

# Demographic change and the future demand for public hospital care in Australia, 2005 to 2050

Deborah J Schofield and Arul Earnest

## Abstract

**Background:** Over the next 45 years the Australian population will age rapidly as the baby boomer cohort moves into retirement and then old age. As the population ages there will be substantial growth in the demand for hospital bed-days, placing a corresponding demand on infrastructure and staffing.

**Methods:** Australian Bureau of Statistics population projections to 2050 and Australian Institute of Health and Welfare public hospital bed-day data from 1993–94 to 2003–04 were used to develop models of future demand and examine the sensitivity of the results to model assumptions.

**Results:** Over the long term, demand for public hospital bed-days was projected to grow faster than population growth. By 2050, ageing will increase the demand for bed-days by between 70% and 130% depending on the underlying assumptions, and the proportion of bed-days devoted to older people will increase from under 50% in 2005 to over 70%.

**Conclusions:** Ageing of the population will increase the demand for health services just as it will become harder to recruit health professionals as the large baby boomer cohort retires from the health workforce. Accordingly, we need to plan now to ensure future needs of the ageing population are met.

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## What is known about the topic?

Ageing of the Australian population will drive expenditure on health services. At the same time the health workforce is ageing, leading to labour shortages which will present challenges for providing health services.

## What does this paper add?

While we now anticipate increased expenditure due to ageing we do not have Australian estimates of how this will translate into increased demand for services. There are some international short- and medium-term projections of the demand for hospital services, however they acknowledge that the projections do not capture the later period when the baby boomer cohort will pass into old age when the greatest demand is placed on hospital services. This paper provides those long-term projections.

## What are the implications for practitioners?

Over the long term, demand for public hospital bed-days was projected to grow faster than population growth with an increasing proportion of bed-days devoted to older people. However, this will occur during a period when it will become harder to recruit health professionals as the large baby boomer cohort retires from the health workforce. ♦

**AGEING OF THE POPULATION** and new technologies will see significant shifts in the demand for health care impacting on all health programs including public hospital services. It is particularly important to plan ahead to ensure the adequacy of health services in the future, as training staff and building health care facilities takes time.

In Australia there have been two significant studies demonstrating how these two factors will drive up the costs of Australian Government spending on health from about 4% to about 8% of gross domestic product in 40 years time.<sup>1,2</sup> Ageing of the health workforce is also likely to lead to a shortage of key hospital health professionals at the very time that demand for their services is increasing. However, while work has

been published on future workforce shortages,<sup>3-5</sup> there has been very little on future demand.

The small body of international work projecting demand for hospital bed-days can be grouped into two types: those that take account of the impact of population growth and ageing (demographic change) only, and those that take account of both demographic change and changes in trends in the use of hospital bed-days. The Manitoba Centre for Health Policy projected hospital bed needs to 2020 using both approaches.<sup>6</sup> They found that the two models produced quite different results because the models including trend changes in bed-day use captured a continuing per capita decline for about 20 years. As a result, they concluded that fewer total bed-days may be required in 2020 than in 2002. However, they also noted that in 2020 the sharp increase in demand from “baby boomers” ageing will just be beginning.<sup>6</sup> The Hawaii Health Information Corporation undertook a very similar analysis for Maui, projecting hospital bed needs from 2005 to 2025.<sup>7</sup> The Health Services Utilization and Research Commission projected future levels of health services for hospital beds and other services based on district acute beds per 1000 population for Saskatchewan and population projections to 2015,<sup>8</sup> but did not take account of any trend changes in bed use.

In 2000, the Department of Health in England released 20-year projections to the year 2019–20 for various health programs (such as maternity). The authors noted that “looking beyond 2020, demographic pressures will become more significant as ageing accelerates”.<sup>9</sup> They raised concerns that the decline in staffed hospital beds may have gone too far, and pointed to the length of hospital waiting lists, although it was also noted that at the time no country had yet seen an end to the trend towards decreased length of stay. Mouza produced minimum and maximum estimates of bed requirements for Greece to 2011, where the estimates varied according to high and low estimates of hospital admissions.<sup>10</sup>

In this paper we make long-run projections of the demand for hospital bed-days in Australia. The estimates to 2050 took account of the period of

rapid ageing of the population when baby boomers will place their greatest demand on the hospital system. We also examined trends in the use of hospital bed-days and how these may impact on future demand. In addition, we undertook sensitivity analysis by examining the impact of the population change alone and increasing longevity, as well as using high and low population projections produced by the Australian Bureau of Statistics.

## Methods

Estimates of future demand were calculated on the basis of ageing and population growth as well as non-demographic trends (resulting from policy change, new approaches to treatment, and new technologies). First, to estimate future demand for hospital inpatient services, figures for total public bed-days were obtained in 5-year age groups by sex from 1993–94 to 2003–04 data collected by the Australian Institute of Health and Welfare (AIHW).<sup>11-15</sup> Second, Australian Bureau of Statistics (ABS) population data for the base year, 2003–04, and future years to 2050 were obtained and grouped in the same age and sex groups as the bed-day data.<sup>16</sup> Then per capita public bed-days for the base year were calculated by dividing the bed-days by the population of each age and sex group.

The *trends model* was developed using both trends in bed-day use as well as demographic change. To develop the trends model, bed-days per person by two age groups (under 65 years and 65 years and over) were calculated from historical data for the period 1993 to 2003. For the years 2004 to 2050 a projection model was used to estimate bed-day use. The models of best fit were power functions, using the method of least squares, for making predictions for subsequent years. The models were:

$$\text{BPU65} = 0.545 * n^{(-0.0438)} \quad (1)$$

$$\text{BPO65} = 4.0335 * n^{(-0.1263)} \quad (2)$$

Where:

BPU65 = Bed-days for people under 65 years, and

BPO65 = Bed-days for people 65 years and over.

The trends implicitly capture actions such as policy changes which have resulted in shorter length of stay, introduction of new technologies and treatments, and improved population health. Projected bed-days was used to calculate projected annual growth in bed-day use for the two age groups. The growth rates were then multiplied by the bed-day use in the base year to project bed-day use in the years 2005 to 2050. Projections of total hospital service use were then derived by multiplying the projected per capita average hospital bed-day use by the projected population in each of 19 age groups (<1 year; 0–4 years; 5–9 years; 10–14 years; 15–19 years; 20–24 years; 25–29 years; 30–34 years; 35–39 years; 40–44 years; 45–49 years; 50–54 years; 55–59 years; 60–64 years; 65–69 years; 70–74 years; 75–79 years; 80–85 years and 85+ years) by sex for each year.

Finally, sensitivity analysis was undertaken to compare the impact of high and low population growth forecasts on projected demand for public hospital bed-days using the trends model. In addition, the impact of modelling the impact of ageing and population growth alone and then the impact of ageing and population growth and greater longevity were also estimated. The *high* and *low population-growth* models also used population projection series produced by the

ABS. The ABS produces three population projection series. Series A assumes high population growth as a result of high migration, life expectancy (92.2 years for men and 95 years for women from 2050–51) and fertility. Series B assumes medium population growth resulting from lower migration, life expectancy and fertility. Series C assumes low population growth and has the same life expectancy and fertility assumptions as series B, but lower migration.<sup>17</sup> Both Series B and C assume life expectancy of 84.2 years for men and 87.7 years for women from 2050–51.

The *demographic change model* projected on the basis of demographic change alone. For the demographic change model, demand for bed-days was projected from the base year (2004) to the final year (2050). To do this, the per capita average health service use for the base year was multiplied by the projected population for each age group in 2004 and for each year through to 2050.

The *longevity model* used unpublished ABS forecasts of expected extra years of life for people aged 55 and over. (Australian Bureau of Statistics. Expected years of life projections. 29 November 2005.) It was assumed that as the population lived longer, their higher health costs in the years approaching death would occur later and pro-

## I Population change, Australia, 2005 to 2050



Source: Australian Bureau of Statistics.<sup>16</sup>

duce corresponding improvements in health at younger ages. Therefore it was assumed that for every additional year of life expectancy beyond the age of 65 years, utilisation decreased to the level of people 1 year younger. The method used is similar to that used by Badham<sup>18</sup> when projecting hospital expenditure in Australia. The approach in this paper is slightly more sophisticated in that it captures the projected increase in life expectancy by sex and 5-year age groups for ages 55 to 85 and over, whereas Badham used projected increase in life expectancy for the ages 65 and over as a single group.

## Results

### *Population change and use of hospital services by the aged*

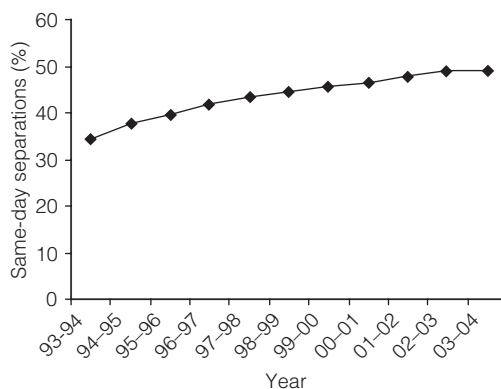
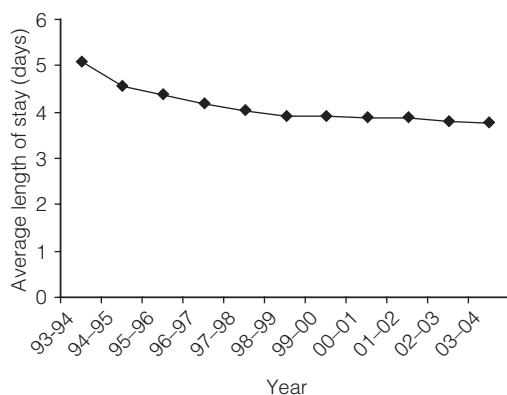
Over the next 45 years the age structure of the population will change markedly (Box 1). In 2005, the baby boomer bulge from about age 40 to 60 years is pronounced and the population pyramid tapers away quickly from the age of 60 years. However, by 2050 the population pyramid takes on the distinctive “coffin shape” as the population ages, longevity increases and fertility declines. People aged 65 and over will double as a proportion of the population, increasing from 13% in 2005 to 27% by 2050.

### 2 Average bed-days by age group and sex, Australia, 2003–04

Age (years)	Female	Male	Total	Use relative to the average for all ages (%)
< 1	2.4	2.7	2.6	212.4
1 – 4	0.2	0.3	0.3	–67.5
5 – 9	0.1	0.1	0.1	–84.0
10 – 14	0.1	0.1	0.1	–82.8
15 – 19	0.3	0.2	0.3	–65.9
20 – 24	0.5	0.4	0.4	–45.3
25 – 29	0.7	0.4	0.5	–33.5
30 – 34	0.7	0.4	0.6	–31.7
35 – 39	0.5	0.4	0.5	–41.4
40 – 44	0.4	0.5	0.4	–46.0
45 – 49	0.5	0.5	0.5	–40.1
50 – 54	0.5	0.6	0.6	–29.8
55 – 59	0.7	0.8	0.7	–9.7
60 – 64	0.9	1.1	1.0	26.5
65 – 69	1.4	1.7	1.5	87.4
70 – 74	2.1	2.6	2.3	184.1
75 – 79	2.9	3.5	3.2	293.6
80 – 84	4.2	4.4	4.3	425.6
85+	6.2	6.5	6.3	674.7
Total	0.8	0.8	0.8	0.0

Source: Australian Institute of Health and Welfare 2005.<sup>11</sup> ◆

### 3 Average length of stay and same-day separations, 1993–04 to 2003–04



Source: Australian Institute of Health and Welfare 2005<sup>11</sup> and 1997.<sup>14</sup> ◆

It is this change in the age structure of the population that will drive future demand for hospital services because older people require more hospital care. For example, individuals aged 65 to 69 years use about 3 times as many bed-days as 40 to 44-year-olds, while someone in the 80 to 84 age range uses more than 10 times as many days (Box 2).

### Trends model

In Australia there has been a decline in the average length of stay. However, the decline has plateaued since the year 2000 and the rise in same-day separations has also slowed (Box 3).

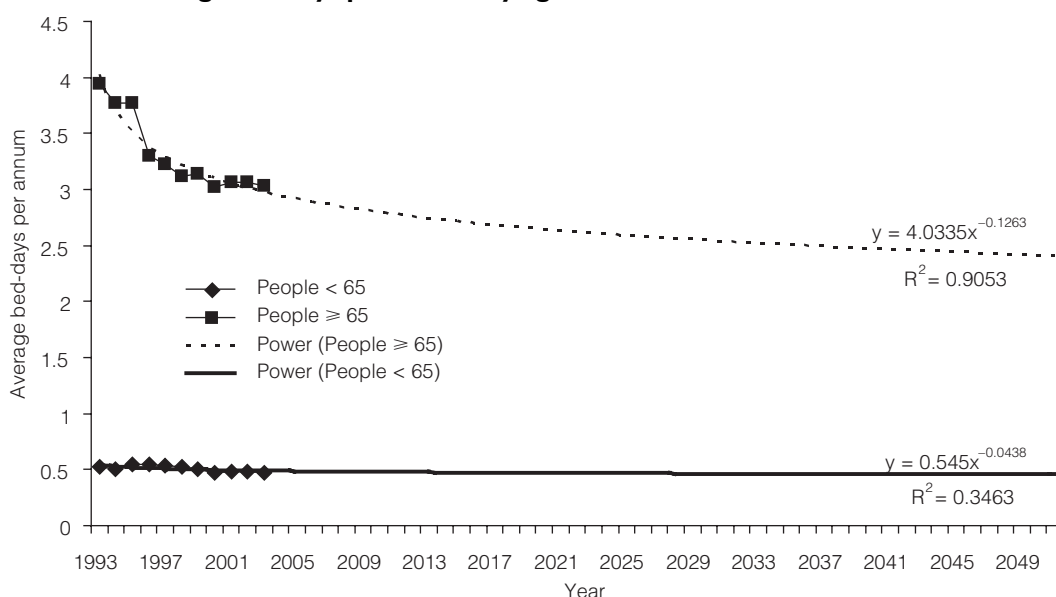
As the average length of stay has declined, so have the available beds relative to the population. Between 1993–94 and 2003–04 the available public beds per 1000 population declined from 3.5 to 2.7.<sup>11–15</sup> Accordingly, the policy driver that has placed a brake on the growth in hospital bed-days can be expected to have a more limited effect in containing demand for hospital bed-days in the future. Powers functions using the method of least squares were used to make predictions of

bed-day use for subsequent years. These resulted in a projected decline in average bed-day use from 2005 to 2050 of 20% for people aged 65 years and over, and 3% for people aged less than 65 years (Box 4).

When these forecasts of trends in declining average bed-day use as well as demographic change were applied to the model, demand for public hospital bed-days outstripped population growth (Box 5). Between 2005 and 2050 the demand for hospital bed-days was projected to grow by about 80%, to about 30 million bed-days in 2050.

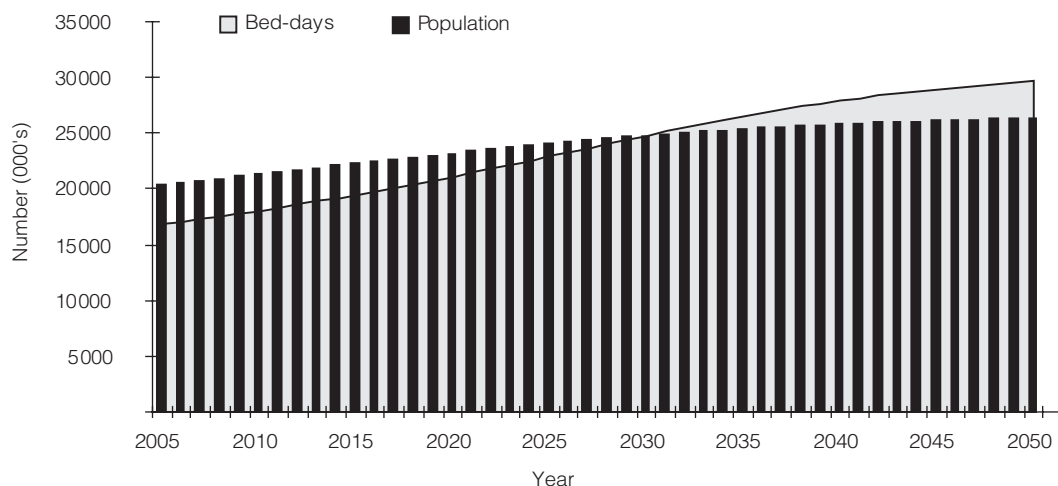
The growth in the proportion of bed-days provided for younger people was markedly lower than for older age groups. Growth in bed-days between 2005 and 2050 for people less than 50 years of age was projected to be slightly negative at -0.4%. Growth in bed-days provided to people 60 years and over increased by about 145%, and for those aged 85 and over, by about 320%. The proportion of hospital bed-days devoted to older people is set to increase sharply. By 2050 the proportion of bed-days used by the 65+ age

#### 4 Forecast average bed-days per annum by age to 2050



Source: Australian Institute of Health and Welfare 2005<sup>11</sup> and 1997.<sup>14</sup>

## 5 Growth in population and demand for public hospital bed-days, trends model, Australia, 2005 to 2050



Rounded to the nearest 50. Source: Trends model, authors' calculations.

group was projected to increase from 47% in 2005 to 67% (Box 6).

### Sensitivity analysis

Because projected demand for public hospital bed-days is driven by assumptions about population growth and ageing, it is important to know how different assumptions affect future bed-day demand. Accordingly, we assessed the sensitivity of the trends model to demographic assumptions and also to alternative assumptions about growth.

Most of our analytical models use series B, the ABS medium population growth series. These models include the trends model (Model B), the greater longevity model (Model D), the demographic change model (Model E), the detailed demography version of the trends model (Model F) (with projections undertaken for 20 age and sex groups; male and female by age groups <1, 1–4, 5–14, 15–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75 or more) and Model G, increased public share model (which tests the effect of the share of public to private bed-days increasing at the same rate as it has fallen over the last 10 years, as might happen if private health cover coverage were to fall once again). The greater longevity model (Model D) assumed that increased

longevity would mean corresponding improvements in health at younger ages. Model E assumed that the only drivers of hospital use would be population growth and ageing. Two further models were developed using the same trends in bed-day use as the trends model (B), but using the ABS high growth population series for Model A and low population growth series for Model C. The projected growth over the 45 years from 2005 to 2050 varied from about 70% to 130% depending on the model (Box 7).

Model A, the trend model using the high population growth assumption, produced the highest projected bed-day demand with growth of about 130% to 2050, or an additional 21 500 bed-days. Accordingly, there is significant upside risk beyond 2025 if the population does prove to have greater longevity. An increase of about 7 years of life expectancy could dramatically increase the demand for hospital care.

The demographic model accounting for ageing and population growth only (Model E) provided the next highest forecast growth of about 114%, or an additional 18 500 bed-days.

The trend model adjusted for potential increase in the proportion of public bed-days if private

health insurance were to fall again (Model G) produced forecast growth of about 99%, or an additional 16 250 bed-days. Model D, which accounts for greater longevity and medium population growth, forecast growth of 88%, or an additional 14 000 bed-days.

Model B, using series B population projections (the same medium population growth as for the demographic model), produced lower projected growth at 81% and about 13 000 additional bed-days. Model F, using series B population projections but with bed-day growth forecast for 20 age and sex groups, produced lower projected growth than Model B at 74% and about 12 125 additional bed-days. Model C, using series C projections (with low population growth), produced the lowest growth at 69%, about 11 000 additional bed-days.

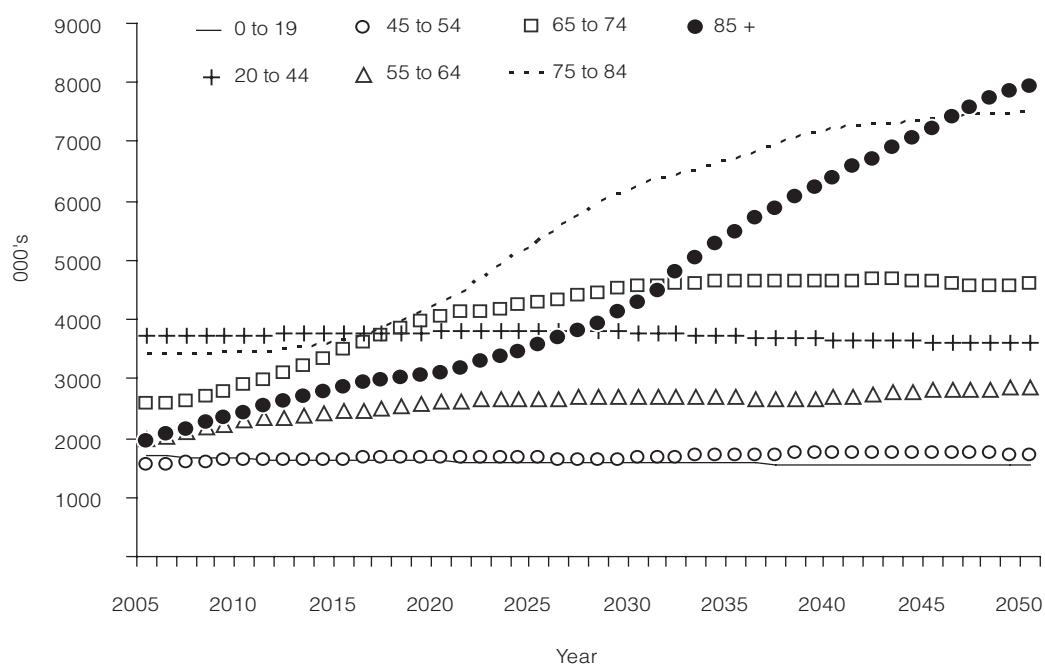
## Discussion

We cannot be complacent about the future demands of an ageing society. As the population

ages there will be significant growth in the demand for hospital bed-days, placing a corresponding demand on infrastructure and staff numbers. In 2003–04 there were about 90 000 full-time equivalent nurses working in Australian public hospitals and about 20 000 salaried medical officers. With the demand for hospital bed-days projected to almost double over the next 45 years, there will be a need for additional staff to cover this increase. However at the same time as demand is rising, the health workforce is ageing, with high exit rates expected as doctors and nurses retire from the workforce.<sup>3</sup>

Policies such as early discharge and same-day treatment have, up until now, masked pressures on demand for hospital services due to ageing of the population. However, it seems that the majority of the efficiency gains to be made from these policies have been obtained. In fact, the current political environment suggests that the trend may be towards greater provision of services rather than less. At the national level, the Australian

### 6 Growth in demand for hospital bed-days, by age, Australia, 2005 to 2050



Source: Trends model, authors' calculations.

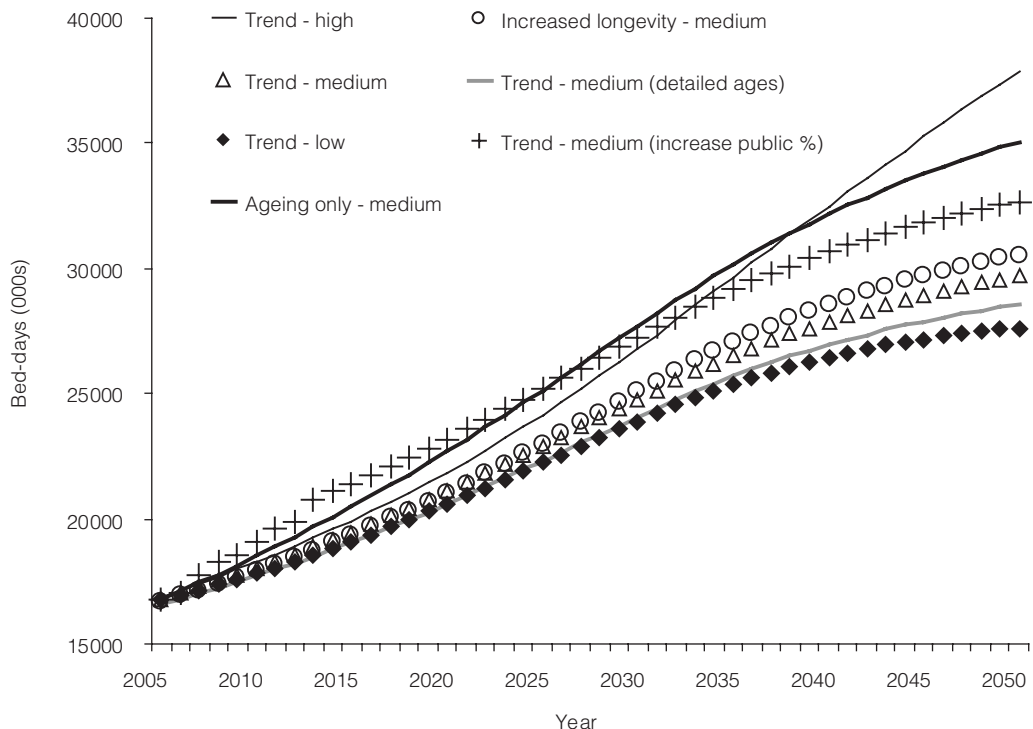
Government requires that the Australian states and territories match funds provided under the Australian Health Care Agreements for public hospitals.<sup>19</sup> With waiting times increasing under some measures — 10% of patients waited more than 193 days in 2003–04 compared with 175 days in 1999–00 — there is also considerable community pressure to reduce waiting times for elective surgery.<sup>11</sup> State governments are responding. For example, the Queensland Government in the 2005–06 budget announced funding to reduce waiting lists by allowing 4 000 additional patients to receive elective surgery as well as opening some additional hospital beds.<sup>20</sup>

While improved health status as longevity increases may delay the most intensive period of hospital use until later in life, this is by no means certain. The Productivity Commission suggests that the main areas of growth in hospital use have

been greater use of new technologies such as prostheses, and same-day procedures, which are not associated with the end of life.<sup>1</sup> Nonetheless, the trends model in this paper suggests that factors which have limited growth in hospital use in the past, such as improved health and policies to provide more care in the community, may continue to help contain future hospital use, albeit to a lesser extent.

Not only can we expect demand for hospital bed-days to outstrip population growth, but the composition of the type of care required will also change. With a far greater proportion of hospital beds required for older people (about three quarters of all bed-days) there will be a much larger focus on care for people who have high rates of comorbidity (several conditions) and complex conditions. For example, we can expect a sharp increase in the most common reasons for admis-

## 7 Sensitivity to assumptions of projected demand for hospital bed-days, Australia, 2005 to 2050



Rounded to the nearest 50. Source: Longevity model, demographic change model, trends model, authors' calculations.



sion to hospital for people over 65 years, including treatment involving dialysis or rehabilitation, treatment for angina or heart failure, cataracts, chronic obstructive pulmonary disease or malignant neoplasms of the skin.<sup>11</sup>

## Conclusion

This study has projected that increased demand for health services because of the ageing of the population will coincide with difficulty in recruiting health professionals as the large baby boomer cohort retires from the health workforce. Accordingly, we need to plan now to ensure future hospital needs of the ageing population are met.

## Competing interests

The authors declare that they have no competing interests.

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