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Population Ageing and Health Care Expenditure

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Documents reviewed

- *Health, life expectancy, and health care spending among the elderly*. By J. Lubitz, L. Cai, E. Kramarow, and H. Lentzner (N.Engl.J.Med, 2003, vol. 349, no. 11, pp. 1048–1055).
- *Does the aging of the population really drive the demand for health care?* By U. E. Reinhardt (Health Aff.[Millwood.], 2003, vol. 22, no. 6, pp. 27–39).
- *Economic implications of increased longevity in the United States*. By D. P. Rice and N. Fineman (Annu.Rev.Public Health, 2004, vol. 25, pp. 457–473).
- *The impact of ageing on expenditures in the National Health Service*. By M. Seshamani and A. Gray (Age Ageing, 2002, vol. 31, no. 4, pp. 287–294).
- *Health care expenditures and ageing: An international comparison*. By M. Seshamani and A. Gray (Appl.Health Econ.Health Policy, 2003, vol. 2, no. 1, pp. 9–16).
- *Ageing and health-care expenditure: The red herring argument revisited*. By M. Seshamani and A. Gray (Health Econ., 2004, vol. 13, no. 4, pp. 303–314).
- *A longitudinal study of the effects of age and time to death on hospital costs*. By M. Seshamani and A.M. Gray (J.Health Econ., 2004, vol. 23, no. 2, pp. 217–235).
- *Securing Our Future Health: Taking a long term view*. By D.Wanless (London: HM Treasury, 2002).
- *Longevity and health care expenditures: The real reasons older people spend more*. By Z. Yang, E. C. Norton, and S. C. Stearns (J.Gerontol.B Psychol.Sci.Soc.Sci., 2003, vol. 58, no. 1, pp. S2–10).

Abstract

The OECD's most recent projections of the impact of population ageing on public expenditures suggest that health and long term care will account for about half of the increase in age-related social expenditures between 2000 and 2050. Projections of health care spending are subject, however, to more uncertainties than projections of pension expenditure. Making reliable forecasts of the impact of demographic change on national health expenditures is clearly important. This paper reviews the evolution of research in this area, examines evidence from recent work, and considers the implications of this work for health care policy and future research.

Background

The increasing number and proportion of people over the age of 65 in many countries of the world is paralleled by mounting concern over the impact of this trend on public expenditures. The OECD's most recent projections suggest that, in thirteen countries with available information, population aging will create a rise in age-related social expenditures from an average of under 19% of Gross Domestic product in 2000 to almost 26% of GDP by 2050, with old-age pension payments and expenditure on health care and long term care each responsible for approximately half of this increase (Dang, Antolin, & Oxley, 2001). And as that study noted, projections of health care spending are considerably more uncertain than for pension expenditure: whereas current pension legislation provides at least a framework for estimating future benefits, there are no such rules for estimating future demand for and supply of health care. In addition, it is not clear exactly which demographic features have the strongest effect on health care spending: candidates include the number of people over a certain age, the number with given levels of disability or ill-health, and the number in the final years of their lives.

Partly in consequence of this uncertainty, methods of projecting the impact of demographic change onto health care spending vary substantially. Most projections have traditionally calculated the actual health care expenditure per capita in different age (or age and sex) groups, and then multiplied through by the projected number of people in each age group. However, a number of recent contributions have questioned this approach, suggesting that health care expenditure is driven more by the proximity of an individual to death than by their age per se.

Making reliable forecasts of the impact of demographic change on national health expenditures is clearly vitally important. So here I review the evolution of research in this area, then examine evidence from recent work, and conclude by considering the implications of this research for health care policy and for future research.

Ageing populations and health expenditure: the evolution of research

One of the earliest serious attempts to calculate the impact of demographic change on health care was made by Abel-Smith and Titmuss in 1956 as part (Appendix I) of their study of NHS costs undertaken on behalf of the Guillebaud

Committee (Abel-Smith & Titmuss, 1956). Their method was similar to that later adopted by many other analysts: they assumed (while emphasising the unreality of the assumption) that

> …certain estimated population changes are the only changes which will affect the current cost of the National Health Service. Everything else remains unchanged: the incidence and character of sickness and injury; standards of diagnosis; quantity and quality of treatment; the provision of resources in goods and services; the present level of unsatisfied demand; and the present proportionate distribution of consumer use of the service by age, sex and many other factors. (p. 154)

They took the Registrar-General's main population projections for the period from 1951/2 to 1971/2, combined this with data from the 1951 Census on the proportions of the population in hospital by age and sex, and estimated that the hospital population might increase by 11.2% in the years to 1971. After adjusting for differences in type and cost of hospital, this equated to an increase in total hospital in-patient costs of 10.6% between 1951/2 and 1971/2. Less than half of this was accounted for by population ageing, with the major component attributable to a projected increase in the total population.

In the event, NHS expenditure in volume terms in fact increased by 71% between 1951 and 1971 (Royal Commission on the NHS. Chairman: Sir Alec Merrison, 1979, Table 7), and the contribution of changes in demographic structure to this was negligible. Perhaps as a consequence, the subject attracted little additional attention for many years. However, during the 1970s interest began to return, partly as a result of various policy initiatives to define the NHS's client group priorities and to improve the information base on which priority planning could be based. In 1976 the House of Commons Expenditure Committee published estimates of per capita health expenditure on different age-groups, accompanied by details of the methods used to derive these estimates (House of Commons Expenditure Committee, 1977). In brief, the calculations were made by weighting the projected population changes in each age-group by the estimated health expenditure per person in these groups to obtain an expenditure-based estimate of the total volume of services in future years. Annually updated estimates were subsequently published throughout the 1980s and 1990s in the Public Expenditure White Paper, Social Service Select Committee Reports, and other Department of Health Annual Reports and miscellaneous publications. Typically, these estimates were described as showing the likely growth in future NHS expenditure that was 'required due to demographic change'.

Similar analyses were conducted in a number of other countries. For example, in 1991 Marzouk published an estimate of the projected resources required to deal with an ageing population in Canada, in which he attempted to allow for the uneven distribution of health spending per capita by age group, but also the likely impact of increases in per capita health care use among the elderly. He predicted that demographic shifts and changes in utilization patterns were likely to result in a doubling of Canadian health care spending as a share of gross domestic product over approximately 40 years. Similar conclusions were reached in other Canadian studies, which demonstrated that demographic trends by themselves were likely to explain only a very small part of future growth of health expenditure (Barer, Evans, & Hertzman, 1995).

In the US the National Health Expenditures Projection Team at the Health Care Financing Administration (HCFA) during the 1990s made a series of projections for private and public health spending, again in which the effect of demographic change were captured by attaching weighted indexes, based on the distribution of use and intensity of services, to different age/sex groups (Smith, Heffler, & Freeland, 1999). And in 2001 the OECD published an analysis of the fiscal implications of ageing, in which again the health care component of the analyses relied on projections based on per capita health care expenditures by age group, multiplied by the projected numbers of people in each age group: in fact all but one of the 14 countries reporting estimates made use of this method (Dang, Antolin, & Oxley, 2001).

However, as time elapsed a number of reasons emerged to foster doubts about the analytical assumptions and conclusions of this forecasting method. In the first instance, the observed cross-sectional and time-series relationship between changes in demographic structure and changes in health expenditures was not at all clear. For example, an OECD study in 1987 suggested on the basis of simple expenditure decomposition that demographic change contributed on average only 0.8% of the 5.9% average annual increase in real health expenditure across the OECD between 1960 and 1984, and that variations between countries in this proportional contribution seemed to be very weakly related to the actual demographic experience of the country concerned (OECD, 1987).

A more recent study of national health expenditure trends for Japan, Canada, Australia, and England and Wales attempted a retrospective application of these projection methods. First, the authors calculated changes in age-specific per capita health expenditure and demographic composition over time. They then determined the extent to which isolated changes in population growth, demographic structure and age-specific per capita expenditure could predict observed increases in health expenditure. Changes in demographic structure were estimated to be responsible for only approximately 2% of the observed increases in health care expenditures in England and Wales over the years from 1985/87 to 1996/99, compared to 6%, 14% and 56% for Australia, Canada and Japan respectively (Seshamani & Gray, 2003; Seshamani & Gray 2002). Again, the important point was not that these methods produced a small estimated demographic impact, for this was not always the case, but rather that the basis of their analytic method was opaque. This was confirmed by a

series of econometric analyses of the determinants of health care expenditure in developed countries, which almost uniformly found the demographic structure of the population to be a non-significant explanatory variable (Gerdtham *et al*, 1992; O'Connell, 1996; Gerdtham *et al,* 1998; Anderson & Hussy, 2000).

In response to these problems, researchers began to examine the possibility that a person's age might be a much less reliable predictor of health care expenditure than their proximity to death, given that health care interventions are common in the latter stages of life and that a high proportion of individuals who die are in hospital at the time. In the first instance this research focused on quantifying the concentration of health care expenditure in the last months or years of life. An early example of this work was a study of Medicare enrollees in 1984 which demonstrated that those who died in 1978 (decedents) comprised 5.9% of the study group but accounted for 28% of Medicare expenditures. However, although there was clear evidence that use of services increased markedly as death approached, only 6% of persons who died incurred total Medicare expenditures of more than $15,000 in their last year of life, suggesting that 'heroic' efforts to prolong life were not particularly commonplace (Lubitz & Prihoda, 1984).

These findings were subsequently replicated both in other Medicare studies and in analyses elsewhere. For example, Riley and colleagues found that this concentration of Medicare expenditure in the last year of life was also evident in particular disease categories such as heart disease and cancer (Riley *et al*, 1987). Lubitz and Riley found that this concentration was stable over time (Lubitz & Riley, 1993). And Hogan and colleagues found virtually no change in this pattern over a twenty year period, with about one-quarter of Medicare outlays occurring in the last year of life as a result of hospital-based interventions and palliative care, nursing home stays and hospice care (Hogan *et al*, 2001). Throwing further doubt on the simple relationship between age and health expenditure, a study by Levinsky and colleagues looked at a large sample of Medicare beneficiaries who died in 1996, and showed that during this last year of life health care expenditures per person actually declined with age, a pattern that was found in different geographical areas, for both sexes, for black and white beneficiaries, irrespective of degree of comorbidity, in hospices and hospitals, and regardless of cause or site of death (Levinsky *et al*, 2001). The apparent explanation was that as age increased the probability fell of being admitted to hospital and intensive care, or of receiving interventions such as cardiac catheterization, dialysis, ventilators, or pulmonary artery monitors. A similar research result was reported by Perls and Wood, who used a large dataset from all nonfederal Massachusetts hospitals to ascertain the relationship between age, health expenditure and proximity to death (Perls & Wood, 1996). This study found that hospitalisation costs peaked in those aged 70–79 years old and declined with age thereafter. And Miller extended these analyses by demonstrating that these effects of proximity to death were detectable not only in the last year of life but up to 10 years prior to death (Miller, 2001).

In other countries, a Dutch study found that hospital costs rose by 170% when moving from the second to last year of life, and also found that long-term care costs increased by 130% (Stooker *et al*, 2001). However, this study found an overall lower level of concentration than Medicare studies, with the end-of-life share of total health expenditure about 10%, leading them to suggest that any interventions to reduce costs in the last year of life might have a small impact on the total health care budget. A Canadian study to assess the effects of age and proximity to death on costs of both acute medical care and nursing and social care found that age was less important than proximity to death as a predictor of costs, but that this was less pronounced for social and nursing care costs (Mcgrail *et al,* 2000). A UK study examined the relationship between patient age, proximity to death and general practitioner costs per month of care of a group of nursing home patients, and again found that costs were unrelated to age, but significantly related to proximity to death (O'Neill *et al,* 2000).

Perhaps the most influential study of this type was published by Zweifel and colleagues in 1999 (Zweifel, Felder, & Meiers, 1999). Using longitudinal data from a Swiss health insurer, they analysed the relationship between health care expenditure and age over the last eight quarters of life of individuals who died during the period 1983–1992. They found that remaining lifetime was a highly significant predictor of health care expenditure, but that a person's calendar age was not statistically significant. They therefore concluded that the simple ageing of the population was possibly a 'red herring' when looking for factors influencing the growth of health care expenditure.

In summary, these proximity to death studies all confirmed that health expenditure was highly concentrated towards the end of life, and that the relationship between age and health expenditure was weak and possibly inverse once proximity to death was allowed for. It followed from this that the positive relationship between age and health care expenditure observed in so many previous cross-sectional studies – the relationship on which many expenditure projections were based – was largely a consequence of the fact that the probability of dying rises with age. And if this was the case, then many of the expenditure projections were ill-founded and possibly quite inaccurate.

Projections of health expenditure

In light of the observed importance of proximity to death in explaining the distribution of health expenditure, a number of studies have attempted to incorporate these findings into health expenditure projections. One approach, adopted in a Dutch study, was to multiply a constant 'cost of death' by the probability of death in each age group, and then estimate the 'recurrent' health care costs in each group

as total costs minus the 'death-related' costs. Death-related costs therefore increased with age while recurrent costs proportionately fell, resulting a slower projected growth in overall health care spending as the 'costs of death' are pushed into the future by rising life expectancy (Dang, Antolin, & Oxley, 2001).

A different approach was taken by an American study, which took population projections over the period from 1992 to 2050, estimated the number of people each year in each age group surviving or in their last year of life, and then multiplied through by the per capita expenditure of survivors or decedents as estimated in previous Medicare studies (Cutler & Sheiner, 1998). The consequences of this were very substantial: when no account was taken of proximity to death, Medicare costs were projected to increase in real terms by approximately 9% per annum, but when proximity to death was included in the analysis the projected growth rate fell to 2% per annum. Using similar methods, Miller demonstrated that making allowance for proximity to death led to substantially lower US health expenditure projections than traditional projection approaches (Miller, 2001). Such results persuaded the technical advisers to Medicare to recommend in 2000 that incorporating information on survivor/decedent spending in projections of health expenditure would allow more consistent treatment of spending changes associated with improved mortality (Technical Review Panel on the Medicare Trustees Reports, 2000). In making this recommendation, they were also drawing on the knowledge that such calculations were also entering the actuarial literature on health insurance (Reese, 2000).

In the UK, the first attempt to incorporate proximity to death into health expenditure projections was made as part of the first report of the Treasury-sponsored investigation of likely long-term health spending requirements (Wanless, 2002). Drawing on an analysis of Scottish hospital data, they projected hospital activity rates and hence expenditure making allowance for differences between survivors and decedents. However, they did not report the difference between including or excluding such an allowance.

Evidence from recent research

In recent years the quantity and quality of research on the relationship between demographic change and health expenditure has increased substantially.

In the first instance, attempts have been made to improve the methodology and the data used to estimate the quantitative importance of proximity to death on health expenditure. A replication of the work of Zweifel and colleagues, but using improved methodology and a much richer longitudinal hospital data set from Oxfordshire, England, showed conclusively that both age and proximity to death to have significant effects on quarterly hospital costs (Seshamani & Gray, 2004a). Age was found to significantly affect quarterly costs in some of these analyses, but the quantitative importance of age was small compared to proximity to death: in particular, the tripling of quarterly costs that was found with approaching death in the last year of life.

Using the same 29-year longitudinal English dataset, these authors then went on in a separate paper to extend their analyses, and showed that the effects of proximity to death on hospital costs could be detected up to 5 years prior to death (Seshamani & Gray, 2004b). Again they found a small positive association between age and health expenditure, but demonstrated that the large (tenfold) increase in costs from 5 years prior to death to the last year of life greatly overshadowed the 30% increase in costs from age 65 to 85. They were therefore able to conclude that expenditure projections must consider remaining life expectancy and not simply age.

In similar analyses but using Medicare data, Yang and colleagues examined the health care use of 25,994 elderly persons from the 1992–1998 Medicare Current Beneficiary Survey Cost and Use files (Yang, Norton, & Stearns, 2003). Their results again confirmed strongly that monthly health care expenditures for elderly people do increase substantially with age, but that this is primarily because mortality rates increase with age and health care expenditures increase with closeness to death. Looking at different types of health and social care, they were able to show that time to death was the main reason for higher inpatient care expenditures, but that an increasing elderly population was the main reason for higher long-term care expenditure. Again, they concluded from this that proximity to death needed to be incorporated into health expenditure projections, and that doing so would show that the projected increase in per person health care expenditures caused by greater longevity of Medicare beneficiaries would be less than expected because of the concentration of expenditures at the end of life rather than during extra years of a relatively healthy life.

The same researchers went on to make precisely such projections in a subsequent paper (Stearns & Norton, 2004). First, they demonstrated that a simple model which does not take account of time to death or changing life expectancy predicts health care expenditure by 2020 that is 9% higher than the prediction using an expanded model controlling for time to death. They then showed that this bias was even larger – increasing to a 15% over-estimate – when changes in death rates were also incorporated. These predicted differences reinforce the conclusion that time to death should be included in models for predicting health care expenditures.

Of course, it can be argued that, while time to death is a better predictor of health expenditure than age, it is in turn a crude measure of health status: declining health status results in increased health expenditure and ultimately in death. Consequently, it may well be fruitful to measure the relationship between health status and health expenditure. Lubitz

and colleagues have attempted to do this recently, using data from the US 1992–1998 Medicare Current Beneficiary Survey, which allowed them to classify individuals according to their functional status, whether or not they were institutionalized, and their self-reported health. They were also able to estimate the relation of health status at 70 years of age to anticipated life expectancy (using life tables) and to measure cumulative health care expenditures from the age of 70 until death for those individuals who died during the study period (Lubitz *et al*, 2003). Not surprisingly, they found that elderly persons in better health had a longer life expectancy than those in poorer health, but they also found that cumulative health care expenditures up to death were similar. For example, a person with no functional limitation at 70 years of age had a life expectancy of 14.3 years and expected cumulative health care expenditures of about 136,000 US dollars (in 1998 dollars), whereas a person with a limitation in at least one activity of daily living had a life expectancy of 11.6 years and expected cumulative expenditures of about 145,000 dollars. These results suggested that improvements in healthy life expectancy might not necessarily increase health expenditures.

Implications for health care policy and future research

As a result of the substantial research effort sketched above, a much clearer picture is beginning to emerge of the relationship between ageing populations and health expenditure. The first clear lesson is that the widely held belief that there is a mechanistic relationship between an ageing population annual growth in the demand for health care and in national health spending is incorrect: in a recent essay reviewing existing literature and reporting new results, Reinhardt has indeed claimed that this is a myth (Reinhardt, 2003). This is in large part because the question is mis-specified: age is not a particularly good predictor of health expenditure, and simple projections based on age-specific health expenditure will therefore be misleading.

The research reviewed above also shows quite conclusively that time to death is a substantially better predictor than age of health expenditure, and that when this is incorporated into projections of future health spending the predicted growth rates are typically lowered.

It is also clear that time to death is in turn one measure of health status. Of course at the individual level time to death is not easy to predict. However, at the population level, even crude measures of health status such as functional impairment and disability allow a much clearer insight into the factors explaining demand for health care. There is evidence – for example from the work of Kenneth Manton and colleagues (Manton, Stallard, & Corder, 1998) – that disability is in fact declining in at least the US elderly population, and this may not just lessen the upward pressure of demographic change on health expenditure, but may result in longer health life expectancy and potentially lower per capita demands on health and social services (Singer & Manton, 1998).

It is also important to bear in mind that changes in demographic structure and in health status are only part of a much wider set of influences on future health expenditure. As other commentators have recently pointed out, the future needs for long-term care cannot be projected in the same way as health care (Rice & Fineman, 2004). In addition, there are likely to be continuing technological advances in the health care interventions available and in the methods for delivering them. Demographic change will also affect the health care work force, which is typically one of the largest in most developed countries, and this will in turn affect the way in which care is delivered. And finally, expenditure on health care and long-term care remains just one of many claims on national income and individual spending. The scope for future research is therefore continuing to expand.

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