

# The impact of changing patterns of disease on disability and the need for long-term care

Carol Jagger, Ruth Matthews, James Lindesay and Carol Brayne

*Summary: Projections of need for long-term care generally assume constant age-specific disability prevalence or reductions based on the improved health of incoming older cohorts. Explicit linkages to trends in disabling diseases are rarely made. We address this through a macro-simulation model, SIMPOP, with three health scenarios: (i) constant age-specific disease prevalence; (ii) reduced disease prevalence and disease-specific disability; and (iii) continued trends of increasing disease prevalence and disabling effect. We find that assumptions of constant or reduced age-specific disability prevalence in all age groups over the next 20 years still result in large increases in the numbers requiring long-term care.*

*Keywords: Ageing, disability, simulation model, age-related disease, long-term care.*

Disability, as measured by the ability to undertake basic activities of daily living (ADLs) for self-care, is a major driver of the need for long-term care (LTC). Projections of future need for LTC generally assume that either the prevalence of disability will remain constant within age groups or that it will reduce as incoming cohorts of older people are healthier. The latter view is not universally held; an OECD review of the trends in ability to self-care at age 65 and over found that only half of the eight countries included showed clear decreases in disability rates.<sup>1</sup> Moreover evidence for this in the United Kingdom is equivocal, with one study suggesting an increase of 31% in the prevalence of moderate disability in the young old (65–69 years) between 1991 and 1997<sup>2</sup>, whilst another reported a decrease in high dependency between 1998 and 2008 of 6% in men and 39% in women.<sup>3</sup>

Focussing solely on disability as a driver of LTC neglects the fact that all conceptual models of the disablement process begin

with active pathology or disease.<sup>4</sup> Cardiovascular and cerebrovascular disease, sensory problems (vision and hearing), arthritis, incontinence, dementia and depression are major causes of late-life disability<sup>5</sup> and there have been considerable temporal changes in a number of these. However, very old age, where demand for LTC is greatest, is not characterised by single diseases but by multi-morbidity.<sup>6</sup> In addition to the co-occurrence of disease, treatments for one disease may have beneficial effects for others whilst lifestyle factors such as smoking and obesity, the latter with increasing prevalence over time, are risk factors for a number of diseases. Not only do these relationships cast doubt on the assumption that age-specific prevalence rates of disability will remain constant, but they also imply that projecting disability through models of single diseases and their risk factors is unrealistic. This article reports the findings from a macro-simulation model, SIMPOP, on how trends and treatments in multiple

chronic conditions: arthritis, coronary heart disease (CHD) and strokes, as well as dementia and cognitive impairment, might impact on disability and the future demand for LTC. It is worth noting that assumptions about future disability levels have a very important impact on future expenditure on LTC\*.

## Modelling the impact of multiple diseases on disability

The macro-simulation model, SIMPOP, projects the number of older people (aged 65+ years) with disability from two-year transition probabilities to and from disability and to death derived from the MRC Cognitive Function and Ageing Study (MRC CFAS),<sup>7</sup> and then applied to the 1992 mid-year England and Wales revised population estimates. Disability was based on inability to perform activities of daily living and chosen to be parsimonious with a model of LTC needs and costs.<sup>8</sup>

Disability prevalence at baseline (1991–92) ranged from 3.7% at 65 to 66 years to 58.7% at 91 years and over. The sixteen diseases and conditions included in the

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\* In Comas Herrera *et al* in this issue, the disability scenarios presented here are used to show how sensitive future LTC expenditure will be to changes in disability.

model were generally self-reported, although diagnostic scales were used for angina, peripheral vascular disease and cognitive impairment. Estimates of the prevalence of CHD (defined as heart attack and/or angina), stroke, arthritis, diabetes and Parkinson's disease in 2006 from SIMPOP were compared to the Health Survey for England (HSE) 2005,<sup>9</sup> and were found to be close, the exception being diabetes whose prevalence was then increased in SIMPOP to national values. More detail on SIMPOP and the measures are available.<sup>10</sup> The condition with the highest prevalence was arthritis which was reported by 52.3% of the 65+ population at baseline.

### Health and disease scenarios

Three parameters for each disease could be altered in SIMPOP to mimic future changes in mortality and morbidity: the disease prevalence and the probabilities of death and disability within two years conditional on the disease. To inform the magnitude of change, literature on arthritis, stroke, CHD and dementia, in both those currently aged 65 years and over and in those who would be 65+ by 2030, was systematically reviewed for evidence on: trends and risk factors; disease-specific disability; preventive strategies and treatments and their efficacy, cost-effectiveness and diffusion.<sup>11</sup> Given the paucity of data on the impact of interventions in any of the disease areas, particularly on disability, we assumed a change of 5% in either the transition probabilities to onset of disability or to death to represent a small impact, and 10% a moderate impact. Based on the reviews, three global scenarios were developed and applied to SIMPOP to produce numbers of older people with and without disability and age-specific disability and disease prevalence from 2010 to 2030 (Box 1).

### Projections under different health scenarios

The Central Health Scenario suggests that between 2010 and 2030 there will be an increase of 49% in the total older population (65+), from 9.2 million to 13.7 million, although there will be a much greater rise in the numbers with disability (89%, 901,000) (Table 1). This results from the rising numbers of older people with key disabling diseases which occur despite the scenario's assumption of constant disease prevalence, since numbers in the 85 and over age group increase by 139% over the time period in contrast to the 65–74 age

#### Box 1: Global health scenarios modelled in SIMPOP

##### *Central Health Scenario*

Prevention strategies and effective treatments offset the negative influences of obesity and other cohort trends; for example, the emergence of ethnic minorities (with increased CHD, stroke and diabetes) into older cohorts. Age-specific prevalence of diseases, incidence of, and recovery rates to dependency, all remain at 2006 levels and mortality rates decline at levels commensurate with the Office for National Statistics principle projections.

##### *Improving Population Health Scenario*

Individuals take their health seriously with a decline in risk factors, particularly smoking and obesity, reducing the prevalence of stroke, CHD, arthritis and mild cognitive impairment (CI) (by 2% every two years from 2012). The health service is responsive with high rates of technology uptake for disease prevention and excellent diffusion rates of treatments to all who can benefit, particularly in terms of control of vascular risk factors (10% decrease in disability onset for arthritis, stroke, CHD and mild CI from 2012 and a further 5% reduction in mortality from stroke, CHD and mild dementia from 2016). New cohorts of older people are healthier than previous ones (5% reduction in prevalence of disability for each cohort).

##### *Continuation of Current Trends Scenario*

Current obesity trends of 1–2% increase annually continue, resulting in higher prevalence of arthritis, stroke, CHD and vascular dementia (2% increase every two years from 2012) but also their associated disability (10% increase in onset of disability for these diseases). Ethnic minorities enter the older population in significant numbers and add to the prevalence of stroke and CHD. Treatments continue to focus on reducing mortality (further 5% reduction in mortality from stroke, CHD and mild CI from 2016).

group which increases by 41%. Moreover, growth in the numbers aged 85 and over has two further consequences. Firstly, there are different proportionate increases in diseases, from 40% for diabetes to 80% for dementia, the prevalence of the latter rising more strongly with age. Secondly, the prevalence of disability increases (Table 1), showing that constant disease prevalence with population ageing does not imply constant disability prevalence.

Improvements in the prevalence of disability for the incoming cohorts (65–66 year olds) in the Improving Population Health Scenario have a modest effect on the numbers with disability and prevalence by 2010, mostly in the youngest age group (Table 1). Further reductions in mortality due to disease prevention will cause the size of the older population as a whole to increase further, by 52% with 172,000 fewer disabled older people than under the Central Health Scenario. Nevertheless, these reductions are relatively small when compared to the extra numbers requiring LTC under the Central Health Scenario, some 901,000 between 2010 and 2030. In addition, with this level of health improvement the prevalence of disability still increases, by 2.4% in those aged 85 plus (Table 1).

If current health trends continue there will be slightly fewer older people in total than projected under the Central Health Sce-

nario and marginal increases in the numbers with disability and diseases, particularly stroke and dementia. But the prevalence of disability at a level that will require LTC will rise by over 10% in the oldest old.

### Conclusion

How realistic are the scenarios that we have explored and why were they selected? The Central Health Scenario assumes a 'status quo' in that levels of disease and onset and recovery from disability will remain at the same levels as they were between one and two decades earlier. This scenario may also reflect that any positive health changes, such as reductions in risk factors or more effective treatments for disease, are offset by the changing composition of new cohorts which will comprise greater proportions of ethnic minorities, particularly those from South Asia, who are known to have high rates of CHD, diabetes and stroke, though little is known of whether the disabling effects of these diseases are the same as for the white population. Thus, the Central Health Scenario can be thought of as representing the effect of population ageing alone. This scenario clearly shows that population ageing will result in an increasing trend in disability prevalence and a substantial increase of almost one million in the numbers of older people needing LTC, many of these being the very old with multiple diseases

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**Table 1: Simulated total and disabled populations (thousands) aged 65+ for Central Health Scenario, Improved Population Health Scenario and continuation of current trends**

	2010	2020	2030
<b>Central Health Scenario<sup>a</sup></b>			
Total population (1,000s)	9,181	11,224	13,663
Disabled population (1,000s)	1,011	1,366	1,912
Prevalence of disability			
65+ (%)	11.0	12.2	14.0
65-74 (%)	5.2	5.5	5.4
75-84 (%)	11.9	12.7	13.5
85+ (%)	31.1	34.7	37.9
<b>Improved Population Health Scenario<sup>b</sup></b>			
Total population (1,000s)	9,189	11,324	14,033
Disabled population (1,000s)	985	1128	1740
Prevalence of disability			
65+ (%)	10.7	10.7	12.4
65-74 (%)	4.7	4.5	4.1
75-84 (%)	11.9	11.8	12.0
85+ (%)	31.1	32.3	33.6
<b>Continuation of Current Trends Scenario<sup>c</sup></b>			
Total population (1,000s)	9,181	11,186	13,438
Disabled population (1,000s)	1,011	1,431	2,058
Prevalence of disability			
65+ (%)	10.7	12.8	15.3
65-74 (%)	4.7	5.7	5.8
75-84 (%)	11.9	13.4	15.2
85+ (%)	31.1	36.7	42.7

Notes:

<sup>a</sup> Assumption of no change in age-specific prevalence of disease, incidence and recovery rates to disability, and mortality rates continuing to decline at levels commensurate with Office for National Statistics principal projections.

<sup>b</sup> Assumption of reduction in the prevalence of arthritis, stroke, CHD and mild dementia by 2% every two years from 2012 and for moderate/severe dementia every two years from 2016, a 10% decrease in disabling consequences of arthritis, stroke, CHD and mild dementia from 2012, a further 5% reduction in mortality from stroke, CHD and mild dementia from 2016, and prevalence of disability in 65-66 year olds reducing by 5% every two years.

<sup>c</sup> Assumption of increase in the prevalence of arthritis, stroke, CHD and mild dementia by 2% every two years from 2012 and for moderate/severe dementia every two years from 2016, a 10% increase in disabling consequences of arthritis, stroke and CHD from 2012 and a further 5% reduction in mortality from stroke, CHD and mild dementia from 2016.

and conditions, and with 80% more older people with dementia.

Evidence for reductions in the levels of disability in the older population worldwide are varied.<sup>1,12</sup> Even in countries such as the United States where declines have occurred in the region of 1-2% per year over the last 20 years, these are alongside increases in the prevalence of chronic disease, suggesting that more effective treatments and greater use of assistive technology are

allowing older people to remain independent. Our choice of reductions of 2% every two years is therefore conservative in US terms but optimistic for countries such as Sweden where disability prevalence has increased. More importantly, assumptions that the prevalence of disability will remain constant are optimistic since even with improving population health, disability prevalence in the very old has continued to increase. Our worst-case sce-

nario assumes a continuation of current health trends, although the ageing of the Asian population in the United Kingdom, with its higher levels of CHD, stroke and obesity, suggests that this scenario may be optimistic. If current levels of health prevail and obesity trends continue, the older population with disability at a level that will require care will almost double between 2010 and 2030. Thus, efforts should now be focused not only on disease prevention but on slowing down the progression to disability.

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## Disability, dementia and the future costs of long-term care

Adelina Comas-Herrera, Juliette Malley, Raphael Wittenberg, Bo Hu and Carol Jagger

*Summary: Increasingly sophisticated efforts to project future long-term care (LTC) expenditure highlight that this is very sensitive to assumptions made about future rates of disability and dementia. This article reviews different ways of formulating such assumptions and gives examples of their impact on future LTC expenditure projections in England. Using disability scenarios from an epidemiological model (based on assumptions about chronic diseases and their outcomes and expected treatments), suggests that assuming constant prevalence of disability may be optimistic. The projections indicate that investing in cost effective public health and management of chronic conditions measures that moderate disability or slow down the progression of dementia may produce good returns in terms of reducing the future costs of LTC.*

*Key words: disability trends, dementia, long-term care expenditure, compression of disability, chronic conditions*

As the numbers of older people rise, so do concerns about future levels of expenditure on long-term care (LTC) and how this care should be funded. In the last decades there have been increasingly sophisticated efforts to project future LTC expenditure, both at national and international levels. As LTC services are very labour intensive and there is limited scope for productivity improvements,<sup>1</sup> the idea that future LTC costs could be contained as a result of care needs not growing as fast as the future number of

older people has attracted a great deal of attention. However, in many countries there is no evidence that this may be the case.<sup>2</sup>

Projections of LTC demand and associated expenditure have shown that relatively small changes in the prevalence rates of functional disability can have a substantial impact on future expenditure.<sup>3,4</sup> This means that it is important to choose carefully the assumptions made about future

disability and dementia rates of older people, as increases in the future numbers of older people may not necessarily be accompanied by increases of the same magnitude in the number of people requiring LTC.

#### Projecting LTC expenditure

This article reviews different approaches to choosing assumptions about the future care needs of older people, including: extrapolation from past trends; hypothetical decreases in prevalence rates in order to take into account changes in life expectancy; asking experts for their views about the future; and projections based on expected changes in the prevalence of chronic conditions and mortality rates.

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