

# An alternative approach to projecting health expenditure in Australia

Stephen Begg, Theo Vos, John Goss and Nicholas Mann

## Abstract

**Objective:** To introduce a large body of work that explores the modelling of expenditure on health services per person living with major causes of disease or injury as a valid basis for conclusions regarding future health expenditure in Australia.

**Methods:** Separate projections were calculated for important health conditions (or groups of conditions) by type of expenditure (hospital care, medical services, pharmaceuticals, aged care homes and other health services). Analyses accounted for expected changes in the number of affected cases, the proportion of cases treated, the volume of health services per treated case and excess health price inflation.

**Results:** Total health expenditure in Australia is expected to increase from 9.4% of GDP in 2002–03 to 10.8% of GDP in 2032–33. This represents a 15% increase in the “health:GDP” proportion over the projection period, or an annual growth of 0.5%. Two-thirds of this growth is accounted for by expected increases in population size and population ageing.

**Conclusions:** The lower annual growth in the “health:GDP” proportion compared with other estimates for Australia (range, 0.9% to 1.7%) was attributed to different assumptions regarding non-demographic growth factors, particularly volume per case. Explicit modelling of these factors separately for each condition ensured that assumptions remained within plausible limits.

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IMPROVEMENTS IN HEALTH, particularly among the elderly, have been an important consequence of economic development. Better health, in turn, has led to greater economic development and more people surviving to old age. Together with decreasing fertility, this has contributed to population ageing. Interest is increasing across the developed world in the long-term sustainability of public finances in the context of these widespread demographic trends.

In most countries with time series data, expenditure on health has increased substantially across all components of the health system beyond what can be explained by changing age structure and size of the population alone. The main non-demographic factors influencing these trends are: new technologies, such as diagnostics, drugs or procedures; changing medical practice and policy; the organisation and financing of the health care system; the intensity or coverage of health services; the greater rate of increase in health prices compared with general prices (“excess health inflation”); and changes in population health status.

The influence of non-demographic factors is unlikely to be uniform across the health care system. Furthermore, is likely to vary over time depending on the type of health service and the particular health problem it addresses. Taking into account such detail when projecting health expenditure would be impractical. Instead, analysts have tended to extrapolate from observed trends in expenditure growth for aggregate categories of expenditure.

A common approach has been to apply growth factors for the combined effect of the non-demographic growth in health expenditure over time without necessarily making explicit the identified non-demographic growth factors.<sup>1–6</sup> A few of these studies have considered overall changes in

population health status by making assumptions about the increase in healthy years lived as life expectancy increases.<sup>1,2</sup> Some have also included an “end-of-life” adjustment to account for the fact that many health resources are used in the last year of life;<sup>2,5,7</sup> improvements in life expectancy shift this “expensive” period to older ages.<sup>8,9</sup>

Two health expenditure projection models have explicitly accounted for changes in population health status in greater detail.<sup>3,4</sup> The first model projected public health expenditure in The Netherlands based on historical expenditure by disease, age and sex, and epidemiological projections of incidence and prevalence for 52 disease groups. This study did not quantify the contribution of disease trends to expected changes in health expenditure. The second model projected health expenditure in Australia for nine disease groups in a pilot study covering less than half of all health expenditure. This study did not quantify the contribution of changes in population health status to expected changes in *total* health expenditure.

The aim of this research note is to introduce a body of recent work undertaken by researchers at the University of Queensland’s School of Population Health and the Australian Institute of Health and Welfare that applied the methods developed for the pilot study to all components of health expenditure. This work provides an alternative analysis of future health expenditure in Australia by incorporating likely changes in both the epidemiology of disease and injury, and the volume of health service delivery for a comprehensive set of health outcomes over the period 2003–2033.

## Methods

Separate projections were calculated for each health condition (or group of conditions in some cases) and “type” of expenditure (hospital care, medical services, pharmaceuticals, aged care homes and other health services). Analyses accounted for expected changes in the number of affected cases (“epidemiology”), the proportion of cases treated (“treatment proportion”), the volume of health services per treated case (“treat-

ment volume”), and excess health price inflation (“price”). Numbers of cases were calculated to be a function of changes in population size and age structure, as well as trends in epidemiology. A brief overview of the data sources and methods used to derive each of these components follows. A more detailed account is available as a background paper for the United Nations World Economic and Social Survey 2007.<sup>5</sup>

### **Population size and age structure**

Population projections were obtained from the Australian Bureau of Statistics (ABS) “Series 8” population projections.<sup>6</sup> This series is based on the 2001 census and assumes high net overseas migration (125 000 annually), constant improvements in life expectancy (low mortality assumption), and total fertility declining to a rate of 1.6 by 2011 and then remaining constant.

### **Incidence and prevalence**

Estimates of incidence and prevalence were obtained from the Australian Burden of Disease and Injury 2003 study. Methods and assumptions for these estimates are described in detail elsewhere.<sup>7</sup> The key analytical steps were:

1. Baseline models specifying the complete epidemiology for over 178 diseases and injuries in Australia for the year 2003 were developed using a large range of data sources, methods and assumptions.

2. Trends in observed cause-specific mortality over the period 1979–2003 were analysed and projected into the future using a combination of regression techniques.

3. Hazards for fatal conditions were extrapolated backwards and forwards from baseline using assumptions about the relative contribution of incidence and case-fatality to changes in cause-specific mortality (both observed and projected). For non-fatal conditions, incidence was the only hazard for which extrapolations were made.

4. The epidemiology of each condition was estimated in a temporal model that accounted for changes in all-cause mortality as well as changes in incidence and case-fatality (where appropriate) at all points throughout the projection period.

**I Projected total health expenditure (2002–03 dollars), Australia, 2002–03 to 2032–33**

	Year				Change
	2002–03	2012–13	2022–23	2032–33	2003–2033 (%)
Total health expenditure (\$ billion)	71.4	91.7	122.2	162.3	127.4%
Gross domestic product* (GDP; \$ billion)	762	995	1,230	1,500	96.9%
Total health expenditure as a proportion of GDP	9.4%	9.2%	9.9%	10.8%	14.9%

\* Source: Australian Treasury

5. Absolute numbers of incident and prevalent cases were derived by applying the population rates from the above analyses to projected population estimates.

### **Treatment proportion and treatment volume**

Comparable per-unit health care costs by health condition and type of expenditure (hospital care, medical services, pharmaceuticals, aged care homes and other health services) were available for two time periods (1993–94 and 2000–01) from previous work.<sup>8,9</sup> These estimates were divided by epidemiological estimates for the same years to derive estimates of treatment proportion and treatment volume for each health condition, type of expenditure and time period. Expected future changes in these parameters were extrapolated from the observed changes between 1993–94 and 2000–01.

For most conditions, prevalent cases were used to derive these parameters because total expenditure for a condition was assumed to be primarily influenced by the number of people with the condition at a point in time. For cancer, incident cases were used because most expenditure for cancer occurs in the first year after diagnosis. For ischaemic heart disease and stroke, expenditure on admitted patients was derived from incident cases, while medical and pharmaceutical expenditure was derived from prevalent cases. For some conditions the data for the period 1993–94 to 2000–01 were deficient so that valid trends in treatment proportion and volume could not be estimated. In this case a standard growth in treatment volume of 2.5% per 5 years was assumed.

Judgement was used to adjust observed trends in treatment proportion and treatment volume that appeared unusual and could not be explained, or were considered unsustainable into the future. Lipid lowering drugs for the prevention of cardiovascular disease, for example, experienced a large increase in expenditure over the period 1993–94 and 2000–01. When these drugs go off patent it is likely that per unit pharmaceutical costs for this disease will decrease.

### **Price**

The “price” factor is the amount by which health prices are expected to exceed general inflation in the economy. This is often called “excess health price inflation”. In the period 1993–94 to 2000–01 excess health price inflation averaged 0.73% per year with small variations across areas of expenditure. In this model, excess health price inflation was assumed to increase into the future at the average rate of 0.73% across all areas of expenditure except dental services where a higher rate of 2.0% was assumed. It would be desirable in future models to vary this assumption for more areas of expenditure.

### **Decomposition of factors**

Decomposition of the respective contribution of each of the factors in the projection model to changes in total health expenditure should account for expected interaction between factors. A saturated multiplicative model was adopted to simplify this analysis in which interaction effects were allocated to each factor in proportion to the ratio of the sixth root of that factor to the sixth root of all factors combined.

## 2 Projected total health expenditure (2002–03 dollars) by cause, Australia, 2002–03 to 2032–33

Cause	Expenditure by year (\$ billion)		Change 2003 to 2033	
	2002–03	2032–33	\$ billion	Percentage
Cardiovascular	7.9	16.2	8.3	104.7%
Treatment	4.5	9.4	5.0	111.1%
Prevention	3.4	6.8	3.3	96.2%
Respiratory	5.9	12.6	6.7	113.0%
Chronic obstructive pulmonary disease	0.6	0.8	0.2	35.3%
Other respiratory	5.3	11.8	6.5	121.8%
Injuries	5.6	9.4	3.8	67.4%
Dental	5.1	12.4	7.3	144.0%
Mental	4.3	8.5	4.2	97.1%
Digestive	4.0	9.7	5.6	139.0%
Neurological	4.0	15.1	11.1	279.9%
Dementia and Parkinson's	3.5	13.9	10.4	294.3%
Other neurological	0.5	1.2	0.8	167.8%
Musculoskeletal	3.7	9.9	6.1	163.5%
Genitourinary	3.1	6.8	3.7	122.2%
Cancer	2.8	5.2	2.4	84.0%
Sense disorders	2.3	5.1	2.8	124.4%
Endocrine, nutritional and metabolic	2.2	4.1	2.0	91.2%
Skin	2.0	4.5	2.5	127.4%
Maternal	1.8	2.5	0.7	40.9%
Infectious	1.5	2.7	1.2	74.6%
Diabetes	1.4	7.0	5.6	400.8%
Neonatal	0.5	0.7	0.2	41.7%
Congenital	0.3	0.4	0.1	55.3%
Other	13.0	29.6	16.6	127.4%
<b>Total health expenditure</b>	<b>71.4</b>	<b>162.3</b>	<b>90.9</b>	<b>127.4%</b>

### Comparisons with other studies

Comparisons with other studies that use different projection periods was achieved by annualising projected growth in health expenditure and expressing this as percentage points above projected growth in gross domestic product (GDP).

### Results

Total health expenditure in Australia is expected to increase from \$71.4 billion in 2002–03 to \$162.3 billion in 2032–33, an increase of 127.4%

or \$90.9 billion (Box 1). On the basis of Australian Treasury estimates, GDP will increase by 96.9% over the same period, meaning that health expenditure is expected to increase from 9.4% of GDP in 2002–03 to 10.8% of GDP in 2032–33. This represents an increase of 14.9% in the “health to GDP” proportion, or an annual growth of 0.5% greater than growth in the economy more generally.

Neurological and sense disorders — mostly dementia and Parkinson's disease — are expected to experience the greatest absolute growth in

### 3 Projected total health expenditure (2002–03 dollars) by area of expenditure, Australia, 2002–03 to 2032–33

Expenditure area	Expenditure by year (\$ billion)		Change 2003 to 2033	
	2002–03	2032–33	\$ billion	Percentage
Admitted patient services	23.4	51.7	28.3	121.0%
Medical services	14.6	28.7	14.1	96.5%
Pharmaceutical prescriptions	10	24.5	14.5	145.2%
Residential aged care (high care)	4.9	16.8	11.9	241.9%
Other health services	18.5	40.6	22.1	120.0%
<b>Total health expenditure</b>	<b>71.4</b>	<b>162.3</b>	<b>90.9</b>	<b>127.4%</b>

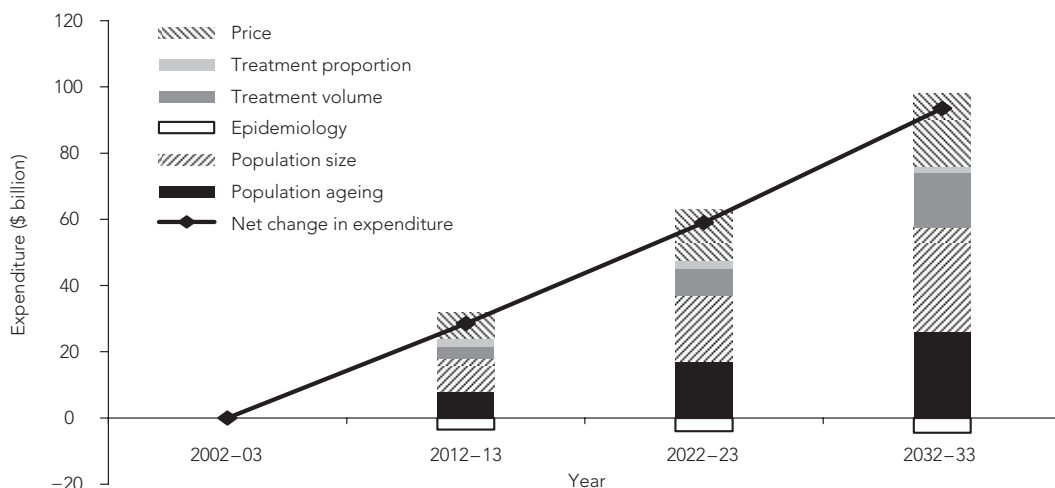
expenditure over the projection period, followed by cardiovascular disease and dental services (Box 2). The expected growth for cardiovascular disease is due to a \$5.0 billion increase in expenditure on treatment services and a \$3.3 billion increase in expenditure on prevention efforts (mainly blood pressure lowering drugs and lipid lowering drugs). Diabetes is expected to experience the greatest proportional increase in expenditure over the projection period, followed by neurological disorders, musculoskeletal conditions and dental services.

Admitted patient services are expected to experience the greatest absolute growth in

expenditure over the projection period, followed by other health services and pharmaceutical prescriptions (Box 3). Residential aged care expenditure is likely to show the greatest proportional increase in expenditure, followed by pharmaceutical expenditure. Expenditure on admitted patients in hospitals is expected to show a similar growth to health expenditure as a whole, while medical services expenditure will experience a somewhat lower growth.

Decomposition analysis shows that population ageing and increases in population size are likely to account for two-thirds of the expected \$90.9 billion increase in total health expenditure

### 4 Decomposition of factors leading to projected change in total health expenditure, Australia, 2002–03 to 2032–33



### 5 Health expenditure growth as percentage points above projected gross domestic product (GDP) growth for selected countries

Country	Annual growth in health expenditure (% above growth in GDP)
<b>Australia</b>	
Intergenerational Report <sup>10</sup>	1.7
Productivity Commission <sup>11</sup>	1.6
OECD <sup>2</sup>	
Cost pressure scenario	0.9
Cost containment scenario	1.2
This study	0.5
<b>Other countries</b>	
USA <sup>12</sup>	2.3
Hong Kong <sup>13</sup>	1.9
OECD average <sup>1</sup>	
cost pressure scenario	1.4
cost containment scenario	0.9
New Zealand <sup>14</sup>	0.5
European Union countries <sup>2</sup>	
average	0.5
high (Spain)	0.6
low (Portugal)	0.2

OECD = Organisation for Economic Co-operation and Development

over the projection period (\$29.4 billion and \$28.4 billion, respectively) (Box 4). Excess health price inflation (\$19.1 billion), changes in treatment volume (number of health services provided) per case (\$14.0 billion) and, to a lesser extent, treatment proportion (\$1.3 billion) also contribute to this increase. Favourable trends in the epidemiology of cardiovascular disease, chronic obstructive pulmonary disease (COPD), cancers and injuries are expected to decrease overall expenditure by \$5.0 billion. This reduction will be offset by large increases in diabetes and other diseases, which are expected

to result in a \$3.7 billion increase in treatment expenditure. The net effect of epidemiological trends is expected to be a \$1.3 billion reduction in total health expenditure over the projection period.

Annualised projected growth in health expenditure in this study is comparable to reported estimates for the European Union and New Zealand. Higher estimates are reported for Hong Kong, the United States and Australia in previous studies, with those for OECD (Organisation for Economic Co-operation and Development) countries lying in the middle of this range (Box 5).

### Discussion

This analysis suggests that total health expenditure in Australia will grow by 0.5% greater than growth in the economy, to 10.8% of GDP in 2032–33. Population ageing will account for 32.3% of this growth; and non-demographic factors (excess price inflation, treatment proportion and volume per case) a further 36.5%. The remaining 31.2% will be due to increases in population size, a particular feature of a high immigration country such as Australia.

An annual growth of 0.5% greater than growth in GDP is comparable to estimates for the European Union and New Zealand but is lower than estimates for Hong Kong and US. Other estimates for Australia are not directly comparable as they relate to different projection periods or do not quantify expected changes in *total* health expenditure. The Australian Treasury, for example, estimated that federal government spending on health (including aged care) would grow by 1.7% greater than growth in the economy to 7.9% of GDP in 2032–33.<sup>10</sup> The Australian Government's Productivity Commission estimated that all government spending (federal, state and territory) would grow by 1.6% greater than growth in the economy to 9.4% of GDP in 2034–35.<sup>11</sup> The OECD estimated that all government health expenditure in Australia would grow by 0.9% greater than growth in the economy to 8.5% of GDP in 2050 in a cost-contain-

ment scenario.<sup>1</sup> In a cost-pressure scenario, this growth was estimated to be 1.2%.

Few studies have explicitly commented on the relative contribution of demographic and non-demographic factors to growth in health expenditure. The OECD study estimated that the effect of population ageing would be about half the estimated effect of non-ageing residual factors in a cost-pressure scenario, but that these factors would contribute in equal proportions in a cost-containment scenario.<sup>1</sup> Similarly, the New Zealand study estimated that for the period 2020–2040 — which is when the “baby boomer” generation will move into the very old ages — ageing would have a similar impact as non-demographic growth.<sup>14</sup> With the exception of the OECD cost-pressure scenario, these estimates are largely consistent with the findings reported here.

Variation in estimates of growth in health expenditure between different models is likely to reflect differences in underlying assumptions. Certain assumptions have only a small impact on projection estimates. The OECD and Productivity Commission models allowed for “proximity to death” costs but this had only a minor downward impact on projections.<sup>1,11</sup> The OECD model also assumed that years gained from improvements in life expectancy were equivalent to years in full health, an assumption that lowered estimates of growth by a small amount. Likewise, epidemiological trends, as this paper has shown, have only a marginal downward effect when the net impact across all conditions is considered.

Assumptions regarding non-demographic growth factors have a much greater impact. The OECD, Treasury and Productivity Commission all used estimates of non-demographic expenditure growth of around 2.6% per year compared with an average of around 1.2% per year in our study. The latter was calculated separately for each condition to explicitly account for condition-specific assumptions regarding excess health price inflation, volume per case and treatment proportion. Since excess health price inflation was set to be constant across conditions, much of the variability in expenditure

estimates is due to differences in volume per case assumptions.

Changes in volume per case over time are largely influenced by the introduction of new technologies and changes in treatment practices. Volume per case assumptions in this paper were based on information from two time points 7 years apart. By quantifying changes in volume per case for each condition over this period, it was possible to ensure that trends in volume per case remained within plausible limits. There is uncertainty about whether trends observed over such a short period are likely to continue to influence expenditure in future years. There is likely to be greater uncertainty, however, around a single non-demographic growth estimate for all conditions, as has been assumed, either explicitly or implicitly, in other expenditure projection models.

An important by-product of this work is the quantification, for the first time, of a comprehensive description of likely future health expenditure in Australia by area of expenditure, health condition, age and sex. Researchers wanting to model the cost-effectiveness of treating health conditions under various intervention scenarios will find this a useful resource. Health planners concerned with the changing health service needs of Australia's ageing population may also find it of interest. The findings presented here, for example, show that there is likely be twice the growth in demand for residential age care services than there will be for admitted patient services over the next 30 years. Similarly, growth in demand for services from particular specialty areas such as diabetes, neurology and geriatrics is expected to outstrip growth in demand for other specialty areas such as paediatrics and gynaecology.

Australia's preparedness for the economic and social consequences of population ageing will be greatly enhanced by forward planning around the infrastructure and workforce needs that are likely to emerge over the coming decades. The analyses introduced in this paper have the potential to make a valuable contribution to this debate.

## Competing interests

The authors declare that they have no competing interests.

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