of the 2001 Commonwealth Fund International Health Policy Survey found that those with private coverage had significantly reduced odds of reporting to wait 6 months or more for elective surgery (Schoen & Doty, 2004).

To date there has been relatively scant attention paid to investigating equity among the older population; the highest consumers of health services who face potentially greater difficulties in accessing care. Of the total number of inpatient procedures and interventions that were delivered in the year 2006-2007 in public (National Health Service; NHS) hospitals, 44% were for individuals aged 60 and over (who made up 21% of the population in mid-2006) (Office for National Statistics, 2008; The NHS Information Centre, 2008). Moreover, in 2003-04 people aged 65 and over accounted for approximately 43% of total expenditure on hospital and community health services, a

group, however, that comprised around 16% of the population in that year (Department of Health, 2006b). Barriers to access in the general population are likely to be more pronounced among older people. Limitations in mobility, insufficient social support, and reduced access to health and health care information sources such as the internet probably increase with age. A recent review of the literature of inequalities in the use of services among older people in England found evidence of inequitable utilisation, in particular for specialized services, which the authors attributed to differences in individuals' knowledge of services, expectations of the benefits of treatments, likelihood of delaying seeking treatment, confidence interacting with health care professionals, and transportation-related barriers to access (Fernandez, McDaid, Kite, Schmidt, Park, & Knapp, 2008).

The present study contributes to the literature on inequity in older people in the UK by measuring income-related inequity after controlling for differences in need in the use of GP, outpatient, inpatient and dental check-ups with longitudinal data from the period 1998 to 2006. Panel analyses have the advantage of allowing us to control for unobserved time-invariant individual heterogeneity. A further advantage of panel data to model demand for health care is that it allows us to control for the past year's utilisation and to measure trends over time. By using the mobility index is also possible to analyse differences in inequity due to changes in income ranking over time. If access to health care is systematically associated with income over time, long-run income-related health inequality will differ from measurements made over a short time span. Inequity will tend to increase in the long run if higher health care users are upwardly income mobile or lower health care users are downwardly income mobile, and vice versa.

II. DATA AND VARIABLE DESCRIPTION

This study was conducted using data from the BHPS, a longitudinal cohort survey of adult members of a nationally representative sample of UK households[1]. Initial household selection was made using a two-stage clustered probability design and systematic sampling. The survey collects data from all adult members of the household. Those in the initial sample are followed until they refuse to participate, die, or are lost to follow-up; each year approximately 0.5% of the sample died. The present study included all individuals aged 65 or over in the period 1997 to 2006, as 1997 was the first year Northern Ireland was included. We include one-year lagged variables in the models, therefore the final sample covers the years 1998 to 2006, with observations in 1997 used to create the lagged variables for 1998. Proxy respondents due to inability to respond themselves (about 4% of the sample) were excluded from the analysis, as well as observations with any missing information on the variables of interest (a further 2% of the sample). The resulting sample is an unbalanced panel of 4104 individuals yielding 19,538 observations.

The dependent variables of health care utilisation were measured by four separate questions asking the respondent whether he or she had visited a GP/family doctor, outpatient specialist, hospital as an inpatient, and dentist for a check-up in the past year. Utilisation of GP, specialist, inpatient and dental care are considered separately, and are measured as dichotomous (yes/no) variables to indicate the likelihood of a contact. Over the nine-year period, 85.6% of the sample had visited a GP at least once in the past year, 42.3% visited a specialist at least once in the past year, 16.5% had been treated in hospital as an inpatient in the past year, and 44.5% visited a dentist for a check-up at least once in the past year. GPs act as gatekeepers to specialist and hospital services in the UK (except

[1] The data and tabulations used in this publication were made available through the ESRC Data Archive. The ESRC Research Centre originally collected the data on Microsocial Change at the University of Essex (now incorporated within the Institute for Social and Economic Research). Neither the original collectors of the data nor the Archive bear any responsibility for the analyses or interpretations presented here.

in the case of emergencies); therefore, the extent of GP use in the past year is included as an independent variable in the models of GP, specialist and hospital services.

The survey further distinguishes between public (NHS) and private specialist, inpatient and dental services; public utilisation is measured by excluding individuals who reported that their service use was fully or partly private. A description of all variables in the models for the period 1998-2006 is presented in Table 1.

Insert Table 1 here

Measures of need are examined separately and approximated from several health and demographic indicators. Self-assessed health (SAH) derives from the combination of two questions: "Please think back over the last 12 months about how your health has been. Compared to people of your own age, would you say that your health has on the whole been: excellent, good, fair, poor, or very poor?" and "In general would you say your health is: excellent, very good, fair, or poor". Four categories were created following the methods of (Hernández-Quevedo, Jones, & Rice, 2005): excellent; very good or good; fair; and poor or very poor. One-year lagged self-assessed health in four categories was not found to significantly affect utilisation and therefore was not included in the final models. More specific need indicators were also included.

The BHPS includes different types of health problems, such as problems with sight, hearing, skin conditions/allergy, chest/breathing, heart/blood pressure, stomach or digestion, diabetes, anxiety or depression, alcohol or drugs, epilepsy, migraine, cancer, stroke, and other problems; these are included as dummy variables. Finally, age groups, gender, and whether the individual reports any limitations in daily activities due to health problems are included. An assumption that underlies this research is that individuals with health conditions and poorer self-assessed health have a greater need for health care, an assumption that is likely to hold in the majority of cases. However it is important to acknowledge the possibility that some health conditions may not need physician services

(Culyer & Wagstaff, 1993; Goddard & Smith 2001); instead, they may require allied health services or social services, for example, which may lead to an overestimate of inequity. Sensitivity analyses that included age and gender interaction terms did not affect the results and therefore were not included in the final estimations. Also, when we included health conditions as a dummy variable that takes a 1 if the individual reports any conditions and 0 if he or she reports no conditions the estimates of inequity remained unchanged, and in the final analyses we included the health conditions separately.

This comprehensive set of needs indicators is included in order to be consistent with the literature and to overcome the limitations and potential biases associated with crude self-assessed health (Lindeboom & van Doorslaer, 2004; O'Donnell & Propper, 1991; van Doorslaer & Gerdtham, 2003). Community-level health indicators such as mortality rates are not included as these have been shown to be unrelated to individual-level health care utilisation (Morris, Sutton, & Gravelle, 2005). In the case of dental check-ups, only age is considered to be 'need-related' in the absence of oral health indicators.

The standard set of indicators of socioeconomic status that have been shown to affect the use of health care services are included the models. One such measure is housing tenure (whether the household owns their home, rents privately, or rents socially). Particularly among individuals who are retired, home ownership represents an important indicator of socioeconomic status (Costa-Font, 2008; Crystal & Shea, 1990). Since studies have shown that different levels of knowledge of available services and communication skills with health professionals may drive socioeconomic inequalities, it is important to measure the effect of education on utilisation. Highest educational qualification is grouped into three categories: no qualifications, non-advanced qualifications, or advanced qualifications. Socio-demographic information on marital status (not married, widowed, or married) and smoking status (current smoker or not) is also included (Grundy & Sloggett, 2003).

We also consider whether the individual is covered by private medical insurance (PMI) (which can be either through self or spouse), which reduces the cost of private health services. Such coverage would be expected to increase utilisation overall, as shown with specialist services (Jones, Koolman, & van Doorslaer, 2007), but not necessarily the use of NHS services when these are considered separately.

Region of residence (in 19 regions) is included in order to control for regional differences in supply across the UK (Gravelle & Sutton, 2001; Hann & Gravelle, 2004; Moles, Frost, & Grundy, 2001; Propper, Damiani, Leckie, & Dixon, 2007). GP visits in the previous survey year is also included as an explanatory variable in the models (except dental care), since previous utilisation is predictive of current utilisation (Propper, 2000), and GPs serve as the gatekeepers to specialist and inpatient care. Lagged utilisation of specialist or dental services is not included to limit possible specification bias arising from a correlation between income and past use. Time dummies are included in the models in order to capture any changes in utilisation over time. [2]

Income, the variable used to rank the sample, is measured as net household income in the last year. Income is derived from disaggregated income sources including labour and non-labour income, transfer income, investment income, benefit income and pension income. It is equivalized for household composition using the OECD equivalization scale and is adjusted by an annual 'before housing costs' price index to express incomes in January 2008 prices (Levy & Jenkins, 2008). Labour income contributes only 6% to total household income, and the majority of the sample (85%) has no labour income. Income from benefits and pension makes up the large part of household income, on average contributing 65% and 24%, respectively. Income is unequally distributed across this older population, with a Gini index of income inequality of 0.28 (which is slightly less unequal than in the general population, 0.30). Income levels are relatively low. The median

[2] Ethnicity has been shown to impact utilisation (Morris et al., 2005), but such information was not included in this study due to the limited information on non-white ethnic groups: in the first wave of the survey, 93% declared white ethnicity, 4% did not respond, and the remainder chose one of six options.

annual equivalized income among the 65 years and older population group is £10,618, with income at the 10th percentile at £6200, and the 90th income percentile is £20,517.

Measures socioeconomic and health status are unlikely to be completely independent: higher education is associated with higher income, and both are associated with better health. However the literature is consistent in accepting the possible collinearity of independent variables for the sake of preventing bias from omitted variables (Gravelle, Morris, & Sutton, 2006). It is also possible that there is reverse causality between income and utilisation, whereby under-utilisation of services leads to worse health outcomes and, consequently, lower income. However there is considerable agreement in the literature on the direction of causality from income to health as opposed to from health to income. Those studies that have attempted to correct for potential endogeneity of income found either that the effect of income on health does not change, or it increases, when instrumental variable approaches are taken (Ettner, 1996; Lindhal, 2005; Lecluyse and Van Ourti, 2005) or that by using inheritance as an instrument for short-term changes in wealth, the effect of such changes in wealth on health becomes non-significant (Meer et al. 2003).

III. ANALYTIC STRATEGY

Equity can be understood as the extent to which health care utilisation is affected by factors unrelated to the need for health care, such as income and other socioeconomic indicators (Gravelle, Morris, & Sutton, 2006). In this study, we estimate income-related inequity in health care utilisation based on the concept of concentration curves, which compare the cumulative distribution of health care utilisation with the cumulative distribution of the population ranked by income (Kakwani, Wagstaff, & van Doorslaer, 1997; O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008; Wagstaff & van Doorslaer, 2000). First, we calculate the concentration index (CI) for unadjusted utilisation.

(1) $$CI_{unadj} = \frac{2\sigma_R^2}{y_m} y$$

where σ_R^2 is the variance of the income rank (R) in the population (calculated separately by survey year), y is the utilisation variable of interest, and y_m is the weighted mean of utilisation. Unadjusted CI equals zero if all individuals have an equal probability of seeking health care, regardless of income.

Second, utilisation is regressed on a set of needs and non-needs variables. Estimates of each health care use (GP, specialist, hospital or dental care) are obtained by using a random effects probit model where the dependent variable y_i equals 1 if the individual used health care or zero otherwise.

$$y = 1 \quad \text{if } y^* > 0$$
$$y = 0 \quad \text{otherwise}$$

where,

(2) $$y_{it}^* = X'_{it}\beta + Z'_{it}\delta + \alpha_i + \varepsilon_{it}$$

X and Z are the vectors of need and non-need variables, and the error term is represented by two components, α_i and ε_{it}. The former is the individual effect that is treated as random while the latter is the idiosyncratic disturbance.

Third, we hold the non-needs variables constant (at the sample means) to predict needs-adjusted utilisation for each individual, and then standardize utilisation to the sample mean. This standardization calculates the level of utilisation that is expected on the basis of the average utilisation in the sample for individuals with the same level of need. Needs-standardized utilisation then replaces actual utilisation in equation (1) to calculate the CI of needs-standardized inequality, which is interpreted as horizontal inequity (HI). HI would equal zero if after controlling for differences in need, the probability of health care use is independent of income. The estimate of HI is positive if

after standardizing for need higher income individuals are more likely to use health care than those with lower income, and negative if those with higher income are less likely to use health services than the lower income individuals. In all models the dependent variable is binary, therefore the minimum and maximum possible values of the CI range between μ-1 and 1-μ, where μ is the variable mean (O'Donnell, van Doorslaer, Wagstaff et al., 2008). The 'convenient regression' of CI and HI on the income rank is used to calculate the standard errors of the indices, and we use a between effects OLS. We also calculate HI separately for each of the nine years to compare it to the overall level of HI that is estimated with the above panel methods to observe any changes over time and to calculate a mobility index.

By using multiple waves of the BHPS (an unbalanced panel) it is possible to account for individual-specific unobservable effects in the error term (Wooldridge, 2002). The advantage of the random effects model over a fixed effects model is that it permits the inclusion of covariates with limited (or no) time-variation; such an approach is consistent with the literature (Propper, 2000; van Ourti, 2004). The random effect model provides efficient estimates of the coefficients and also gives information on the extent of variability in health care use due to individual effect, under the assumptions that both error terms are normally distributed and independent of the independent variables.

A longitudinal perspective enables us to assess whether inequalities have reduced or increased with time and to identify the role of changes in income rank on utilisation. By measuring inequalities in the short-term (using cross-sectional data) and long-term (aggregated over a series of periods), a mobility index (MI) can be created (Jones and López-Nicolás, 2004). This index is equal to one minus the ratio of the long-term inequity index and the weighted sum of all the short-term inequity indices. Weights (w_t) are equal to the ratio between the short-run and the long-run average utilisation of health care.

$$MI = 1 - \frac{HI^{LT}}{\sum w_t HI^{ST}} \quad \text{, where} \tag{3}$$

$$w_t = \frac{\bar{y}^t}{T\bar{y}^T} \quad . \tag{4}$$

If the long-term index is equal to the weighted sum of the short-term inequity indices, MI equals zero. In this situation income ranking remains constant over time. Whenever there is perfect mobility in both access to health care and income over time, then the long-run HI equals zero and therefore the MI equals 1. If MI is negative (positive) the long-term inequity is larger (smaller) than the short-term estimate of inequity. These differences between the short- and lung-run estimates of HI emerge if there is income mobility that is systematically associated with differences in the utilisation of health care. When downwardly (upwardly) income mobile individuals have a lower (higher) income rank in the long-run than in the short-run, this increases income-related inequality.

One methodological challenge associated with panel data is attrition, or the rate of drop-outs between years. Studies using BHPS data have demonstrated that there are systematic patterns of attrition by socioeconomic characteristics and health status, although they argue that this does not bias the panel data estimates (Contoyannis, Jones, & Rice, 2004; Jones, Koolman, & Rice, 2005).

IV. RESULTS

The results of the random effects probit models for the likelihood of accessing each health service during the period 1998 to 2006 are reported in Table 2. Indicators of health care need are the most significant determinants of health service use in all areas (except dental care where only age was considered needs-related). Older individuals are more likely to be admitted to hospital, and less likely to visit a dentist. The likelihood of contact in any

health service increases with most health conditions and with worse self-assessed health. Women are significantly more likely to visit a GP and dentist, and less likely to be admitted as an inpatient.

Among the non-needs factors, higher income individuals are more likely to visit a specialist and dentist, but there is no significant association with GP or inpatient care. Holding PMI is significantly associated with the likelihood of GP, specialist or dentist visit but not hospital admission. Home ownership and higher educational qualifications are significantly associated with outpatient and, to a greater extent, dental services. As expected, previous contact with health care, as measured by one-year lagged GP visits, increases the likelihood of current use. The time dummies reveal time trends in specialist care, with an increasing likelihood of a visit over the nine-year period, and an increase in the likelihood of a dental check-up only in the past three years.

Insert Table 2 here

The role of individual effects varies to some extent across the four utilisation categories, and explains between 20% (hospital inpatient) and 80% (dental check-up) of the variation in utilisation. This suggests that the importance of using a panel data approach is greatest for the model of dental care.

The estimates of inequity strengthen the results that we obtain with the probability models; Figure 1 shows the estimates of income-related inequity across the different sectors. The needs-adjusted indices of HI are positive and significantly different from zero for GP, specialist and dental care. Over the nine-year period there is little change in the estimates of inequity in GP and inpatient care, although there appears to be a slight decline in inequity in the likelihood of a specialist and dentist visit during this period (Table 3). The mobility index shows a clear role of income ranking on estimates of inequity. For all services but GP, the long run inequity index is higher than the average of the short-run indices. This implies that there are systematic differences in utilisation among individuals who are downwardly and upwardly income mobile. For specialist and hospital care, and

to a less extent also for dental care, upwardly income mobile individuals contribute to inequity; patterns of utilisation are not only pro-rich, but individuals with faster growing incomes have a greater likelihood of accessing these services.

Insert Table 3 here

To test whether the observed inequity by income is due to a greater likelihood of health care use in the private sector among higher income groups, we exclude individuals who reported to have accessed inpatient, specialist, or dental services from the private sector and re-estimate HI. Inequity in inpatient care remains insignificant but is closer to zero. However, significant inequity remains in specialist and dental care despite notable reductions in magnitude (Figure 1).

Consistent with previous international comparisons of equity in health service use that included the UK, we tested the effect of considering only age, gender, self-assessed health and activity limitations as needs indicators. The estimates of inequity were only modestly affected by excluding the health conditions from the models of utilisation. For specialist care the index of inequity increased slightly (to 0.59), which suggests that income may capture some of the effect of the omitted needs variables.

V. CONCLUSIONS

Using panel data methods to estimate equity in health care use among older people in the UK, this study finds evidence of inequity in specialist and dental care, but little or no inequity in GP and hospital inpatient care. Inequitable specialist and dental care is partly explained by the use of private services among higher income groups, but inequity among NHS service users remains significant. The panel analyses reveals that indicators of health care need are most significantly associated with utilisation, non-need indicators are also significant, consistent with previous studies of the general and older populations (Dixon, Le Grand, Henderson et al., 2007; Fernandez, McDaid, Kite et al., 2008; Morris, Sutton, & Gravelle, 2005). Moreover, by comparing short run indices with long-run

indices of inequity it appears that upwardly mobile individuals are more likely to access specialist and hospital care, and, to a less extent, dental care. These findings are consistent with analyses of other European countries (Bago d'Uva et al 2008).

Primary care is relatively equitable, as demonstrated by the index of inequity that is very close to zero, alongside no significant marginal effect of income on the probability of a visit. This is consistent with previous studies of the general population that have found a modest negative association between income and GP visits (Morris, Sutton, & Gravelle, 2005) and a zero index of inequity by income (van Doorslaer, Masseria, & the OECD Health Equity Research Group Members, 2004).

As with primary care, we do not find any evidence of inequity in the likelihood of an inpatient admission, consistent with previous studies of the general population (Masseria, Koolman, & van Doorslaer, 2008; van Doorslaer, Masseria, & the OECD Health Equity Research Group Members, 2004). When individuals who used only private inpatient care are excluded from the analysis (5% of those who reported at least one inpatient stay), the effect of PMI becomes negative, and needs-adjusted income-related inequity nears zero. This finding suggests that the existence of an extensive private sector may drive inequitable utilisation even if at present inequity is not significant. Disaggregating elective versus emergency care, and day versus inpatient care would be beneficial in future research, since specific studies, e.g. of hernia repair, point to an inequitable distribution (Seymour & Garthwaite, 1999). Although they estimated a similar index of inequity, Morris et al (2003) found a significant effect of income on the likelihood of admission to hospital, unlike in our analyses of older people.

The likelihood of visiting a specialist is more concentrated among the richer older people than the poor, even when we consider only the NHS users. This is consistent with the positive income effect on specialist use (and index of income-related inequity) that was found in the late 1990s among the general English population (Morris, Sutton, & Gravelle, 2003; Morris, Sutton, & Gravelle, 2005). The finding that those with higher

education are more likely to visit a specialist is also consistent with previous studies, such as among arthritis sufferers (Propper, Eachus, Chan, Pearson, & Davey Smith, 2005). This education effect also supports the theory that communication with providers and health literacy facilitates access to services. Also a survey of 1400 UK residents from 2001 found that individuals with below-average incomes were significantly more likely to answer yes to the question of whether it was extremely or very difficult to see a specialist when needed, an effect that remained even after adjusting for health, age, education, residence and immigrant/minority status (Schoen & Doty, 2004). There is no clear trend in inequity over the nine-year period, since estimates fluctuate quite largely across the years. However, it seems that overall a slight decline in specialist (and dental care) inequity took place over the time frame of the study, suggesting that the extensive health reforms of this period may have been effective in better aligning the distribution of specialist services with need among the older population.

The greatest inequity was found in dental check-ups, both among all users and only those who visited NHS dentists. Compared to the over-50 population in other European countries and the United States, the level of inequity in dental care that we find would place it second highest among 12 countries (second to the US) (Allin, Masseria, & Mossialos, 2009). The income effect on dental use shown here and in the general population (van Doorslaer, Masseria, & the OECD Health Equity Research Group Members, 2004) is unlikely to be an effect of being rich versus poor but an income gradient across the population since a previous study found that cost-related difficulties in accessing care were reported about equally across the above-and below-average income groups (Schoen & Doty, 2004). Hefty user fees in the NHS likely deter lower income individuals from seeking dental care. Despite many older individuals having special dental needs, such as treatment for tooth decay and gum disease, 82% of the over-60 age group receive no financial assistance for the significant co-payments for NHS services: 80% of treatment costs (Robinson, Patel, & Pennycate, 2004). Past years have seen an

increase in the proportion of older individuals retaining their original teeth (Batchelor, 2004); the proportion of over 65s who are edentulous has fallen from 79% in 1978 to 46% in 1998 (Office for National Statistics, 1998). Because education is also associated with dental check-ups, inequity may be driven by both cost and information barriers; the information hypothesis is consistent with a previous study of over-60s in England that found that higher education and social class, but not income, affected utilisation (McGrath, Bedi, & Dhawan, 1999). Another possible explanation for high levels of inequity in dental care is that private dentists may avoid treating particularly old, frail or unhealthy patients because the fee is perceived to be too low relative to costs of treating these patients (Holm-Pedersen, Vigild, Nitschke, & Berkey, 2005). Therefore a public subsidy, in particular for older people, may play some role in mitigating the financial barrier to dental care in light of the well established impact of insurance on demand for dental care and the negative price elasticity of demand (Sintonen & Linnosmaa, 2000).

In conclusion, we find that wealthier older people, and those with increasing income over time, are significantly more likely to see a doctor, have an outpatient visit and a dental check-up than those with lower income. The highest level of inequity was found in the sector that is the most privatized in terms of funding and delivery – dental care, which suggests that increasing private sector capacity or co-payments in other sectors would have the effect of increasing existing levels of inequity. By using panel data these analyses yield more robust findings than conventional cross-sectional approaches; further work could address the dynamic nature of income and health in the older ages and the impact of inequitable utilisation on inequalities in health.

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Table 1. Description of independent variables and descriptive statistics (1998-2006)

	Description	Mean	Std. dev
Need variables			
Age 70-74	*Reference category is age 65-69*	0.284	0.451
Age 75-79		0.242	0.429
Age 80-84		0.155	0.362
Age 85+		0.095	0.293
Female		0.574	0.494
Good SAH	*Reference category is "excellent"*	0.427	0.495
Fair SAH		0.303	0.460
Poor SAH		0.149	0.356
Limited in activities	*Includes moderate or severe limitations*	0.385	0.487
Health problems	*Reference category is no problems*		
limbs		0.570	0.495
sight		0.142	0.349
hearing		0.250	0.433
skin		0.100	0.300
chest		0.204	0.403
heart		0.471	0.499
stomach		0.130	0.336
diabetes		0.098	0.297
anxiety		0.082	0.274
alcohol		0.002	0.047
epilepsy		0.006	0.077
migraine		0.048	0.214
other problem		0.065	0.246
Non-need variables			
Ln Income	*Natural logarithm of yearly income (continuous variable)*	9.308	0.508
Marital status	*Reference category is married*		
Not married		0.131	0.338
Widowed		0.357	0.479
Lagged GP	*One year lagged number of GP visit (0-5)*	2.802	1.227
Smoker		0.139	0.346
Owns home	*Reference category is rents in social housing*	0.696	0.460
Rents privately		0.047	0.212
PMI coverage	*Coverage through an employer, previous employer or individual plan*	0.073	0.260
Educational qualifications	*Reference category is no qualifications*		
Non-advanced qualification	*Includes apprenticeships and secondary education*	0.258	0.438
Advanced qualifications	*Includes higher degree, first degree, teaching and 'other' qualifications*	0.181	0.385

Table 2. Random effects probit models: determinants of health service use

	GP		Specialist		Hospital		Dentist	
Indicators of health care need	ME	SE	ME	SE	ME	SE	ME	SE
Age 70-74	-0.009	0.040	-0.002	0.033	0.034	0.039	-0.289**	0.052
Age 75-79	0.016	0.045	0.002	0.039	0.121**	0.042	-0.574**	0.068
Age 80-84	0.031	0.054	0.004	0.046	0.213**	0.048	-0.931**	0.086
Age 85+	0.071	0.066	-0.012	0.057	0.342**	0.057	-1.253**	0.112
Female	0.081**	0.036	-0.036	0.034	-0.110**	0.033	0.320**	0.080
Self-assessed health								
good	0.279**	0.040	0.239**	0.042	0.193**	0.055		
fair	0.521**	0.051	0.610**	0.046	0.617**	0.058		
poor	0.649**	0.072	1.005**	0.055	1.204**	0.064		
Health limitations	-0.025	0.034	0.070**	0.024	0.104**	0.027		
Health problems								
limbs	0.136**	0.032	0.101**	0.027	-0.008	0.030		
sight	-0.011	0.048	0.258**	0.036	0.051	0.037		
hearing	0.056	0.038	0.084**	0.031	0.004	0.032		
skin	0.080	0.057	0.145**	0.041	-0.009	0.043		
chest	0.174**	0.046	0.127**	0.034	0.070**	0.034		
heart	0.398**	0.033	0.158**	0.026	0.094**	0.029		
stomach	0.184**	0.055	0.297**	0.037	0.178**	0.037		
diabetes	0.283**	0.067	0.310**	0.048	-0.008	0.047		
anxiety	0.113	0.069	-0.013	0.046	-0.075	0.047		
alcohol	-0.265	0.299	0.185	0.245	0.529**	0.231		
epilepsy	0.183	0.241	0.409**	0.181	0.351**	0.168		
migraine	0.129	0.083	-0.066	0.058	*-0.123*	0.063		
other problems	0.281**	0.070	0.246**	0.046	0.238**	0.048		
Socioeconomic, socio-demographic and lagged utilisation variables								
Income (logarithm)	-0.018	0.033	0.084**	0.028	0.048	0.030	0.278**	0.045
Marital status								
not married	-0.123	0.052	-0.058	0.048	0.034	0.048	-0.088	0.103
widow	-0.094**	0.040	*-0.070*	0.036	0.093**	0.036	-0.232**	0.073
Smoker	-0.180**	0.046	-0.235**	0.043	-0.160**	0.044	-0.675**	0.084
Housing tenure								
home owner	*0.075*	0.042	0.141	0.038	-0.034	0.037	0.615**	0.082
rents privately	0.130	0.081	0.094	0.070	-0.010	0.071	0.087	0.127
Private insurance	0.178**	0.064	0.142	0.056	0.069	0.060	0.470**	0.103
Educational qualifications								
non-advanced	0.067	0.041	0.185	0.038	0.081**	0.037	0.900**	0.092
advanced	0.151**	0.050	0.220	0.046	0.104**	0.046	1.548**	0.112
GP visits in past year	0.415**	0.016	0.165**	0.011	0.132**	0.012		
Time dummies								
1999	-0.056	0.066	0.108**	0.052	0.069	0.060	0.003	0.071
2000	0.025	0.062	0.122**	0.048	-0.055	0.056	-0.056	0.068
2001	-0.024	0.061	0.182**	0.049	-0.041	0.056	0.079	0.068
2002	-0.012	0.062	0.128**	0.050	-0.093	0.057	0.091	0.070
2003	-0.020	0.063	0.214**	0.050	-0.070	0.057	0.035	0.072
2004	-0.026	0.065	0.158**	0.050	-0.033	0.057	0.188**	0.074
2005	0.005	0.063	0.139**	0.051	-0.059	0.058	0.281**	0.075
2006	0.002	0.064	0.244**	0.051	-0.081	0.058	0.249**	0.077
Constant	*-0.346*	*0.320*	*-2.518*	*0.271*	*-2.702*	*0.293*	*-3.091*	*0.444*
Rho	*0.196*		*0.313*		*0.202*		*0.799*	

Note**:** **indicates statistical significance at p<0.05; * at p<0.10. ME is marginal effect, SE is standard error. Also included are 19 regional dummies.

Table 3. Horizontal inequity (HI) in the likelihood of GP, outpatient, inpatient and dentist use, 1998-2006 cross-sections and panel estimates

	GP		Specialist		Hospital		Dentist	
	HI	95%CI	HI	95%CI	HI	95%CI	HI	95%CI
1998	0.007	*(-0.004, 0.019)*	0.071	*(0.035, 0.106)*	0.035	*(-0.022, 0.092)*	0.171	*(0.138, 0.203)*
1999	0.002	*(-0.010, 0.014)*	0.018	*(-0.017, 0.052)*	0.018	*(-0.043, 0.079)*	0.132	*(0.099, 0.166)*
2000	0.015	*(0.006, 0.024)*	0.067	*(0.040, 0.094)*	0.041	*(-0.008, 0.090)*	0.163	*(0.135, 0.191)*
2001	0.009	*(0.000, 0.018)*	0.043	*(0.018, 0.069)*	0.013	*(-0.037, 0.063)*	0.125	*(0.099, 0.152)*
2002	0.012	*(0.004, 0.021)*	0.056	*(0.027, 0.082)*	0.002	*(-0.049, 0.053)*	0.126	*(0.101-0.152)*
2003	0.015	*(0.007, 0.024)*	0.052	*(0.027, 0.076)*	0.032	*(-0.017, 0.082)*	0.131	*(0.106, 0.156)*
2004	0.006	*(-0.004, 0.015)*	0.025	*(-0.001, 0.051)*	0.026	*(-0.025, 0.077)*	0.122	*(0.099, 0.146)*
2005	0.010	*(0.001, 0.019)*	0.043	*(0.017, 0.069)*	-0.024	*(-0.076, 0.028)*	0.111	*(0.088, 0.134)*
2006	0.004	*(-0.005, 0.013)*	0.028	*(0.005, 0.051)*	0.022	*(-0.028, 0.072)*	0.095	*(0.072, 0.117)*
1998-2006	0.007	*(0.002, 0.013)*	0.055	*(0.040, 0.069)*	0.025	*(-0.003, 0.054)*	0.130	*(0.112, 0.148)*

Note: Morris et al calculated an index of income-related inequity of -0.022 for GP, 0.048 for specialist, and 0.012 for hospital inpatient (the index represents the sum total of non-need contributions to inequality by income) for the period 1998-2000 using the nationally representative Health Survey for England (Morris, Sutton, & Gravelle, 2003).

Figure 1. Indices of inequity in the likelihood of a GP, specialist, inpatient and dental contact, with 95% confidence intervals