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Health and Welfare Services Expenditure in an Aging World

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Contents

Abstract

The world's population is aging, albeit at different rates in different countries. IIASA is building an economic-demographic model for exploring the consequences on the global macroeconomy and has so far concentrated on impacts mediated through public and private pension systems. It now wishes to extend the model to cover other sectors whose provision is also highly age-sensitive, including health and welfare services. This paper explores the consequences of population aging for these vital services and considers the basic mechanisms fuelling their growth. These mechanisms fall into essentially two categories: the first is related to the biomedical processes of aging which can lead to chronic illness and disability in old age. The second concerns the costs of treatment and long-term care which, in turn, are a function of medical technology and institutional factors, how services are delivered, and who bears the costs.

Using simple but explicit projection methodologies, we project health care and disability-related expenditure two major world regions, corresponding to more- and less developed countries (MDCs and LDCs). The key policy-related conclusions are:

- Aging will overtake population growth as the main demographic driver of health expenditure growth, but its effect will be less than technological and institutional factors.
- Health expenditure will expand rapidly in LDCs (relative to GDP) to the same sorts of levels currently observed in MDCs.
- The number of disabled will grow substantially, but will level out in MDCs by 2050 (earlier for all but the oldest age groups), while the number of disabled in all age groups will continue to grow in LDCs. Assuming that most care of the disabled continues to be provided by the family and community, projected increases in disability-related expenditure are modest.

Acknowledgments

The author is grateful to IIASA colleagues for the stimulating discussions on the issues raised in this paper but particularly to Landis MacKellar, who heads the social security project, and to Tatiana Ermoliev for incorporating the mechanisms in the IIASA model, which are set out in an annex. Thanks go also to Ingrid Teply-Baubinder for her work on the format and production of the report.

About the Author

Professor Leslie Mayhew, from the Department of Geography, Birkbeck College, University of London, is a long-term collaborator of the Social Security Reform Project and was an Associate Research Scholar at IIASA during summer, 1999. He was formerly a senior civil servant in the Departments of Health and Social Security and a director of the Office for National Statistics in the UK.

Health and Welfare Services Expenditure in an Aging World

Leslie Mayhew

Introduction

The impact of population aging on the world economy is now a major issue. In this paper, which is a contribution to IIASA's project on global social security reform (MacKellar and Reisen, 1998; MacKellar and Ermolieva, 1999), we focus on health care and welfare services for the elderly. Whilst their economic significance is less than pensions, the other main area of impact, these expenditure areas still account for something like 10% of GDP in developed countries. They are major consumers of public expenditure, they straddle the public, private formal and informal sectors and are sensitive to the size and age distribution of the population and patterns of morbidity. Their growth and development over the last 30 years or so, however, is only partly explained by aging and population growth. More important are factors such as technical change (new treatments and drugs), higher utilization per capita, institutional behavior, higher labor costs and so on.

Our focus, however, is on population and aging because of the very different population trajectories in developed and developing regions and their different starting positions. It is now firmly established, for example, that older people consume more health services per capita than any other age group except perhaps the newly born. Their ability to perform daily tasks slowly erodes until, at some stage, they become dependent on others for home help, or possibly residential and long-term care in hospital. The intensity of dependency and sometimes also medication reaches a maximum in the period just before death (Seale and Cartwright, 1994). The economic consequences are therefore varied, involving directly or indirectly the work place, households, and agencies in the public, private and voluntary sectors alike (e.g. see Jackson, 1998). Not surprisingly, governments are becoming increasingly aware of the need for coordinated policies in the fields of employment, pensions, disability and health.

Some trends, though, will pull in opposite directions. It is expected, for example, that future generations of elderly will be better prepared to live independent lives into quite old age, particularly with the aid of modern technology and medical breakthroughs such as body part replacement which will improve the quality of life for some. There is some evidence that the elderly are already living healthier lifestyles and are better educated and informed, with the result that the threshold for frailty and disability is being pushed later into old age in some instances (ONS, 1997; Vol. II). Estimates of future health- and disability-related expenditure depend crucially on whether the longevity revolution is adding healthy life-years or years of illness and dependency to the human life span.

Despite the uncertainty arising from countervailing forces, and certainly based on experience over the last 50 or so years, demand will continue to grow so that health care services will continue to consume a rising share of GDP in all major world-regions. To some extent, this merely reflects the changing consumption basket of aging societies (in the case of the more developed countries or MDCs) and societies undergoing structural economic and social change, including rapid health transition (in the case of less developed countries or LDCs). A rising health-sector share of GDP is not necessarily an adverse trend (Aaron 1996). However, the health sector's increasing claim on resources is not without consequences for the real economy and represents an important index of structural change.

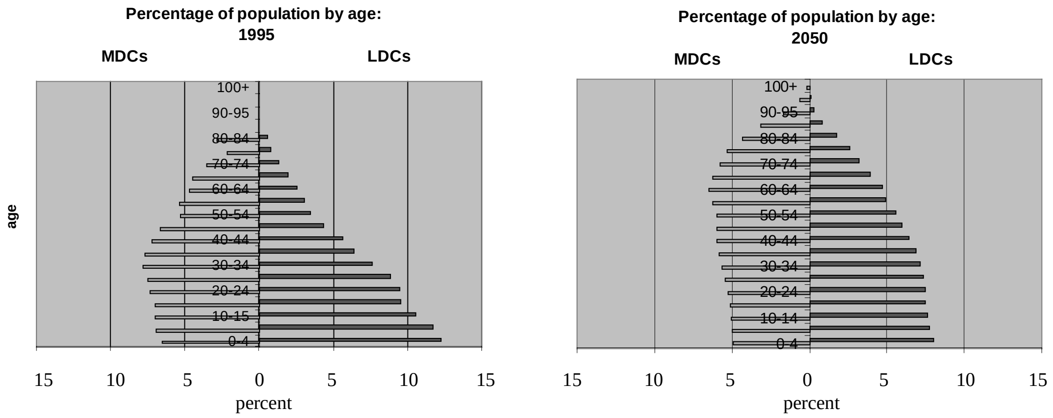
While in some countries health systems confer universal coverage the same is not true of welfare services, which continue to be dominated by care within the family unit or immediate community, the so-called informal sector. A central issue in this case is the extent to which services provided by third parties (state or private residential and nursing homes, etc.) in the formal sector should be paid for out of personal income, sales of assets, and so forth. Again the picture varies substantially even within countries because of differences in income and social factors, such as deprivation, home and family circumstances.

The aim of this paper is to provide greater clarity and a firmer empirical basis for these issues in the context of IIASA's global economic-demographic model, which is aimed at the medium- to long term. Using recently available data we attempt to separate aging effects from other contributors to growth, focussing on aging and disability and the demands elderly and disabled people make on health and welfare services. As with IIASA's model we divide the world into two regions. One comprises MDCs, which also includes newly-independent countries in the European regions of the former Soviet Union. This region accounts for 82% of world GDP, but only 22% of population. The other region comprises LDCs, and includes China, India, and the newly-independent Central Asian countries of the former Soviet Union.

As well as their contrasting economies the differences between the two regions' age profiles is also telling, providing important clues as to the future impact on health and welfare services. Figure 1 shows two population pyramids based on IIASA's central population projections at two points in time, 1995 and 2050. The horizontal axes are scaled to show the percentage of population by age group rather than population number in order to emphasize the differences in shape between regions and between years. In 1995 for MDCs, the pyramid is highly tapered, but still quite broad at the base, whereas in LDCs younger generations dominate the relatively small percentages of elderly. By 2050 the aging process reaches maturity in the more developed countries with the majority of the population concentrated in older age groups. In LDCs the pyramid is substantially transformed to resemble somewhat the pyramid for MDCs, but over 50 years earlier.

Sources of Information on Health and Welfare Services

In considering the scope of health and welfare services we are dependent to a significant degree on the availability of suitable data in the private and public sectors. For welfare services the structure is more complex than for health care. For example, details about of the informal sector are scarce and so its economic value remains an unknown



(a) (b)

Figure 1: Population pyramids in (a) 1995 and (b) 2050. Population in each age group is expressed as a percentage of the total population in a region. Left sides represent more developed countries (MDCs) and the right less developed countries (LDCs). Source IIASA central population projections (Lutz, 1996).

quantity, although it is certainly very large (over 80% of the total is the usual figure quoted). The size of the public sector which provides residential, day and domiciliary services, and benefits in kind (such as meals) is better reported, but there remain many hidden transfers which are categorized elsewhere in national accounts. An example is the cost of residential services, which may be paid directly by the state, whether in part or in full, by the individual, or indirectly through social security benefits. The welfare jigsaw is therefore much harder to piece together.

There is no single or complete source of data on all aspects of these issues. Expenditure in each country is sensitive to cultural, behavioral and institutional factors, morbidity and mortality profiles, as well as to the relative level of economic development. Set against this, however, are the similarities in demography within each major region, the increasingly shared experiences of medical advances and common outlook and values, for example in terms of national and international policies towards disabled people, in which emphasis is on equality in society[1]. The picture that emerges, whilst coherent and persuasive, is built up partly from information available in every country, but partly also from fragmentary information from one or more countries which has been extrapolated to the rest of the region. It follows that the structure of the

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[1] The UN has been especially active in raising the profile of disability as well as health care issues. In 1981, the year of the disabled, it estimated 500 million people with disabilities worldwide of which 400 million were in developing countries. It declared 1983 to 1991 to be ‘The Decade of the Disabled’ and asked each country to prepare long-term strategies and policies for the disabled. It has also been active in the field of statistical collection, designing frameworks and helping countries design their population censuses, the main means of data collection.

approach is as important as the results themselves because the framework, including the IIASA model, can be updated as new and better information becomes available.

A key source of information is IIASA's central scenario for world population projections from 1995 to 2100 (Lutz, 1996), although for the major part we concentrate on the period to 2050 for which information is more reliable. Also invaluable were OECD data bases covering health and welfare services (OECD 1998a, 1998b), the European System of Social Protection Statistics (Eurostat, 1996 and 1998), United Nations and World Bank data (UN, 1998; World Bank, 1993 and 1999), especially for LDCs, and miscellaneous sources and studies drawn from countries as diverse as the UK, US, Canada, Australia, Finland, Japan and China; and relevant conference proceedings. Major shortcomings are in respect of health and disability data for LDCs and as a result key issues are only scratched at the surface. In the case of MDCs which comprises OECD countries and countries in Eastern Europe and the former Soviet Union the analysis prior to 1995 is based on OECD only.

The results presented are therefore a mixture of the firm and not-so-firm, the relatively precise and the indicative. Where necessary, appropriate assumptions and qualifications are therefore spelled out. To a significant degree we build on established trends over long periods, relatively stable features of the population such as the onset and prevalence of disabilities, and on underlying trends in economic growth. No attempt is made to second-guess technological changes that may have impact on the delivery of health care and other services, or major breakthroughs in medical treatments which may otherwise have impact on longevity, health service costs, and so forth. These are presumed to be subsumed in the underlying growth rate.

The paper is structured in two parts: part one considers health services, and part two, disability and welfare services.

Health Care Services

Measuring health expenditure

Medical expenditure is high in the first few years of life and increases again in old age with the onset of chronic illnesses and disability. To determine the contribution of population growth and aging to future expenditure we need to separate the proportion of growth attributable to population trends and aging from the rest. The OECD publishes data on health expenditure per capita in selected age groups as ratio of average population-wide expenditure per capita (OECD, 1998a). Although there are many gaps a coherent picture emerges across countries, which shows expenditure in old age to be significantly greater than in other age groups apart from the very young (see also van der Gaag and Preker, 1998, and the European Commission, 1997).

Data from England and Wales shown in Figure 2 are consistent with the wider OECD picture and have the advantage of being available in time series over the entire age spectrum. Although the period is relatively short, the data are remarkably stable in most age groups. An exception occurs in the case of the very elderly, where the increase and subsequent downturn in the mid-80s marks a change of policy which has to do with the appropriateness of keeping very old people in hospitals (we return to this point later). Otherwise, the flatness of the curves is noteworthy, especially given increases in health service utilization, changes in treatments, improvements in quality, falling lengths of hospital stay and the growing use of, for example, day services.

The stability evident in Figure 2 suggests that relative age-specific expenditure indices should, at least in MDCs, be fairly stable over time. In Table 1, we present such indices calculated from the data plotted in Figure 1, choosing the lowest age group (0-4) as our numeraire. We will presently apply these indices to project how the changing age structure of the population in MDCs is likely to affect growth in health care expenditure. Note that our assumption is not that levels of age-specific per capita health care expenditure in England and Wales are representative of the MDCs as a whole, but that the age profile of such expenditure is representative, a much weaker assumption.

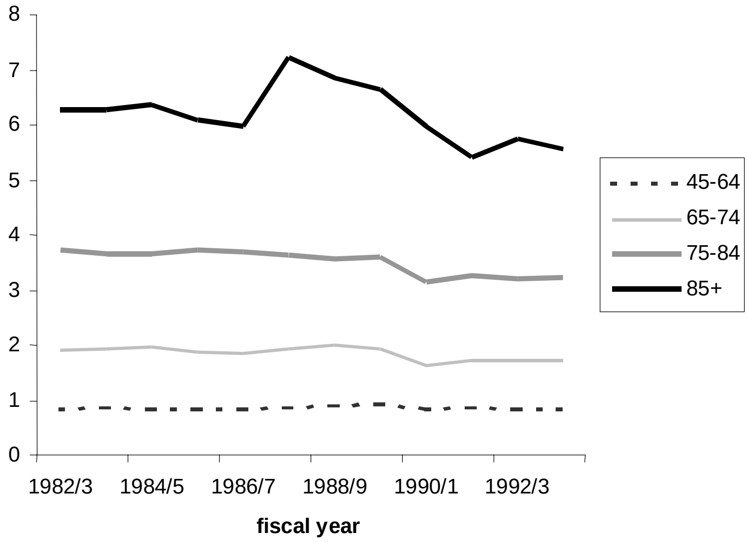

Figure 2: Ratio of per capita health expenditure in different age groups to average per capita health expenditure calculated over all age groups (only older age groups shown for clarity), England and Wales, ca. 1980-90. Source: UK Department of Health, personal correspondence.

0-4	1.00
5-14	0.40
15-44	0.53
45-64	0.82
65-74	1.70
75-84	3.20
85+	5.52

Table 1: Relative Per Capita Health Care Expenditure, by Age, England and Wales ca. 1980-90 (Age 0-4 : 1.00) Source: Calculated from data presented in Figure 2

For LDCs, the issues are substantially different and moreover, equivalent data are unavailable. The nature of the problem is illustrated in Table 2, which is based on data from Murray and Lopez (1996), on the estimated percentage of deaths by major causes in different world regions in 2000 and 2020. In MDCs the majority of deaths are now from non-communicable diseases, whereas in LDCs communicable diseases are still a major cause of death. As is seen, this is expected to change in the medium term so that LDCs will eventually look more like MDCs with gradual convergence over a period accompanied, one assumes, by commensurate changes to the health care services.

At the present time, expenditure on communicable diseases in MDCs is only a small percentage of the total. For example, based on Murray and Lopez's classification, communicable disease accounts for only about 5.5% and 3.3% of hospital and primary care costs in England and Wales, respectively, whereas injury and poisoning account for 5.8%. The rest is non-communicable disease such as neoplasms, psychiatric disorders and cardiovascular malfunctions. So the distribution of expenditure in this case is quite close to the distribution of mortality by cause.

	MDCs		***LDCs***	
Cause of death	***2000***	***2020***	***2000***	***2020***
All deaths (millions)	12.6m	13.5m	43.5m	54.8m
Communicable %	5.8	5.0	32.6	17.5
Non-communicable %	87.3	88.6	55.4	68.8
Injuries %	6.9	6.4	12.0	13.7

Table 2: Pattern of mortality in MDCs and LDCs, in 2000 and 2020 (projected). Source: based on tables at pages pp 616-647 and 760-791, using baseline scenario, Murray and Lopez (1996).

It makes little sense to apply the MDC indices in Table 1 to LDCs, which are characterized by a different morbidity and mortality structure. An alternative is to use mortality rates as a proxy on the crude assumption that age-specific per capita health expenditure is proportional to age-specific mortality rates, the constant of proportionality being invariant over the age spectrum. (If we knew how the coefficient varied with age, we could calculate relative age-specific health expenditure indices directly on the basis of mortality data.) One way of motivating this approach is to assume that all medical expenditure takes place in the year prior to death and that, given the current medical technology in use in LDCs, the cost of the care-basket is invariant with respect to age.

This procedure gives a spread of weights for 1995 that range from 1 to 8, which is slightly more extreme than in the example in Table 1. They fall below the weights shown between the ages of four and sixty at which point they cross. As mortality in future years reduces the weights for oldest age groups fall giving a spread of 1 to 7 as compared with about 1 to 5.5 in MDCs and so some general convergence seems likely. To take the argument one stage further we can scale the weights for both regions by the expected population in each age group to obtain profiles of relative total health expenditure by age group. Because each region and time period are scaled so that index is equal to 1.0 at age 0-4, note that relative health care costs as between MDCs and LDCs cannot be inferred.

As can be seen in Figure 3, the estimated age-profile of health expenditure in LDCs is projected to evolve over time. The expected profile for MDCs for 2050 is also shown for comparison. It shows that age-related expenditure in LDCs overtakes that in MDCs in 1995 by the end of the period in the oldest age groups. Underlying the projections are changes in the age-structure of mortality, as age-specific mortality rates of the aged rise relative to age-specific mortality rates of the young (i.e., mortality rates decline less for the elderly than for the young). If medical spending is linked at the level of the individual to mortality, as we hypothesize, then the population-wide mortality transition will be accompanied by a similar shift in the age-pattern of health expenditure.

However, there is universal agreement that increase in health expenditure in MDCs can be attributed mostly to development and application of new diagnostic procedures, drugs, and medical interventions. The direction of this technological change has been biased toward the elderly. Thus, the steeply rising weights in table 1 represents not only the fact that old people have poorer health than young ones, but that there exist technologies developed over the last fifty years for treating the health conditions associated with old age. Indeed, this finding may be compared with the work by Cutler and Meara (1997) which shows that in 1953 the spending profile was relatively flat compared with today. It is probably reasonable to speculate that the age expenditure profile of the US (and by inference, MDCs as a whole) in 1953 was similar to that shown in Figure 3 for LDCs in 1995.

While the evolution of the LDC age-expenditure curves in Figure 3 reflects changes in the age-structure of mortality, it does not take account of the fact that, if the coefficient of proportionality were replaced with an age- and time-indexed coefficient, it would probably be projected that health expenditures for older age groups would rise even faster. Accelerating this process will be the fact that, while new medical technologies were developed from scratch in MDCs, LDCs are able to import already-existing technologies. Therefore, in presenting the projections in Figure 3, we are aware that, if anything, they understate the rapidity of the changes in health expenditure that may be anticipated.

Method of analysis

We use a "growth factor" method to analyze trends in health care expenditure. Estimated health expenditure in time *t, H(t)*, is related to a base period as follows:

$$H(t) = H(0)\, e^{t(r_P + r_U)}$$

We hypothesize two growth rates, one of which (r_p) reflects demographic change (change in total population and change in age structure) and the second of which (r_U,) calculated as a residual, is interpreted as an underlying rate.

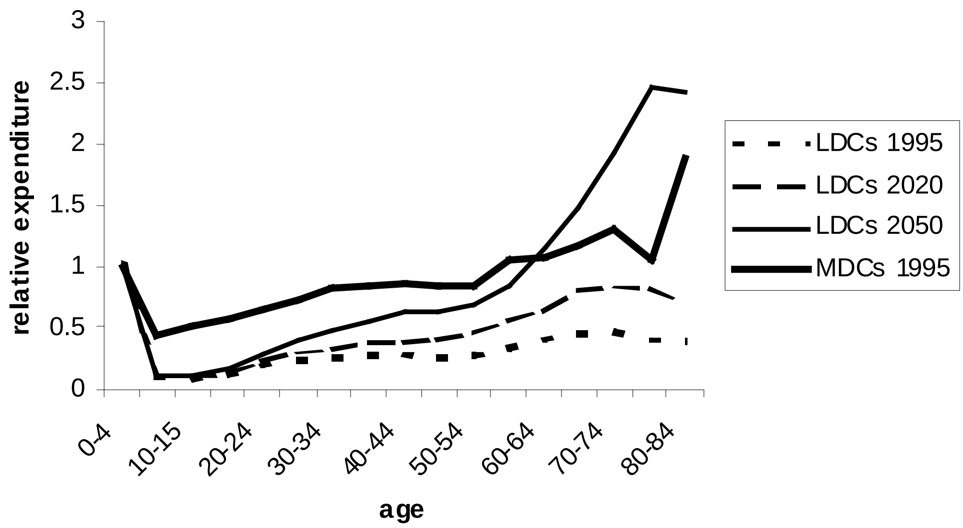

Figure 3: Relative health care expenditure by age group (age 0-4 : 1.0), MDCs (1995) and LDCs (1995-2050) compared.

Let *I(t)* be an index of population size and structure, and let r_P be the rate of change in this index:

$$r_P(t) = \frac{1}{t}\ln I(t)$$

Then it is easy to confirm that

$$r_U(t) = \frac{1}{t}\ln \frac{H(t)}{H(0)I(t)}$$

If we define the demographic index so that *I(0)* = 1, then the underlying rate can be written

$$r_U(t) = \frac{1}{t}\ln \frac{\dfrac{H(t)}{I(t)}}{\dfrac{H(0)}{I(0)}}$$

so that r_U can be interpreted as the rate of growth of total health care expenditure normalized by an index of population size and structure.

The underlying rate reflects technical change, changes in per capita utilization, shifts in the care basket and other factors, whereas the demographic rate combines population trends and aging and is designed to capture the health needs of a growing population and the costs of treating a more elderly population. These assumptions mean, for example, that even if the underlying rate of change is zero, health care expenditure would continue to grow (or fall) depending on changes to population size and age structure. It also means that if the underlying rate falls (as has occurred for example in some transition economies of the former Soviet Union) the GDP share of health could still increase depending on the direction of population change.

As our index of population-related growth in health expenditure, we define

$$I(t) = \frac{\sum_i P_i(t)\, c_i(t)}{\sum_i P_i(0)\, c_i(0)}$$

where $P_i(t)$ is population in age group i, and $c_i(t)$ is the age-specific relative expenditure index. Note that $I(0) = 1$.

It is possible to decompose $I(t)$ into components related to population change (‘volume effect’) and aging ('distribution effect') by rewriting as follows,

$$I(t) = I_P(t)\, I_A(t)$$

with

$$I_P(t) = \frac{\sum_i P_i(t)}{\sum_i P_i(0)}$$

and

$$I_A(t) = \frac{\sum_i p_i(t)\, c_i(t)}{\sum_i p_i(0)\, c_i(0)}$$

where $p_i(t)$ is the proportion of population in age group *i*.

Based on the discussion in the previous section, we assume that $c_i(t)$ is constant over time at the values given in Table1 for MDCs:

$$c_i(t) = \mathrm{c}_i(0)$$

so

$$I^{MDC}(t) = \frac{\sum_i P_i(t)\, c_i(0)}{\sum_i P_i(0)\, c_i(0)}$$

In the case of the LDCs, we have assumed health expenditures are proportional to age-specific mortality, an approach that leads to the expression:

$$c_i(t) = m(0)\, d_i(t)$$

where *m* is a constant of proportionality and *d* is the age-specific mortality rate. As *m* cancels the index is then

$$I^{LDC}(t) = \frac{\sum_i P_i(t) d_i(t)}{\sum_i P_i(0) d_i(0)}$$

The population growth term of the multiplicative decomposition is

$$I_P^{LDC}(t) = \frac{\sum_i P_i(t)}{\sum_i P_i(0)} = \frac{P_T(t)}{P_T(0)}$$

where the T subscript refers to total population in all age groups and the aging component is

$$I_A^{LDC}(t) = \frac{\sum_i p_i(t)\, d_i(t)}{\sum_i p_i(0)\, d_i(0)}$$

I(t) and $I_A(t)$ for LDCs have an immediate interpretation in terms of total deaths and the crude death rate (total deaths over total population):

$$I^{LDC}(t) = \frac{\sum_i D_i(t)}{\sum_i D_i(0)} = \frac{D_T(t)}{D_T(0)}$$

where $D_i(t)$ is deaths in age group I and the T subscript refers to population-wide deaths; and

$$I_A^{LDC}(t) = \frac{\sum_i \frac{P_i(t)}{P_T(t)} \frac{D_i(t)}{P_i(t)}}{\sum_i \frac{P_i(0)}{P_T(0)} \frac{D_i(0)}{P_i(0)}} = \frac{CDR(t)}{CDR(0)}$$

where CDR is the crude death rate.

More Developed Countries

In this and the next section, we consider the application of the growth factor model to health care expenditure in both world regions. In the OECD, health care expenditure has been increasing at the rate of 5.7% per year between 1960 and 1995 in real terms. GDP, meanwhile, grew at 3.4% per year, with the result that health care now accounts for 9.8% of GDP as compared with 4.3% in 1960 (Figure 4). Based on application of the growth factor model, of the total ‘headline’ rate of growth in health expenditure of 5.7%, 1.7% was caused by population changes and aging. The remainder, 4%, by far the largest share, represents the underlying rate, which we have attributed elsewhere to technical, institutional and other effects.

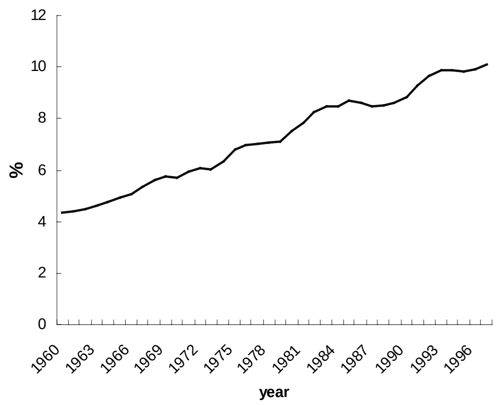

Figure 4: Health care expenditure as a percentage of GDP in OECD countries 1960 to 1995 (Source: OECD, 1998a).

How will population change and aging therefore affect future MDC health expenditure and what will be its share of GDP? This involves three judgments, one about demographic change, another about the underlying rate of growth of health care growth, and the third about the rate of economic growth. Of these, the underlying rate for health care is perhaps the most difficult to judge. As noted, health expenditure in the OECD grew continuously between 1960 and 1995 except for a brief period during the early 1980s when it faltered for a year or two. All the signs are that this level of underlying growth is set to continue albeit possibly at a slightly lower rate as a result of cost containment policies. Extrapolation of the past thirty years of OECD experience would suggest, therefore, that the underlying rate of growth for the MDC region should be a bit less than 4% per annum (pa).

However, the MDC region in the IIASA model includes not only the OECD but Eastern Europe and most of the Former Soviet Union as well. In these regions, GDP has fallen dramatically in recent years (one assumes temporarily) as market reforms are introduced. Interestingly, these countries provide an illustration of what happens to health care expenditure when an economy is in rapid decline. Data from Chellaraj et al. (1996) indicates that the GDP share of heath care has increased as GDP has fallen. This suggests that, even if there is a prolonged period of economic transition, including rigorous health cost containment policies, the underlying growth rate will remain positive in this part of the world.

Taking these factors into account, we assume 3% pa for the underlying rate of future growth in health care expenditure in the MDC region, which is about 1% pa below the OECD rate prior to 1995.

Combining this assumption with the IIASA Central Scenario population projection results in the health care expenditure projections shown in Table 3. Demographic change contributes 1.06% pa to health expenditure growth between 1995 and 2020, declining to 0.74 percent per year in 2020-2050 (see Table 3). Of the 1.06%

pa in 1995-2020 most (0.79% pa) is due to aging and the rest (0.27% pa) to volume (i.e. population increase). Between 2020 and 2050 0.79% pa is due to aging, with a small offset (–0.05% pa) due to a declining population. These results can be compared with the more substantial impact (1.3% pa) of population change and aging in the period 1960-1995, most (0.96% pa) of which was due to population increase. A major conclusion to be elicited from Table 3 therefore is that, not withstanding underlying growth, future demographic pressures on health services will come not from population increase, as in the recent past, but from population aging.

Based on a long-run GDP growth assumption of 3% pa, the projections in Table 3 imply that health care's share of GDP will grow from its present level 9.8% in 1995 to 12.8% by 2020 and 16.0% by 2050. This proportion is broadly equivalent to the current situation in the US. This will be achieved unless there is more pressure to bear down on costs (for example through rationing medical interventions), more recognition is given to preventative care, or there are other changes of policy or technology. If GDP growth is slower, for example, if improvements in productivity fail to compensate for slower labor force growth, then the health share will be even higher.

A potentially important unknown is whether the assumed age-specific relative health expenditure indices taken from Table 1 will continue at the levels indicated or if they will fall, for example as a result of cost containment policies or improving health. If it is assumed that the present relative expenditure indices for the 85+ age group are replaced by those for the 75-84 age group, which are lower, the GDP share of health expenditure is reduced only marginally. If the expenditure indices for age groups over 75 are set equal to those for the 65-74 group, the reduction is about 0.5% of GDP in 2020 rising to just under 2% in 2050. This is a more substantial reduction but it also provides a good illustration of the limitations of cost containment policies aimed solely at the elderly. In comparison we note, for example, that if the underlying rate of growth were to be reduced from 3% to 2%, the GDP share of health expenditure would fall to 10% and 12% in 2020 and 2050 respectively, which is a far more substantial reduction. The key conclusion is therefore that aging, whilst becoming more important, is only one relatively small part of the upward drive in health expenditures.

From the standpoint of applications of the IIASA model it is also important to know how much health expenditure is publicly or privately financed. The relative merits of different forms of provision are not our concern here, only the extent to which they affect the financing of health services and the various contribution rates. The part of total health expenditure that is private is defined as the difference between total and public expenditure. Based on OECD data, private expenditure has dropped from 59% of the total in 1960 to about 40% in 1975 (Figure 5), since when it has stabilized. This somewhat contrary finding (intuitively one might expect private expenditure to increase its share as welfare state expenditure was compressed) is consistent with other studies that private medical expenditure is negatively related to GDP per capita (for example, see Musgrove, 1996). As interesting, however, is the fact that the decline of the private-sector share seems to have been arrested, possibly reflecting the success of cost containment policies in the public sector. In the absence of any obvious trends or other changes in Governments' policies we assume that private health expenditure will continue at around 40% of the total.

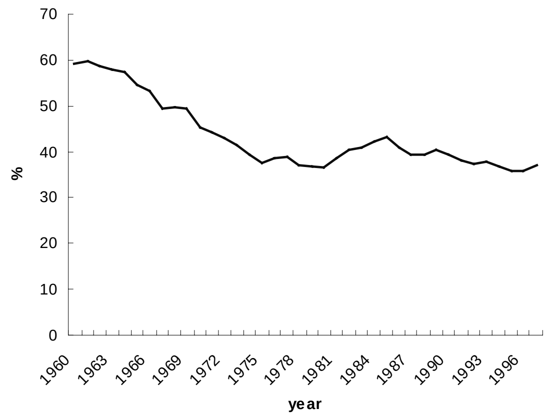

Figure 5: Private expenditure on health as a percentage of total health care expenditure (Source: OECD, 1998a).

	1960-1995	***1995-2020***	***2020-2050***
GDP growth pa %	3.4[(1)]	3.0[(2)]	3.0[(2)]
Health care expenditure growth per annum, *of which*	5.7	4.1	3.7
- underlying rate	*4.4*	*3.0[(2)]*	*3.0[(2)]*
- age & volume	*1.3*	*1.06*	*0.74*
- due to population change	*0.96*	*0.27*	*-0.05*
- due to aging	*0.35*	*0.79*	*0.79*
As % of GDP (end of period)	9.84	12.8	16.0
-of which private	*40*	*40*	*40*

[(1)] Estimate based on the OECD region only
[(1)] Assumption

Table 3: The development of health expenditure and GDP in MDCs, 1960-2050.

Less Developed Countries

There are too many gaps in data for LDCs to produce an equivalently detailed analysis. This means coverage of the key indicators is sparse and the conclusions are necessarily weaker. As far as can be determined, however, the economies of LDCs have been growing at an average of 3.2% pa between 1960 and 1995. We assume this rate of growth to continue at 3%, which is equivalent to our assumption for MDCs. Public expenditure on health care is about 2.7% of GDP (World Bank, 1999) with private medical expenditures unclear, but potentially doubling this. In any event, total expenditure is a much smaller proportion of GDP (very roughly half) than in MDCs. Because no reliable figures are available for earlier years it is not possible to provide an accurate base for determining the historical underlying growth rate of health care expenditure. For projection purposes it seems reasonable to assume 3% pa as we have done for MDCs.

It is possible, however, to estimate the contribution of population change and aging to health expenditure based on the mortality-linked hypothesis described in the previous section. Analysis (see Table 4) shows that the effective contribution of population change and aging in LDCs between 1960 and 1995 is about 0.4% pa, much less than in MDCs. Of particular interest is that this rate breaks down into a 1.9% pa increase due to population growth (double the volume effect in MDCs), but a 1.5% pa *decrease* due to population age structure changes. Rapid fertility decline has decreased the number of very young persons (*vis à vis* the number of young persons in the absence of fertility change), who have relatively high health care costs, but has only recently started to translate into a growing number of elderly persons. Both MDC and LDC populations have "aged" in terms of rising average (and median) age; in the former, however, aging has occurred from the top of the population pyramid, whereas in LDCs, it has occurred from the bottom of the pyramid. Since young adults have the lowest health costs of any age group, the result has been downward pressure on total health expenditure in LDCs in this period.

In the future, deceleration of overall population growth will ease pressure on LDC health expenditure, but population age-structure change will switch from braking expenditure growth to accelerating it. The combined effect of population growth and aging produces a growth rate of 1.8% pa between 1995 and 2020 which then falls to 1.62% pa between 2020 and 2050. Of these totals, 0.26% pa (one-seventh) will be attributable to aging up to 2020 and the rest to population growth; after 2020 the effect of aging increases to 2.35% but the effect of population growth turns negative (-0.73%) pa. Thus, we conclude that the demographic sources of growth in LDC health expenditure are quite different than in MDCs. In the latter, most (in 1995-2020) or all (in 2020-2050) population-related growth is due to aging. In the former, the aging component is only beginning to be felt but is rising in its impact.

With an assumed underlying rate of 3%, total public expenditure on health care as a proportion of GDP is therefore set to increase from 2.7% in 1995 to about 4.2% in 2020 and 6.9% in 2050, the final percentage being higher when private expenditure is added in. If the 4.2% GDP share of public-sector health expenditure expected in 2020 is doubled to arrive at an estimate of total (public plus private) health expenditure of 8.4%, this implies that LDCs in 2020 will face a situation not far removed from that of MDCs in 1995. Doing the same for 2050, total LDC health expenditure at 13.8% of GDP is not projected to be appreciably different than in MDCs (16%). Add to this the possibility that the underlying rate of growth may be more rapid in LDCs than MDCs because of rapid assimilation of MDC medical technology (and, perhaps, less effective cost-containment measures), and it is striking how rapidly the LDCs are projected to approach the situation of today's MDCs.

	1960-1995	1995-2020	2020-2050
GDP growth pa %	3.2	3.0(1)	3.0(1)
Health care expenditure growth, pa %, *of which*	n.a.	4.8	4.62
- underlying rate	*n.a.*	*3.0(1)*	*3.0(1)*
- population and aging	*0.4*	*1.8*	*1.62*
- due to population change	*1.9*	*1.54*	*-0.73*
- due to aging	*-1.5*	*0.26*	*2.35*
As % of GDP (end of period)	2.7(2)	4.2	6.9

(1) Assumption
(2) Public expenditure only

Table 4: The development of health expenditure and GDP in LDCs, 1960-2050

Disability

Measuring disability

Disability may be congenital or acquired during life (through illness, injury or physical deterioration), but especially in old age, at which point many find it difficult to manage without the support of others. Knowing the severity of disability is therefore important because it is an indicator of dependency on others such as friends or family, the state or other agencies. Thus, it is more helpful to think of disability as a continuum rather than a precise condition, which is distinguishable from ill-health in the sense that it describes a physical inability to carry out a particular activity. The main medical conditions associated with disability in old age are circulatory and cognitive diseases, and arthritis.

More precise descriptions and definitions of disability are given in numerous texts and in statistical surveys and compendia. The World Health Organization, for example, has adopted the International Classification of Impairments and Disabilities and Handicaps (ICDIH) as a measurement framework, which is intended to be complementary to the ICD system for diseases (see also annex to this paper). Partly because of the expense and difficulty of measuring disability, even on a sample basis, it will take time to build a consistent and comparable database for all countries.

Estimates of the prevalence of disability are based on numbers of people with disabilities above a certain threshold, so that unless all countries adopt the same threshold, definitions and estimates of the number of disabled are bound to vary. Administrative data on receipt of disability benefits are a potential source of information, but not all countries operate disability benefits and those that do have different eligibility rules.

Many countries ask questions in family and household surveys or in censuses about people’s state of health that potentially provide the basis for international comparison. How disability questions are posed can give rise to different estimates even among the same population, although distributions across age groups tend to be similar. Some years ago the United Nations published a volume disability statistics which is illustrative of the problem (UN, 1990). This showed that Austria headed the disability league having a prevalence 20 times that of Egypt, a result which most observers would find implausible (e.g. see Metts et al., 1998). The reason for the difference in this admittedly extreme case was due to the fact that disability in Egypt was measured on the basis of impairments (for example, blindness) and in Austria on the ability to carry out the tasks of daily living.

Any analysis has to be a compromise between data produced under different definitions and data taken from a representative population under strictly controlled conditions. Our starting point is an in-depth survey of disability carried out in the UK during the 1980s. This highly detailed study, regarded as the 'gold standard' in its field, is still widely used and quoted, and is even used for resource allocation purposes by some local service providers. The basis for the methodology is described in an annex and includes examples from categories ranging from 1, 'least disabled', to 10, 'most disabled'. It is convenient to group these ten categories into three. We arbitrarily choose the cut-offs to be 1-4 least severe, 5-7 intermediate severity, and 8-10 most severe. Figure 6, a key output, shows how disability rates increase with age in each category, whilst Table 5 shows the actual rates on which the graph is based as well as the overall disability rate per thousand.

Table 5 shows that the overall disability rate is equivalent to about 14% of the population. This is roughly equivalent to measures obtained in household and census-based survey questions about 'limiting long-standing illness'. These gave percentages for the UK in the range 12–18% (ONS, 1998), but using obviously less detailed survey instruments. Recent work at the Disability Statistics Center at the University of California, San Francisco (and published on their web site, Kaye et al., 1997), using the National Health Interview Survey (NHIS), whilst not providing breakdowns by severity, provides confirmatory evidence. It shows, for example, an overall US disability rate of 15% in 1994, having risen from 11.7 % in 1970, because of changes in the population age structure. Age-specific rates in the over 60 age group are around 40% in the US as compared with 47% using OPCS prevalence rates which is reasonably close.

As far as Figure 6 is concerned the prevalence rate is accurately described by an exponential equation of the form $\delta_x = A\ exp(bx)$ where δ_x is the prevalence rate at age x and *b* is the rate of increase in disability with age. Calibration yields a value for *b* of 0.052 and for *A* of 7.92 per thousand which could be loosely interpreted as the congenital rate of disability (R-squared = 0.996). Each severity category can be similarly described although the goodness of fit becomes inferior as prevalence levels become lower.

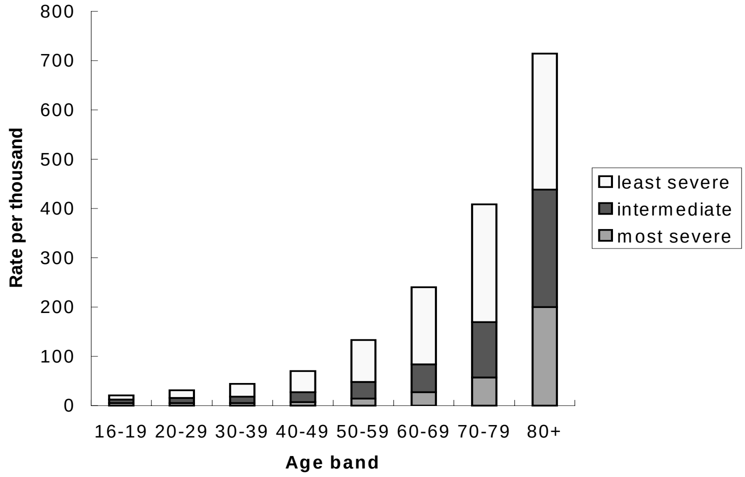

Figure 6: Graph showing the incidence of disability by age and category (source: OPCS, 1988)

Severity	*16-19*	*20-29*	*30-39*	*40-49*	*50-59*	*60-69*	*70-79*	*80+*	*All*
Most	5	5	5	7	14	27	57	200	22
Intermediate	7	10	13	23	34	57	112	238	40
Least	9	16	26	40	85	156	239	276	80
All	21	31	44	70	133	240	408	714	142

Table 5: Disability of rates per thousand by age and severity (adapted from OPCS (1988)).

The period of most severe disability and therefore dependency is concentrated in the last years of life. Reviewing studies carried out in six countries in 1980 and 1993 (Australia, Japan, Canada, UK, France and Norway), OECD observed that this period had hardly changed and that it was significantly higher for women than for men with an combined average of around 2 years. By combining these data with mortality schedules, it is possible to obtain an estimate of the number of severely disabled which is independent of the prevalence rate.

Method of analysis

In a stationary life-table population, the following relationship will hold for small values of *a* relative to life expectancy at age x:

$$ {}_{\infty}L_x \, {}_{\infty}\delta_x = {}_{\infty}D_x a $$

where ${}_{\infty}L_x$ is the number of person years lived above age x, ${}_{\infty}\delta_x$ is the disability prevalence rate above age x, ${}_{\infty}D_x$ is the number of deaths above age x, and *a* is the average period with disability before death. Since

$${}_{\infty}D_x = l_x$$

where l_x is the number of members of the life table population who survive to age x,

$$\frac{{}_{\infty}L_x}{l_x} = e_x = \frac{a}{{}_{\infty}\delta_x}$$

where e_x is life expectancy at age x, from which we can express prevalence above age x as average duration of disability divided by life expectancy at age x:

$${}_{\infty}\delta_x = \frac{a}{e_x}$$

The stock of disabled people above age x is therefore given by,

$${}_{\infty}S_x = \frac{{}_{\infty}L_x a}{e_x}$$

These relationships, which should hold at least approximately in the real world, encapsulate the healthy versus unhealthy life-years issue in the longevity debate. If the duration of disability prior to death is fixed and longevity is increasing, one would expect the prevalence rate to fall. This would correspond to a situation in which a population was living longer, disability-free lives; in other words, increments to life expectancy consisted of disability-free life years. If, in contrast, increments to life expectancy consist of disabled life years, then the prevalence rate would rise over time.

Say, for example, life expectancy at age x was 10 years and the duration of disability prior to death was 2 years. Then if life expectancy and number of years spent in disability rose in lockstep, we might observe prevalence rising as 2/10, 3/11, 4/12, … Using a different example, if the duration of disability remains in constant proportion to life expectancy then prevalence is constant (e.g. 2/4, 4/8, 8/16,…). Thus, our projections of disability prevalence rates depend crucially on whether the longevity revolution is producing healthy or disabled life years.

For a range of reasons, evidence is mixed. The US study cited above found age-specific disability rates to be almost static over 20 years and even increasing in some younger age groups. However, Manton et al. (1997), using longitudinal data from the National Long-term Care Survey, found small but statistically significant reductions in prevalence rates, although similar evidence has not yet accumulated more widely. One reason for the differences is that cross-sectional survey techniques are not sensitive enough to pick up small changes over time.

Disability projections can be done either using a prevalence rate approach (i.e., combining assumptions on prevalence rates with assumptions on mortality, from which duration would follow) or a duration approach (i.e., combining assumptions on duration and mortality, from which prevalence would follow). Each approach has advantages and disadvantages. When applied to historical data from the UK, the duration-based approach (assuming the same duration of disability prior to death over the entire age spectrum) correctly predicts a steep exponential increase in prevalence at ages over 60; however, it overestimates prevalence for younger age groups. The etiology of disability in younger age groups differs from that in older age groups, and deaths prior to old age tend not to be preceded by long periods of disability. Because we place a premium on estimating disability across the age spectrum, we employ the prevalence approach, using the duration approach only for comparison purposes in older age groups and only for the most severe category. We assume prevalence rates are fixed at their initial-year values, recognizing that the results are likely to be at the upper end of disability estimates for older age groups.

In LDCs, both the prevalence and duration approaches are difficult to implement because of lack of disability data. Murray and Lopez (1996) have produced global regional tables of disability based on a different methodology in which levels and duration of disability are associated with the incidence of disease conditions. Inconveniently for IIASA's purposes, the results are expressed in 'severity-weighted' whole-year equivalents, making it difficult to obtain estimates of the *stock* of disabled, by severity, at a point in time. Nevertheless, their results provide useful pointers and background.

The issues are complex but their findings suggest two reasons why direct comparisons between MDCs and LDCs will be of only limited value. The first is that risk factors differ. In LDCs disability is common in younger age due to the generally poorer health status of the population, which is associated with risk factors such as poor nutrition, inadequate housing, high incidence of infectious and parasitic diseases, HIV/AIDS, etc. In MDCs, they argue, the main disability risk factor is simply growing old (others include accidents, tobacco, and alcohol). The second is that, due to low access to health care services, in LDCs long-standing disabilities often arise from untreated medical conditions. As risk factors change with overall economic development and access to medical care expands, it is likely that age-specific disability prevalence rates will change significantly. With this qualification in mind, we still present below the results of the exercise of applying the fixed-prevalence assumption to LDCs. We use MDC prevalence rates, recognizing that these are likely to result in lower-bound estimates of the disabled population in any age group. It may be, however, that projected age structure changes are much greater than likely changes in age-specific rates, in which case projected rates of change in the total disabled population will not be too far wrong.

More Developed Countries

Application of the OPCS UK disability rates to IIASA population estimates indicate how the stock of disabled persons will develop through time if these rates stay the same. Table 6 provides the key details indicating that the number of disabled is set to rise from 127.7 million in 1995 to 181.7 million in 2020 (1.4% pa growth) and 238.3 million in 2050 (0.9 % pa), an 87% increase over the period. The most rapid growth is set to occur in the most severe disability category, a function of the growing share of the population which is very aged (80+). Figure 7 shows the change in the disabled population through time summed over all three severity-categories. It shows that disability in very old age becomes dominant with the change occurring from around 2030 onwards.

After 2050 all age groups tend to level off or fall slightly as the age structure stabilizes. Figure 8 shows the distribution by age and severity category at two points in time, 1995 (left-hand side of the figure) and 2050 (right-hand side of the figure). Whereas in 1995 the number of disabled tails off in older age groups, by 2050 the oldest age groups are the most numerous across all categories. Those in the least severe category are always in the majority although there is convergence at very old ages as transfers take place to more severe categories.

Figure 9 compares alternative projections of the most severely disabled population aged 60+ and 70+. The projections plotted with solid lines are those presented above and were derived using the fixed-prevalence rate approach. Those plotted with dashed lines we calculated by combining an assumed duration of disability of 1.8 years (the figure derived from the OECD study cited above) with IIASA projections of life expectancy at 60 and 70. As is seen there is a close correspondence particularly in the early years between the prevalence in OPCS's 'most severe' category, but estimates diverge thereafter. The reason for this is that the fixed duration method scales by number of deaths, which are declining over time as age-specific death rates decline, whereas the fixed-prevalence method scales by population, which is increasing (obviously, elderly mortality rates are declining faster than the elderly population is growing). The gap between the two sets of projections is around 2 million in 2020, but increases to between 8 and 10 million by 2050 – a difference of 25%. As far as this study is concerned we conclude the overall disability projections are broadly robust in the early years, but need to be treated with more caution in later years, especially for older age groups.

Severity	*1995*	*2020*	*2050*
Most	19.6	29.6	44.1
Intermediate	35.8	51.4	69.6
Least	72.2	100.7	124.5
Total	127.7	181.7	238.3

Table 6: Projected number of people with disabilities in millions in MDCs by severity category in 1995, 2020 and 2050.

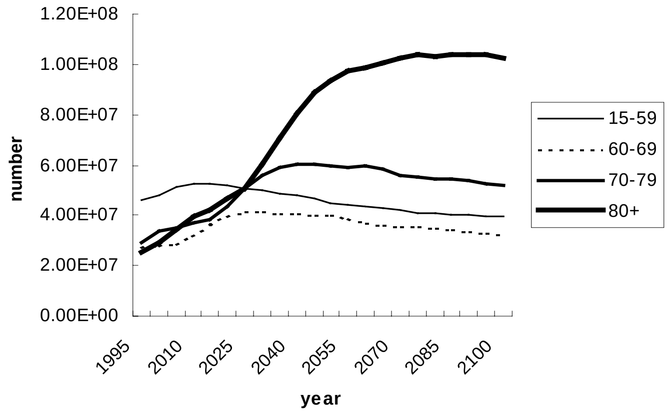

Figure 7: Projected number of people with disabilities in MDCs by age group, 1995 to 2050.

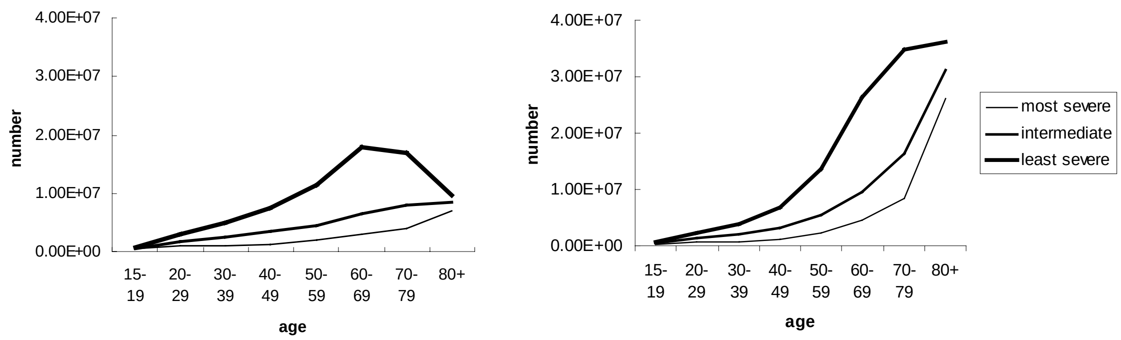

Figure 8: Number of disabled in MDCs, 1995 and 2050 by age group and severity category.

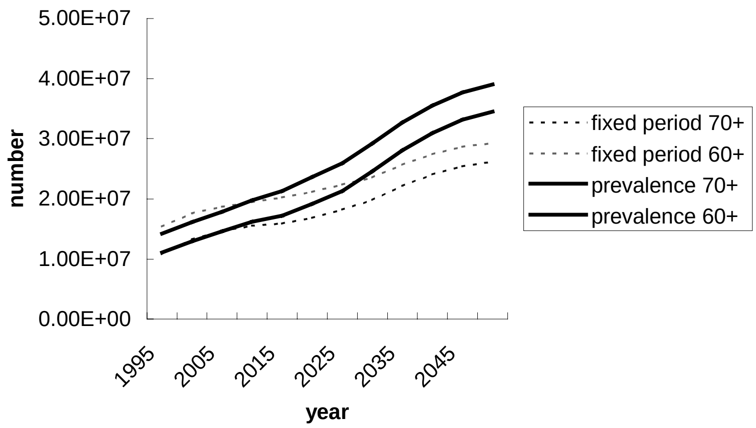

Figure 9: Comparison of estimation methods for the number of 'most' disabled over 60 years and 70 years based on prevalence and fixed period approaches, MDCs, 1995-2050.

Less Developed Countries

The results of applying MDC prevalence rates to LDCs are shown in Table 7 and Figure 10. The results for the initial year are much lower than UN global estimates of the disabled population (footnote 1). The UN estimates the number of disabled persons in MDCs in 1981 to be 100 million, which is in the same neighborhood as our estimate of 127 million for 1995 (see Table 5). Roughly speaking, then, the UN estimate of the disabled population in LDCs (400 million in 1981) is twice as high as the estimate in Table 7 (236.9 million in 1995). In part, this may be because we exclude age groups under 15; however, age specific disability rates under 15 are low. The UN does not elucidate how they arrived at their estimate, so it is difficult to reconcile the difference. However, it is clear that the returns to further research and data collection on LDC disability rates would have a large payoff.

We have already argued that, while we have little confidence in our estimates of the number of disabled persons in LDCs, we have more confidence in our ability to predict rates of growth. It appears safe to conclude that the disabled population in LDCs is set to grow more rapidly than in MDCs. In Table 7, we project growth at an annual average rate of 2.7% pa between 1995 and 2020 and 2.1% pa between 2020 and 2050, for a total increase of 263%. As in MDCs, the most rapid expansion is likely to be in the most severe category, whose numbers are projected to double between 1995 and 2020 and then double again between 2020 and 2050. Moreover, whereas in MDCs growth in the disabled population is projected to decelerate for all age groups save the very old (see Figure 9), in LDCs we expect continued growth across the age spectrum (see Figure 10).

Disability and the Provision of Welfare Services

Whereas our projections of health care costs were done directly on the basis of age-specific expenditure data, in the case of disability, no such data are available. A consideration of the sources of care, and the costs of each type of care, is required before we can proceed to expenditure projections.

Caring services present a diverse and complex structure. By far the biggest contributor is the informal sector, which is defined as services provided by family and friends. Up to 80% of all care is estimated to be channeled through the in formal sector in MDCs and probably over 95% in LDCs. The public and private and voluntary sectors complement the formal sector, and provide a variety of services ranging from long-term care in hospitals to day- and domiciliary services and other benefits in kind, such as transport and home meals. In this section, the aim is to present reasonably coherent estimates of how services may develop to meet projected increases in demand.

Severity	***1995***	***2020***	***2050***
Most	32.6	66.5	134.5
Intermediate	66.3	129.7	242.4
Least	138.1	269.2	482.6
All	236.9	465.4	859.4

Table 7: Projected number of disabled in millions in LDCs severity category in 1995, 2020, 2050 using OPCS prevalence rates.

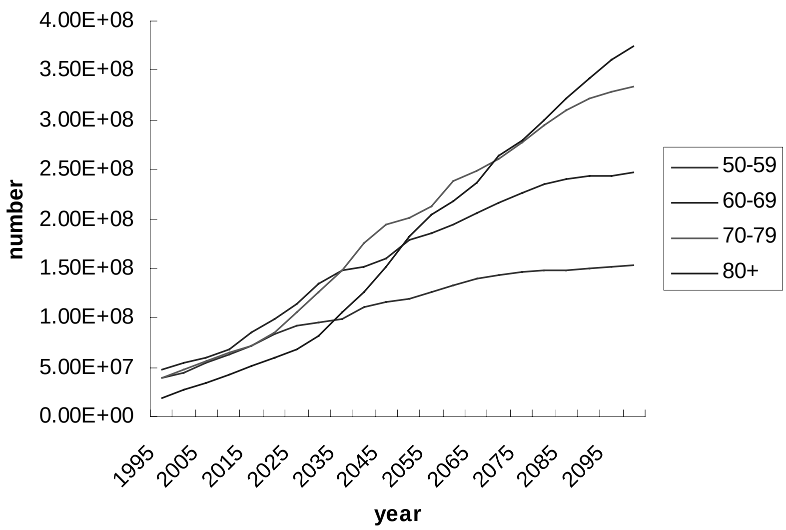

Figure 10: Projected number of people with disabilities in LDCs by age group, 1995 to 2100.

Supply of carers

Only fragmentary information exists for LDCs. Most caring takes place within the family or local community where there are strongly ingrained family traditions for looking after people in old age. In some communities, having children is still regarded as an alternative to a pension (World Bank, 1994), although other societal pressures and family planning policies are changing this. Countries facing up to an aging population, such as China, are developing more formal services particularly in cities, although it will be a long time before rural traditions built around family structures change. Our focus in this section is therefore mainly aimed at MDCs although some parallels are possible.

The ‘supply’ of carers is a factor determining future patterns of care, with demographic pressures (aging of the baby boom generation and consequent increase in the elderly dependency ratio) appearing to favor the formal sector. An increase in very aged (80+) population, it is argued, will put pressure on children who are the mainstay of the informal sector, forcing them to seek alternatives. In practice, the age structure of carers and their relationship to persons cared for is more complex. Indeed, the ages of people with caring responsibilities range equally over the key age groups and include spouses, friends and close relatives in addition to children (DSS, 1997). It may therefore be better to ignore familial relationships and use a different proxy for dependency entirely, comparing the total number of disabled to the able population in carer age groups.

If this approach is applied to the projections in the previous section, then the ratio of disabled to non-disabled over 55 years old in MDCs will stay at 0.5 until 2020 before rising to 0.6 in 2050, indicating a slight tightening in supply in the later period. The comparable picture in LDCs is for the ratio to remain at 0.5 throughout the projection period. Professional carers, by contrast, are drawn from people of working age. A comparable index of the supply of formal-sector carers would be the ratio of the disabled population over 55 to the able population aged 15-55. In MDCs, this ratio is projected to rise from 0.18 in 1995 to 0.37 in 2050; in LDCs from 0.10 to 0.18.

This approach is an oversimplification because it ignores other effects that might limit the supply of carers to the informal sector, such as changes in female labor participation rates or increases in retirement age. It suggests, however, that whereas public concern has focused on the tightening of the supply of informal carers, it is the supply of formal-sector carers that is more likely to be stretched, because of slower labor force growth. Focusing on children caring for parents, as opposed to the more complicated and nuanced picture observed in reality can be misleading.

Projecting services in the formal sector

The costs of informal-sector care consist mostly of the opportunity costs of time spent in unpaid caring at the expense of remunerated employment. The relationship between caring and employment is complicated. Therefore, we limit ourselves in this section (and in the projections that follow) to estimating costs of formal-sector care.

The pattern of consumption in the formal sector partly reflects demand, including the availability and affordability of different services, and partly other factors. For persons with a given level of disability and therefore needs there may several ways of providing the same effective care package based on different combinations of services in either sector. Table 8 is an example from the health management literature and shows equivalent levels of care provided for severely disabled persons under different care options (Bowen and Forte, 1997).

Care ‘experts’ have ranked each alternative, and it is seen that the most expensive form of care is not always the best in their view. For example, 52 weeks a year in a geriatric hospital is ranked higher as a care option than 52 weeks in a residential home. The best ‘package’ identified in this table for this group of clients is the home-based one backed up by home visits and time in a day hospital. The key points to note are that alternative care packages are suitable for different levels of disability and tend to be a mix of home and institutional care, whilst each care package itself has a different cost structure depending on the mix of services within the package. When this is extended to other groups of less disabled people, the tendency, not surprisingly, is for the number and level of services, e.g. health visitor, physiotherapist, ‘meals on wheels’, social worker, laundry, to taper off to, say, one check-up visit a year.

	Care package			
Service	*Option 1*	*Option 2*	*Option 3*	*Option 4*
Geriatric ward in hospital (weeks per year)	52			
Residential Home (weeks per year)				
Day hospital (attendances per week)		52	2	
Home visits (hours per week)			5	5
Home help (hours per week)			12	16
Preference order	2	4	1	3
Relative cost	5.8	1	3	1.4

Table 8: Care options for a severely disabled person in the formal sector (adapted from 'Improving the balance of elderly care services' (Bowen and Forte, page 78, in Cropper and Forte (1997).

It is convenient, for expenditure projection purposes, to base our analysis on similar concepts in which different care options are linked to severity of disability and in turn to the relative costs of care in each mode. Ideally we wish to allocate each disability category to a unique care package, but the reality is that each category will be distributed across options depending on the local institutional environment and cost structures. However, data deficiencies prevent a full and accurate analysis.

Detailed studies by the Department of Health in the UK during the 1980s using the 'Balance of Care' model recognized 29 disabilities categories and 10 care options (for description of model see McDonald, Cuddeford and Beale, 1974). Each care option was broken down into component services so that for a given client group and care option it was possible to identify how many visits a week to their house by type of worker, how many weeks a year were spent in hospital and so on. We have collapsed these 29 disability categories into the three severity categories used here and defined four basic care options – hospital, residential home, day care and home (domiciliary) care. The results (see Table 9) show, as might be expected, a tendency for the most severely disabled to be cared for in hospitals or residential homes although the majority, regardless of severity category, are looked after in a domiciliary environment.

It is particularly interesting to note that institutional care for the most severely disabled is not automatic. This finding is consistent with the more representative survey conducted by OPCS, but is in conflict with some other studies that assume the severely disabled are all in long-term care institutions (for example, see Jacobzone et al., 1998). Such assumptions seem unhelpful in trying to understand properly how these allocative processes operate and ignore the desire of many disabled, regardless of their condition, to remain at home.

	Hospital	*Residential*	*Day*	*Domiciliary*	*Total*
Most	12.9	12.8	10.5	63.8	100
Intermediate	3.1	17.5	7.7	72.6	100
Least	0.39	10.9	9.7	78.9	100

Table 9: Distribution of severity by types of care. Adapted from Balance of Care Studies in the UK.

We used these distributions to provide exploratory indications of demand in MDCs for different types of care assuming previous population projections and age-specific disability prevalence rates, and assuming the split between formal and informal care remains in the ratio of 20:80. The results show a growth of between 40% and 45% in the number of clients in each care category. However, to obtain the full picture one also needs to address not only market shares, but also financial flows. There are several reasons why this is difficult (Carr-Hill, Dalley, 1999).

They include changing Governments' policies in which the trend is to place more responsibility on the individual for care in old age (see for example, Sutherland 1999). There is a lack of information particularly about the private sector, but also some hidden 'subsidies' through help with housing costs within the social security benefits system. Another issue is the relationship between the hospital and residential and community care sectors which are the responsibility of government departments and agencies. Some of the growth in the residential care sector from the mid-1980s can be attributed to policies moving long-term elderly patients out of hospitals and into cheaper accommodation, a trend that also accords with the general views of experts who argue the benefits of community and domiciliary care over hospitals.

Then there is the issue of the relationship, already discussed, between the formal and informal sectors, the formal sector comprising state-run, private and voluntary institutions. One might expect the formal sector to grow faster if the public sector decides to spend more on welfare services than in the past, if old people change their established behavior from wishing to be independent to being dependent, or if the opportunity costs of informal care rise relative to costs in the formal sector.

In this study we restrict ourselves to aspects where there is sufficient information to draw some general conclusions about how caring services might develop into the future based on trends in aging, population change and elderly needs. We used the above-mentioned studies to investigate the level and type of resources used up within three care options, residential, day and home care. We excluded hospital care because its effects are subsumed in previous projections of health care costs, but we tabulate the cost weights for comparison.

Altogether three types of accommodation were considered, three types of community (day) service and ten types of domiciliary service. Each care option includes a mix of services, so for example 'day' will include a certain amount of home-based and medical services. As with the Bowen-Forte example in Table 8 above, resource usage was expressed in relative terms according to each care option and the level of disability giving twelve cost-weightings in all (see Table 10), nine of which are incorporated in the estimation methodology.

Severity	*Hospital*	*Residential care*	*Day care*	*Home care*
Most	10	2.8	1.6	0.9
Intermediate	4	2.8	1	0.7
Least	3.9	2.6	0.4	0.3

Table 10: Cost weightings for different care options used in index (adapted from UK study by Department of Health).

Using the severity-based disability projections, and probability distributions of individuals being cared for in each care environment (assumed to remain constant), we weighted the results by the cost weightings (also assumed to remain constant) to generate an expenditure index which is a function of disability numbers, care options and relative costs. We then anchored the index to 1995 for reasons that will become apparent below.

The index is expressed as follows:

$$I_k(t) = \frac{\sum_{i,j} P_i(t)\delta_{ij}(0)\sigma_{jk}(0)c_{jk}(0)}{\sum_{i,j,k} P_i(0)\delta_{ij}(0)\sigma_{jk}(0)c_{jk}(0)}$$

where

$I_{I(}(t)$ = Index of expenditure for option k (residential care, day care, home care)

$P_i(t)$ = Population in age group i time period t

δ_{ij} = proportion of age group i in disability severity class j

σ_{jk} = proportion of severity class j cared for in care option k (hospital care is excluded)

c_{jk} = relative cost of option k in severity class j

As in the case of the health expenditure previously, the rate of growth of this index can be decomposed into two rates, one population-related and the other underlying. Assumptions on the latter can be combined with IIASA's population projection to project the index forward in time.

The OECD social expenditure database provides public expenditure figures on services for the elderly in our three categories from 1980 to 1995. It shows a dip in the early 1980s corresponding to the recessionary period followed by strong growth in the sector averaging over 7.5% pa between 1984 and 1995. Only a small proportion of this growth is related to aging, with the rest more suggestive of rapidly evolving market conditions (growth of the public sector at the expense of the private sector, growth of the private formal sector at the expense of the private informal sector.) Unfortunately data only start at 1980 and so the series is not long enough to infer long-run trends. It seems, however, that the two main areas of growth have been in residential care and domiciliary (home) services with day services remaining relatively static. Total public expenditure on disability-related services accounts for a much smaller proportion of GDP than public expenditure on health. The figures suggest something between 0.5% for countries like the US to over 2.5% for some Scandinavian countries. As far as can be determined these differences are attributable to the differing shares of the private sector (for which little comparative data are available) rather than to fundamental differences of approach to disability.

To provide some measure of comparison we used the OECD public expenditure historical time series (1980-95) to create a new statistical series in which we set 1995 equal to 100. We then applied growth rates calculated from projections of the index above to "grow" the OECD data series forward into the future.

In the health sector, we assumed an underlying growth rate of 3% pa. We expect, however, that Governments will be more effective in containing the cost of disability care than they have been in the case of heath care. First, health care is in significant degree demand-driven, as persons who would not otherwise consume health care do so as their income rises, as services become more easily available, etc. No one, by contrast, demands to become disabled. Second, Governments have traditionally contained costs of welfare and long-term care services by rationing the of public formal-sector care, effectively concentrating care in the informal sector where most carers are women. There is no sign that they are likely to abandon this strategy. On the assumption that the underlying rate of growth in disability-associated expenditures will be certainly no higher than the underlying rate for health care, we therefore consider three scenarios, 1%, 2% and 3% pa. The same underlying growth rate is applied to each of the three care arrangements (residential, day care, home care).

Figure 11 plots the results for the case of 1% underlying growth, the period up to 1995 representing OECD data and the period after 1995 representing the forward extrapolation based on projected growth in our index. Note that each of the three curves ‘splices’ on to the OECD series reasonably well, that is, there is no abrupt change of slope to be observed 1995.

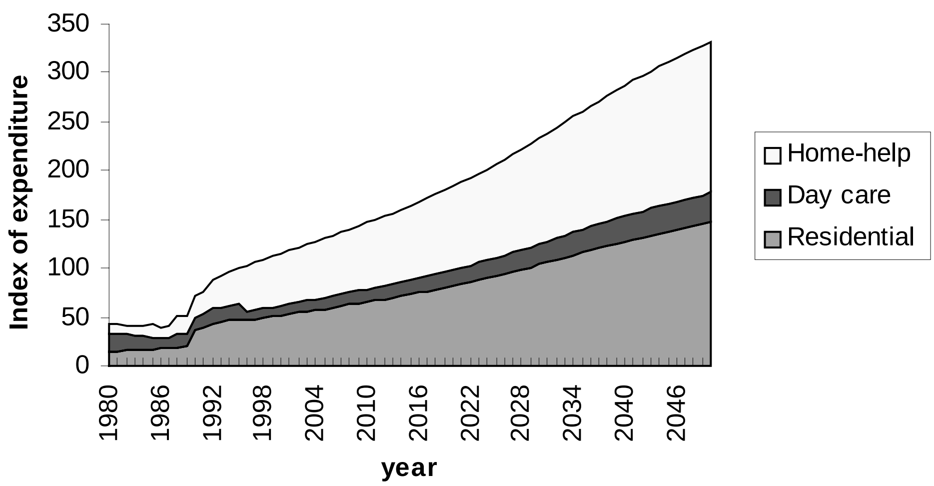

Figure 11: Growth in public expenditure on welfare services based on population aging and an assumed 1% pa underlying rate of growth.

The results show a roughly 50% increase in expenditure between 1995 and 2020 followed by a doubling between 2020 and 2050. As is seen from Table 11, however, the impact on the share of disability-related expenditure in GDP is relatively small even when the underlying growth rate is assumed to be higher. The main conclusion therefore is that welfare services, in terms of their pressure on public expenditure, are less than might be expected from the large increases expected in the numbers of people with disabilities. This conclusion is based, as we have stressed, on the assumption that the informal sector continues to supply the bulk of care and that the public-private split in the formal sector remains unchanged. The figures in Table 11 should not be construed to mean that the broad economic impact of disability is modest, as such an assessment would require much more analysis of the informal sector.

	1995-2020	2020-2050
Welfare growth (% pa) due to aging	*1.44*	*3.65*
% of GDP (at end of period)		
underlying rate of growth		
1% pa	0.98	1.5
2% pa	1.1	2.4
3% pa	1.4	4.2

Table 11: Public expenditure of welfare services, rates of growth and GDP share.

Conclusions

The results indicate that health care will continue to consume a greater proportion of national income in both regions. In MDCs, whereas population growth was the main cause of growth between 1960 and 1995, aging will overtake it as the main demographic cause of health expenditure increase. In LDCs, population growth will also give way to aging, but not until after 2050. These conclusions are fairly robust in the sense that quite large changes in the per capita health expenditure weights for the very old make only a small difference to the outcome in terms of GDP share.

Thus, even if it is assumed that countries achieve some success in controlling health care costs for higher age groups, health expenditures will still rise unless there are accompanying reductions in the underlying growth rate, through, for example, greater use of rationing or effective preventive programs. As far as the IIASA model is concerned, the historical pattern of development and the altruistic, high-profile nature of the health care system suggest that it is more realistic to the underlying growth rate is exogenous, with additional growth deriving from population aging and change. Precise assumptions about the underlying growth rate can be adjusted for use in different scenarios.

The other impact of aging considered in this study is on welfare services. Large increases in disability are predicted due to aging regardless of the methodology used. The association between aging and disability will lead to potentially large increases in the numbers of people requiring care in both MDCs and LDCs, although the estimates for LDCs are much less certain. Whereas in MDCs the number of disabled is projected to plateau by around 2050 (earlier for age groups apart from the very old), the number of disabled in LDCs will continue to grow. The amount of growth is sensitive to how disability is measured and assumptions about the biological processes of aging and whether healthier lifestyles will reduce the incidence of chronic disease in the medium term. So, there remains much uncertainty as to the precise levels.

The role of welfare services is also difficult to predict partly for this reason, but partly also because of the dominance of the informal sector. For example, if all informal care were to be charged at the same rate as formal care, welfare services would count for as greater share of GDP as health (see Laing and Buisson, 1998).

Data for the formal sector indicate a fast-growing, but relatively immature industry whose growth is susceptible to Government intervention and regulation. The future is therefore inherently difficult to predict and experience indicates that the expected demographic pressures may not translate mechanistically into more nursing or residential accommodation. Insurance markets for disability-related nursing care are still in their infancy but may, if they take off, induce more flows from the informal to the formal sector. In any event the share of GDP and private expenditure on long-term care is likely to remain at fairly low levels for some while and therefore its impact within the IIASA model will be small overall.

However, the impact within the relevant age groups will, it seems, be greater. Analysis suggests that the supply of informal carers is likely to decline in MDCs although not by as much as expected. Those elderly people needing institutional care will be expected to contribute more from their personal income and wealth to their upkeep. In addition, a shrinking workforce may lead to shortages in professional carers, which could lead to increases in costs. Any shortfall might well lead to additional migration of labor from LDCs to MDCs, particularly females in caring professions. These details will need to be tracked carefully within the IIASA model and updated to reflect behavior and as government policies change. For now, it is proposed that welfare services are also handled exogenously in the model for the simple reason that it is easier to keep a grip on the assumptions and outputs.

Annex: Overview of Method Used to Measure Disability

This annex gives an overview and examples of the measures and scales developed by the Office for Population and Censuses in the UK (Martin *et al.*, 1988) which was used to produce age and sex specific disability prevalence rates for 10 different categories of severity. The original methodology, which has been used many times since and is still being developed and refined, draws on the conceptual framework developed in the World Health Organization's International Classification of Impairments, Disabilities and Handicaps (ICIDH).

The ICIDH identifies the following separate consequences of disease: impairment, disability and handicap.

- *Impairment* is defined as 'any loss or abnormality of psychological, physiological or anatomical structure or function', in other words, parts or systems of the body that do not work.
- *Disability* is defined as 'any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being', or things people are unable to do.
- *Handicap* is the relationship between impaired and/or disabled people and their surroundings and refers to 'a disadvantage for a given individual, resulting from an impairment or disability, that limits or prevents the fulfillment of a role (depending on age, sex and social and cultural factors) for that individual'.

Disablement refers to all three consequences of the disease or trauma. To give an example, someone with a particular impairment, such as diabetes, would not be considered disabled if this had no effect on his or her ability to undertake normal activities. If, however, such activities were restricted by the disease or its sequelae (perhaps because of consequent vision or heart problems), then he or she would be classified disabled. If these disabilities disadvantaged a person in their daily life, such as an inability to work or participate socially, then the person would be considered handicapped.

Preparatory work for these surveys included construction of separate measurement scales in ten areas of disability:

Locomotion
Reaching and stretching
Dexterity
Seeing
Hearing
Continence
Communication
Personal care
Behavior
Intellectual functioning

Professionals provided input with expertise in disability, researchers, professional carers, voluntary organizations, and members of the Department of Health and Social Security (over 100 in all). Judges were asked to place combinations of different disabilities on a 15-point scale. The combinations differed according to the disabilities included, their levels of severity, and so on. Using statistical techniques to model the judge's placements for each combination of disabilities, it was found that by taking into account only the three most severe disabilities and their severity scores a correlation between the judges' ratings and the model could be achieved. This produced the following formula:

Worst + 0.4 (second worst) + 0.3 (third worst)

This was applied to everyone in the survey drawn from the population of Great Britain and the disability scores were placed into 10 categories ranging from most severe (10) to least severe (1). Scores are placed in bandwidths equal to 1.95; for example, some one with a score of between 17 and 18.95 would be placed in category 9, whereas someone with a score between 11-12.95 would be placed in category 6. There is no absolute meaning to terms such as severe and very severe. In this study the ten categories are grouped into three for convenience only:

'Most' severe (categories 8-10),
'Intermediate' severity (categories 5-7)
'Least' severe (1-4)

Note that persons with only one or two minor disabilities score zero. How each of these categories are related and how people may be judged may be seen from the examples below, also based on Martin et al., 1988.

A selection is reproduced here to give a picture of what is implied by allocation to a particular severity category. Many more examples are provided in the reference cited.

Examples of placement into severity categories

Severity Category 1 Man aged 59: deaf in one ear; overall severity score 1.5 [severity category 1]; *hearing score* 1.5; difficulty hearing someone talking in a normal voice in a quiet room.

Severity Category 2 Woman aged 71: angina; eye problem. Overall severity score 4.25 [severity category 2]. *Locomotive score* 3.0; cannot walk 200 yards without stopping or severe discomfort. *Seeing score* 1.5; cannot see well enough to recognize a friend across the road; has difficulty seeing to read ordinary newspaper print.

Severity category 6 Man aged 65: arthritis in spine and legs; stroke affecting right side; heart condition. Overall severity score 11.55 [severity category 6]. *Locomotion score* 7.0; always needs to hold on to something to keep balance; cannot bend down and pick up something from the floor and straighten up again; can only walk up and down a flight of ten stairs if holds on and takes a rest; cannot walk 200 yards without stopping or severe discomfort. *Reaching and stretching score* 6.5; has difficulty holding arm in front to shake hands with some. *Dexterity score* 6.5; has difficulty picking up and pouring from a full kettle or serving food from a pan using a spoon or ladle; has difficulty unscrewing the lid of a coffee jar or using a pen or pencil; can pick up a small object with one hand but not the other.

Severity category 10 Man aged 55: stroke; overall severity score 19.05 [severity category 10]. *Locomotion score* 11.5; cannot walk at all. *Personal care score* 11.0; cannot feed self without help; cannot carry out following without help: get in and out of bed; wash all over; get in and out of chair; wash hands and face; dress and undress; get to toilet and use toilet. *Dexterity score* 10.5. Cannot carry out any activities involving holding, gripping and turning. *Reaching and stretching score* 9.0; Cannot put either arm up to head to put a hat on; cannot put either hand behind back to put jacket on or tuck in shirt; has difficulty holding either arm in front to shake hands with someone. *Communication score* 5.5; is very difficult for strangers to understand. *Continence score* 2.5; loses control of bladder at least once a month.

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