Health care costs in the English NHS: reference tables for average annual NHS spend by age, sex and deprivation group

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Introduction

Economic evaluation of health technologies is routinely applied in the English NHS to assess whether new technologies represent a cost-effective use of health care resources. The current health technology assessment (HTA) process, as implemented by the National Institute for Health and Care Excellence (NICE), considers in its assessment all future health benefits following treatment, whether these benefits flow directly from the treatment of the condition targeted by the technology being assessed or are incidental to this treatment. NICE's most recent methodological guidance for HTA, however, indicates that only future health care costs pertaining directly to the condition targeted should be considered in the economic evaluation of the technology, rather than all future health care costs (NICE, 2013)

> *"Costs related to the condition of interest and incurred in additional years of life gained as a result of treatment should be included in the reference-case analysis. Costs that are considered to be unrelated to the condition or technology of interest should be excluded."*

This uncomfortable asymmetry in the evaluation process has been recognised by the academic health economics community, and recent literature suggests a consensus emerging among health economists that costs and health benefits be dealt with in a similar manner (Morton et al., 2016). Put simply, in order to be coherent, economic evaluation should consider either all future costs and all future health benefits or alternatively consider only disease-specific future costs and disease-specific future health benefits (van Baal et al., 2016). Deciding and demarcating what should and should not count as unrelated is rarely straightforward, hence of the two options it would seem that considering all future costs and all future health benefits is to be preferred.

It is well recognised that health care costs vary across the life-course, with greater health care use by the very young, women during their child-bearing years and all people towards the end of their lives (Kelly et al., 2016). There is also increasing evidence that health care use varies by deprivation, with people living in more deprived neighbourhoods making greater use of health care at any given age than those living in more affluent neighbourhoods (Asaria et al., 2016). Both of these are important factors to consider when estimating future health care costs for the purpose of economic evaluation.

This paper describes how average health care costs were calculated by age, sex and neighbourhood deprivation quintile group using the distribution of health care spending by the English NHS in the financial year 2011/12. The results presented here can be used by cost-effectiveness analysts to populate their extrapolation models when estimating future health care costs. The results will also be of interest to the broader community of health researchers as they illustrate how NHS spending is distributed across different subgroups within the population.

Methods

Data

Hospital admissions in England are recorded in the Hospital Episode Statistics (HES) dataset used to reimburse hospitals for the care they provided to patients admitted to hospital. This dataset contains details on every episode of care, and a new finished consultant episode (FCE) record is created for every new hospital admission and every time responsibility for the care of a patient passes from one consultant to another. The HES FCE records data about the patient (age, sex, and place of residence) and their hospital stay (diagnoses, procedures, length of stay). Using this information, the FCE is allocated to a healthcare resource group (HRG), which collates hospital stays that use similar levels of resources. Hospitals are reimbursed by the NHS through the payments by results (PbR) system based on the HRG, adjusted for the specifics of the case – e.g. more complicated cases with longer than usual lengths of stay attract additional reimbursement. The costs that are attached to each HRG for each year and the variations in payments for more complex cases are given in the NHS national reference costs (Department of Health, 2012). Details of how to derive costs from HES data are available in the PbR documentation (Department of Health, 2012), and their use in health economic analysis is discussed in Asaria et al. (2015). We used HES inpatient data for financial year 2011/12 and associated reference costs in this study.

Hospitals also provide a range of services to patients that do not require admission; these include visits to see specialists and various programmes of follow-up care. These are collected in the HES outpatient dataset. Outpatient visits are not currently part of the PbR system and so cannot be as easily micro-costed in the same way as inpatient admissions. For the purpose of this analysis, we therefore assume that there is no systematic variation in the costs of outpatient visits and hence use the total NHS spend on outpatient care and the count of the total number of outpatient visits to calculate an average cost per outpatient visit. The total cost of outpatient visits was calculated using the Department of Health's reported budget for hospital and community health services from which total inpatient admissions costs were subtracted (Department of Health, 2012).

The other key area of NHS spending is on primary care. We split primary care spending into two parts for the purpose of this analysis. The first part consists of visits to general practitioners, prescriptions and pharmaceutical services. The second consists of spending on dental and ophthalmology services. Detailed administrative data covering primary care are not currently collected in the same way that they are for secondary care. There are, however, various pieces of research looking at demographic patterns in visits to general practitioners, and we used research by Q Research (NHS Digital, 2011), together with our analysis of outpatient hospital data, to estimate the distribution of primary care use in the first part of the primary care budget. The second part of the primary care budget was assumed to be equally distributed across the population for the purposes of this analysis. Figures for total NHS spending on the various sub-categories of primary care were taken from the Department of Health's published accounts (Department of Health, 2012).

The basic geographical unit of analysis used in this study was the lower layer super output area (LSOA). The country is divided into 32,482 LSOAs based on the 2001 census, each containing on average 1,500 people (range 1,000 to 3,000). Population data for 2011/12 were taken from the ONS mid-year population estimates split by LSOA, sex and age (ages 0-84 in single year estimates and then 85+). Area deprivation for LSOAs is measured using the index of multiple deprivation (IMD) for 2010. We grouped LSOAs into deprivation quintiles based on their IMD overall rank, ranging from Q1 (the most deprived fifth of LSOAs) to Q5 (the least deprived fifth of LSOAs).

Analysis

HES inpatient data were grouped into age, sex and IMD quintile categories. The total cost for each age, sex and IMD quintile group was calculated by combining the HRG associated with each admission with the relevant reference cost. This aggregated cost was then divided by the ONS population estimate for each age, sex and IMD quintile group to calculate average inpatient costs for each group:

$$average\_inpatient\_cost_{age,sex,imd} = \frac{\sum inpatient\_costs_{age,sex,imd}}{\sum population_{age,sex,imd}}$$

HES outpatient data were grouped into age, sex and IMD quintile categories. The total number of outpatient visits for each age, sex and IMD quintile group were counted. These counts were multiplied by the average cost of an outpatient visit and divided by the ONS population estimate for each age, sex and IMD quintile group to calculate average outpatient costs for each group:

$$average\_outpatient\_cost_{age,sex,imd} = \frac{\sum outpatient\_visits_{age,sex,imd}}{\sum population_{age,sex,imd}} \times \frac{total\_outpatient\_budget}{\sum outpatient\_visits}$$

Total numbers of visits to general practitioners were calculated by combining utilisation rates by age and sex with ONS population data. The deprivation gradient from outpatient visits was applied to these totals to get the age, sex and IMD group breakdown of GP visits. These were then divided by the overall total number of GP visits to derive primary care weights which were applied to the budget for GP, prescription and pharmaceutical services to get total NHS spend on these categories by age, sex and deprivation group. This spend was then divided by the ONS population estimate for each age, sex and IMD quintile group to calculate average costs for each group:

$$average\_gp\_pharma\_cost_{age,sex,imd} = \frac{gp\_utilisation\_rate_{age,sex} \times population_{age,sex}}{\sum\sum gp\_utilisation\_rate_{age,sex} \times population_{age,sex}} \times \frac{\sum outpatient\_visits_{age,sex,imd}}{\sum outpatient\_visits_{age,sex}} \times \frac{total\_gp\_pharma\_budget}{\sum population_{age,sex,imd}}$$

The dental and ophthalmic services budget was assumed to be equally allocated to each subgroup and so just averaged across the total population:

$$average\_dental\_opthalmic\_cost = \frac{total\_dental\_opthalmic\_budget}{\sum population}$$

Finally total average NHS spend by age, sex and IMD quintile group was calculated as a sum of the averages of these subcategories of NHS spend:

$$average\_nhs\_cost_{age,sex,imd} = average\_inpatient\_cost_{age,sex,imd} + average\_outpatient\_cost_{age,sex,imd} + average\_gp\_pharma\_cost_{age,sex,imd} + average\_dental\_opthalmic\_cost$$

The analysis was performed using Oracle 11g, R 3.2.3 and MS Excel 2013 - the analysis code is available at https://github.com/miqdadasaria/hospital_costs

Results

The breakdown of average annual NHS spend by age and deprivation quintile group is illustrated for females and males in figures 1 and 2 respectively. Both figures display a clear deprivation gradient, with costs for people living in more deprived neighbourhoods being higher than for those living in more affluent neighbourhoods at any given age. It is also evident from the figures that costs rise steeply after the age of 60, and continue to rise with age beyond this point. Finally, figure 1 shows a spike in health care costs for women of child-bearing age, with this spike occurring at a younger age for those living in more deprived neighbourhoods. A full breakdown of these results in tabular format can be found on our website at www.pssru.ac.uk/projectpages/unit-costs/2017.

Figure 1: Average annual NHS spend by age and neighbourhood deprivation quintile group for females in England 2011/12

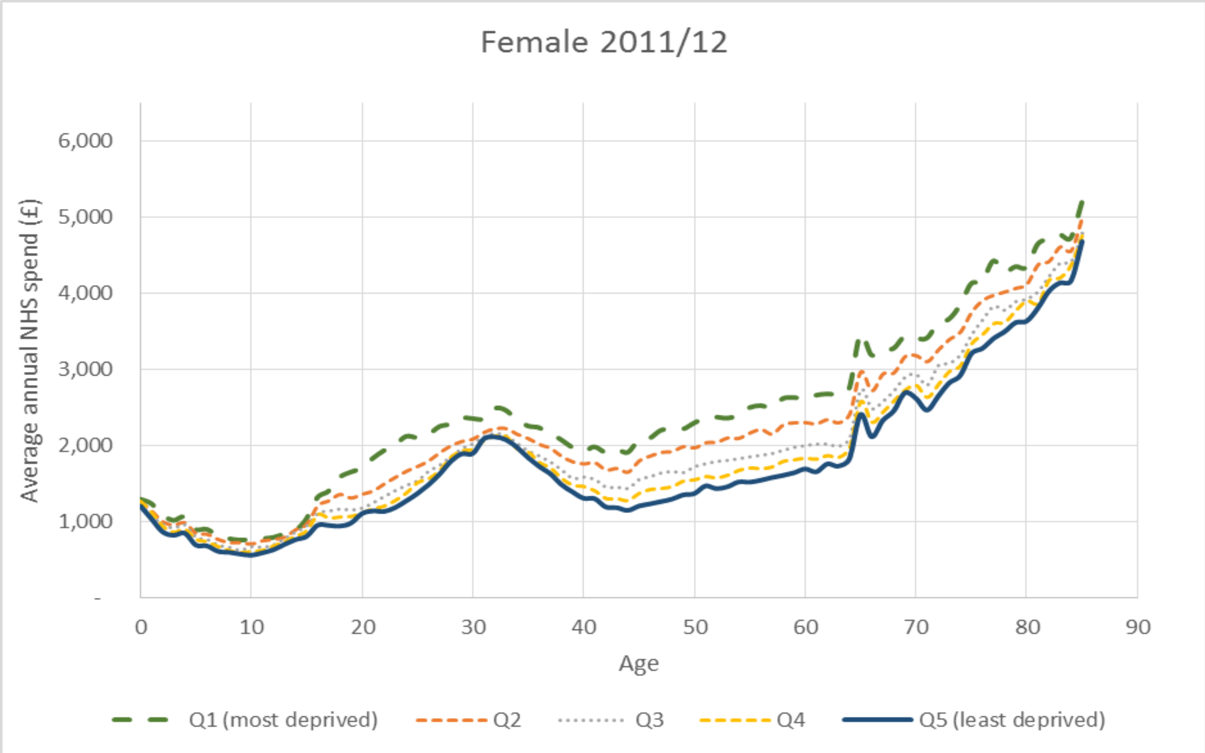
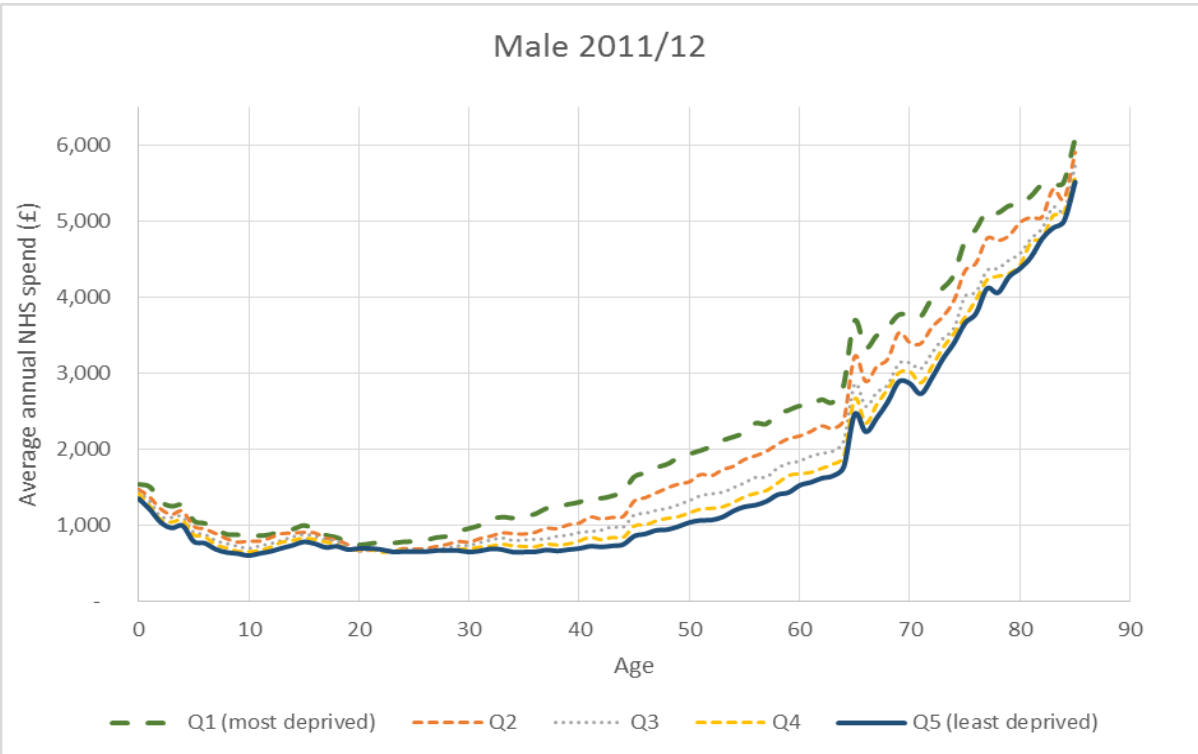


Figure 2: Average annual NHS spend by age and neighbourhood deprivation quintile group for males in England 2011/12



We also use these results to calculate the total cost borne by the NHS associated with inequality. This is calculated as the difference between observed costs and the costs if we assume those living in more deprived neighbourhoods had similar average costs to those living in the most affluent fifth of neighbourhoods. This total cost associated with inequality for year 2011/12 was £12.52 billion.

Discussion

The analysis presented here indicates that health care costs at any given age are higher for those living in more deprived neighbourhoods than those living in more affluent neighbourhoods. Research looking at the social distribution of health has found that quality of life is also lower at any given age for those living in more deprived neighbourhoods than for those living in more affluent neighbourhoods (Love-Koh et al., 2015). Taken together, these results when applied in health technology assessment mean than new technologies, even if equally effective across the deprivation gradient, will have less chance of being deemed cost-effective for those living in more deprived areas than for those living in more affluent areas when we take into consideration the variation in remaining lifetime health care cost and quality-adjusted health gain. Health care provision is not just about maximising aggregate health in the population but also has the reduction of health inequalities as one of its key objectives; this is reflected in the high levels of health inequality aversion demonstrated by members of the public in England (Robson et al., 2016). Standard cost-effectiveness analysis can be extended to account for these differential lifetime health care cost and quality of life trajectories as well as incorporating the notion of health inequality aversion by using novel methods such as distributional cost effectiveness analysis (DCEA) (Asaria et al., 2015, 2016).

There are a number of limitations that should be considered when using the results presented here in the context of cost-effectiveness analysis. The first is that these estimates are based on data for the financial year 2011/12. When using these results to extrapolate costs for other years, care must be taken to understand how best to adjust these costs to reflect how they will change over time. This is no different to other costs used in cost-effectiveness analysis, and similar approaches can be applied to deal with the extrapolation of these costs. The second is what is to be assumed about neighbourhood deprivation over time. For example, are people who currently live in the most deprived fifth of neighbourhoods likely to remain living in similarly deprived neighbourhoods throughout their lives? If deprivation specific costs are to be used, then a view needs to be taken on the degree of social mobility over time. Finally, the costs presented here are average costs; to reflect the uncertainty in these average costs - for example, for use in probabilistic sensitivity analysis of a cost-effectiveness model - some measure of their distribution would need to be calculated.

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