Projection of health care expenditure by disease: a case study from Australia

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1. Introduction

An important consequence of economic development is improvement in population health. Improved population health in turn, leads to greater economic development and more people surviving to old age which, along with decreasing fertility, leads to the 'ageing of the population' affecting most countries in the world to a greater or lesser extent. This is called the demographic transition.

In addition, in many of the more developed countries ageing of the population will be accentuated in coming decades as the 'baby-boom' generation ages (Figure 1). This is the generation born just after the Second World War when fertility rose sharply. They are currently in their 50s and in coming decades will be reaching ages at which health expenditure per person rises steeply.

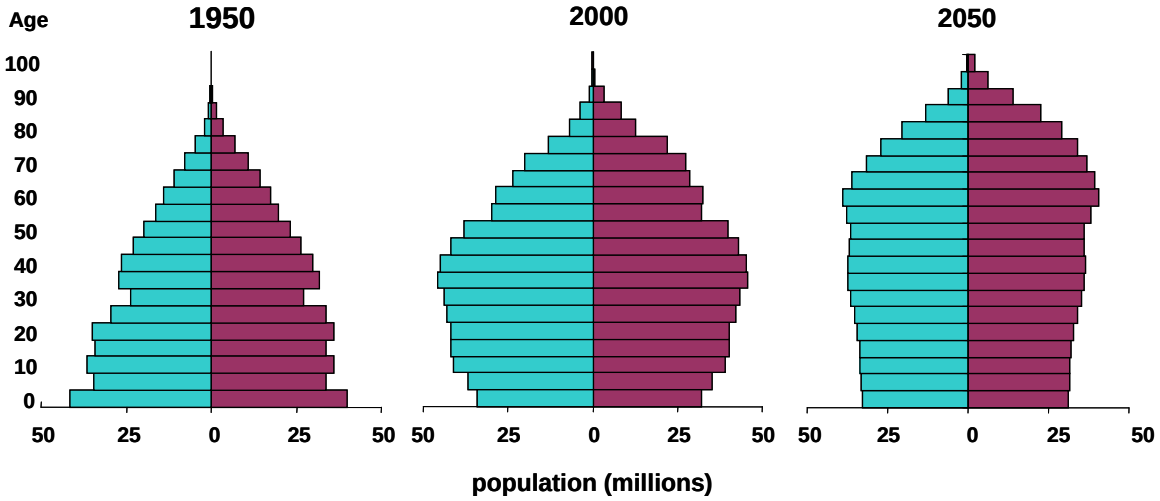

Figure 1 Population pyramids more developed countries, 1950, 2000 and 2050 (data from: UN Population Division, http://esa.un.org/unpp/)

Governments in the more developed countries with pronounced effects of population ageing are concerned about the long-term sustainability of public finances –and in particular the financing of health care– in the context of these demographic trends. The Australian, Hong Kong, United States and New Zealand governments, and the Organisation for Economic Co-operation and Development (OECD) and European Economic Policy Committee (EEPC), for example, in recent times have all commissioned reports on future public expenditure in general or more specifically expenditure on health [1-9]. Characteristics of these studies are summarised in Table 1.

These reports have used different ways to project health expenditure. The most basic approach is to couple demographic projections of population by age and sex with current per capita health expenditure by age and sex. This has been named the '*pure ageing*' scenario in a recent European Union report [4] and was the principal method of projection in an earlier version of projections for the European Union countries [10]. As health expenditure increases significantly with age (for example see estimates of health expenditure by age and sex for European Union countries in Figure 2), projected expenditure increases in an ageing population.

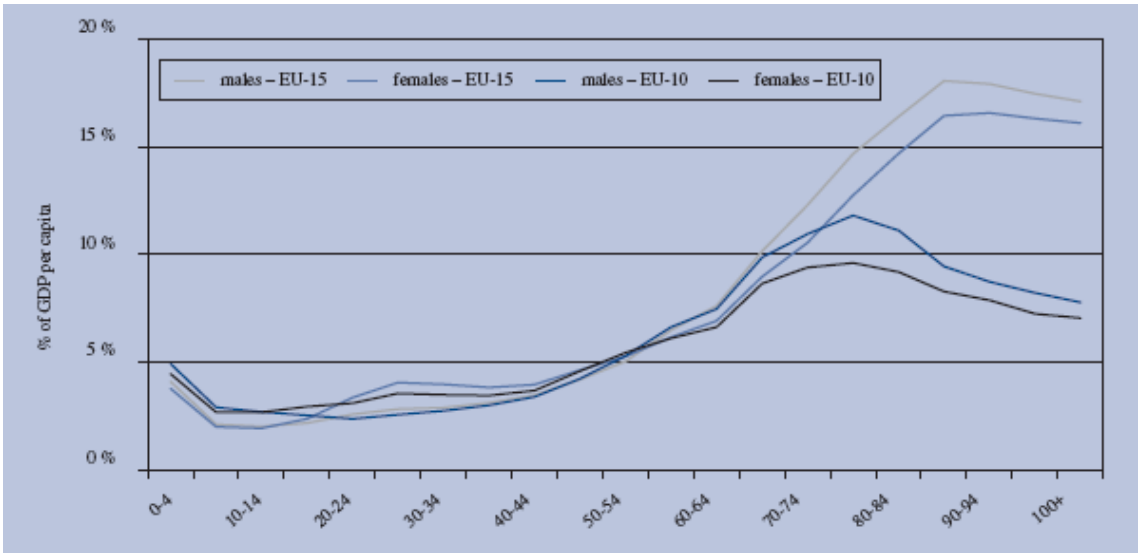

Figure 2 Average health expenditure per capita by age and sex for European union countries (reproduced from [4])

However, in most countries with time series of health expenditure data, expenditure per person is increasing substantially for all components of expenditure beyond what can be explained by the demographic factors of changing age structure and size of the population. The main non-demographic factor that influence these trends in the per person costs 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 to general prices ('excess health inflation'); and
changes in population health status.

It is important to realise that health systems are complex. They provide a wide range of preventive, curative or rehabilitative interventions for a multitude of health problems. The influence of non-demographic factors is not uniform across different components of the health care system and may vary considerably over time depending on the type of health service and the particular health problem it addresses. Taking all such detail into account when projecting health expenditure would be impractical and require prohibitive amounts of information and analytical resources. Instead, analysts extrapolate from observed trends in expenditure growth for aggregate categories of expenditure. The common approach is to apply growth factors for the combined effect of the non-demographic growth in health expenditure over time without necessarily making any of the identified non-demographic growth factors explicit[2-7].

A few studies have considered overall changes in population health status making broad assumptions about the increase in healthy years lived as life expectancy increases [3, 4]. Other studies [3, 4, 9] have included an adjustment for 'end-of-life' health expenditure, i.e. taking into account that individuals use many health resources in their last year of life. As life expectancy improves there will be a shift of this 'expensive' period to older ages [11, 12]. The only examples of health expenditure projection studies that have taken changes in population health status in greater detail explicitly

into account are from the Netherlands and Australia [8, 9]. The first of these studies projected public health expenditure in the Netherlands for 52 disease groups based on historical expenditure by disease, age and sex data and epidemiological projections of incidence and prevalence of these diseases. The report does not specify the contribution of disease trends to the expected change in health expenditure estimates. The second study projected health care expenditure in Australia for 9 disease clusters that were responsible for 71% of disease burden in the year 2001 and 43% of total health expenditure. Favourable trends in cardiovascular disease and tobacco-related disease in part compensated for the projected increase in expenditure due to demographic changes and increased intensity of treatment and prevention activities. The increasing prevalence of overweight and obesity in Australia led to projected steep increases in diabetes and as a consequence very rapid growth of expenditure for this disease. The study, however, covered less than half of all health expenditure and hence did not provide insight into the magnitude of the contribution of changes in population health status to the projections of total health expenditure.

Currently, there are few countries that have the data to make detailed disease-specific projections of health expenditure. It requires time series of health expenditure as well as the epidemiology by the same disease categories. For countries lacking this detailed information it is of interest to know what the magnitude of change in projected health expenditure would be if this is done disease-by-disease or for aggregate expenditure data across all diseases.

The first aim of this report is to provide a case study of disease-specific health expenditure projections for Australia by completing and updating the previous projections to cover all diseases and then to contrast the sum of these disease-specific projections with previous health expenditure projections for Australia which applied demographic and non-demographic growth factors to aggregate expenditure categories across all diseases. The second aim is to discuss the potential implications of the Australian disease-specific findings for health care provision and financing in other countries and in particular developing countries.

The remainder of the report is structured in three parts. The main part that follows provides the methods and results of the Australian case study of disease-specific health expenditure projections. These findings are then contrasted with previous, more ‘traditional’ approaches to projecting health expenditure on aggregate data in Australia. The last section discusses the potential implications of the Australian case study to future health expenditure in other countries and in particular, for less developed countries that are facing rapid growth on the ageing of their populations.

Table 1 Study characteristics and major findings of recent country studies projecting health expenditure

Country	Period	Type of expenditure	Method of projection	Results, comments
European Union countries [4]	2004–2050	Government expenditure aggregated across all types of service	Demography Broad assumption about improvement in health (postponement in disability at half pace of increase in life expectancy) Death-related costs Income elasticity demand for health care Sensitivity analyses: 'Pure ageing' Costs evolve with GDP per worker	Five intermediate scenarios a. 'pure ageing' scenario: 1.7% b. constant health (i.e. compression of morbidity) scenario: 0.9% c. last year of life costs scenario: 1.3% d. income elasticity (1.1 tapered to 1 over projection period) scenario:2.0% e. cost evolving with GDP/worker scenario: 2.3% Reference scenario (average a+b, c and d): increase in expenditure ranging from 0.5% to 2.2% of GDP between countries (average 1.6% increase across all 25 countries from 6.4% of GDP in 2004) 'Health status of elderly, not age per se determines increase in expenditure'
OECD [3]	2005–2050	Public spending on health and long-term aged care	Demography Broad assumption about improvement in health ('healthy ageing') Death-related costs Income and a residual to capture changes in technology/health prices/policies as non-demographic growth factors	Main results presented as cost-containment (residual of 1% in 2005 reduces to 0 over period to 2050) and cost-pressure (constant residual of 1%) scenarios. Demographic & health factors alone lead to increase from 5.7% to 6.3% of GDP across all countries (5.6%-6.5% in Australia) Cost-containment: 7.7% (all countries) and 7.9% (Australia); 8.5% if Australian residual is used; 8.5% (all countries) and 8.7% (Australia) if 1.5% residual is used Cost-pressure: 9.6% (all countries) and 9.7% (Australia) Sensitivity analysis on income elasticity of 0.8% and 1.2% (combined with cost-containment scenario): expenditure growth to 6.9% and 8.7% (all countries) and 7.1% and 8.9% (Australia), respectively Compression of morbidity (doubling of longevity increase into healthy years gained) with cost-containment scenario: 7.0% (all countries) and 7.1% Australia Expansion of morbidity (no healthy ageing adjustment) with cost-containment scenario: 8.7% (all countries) and 8.5% Australia

Country	Period	Type of expenditure	Method of projection	Results, comments
US [1]	2005–2015	National health spending by type of service	Actuarial, econometric and judgment inputs. Constant term to capture medical innovation and other non-specified growth factors Income Medical price inflation	Expected rise in expenditure from 16% to 20% of GDP Ageing small component of growth (<10%) Constant for non-demographic growth (excluding medical price inflation) contributes around 18% of growth Other factors of growth not quantified
New Zealand [5]	2001–2051	Government funded health expenditure (around 70% of total health expenditure)	Demography Other health spending growth (price, technology, trend in referral and treatment, demand & new initiatives)	Growth from 6.5% to 8.5% of GDP Most rapid ageing between 2020 and 2040 Ageing estimates to have contributed 0.4% of 1.3% annual growth in expenditure between 1978 and 1998; becoming more prominent driver between 2020 and 2040: 1.0% out of 1.8% Model not so sensitive to relative per capita costs of older people but more to health spending Non-demographic rate of growth 'makes the difference' as ageing impact is unavoidable: if non-demographic growth is 0.5% instead of 0.9% or if assumed stronger growth of economy, health expenditure as % of GDP could be flat
Hong Kong [2]	2001–2033	Total health expenditure by type of service	Demography Health price inflation Other non-demographic growth	Growth from 5.5% to 10% Population ageing contributes relatively little Model most sensitive to assumption of excess health inflation 480 scenarios in sensitivity analysis
Nether-lands	1994–2015	Total health expenditure projected by disease and type of service	Demography Disease-specific trends included Death-related costs Historical non-demographic growth by disease and sector	non-demographic factors contribute 1.1-1.2%; impact of ageing and population growth small (less than 20%) excluding end of life costs leads to small overestimate only
Nether-lands [9]	2003–2025	Total health expenditure projected by disease and type of service	Demography Disease-specific trends included Death-related costs Historical non-demographic growth by disease and sector	Based on demography only, expenditure will grow from €57B to 70B and most of this is due to ageing Taking cost of death and shift of expenditure to higher ages into account results in small downward shift of demographic projections only Technology and price inflation greater contributors (though not

Country	Period	Type of expenditure	Method of projection	Results, comments
				quantified over comparable period as above estimate for ageing 'Competitive world' (market forces, globalisation leading to higher economic growth and high immigration) and 'Caring region' (more government influence; less economic growth; emphasis on quality of life) scenarios described but results of expenditure projections according to scenarios not in publication
Australia [7]	2001–2042	Federal government expenditure by type of service	Demography Non-demographic growth by type of service	Growth from 4.0 to 8.1% of GDP Non-demographic growth most important driver of health expenditure projections but aged care growth from 0.7%-1.8% of GDP largely due to ageing Very steep increase in drug expenditure projected (based on recent trends)
Australia [6]	2002–2044	Government health expenditure by type of service (not long-term aged care)	Demography Non-demographic growth by type of service End of life expenditure	Base assumption of non-demographic growth 0.6% percentage points of GDP growth Main results show increase from 5.7% to 10.3% of GDP (9.1% and 11.6% if non-demographic growth is halved or increased by 50%) Sensitivity analysis: assume 'effective age' (increase in life expectancy means expenditure shifts to that of younger ages at baseline) --> 9.9% Exclude end of life expenditure: 10.8% Concludes that end of life expenditure and health improvement with 'effective age' assumption do not qualitatively alter expected impact
Australia [8]	2001–2031	Total health expenditure by age, sex, and type of service for major diseases constituting 71% of disease burden (in DALYs) and 43% of health expenditure	Demography (ageing and population growth) Non-demographic growth separated into health price inflation (across all diseases), 'volume per case' (intensity of treatment) by disease and treatment proportion ("coverage') for some preventive services Cost per capita projected per incident/prevalent case	Hospital, medical visits, drugs and long-term aged care expenditure for these disease to increase from 3.7% to 5.1% of GDP Ageing (44%) and population growth (28%) are the main drivers of growth followed by changes in volume per case (18%) and excess health inflation (16%) while disease trends temper growth by a net 11% Favourable trends in cardiovascular disease and tobacco-related disease are to some extent countered by steep increase in diabetes

2. Australian case study

2.1 Methods

Our projections of health care expenditure are built on what we believe to be the most plausible scenario of future trends in terms of the demographic changes in population structure, disease epidemiology and non-demographic growth factors affecting health expenditure per individual with disease.

2.1.1 Population projections

We use Australian Bureau of Statistics (ABS) 'Series 8' population projections based on the 2001 census assuming high net overseas migration of 125,000 annually; constant improvements in life expectancy (low mortality assumption); and total fertility rate declining to 1.6 by 2011 and then remaining constant [13].

2.1.2 Projections of incident and prevalent cases

For the disease specific parameters, we first developed internally consistent disease models based on the best available data in the year 2003 and then applied trend data to incidence and case fatality rate assumptions to estimate incidence and prevalence for the period 1994 to 2033.

Baseline models for 2003

Disease models based on recent epidemiological data were available from the Australian Burden of Disease and Injury Study for the year 2003. Appendix A lists the input parameters and their data sources. Full details on methods are available in that report [14].

We used *DisMod2* software [15] to derive a consistent set of epidemiological parameters for each disease. With population counts and all-cause mortality rates in the background, *DisMod2* allows derivation of unknown disease parameters as long as three out of five are defined. The five parameters are incidence, prevalence, remission (i.e. cure), average duration and excess mortality (either entered as a population mortality rate, a case fatality rate or a relative risk of mortality). The calculated output values for incidence, remission and case fatality from the 2003 models were then used as inputs to disease models in future years.

Mortality trends and projections

We extrapolated into the future observed all-cause mortality rates for the period 1979 to 2003 using simple log-linear Poisson regression and projected population figures. We then collapsed cause-specific mortality data for the same period into 51 clinically meaningful conditions, or groups of conditions, and used multinomial logistic regression to model changes in the contribution of each group as a proportion of all-cause mortality with changes in absolute levels of all-cause mortality expressed as rates per unit of population. These models were used to predict the future cause-specific structure of mortality based on our projected all-cause mortality rates. Separate analyses were done for each age group (0,5,10…85) and sex.

Projected incidence and prevalence

The observed trends in cause-specific mortality rates can be due to a change in incidence and/or a change in case-fatality. Among the causes analysed, cardiovascular diseases, cancers, COPD, diabetes, alcohol-related conditions, road traffic accidents, falls, suicide and homicide showed significant mortality trends. The apparent trend in dementia mortality was ignored because: (a) there has been a shift in coding practices with more deaths being attributed to dementia; (b) prevalence data from international epidemiological studies show no clear change over time; (c) the case fatality is unlikely to have changed much over time as there are no effective life-saving interventions.

Mortality trends for cancers, COPD, diabetes, alcohol-related conditions, road traffic accidents, falls, suicide and homicide were assumed to be fully due to changes in incidence. Incidence trends for these causes were therefore adjusted to reflect changes in mortality over the projection period, with case-fatality being held constant. Findings from Unal et al. [16] suggest that 58% of the drop in cardiovascular mortality observed in England and Wales was due to a drop in incidence and the remaining 42% due to a reduction in case fatality. The same proportions were assumed to apply in this study to all cardiovascular diseases over the projection period.

Changes in the diagnostic criteria for type 2 diabetes in surveys and a paucity of representative survey data meant that there was no direct measurement of trends of type 2 diabetes in Australia from which to project the incidence of this disease. Body mass index (BMI, defined as body weight in kilograms divided by the square of a person's height in meters), overwhelmingly the main risk factor for type 2 diabetes, however, has been measured consistently at various points over recent time. The approach taken in this study, therefore, was to translate historical trends in BMI into expected changes in diabetes incidence following the risk attribution methods described in the WHO Comparative Risk Assessment project.

Haby et al [17] analysed trends in BMI using data from five measurement surveys: the three National Heart Foundation Risk Factor Prevalence studies in the 1980s [18-20], the National Nutrition Survey of 1995 [21] and the AusDiab study of 1999/2000 [22]. Projected mean BMI by age group and sex was derived from Haby et al.'s regression model of the mean of log-transformed BMI values on age, birth cohort and sex. Similar techniques were applied to the standard deviations of BMI values so as to fully describe the expected change in the distribution of this risk into the future (a change which can be characterised as a broadening of the distribution in the tail towards the highest BMI values rather than at the other end of the distribution with low values).

Using the RR for each unit increase in BMI from a meta-analysis of the Asia-Pacific Cohort Study collaboration [23] and a lognormal transformation of the mean and standard deviation values we can integrate the area under the curve of the BMI distribution multiplied by the relevant RR values and calculate the difference in this area under the curve at successive years into the future. This proportion change over time is then applied to the incidence of diabetes.

We have no data to estimate a trend in case fatality for diabetes. Instead, we make a bold assumption that it reflects half the trend calculated for cardiovascular disease, arguing the at least half of all mortality in diabetics is of vascular origin and would benefit from the same favourable trends observed for other cardiovascular disease. This

results in considerable increasing trends in the incidence of type 2 diabetes, and even greater increases in future prevalence.

Mortality trend data are not relevant for conditions that are largely non-fatal. These include the mental, sense organ and musculoskeletal disorders. The only mental health survey in Australia was carried out in 1997 and hence there are no trend data. Also, internationally there is no clear evidence of secular trends due to a paucity of mental health survey data collected using comparable diagnostic tools and criteria. Therefore we assume no trends. Similarly, we apply no disease trends to hearing loss (only one community survey), the various causes of vision loss and musculoskeletal disorders (no evidence for trends).

Based on the above considerations we used the 2003 disease rates of incidence, case fatality and their trends to forecast and backcast the numbers of incident and prevalent cases by disease for the years 1994, 2001, 2003, 2013, 2023 and 2033.

2.1.3 Projected per unit health care costs

Current per unit health care costs by type of expenditure (hospital care, medical services, pharmaceuticals, aged care homes and other health services) have been estimated as part of the Australian Institute of Health and Welfare (AIHW) disease expenditure project [24]. A previous study estimated disease expenditure for the year 1993–94 using similar methods [25]. We project the per person health care costs for a particular cause in the year 2000-01 forward into the future based on expected changes in a) the population level and age-structure; b) disease rates; c) the volume of health service delivery per case of disease; and d) health prices.

We calculate expected increases in the cost per case in the future from observed differences in the costs per case for each area of expenditure and for each disease between the 1993-94 and 2000-01. The changes between 1993-94 and 2000-01 have not been applied in a mechanical way to the future estimates, but judgement has been used to adjust trends in the period 1993-94 to 2000-01 that may have been unusual. Some large increases in the period 1993-94 to 2000-01 were considered not be sustainable into the long term. For example, the rate of increase for antihypertensives and hypolipidemic drugs in this period would if it continued result in the whole of the population imbibing many of these pills per day. And increases for some age groups for some technologies were catch-up increases which could not continue at that rate eg a 600% increase in dialysis for those 75 years and over in the period 1993-94 to 2000-01.

The ‘price’ factor is the amount by which health prices are expected to exceed general inflation in the economy. It is often called ‘excess health price inflation’. In the period 1993-94 to 2000-01 excess health price inflation averaged 0.73% per year or 3.55% per 5 years. This factor is applied to all areas of expenditure except for dental services where an excess health price inflation rate of 2.0% per year or 10.4% per 5 years is applied. Excess health price inflation does vary somewhat across the areas of expenditure, and it would be desirable for future modelling to vary this assumption,

Projection model

The model projects expenditure from 2000-01 with changes in 4 factors:

1. cases of disease;
2. proportion of cases treated (treatment proportion);

3. volume of services per treated case; and
4. excess health price inflation ('price').

The change in number of cases is also decomposed into change in disease rate, change in age structure and change in total population.

The non-demographic factors are growth in

1. age-standardised disease rate
2. proportion of population with disease treated
3. volume of services per treated case, and
4. excess health inflation

The demographic factors are changes in

1. age-structure of the population, and
2. the size of the population.

The model is set up for maximum flexibility. For each disease there are 20 age-sex, 16 area of expenditure and 5 time period cells (2001, 2003, 2013, 2023 and 2033) and 4 growth factors giving a total of 6,400 parameters that can be changed.
The ageing factor is the impact of age structure alone on changing health expenditure.
The population factor is the impact of the increase in total population. In the period 2003 to 2033 total population is projected to increase by 34% to 26.6 million.

The factors in this model interact with each other. Therefore, it is not possible to allocate the overall growth in expenditure exclusively to each of the determining factors. It would be possible to calculate and present each of the interaction terms separately, but for a 6-factor model there are 36 interaction elements as well as the 6 factors. Such complexity does not aid analysis or interpretation. Instead, we allocate the interaction effects using a saturated multiplicative model. This allocates interaction effects to each of the 6 determining factors in proportion to the ratio of the sixth root of each factor to the sixth root of the factors combined. The GDP used in percent of GDP calculations in this report is the same as used in the Australian Treasury's 2002 Intergenerational Report [7].

Table 2 Changes in population characteristics and Gross Domestic Product, 2003–2033

	2003	2013	2023	2033
Population (millions)	19.9	22.2	24.5	26.6
Change over decade		12%	10%	9%
Percent 65+	11.3%	13.3%	17.0%	19.5%
Change in number of people 65+ over decade		17%	27%	15%
Percent 85+	1.5%	2.2%	2.8%	4.6%
Change in number of people 85+ over decade		49%	31%	61%
GDP ($Billions 2002-03 prices)	762	995	1230	1500
Change over decade		31%	24%	22%

GDP from the 2002 Intergenerational Report [7]

Expenditure per case is calculated for each age-sex cell for each disease, and it is the change in expenditure per case along with changes in cases of disease, which drive the projection for a particular disease. For most diseases the expenditure is per prevalent case, as the total expenditure for a disease primarily relates to the number of people with the disease at a point in time. However for cancer the expenditure per incident case is calculated, as most of the expenditure for cancer occurs in the year after diagnosis. It is then the change in this expenditure per incident case, which drives the cancer expenditure changes. For ischemic heart disease and stroke, we decided to project the admitted patient costs by the change in expenditure per incident case, while other costs like medical and pharmaceutical costs are driven by the change in expenditure per prevalent case. For some diseases the data for the period 1993-94 to 2000-01 was deficient so that valid trends in cost per case could not be estimated. For these diseases a standard growth in volume per case of 2.5% per 5 years was assumed.

2.2 Results

2.2.1 Incidence and prevalence

Projected changes in incidence for cardiovascular disease and cancer, the disease groups for which we used incidence to derive per person costs, are summarised in Table 3.

Table 3 Change in incidence (numbers and standardised rates) by broad cause group, 1994 to 2033

	Reference	% change from reference year				
Cause group	**Year (2003)**	**1994**	**2003**	**2013**	**2023**	**2033**
Infectious and parasitic diseases						
Number	17,552,716	-7.6	0.0	7.9	15.2	21.2
Rate per 1,000	882.9	0.0	0.0	0.0	-0.1	-0.1
Acute respiratory infections						
Number	29,460,104	-6.6	0.0	6.5	13.4	18.8
Rate per 1,000	1481.8	0.0	0.0	0.0	0.0	0.0
Maternal conditions						
Number	71,905	-2.2	0.0	6.0	10.5	9.3
Rate per 1,000	7.2	0.0	0.0	0.0	0.0	0.0
Neonatal causes						
Number	11,607	4.2	0.0	-1.9	3.2	2.7
Rate per 1,000	0.6	0.0	0.0	0.0	0.0	0.0
Nutritional deficiencies						
Number	940,777	-10.2	0.0	12.1	24.3	35.0
Rate per 1,000	47.3	-0.5	0.0	0.0	-0.1	-0.3
Malignant neoplasms						
Number	468,990	-13.1	0.0	11.4	23.9	32.5
Rate per 1,000	23.6	8.2	0.0	-13.2	-26.1	-38.9
Other neoplasms						
Number	21,027	-17.5	0.0	14.7	25.3	35.4
Rate per 1,000	1.1	-1.0	0.0	0.0	-0.3	-0.8

Cardiovascular disease						
Number	86,507	5.2	0.0	7.3	20.7	43.1
Rate per 1,000	4.4	34.2	0.0	-18.4	-31.8	-40.4
Congenital anomalies						
Number	2,363	-0.3	0.0	2.1	9.5	12.0
Rate per 1,000	0.1	0.0	0.0	0.0	0.0	0.0
Unintentional injuries						
Number	267,602	4.2	0.0	4.8	9.0	16.7
Rate per 1,000	13.5	17.9	0.0	-8.5	-16.5	-22.5
Intentional injuries						
Number	41,423	3.5	0.0	-1.1	-9.5	-19.8
Rate per 1,000	2.1	11.5	0.0	-8.5	-19.5	-29.8

The remaining groups comprise diseases for which we used prevalence to derive per capita costs (Table 4). A more detailed discussion on selected diseases follows this table. Full details regarding all diseases can be found in Appendix B.

Table 4 Change in prevalence (numbers and standardised rates) by broad disease group, 1994 to 2033

	Reference	% change from reference year				
Cause group	**Year (2003)**	**1994**	**2003**	**2013**	**2023**	**2033**
Diabetes mellitus						
Number	1,170,899	-28.9	0.0	47.7	115.8	206.6
Rate per 1,000	58.9	-10.8	0.0	15.6	34.6	57.1
Endocrine and metabolic disorders						
Number	27,771	-7.9	0.0	7.8	12.8	16.6
Rate per 1,000	1.4	0.0	0.0	0.0	0.0	0.0
Mental disorders						
Number	2,914,597	-10.4	0.0	12.4	22.2	29.6
Rate per 1,000	146.6	0.0	0.0	0.1	0.0	0.0
Nervous system and sense organ disorders						
Number	3,998,247	-18.3	0.0	26.6	60.7	101.2
Rate per 1,000	201.1	-0.5	0.0	0.4	0.7	0.8
Cardiovascular disease						
Number	565,438	-1.5	0.0	4.2	13.1	27.8
Rate per 1,000	28.4	24.5	0.0	-20.3	-34.2	-43.1
Chronic respiratory disease						
Number	1,743,770	-8.5	0.0	8.3	15.6	22.5
Rate per 1,000	87.7	4.8	0.0	-5.4	-9.7	-12.8
Diseases of the digestive system						
Number	251,057	-17.7	0.0	20.6	40.0	56.5
Rate per 1,000	12.6	-0.3	0.0	-0.2	-0.4	-0.4
Genitourinary diseases						
Number	417,875	-15.0	0.0	19.9	44.3	70.5
Rate per 1,000	21.0	-0.9	0.0	0.7	1.0	1.1
Skin diseases						
Number	518,886	-9.7	0.0	12.7	24.4	35.9
Rate per 1,000	26.1	0.1	0.0	-0.1	-0.1	-0.1

Musculoskeletal diseases						
Number	1,770,778	-18.8	0.0	25.7	56.0	89.3
Rate per 1,000	89.1	-0.2	0.0	0.2	0.3	0.4
Oral conditions						
Number	2,970,487	-16.8	0.0	23.6	51.9	82.2
Rate per 1,000	149.4	0.2	0.0	-0.1	-0.1	-0.1

Stroke

The projected change for stroke between 2003 and 2033 is 10,962 incident cases. This represents an increase of 55.8% from 19,627 to 30,589 new cases per year. These changes are despite substantial declines in the incidence of stroke (40.4% and 40.6% for males and females, respectively) expected over the projection period (Figure 3).

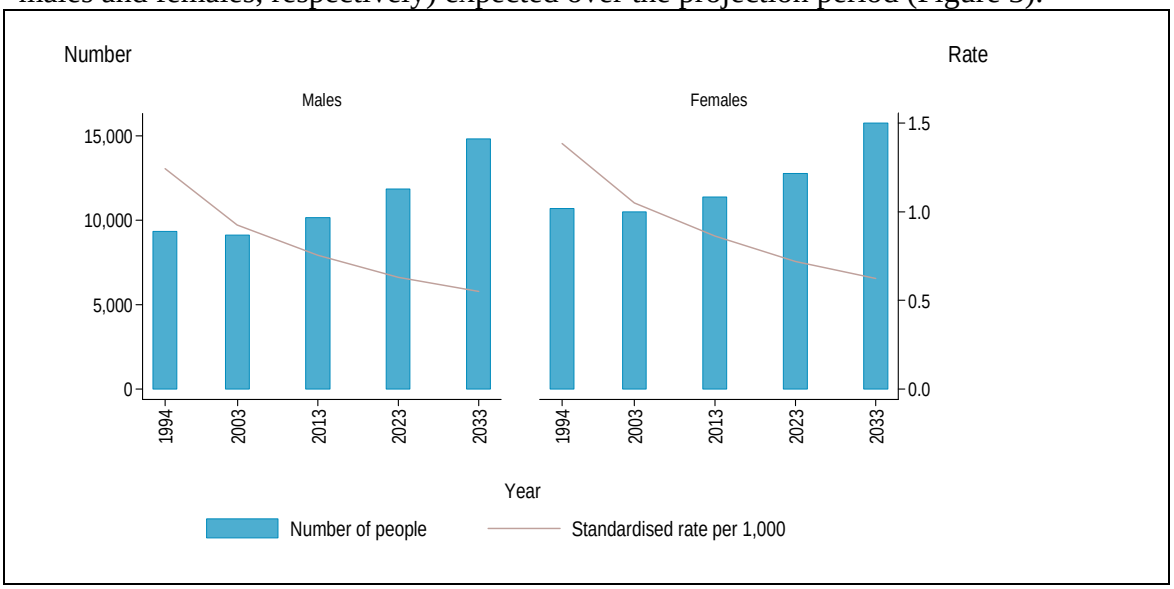

Figure 3 Change in incidence (numbers and standardised rates) for stroke, 1994 to 2033

Age standardisation done according to the Australian June 2001 population.

Ischaemic heart disease

The projected change for ischaemic heart disease between 2003 and 2033 is 10,359 incident cases. This represents an increase of 26.8% from 38,675 to 49,034 new cases per year. Like stroke, these changes are despite the substantial declines in the incidence of coronary heart disease (46.8% and 45.6% for males and females, respectively) that are expected to occur over the projection period (Figure 4).

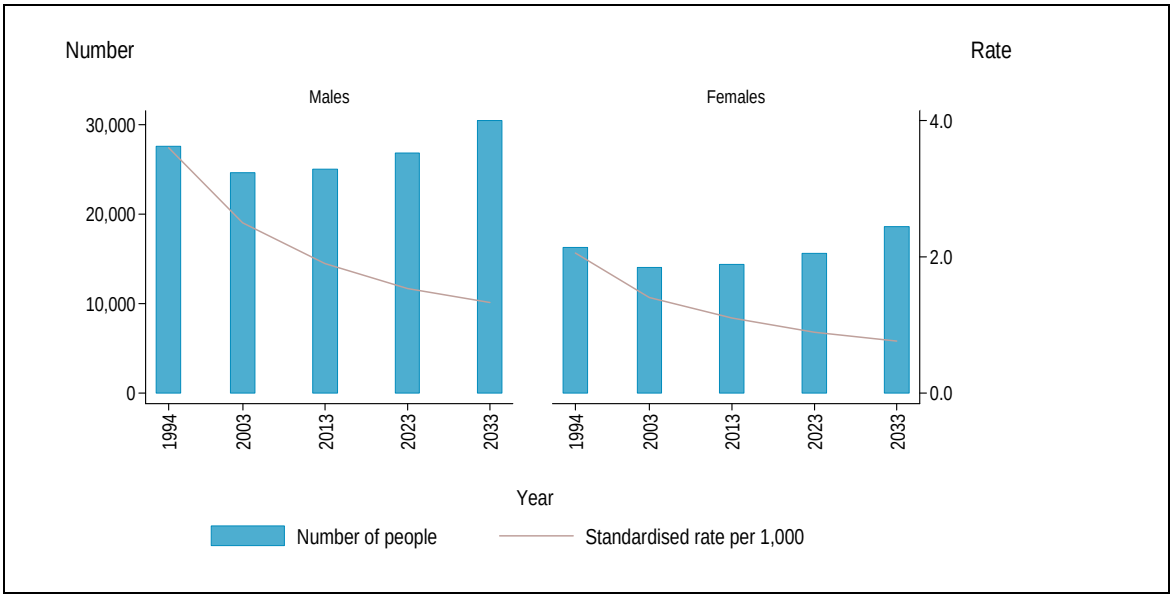

Figure 4 Change in incidence (numbers and standardised rates) for coronary heart disease, 1994 to 2033

Dementia

The projected change for dementia between 2003 and 2033 is 335,894 prevalent cases. This represents an increase of 201% from 167,378 to 503,272 existing cases per year. Unlike stroke and coronary heart disease, these changes are due to population factors alone as rates for dementia are expected to remain stable over the projection period (Figure 5).

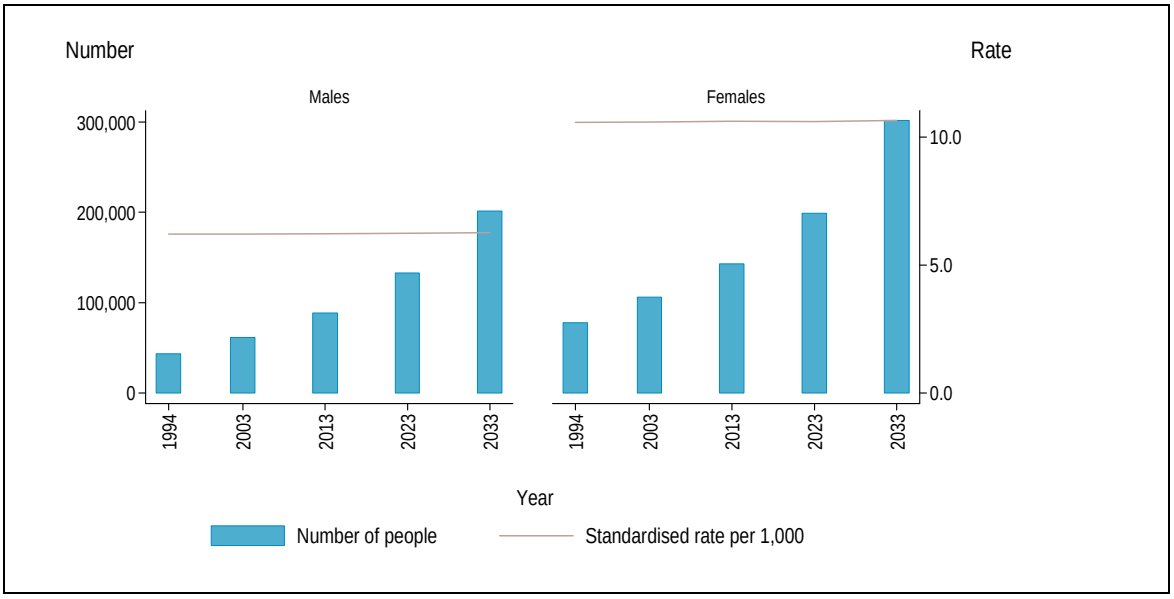

Figure 5 Change in prevalence (numbers and standardised rates) for dementia, 1994 to 2033

Lung cancer

The projected change for lung cancer between 2003 and 2033 is 4,599 incident cases. This represents an increase of 52.7% from 8,734 to 13,333 new cases per year. For

females, these changes will be driven by both increasing rates and population factors until 2023, after which time lung cancer incidence will begin to stabilise as the effects of the smoking epidemic moves through this population. For males, the increases are due to population factors alone as lung cancer rates are expected to decline by 56.4% over the projection period, continuing the decline that has been observed over the last decade (Figure 6).

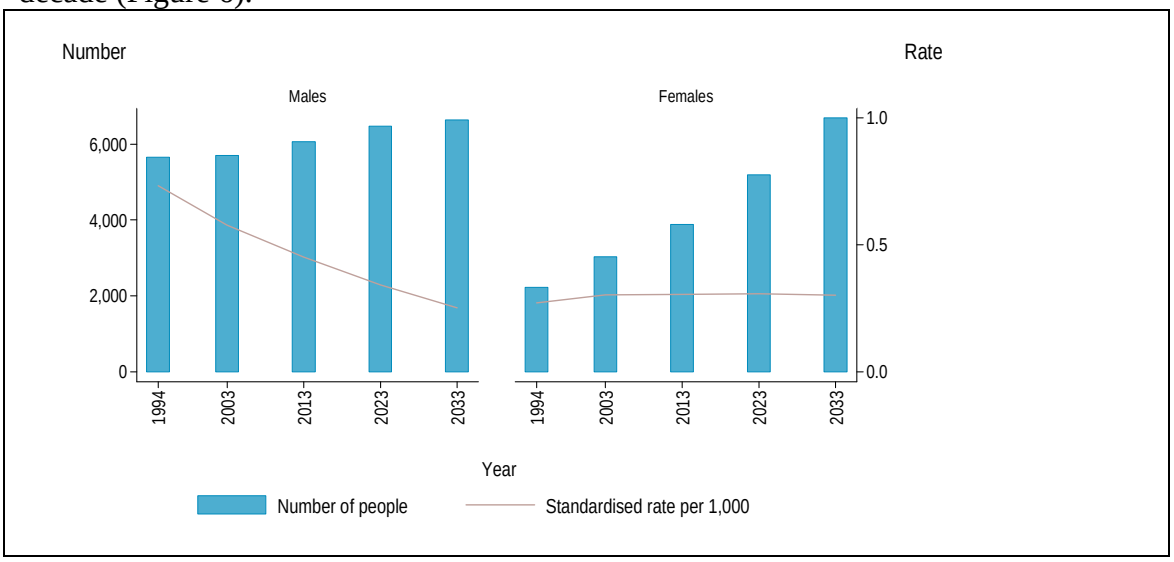

Figure 6 Change in incidence (numbers and standardised rates) for lung cancer, 1994 to 2033

Diabetes

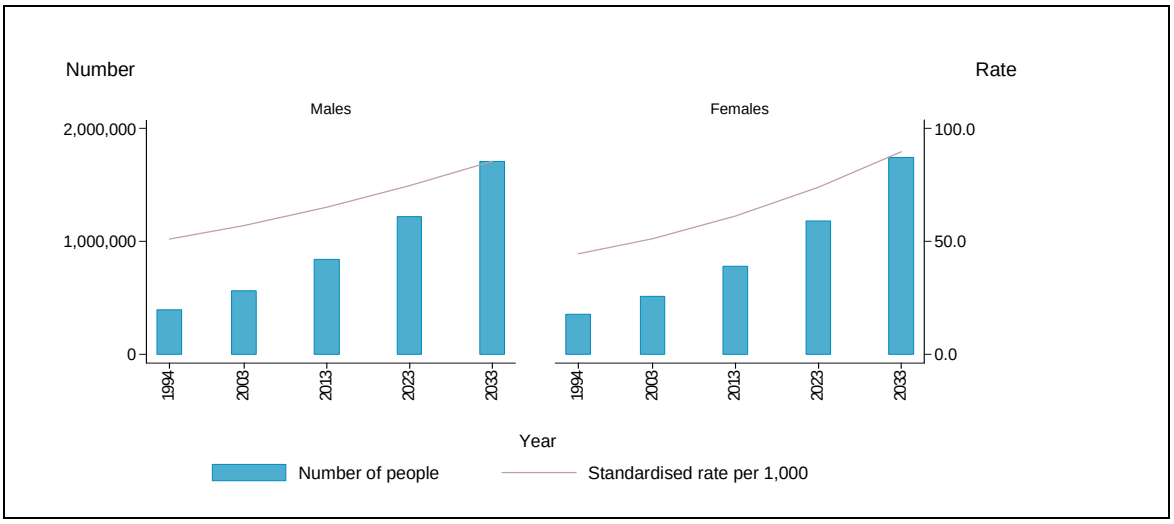

Figure 7 Change in prevalence (numbers and standardised rates) for diabetes, 1994 to 2033

The projected change for diabetes between 2003 and 2033 is 2.376 million prevalent cases. This represents an increase of 221% from 1.073 million to 3.449 million existing cases per year. These changes will be driven by both population factors and increasing incidence due to expected increases in the prevalence of obesity over the projection period (Figure 7).

Road traffic injuries

The projected change for road traffic injuries between 2003 and 2033 is 13,215 fewer incident cases. This represents a decrease of 52.1% from 25,381 to 12,166 new cases per year. These changes are driven by the expected decline in the rate of road traffic injuries (55.6% and 71.1% for males and females, respectively) occur over the projection period (Figure 8).

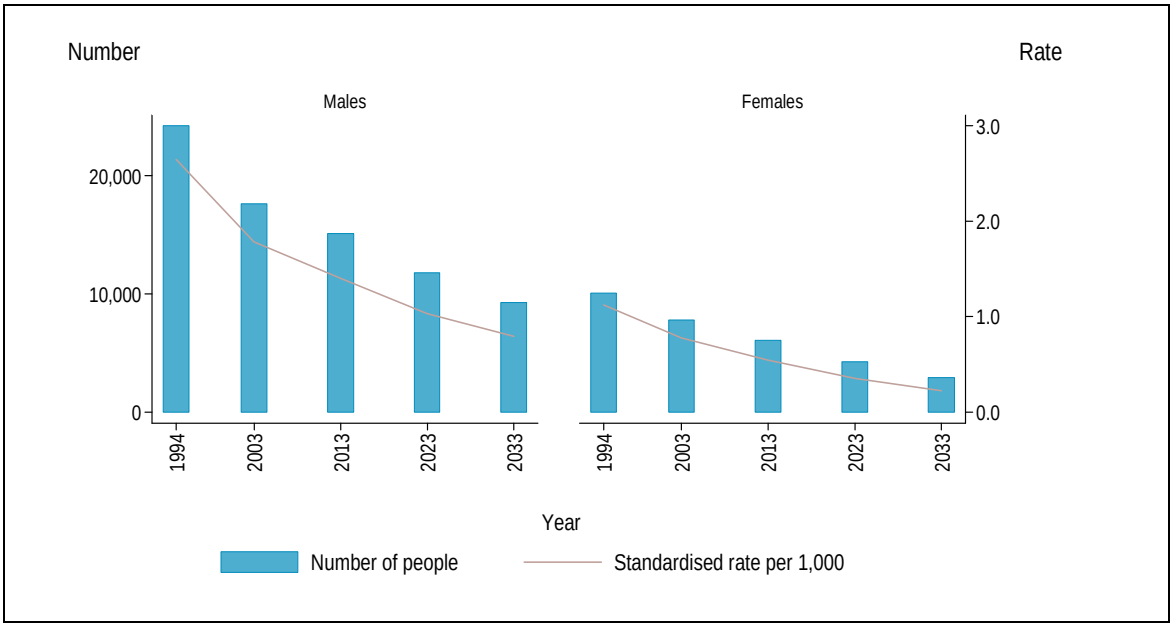

Figure 8 Change in incidence (numbers and standardised rates) for road traffic accidents, 1994 to 2033

Falls

The projected change for falls between 2003 and 2033 is 23,001 incident cases. This represents an increase of 18.4% from 125,322 to 148,324 new cases per year. These changes are despite declines in the rate of falls (36.7% and 34.5% for males and females, respectively) that are expected to occur over the projection period (Figure 9).

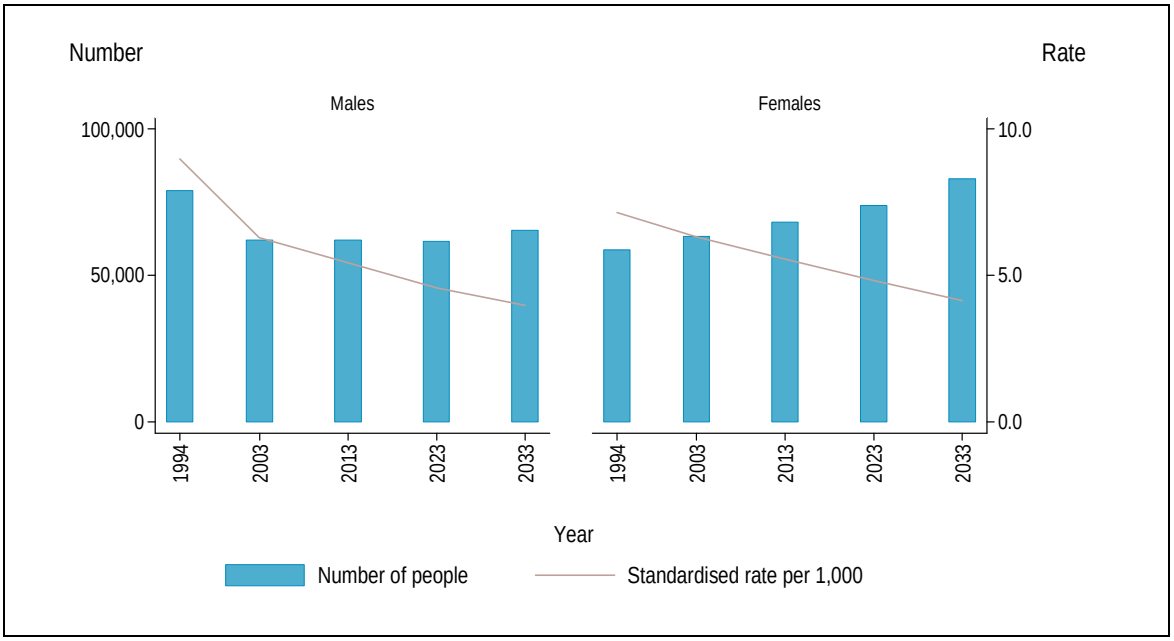

Figure 9 Change in incidence (numbers and standardised rates) for falls, 1994 to 2033

2.2.2 Projected expenditure

Total health expenditure is expected to increase by 127% in the period 2002–03 to 2032–33 from $71 billion to $162 billion – an increase of $91 billion (Table 5). Over the same period GDP is predicted to increase by 97% (Treasury, 2002) and as a result health expenditure is projected to increase from 9.4% of GDP in 2002–03 to 10.8% of GDP in 2032–33.

Projected expenditure by disease

Diabetes has by far the greatest projected increase (401%) followed by neurological disorders (280%), musculoskeletal conditions (164%) and dental services (144%). Expenditure on the treatment of cardiovascular disease is projected to increase by 111%. There is also an increase in expenditure on preventing cardiovascular disease through blood pressure lowering drugs and lipid lowering drugs of 96% leading to an overall change in cardiovascular expenditure of 105% ($7.9 billion to $16.2 billion). The projected increase in expenditure for cancer (84%), injuries (67%), maternal and neonatal services (41 and 42%) is low in comparison.

Table 5: Projected health expenditure (2002–03 dollars), 2002–03 to 2032–33

	Expenditure (billions of 2002-03 dollars)				% change
Disease category	**2002–03**	**2012–13**	**2022–23**	**2032–33**	**2003 to 2033**
Cardiovascular	7.91	10.28	13.00	16.18	105%
CVD treatment	*4.46*	*5.28*	*6.84*	*9.41*	*111%*
CVD prevention	*3.45*	*5.00*	*6.17*	*6.76*	*96%*
Respiratory	5.92	7.35	9.66	12.62	113%
COPD	*0.60*	*0.65*	*0.73*	*0.81*	*35%*
Other respiratory	*5.32*	*6.70*	*8.93*	*11.81*	*122%*
Injuries	5.59	6.48	7.68	9.36	67%
Dental	5.10	6.61	9.11	12.43	144%
Mental	4.30	5.30	6.69	8.48	97%
Digestive	4.04	5.32	7.22	9.66	139%
Neurological	3.98	5.91	9.08	15.13	280%
Dementia & Parkinson's	*3.53*	*5.30*	*8.22*	*13.91*	*294%*
Other neurological	*0.45*	*0.61*	*0.86*	*1.21*	*168%*
Musculoskeletal	3.74	5.13	7.28	9.86	164%
Genitourinary	3.06	3.86	5.10	6.80	122%
Cancer	2.81	3.54	4.50	5.17	84%
Sense disorders	2.29	3.06	4.30	5.13	124%
Endocrine, Nutritional & Metabolic	2.17	2.63	3.33	4.14	91%
Skin	1.96	2.52	3.35	4.45	127%
Maternal	1.78	1.88	2.23	2.51	41%
Infectious	1.55	1.82	2.22	2.70	75%
Diabetes	1.39	2.43	4.21	6.97	401%
Neonatal	0.52	0.56	0.66	0.74	42%
Congenital	0.26	0.28	0.34	0.40	55%
Other	13.01	16.70	22.27	29.58	127%
Total ($b)	**71.38**	**91.66**	**122.23**	**162.32**	**127%**
GDP[(a)] ($b)	762	995	1230	1500	
Total as per cent of GDP	9.37%	9.22%	9.93%	10.82%	

(a) Calculated from first (2002) Intergenerational Report (p. iii) [7]
(b) All numbers including 2002-03 are projected from the 2000-01 base level. Actual total health expenditure in 2002-03 was $73.1 billion and actual GDP was $783 billion.

The largest absolute increase in projected expenditure between 2002–03 and 2032–33 is for neurological disorders ($11.1 billion) followed by cardiovascular disease ($8.3 billion). The smallest projected absolute increase is for congenital disorders ($0.1 billion) (Table 5).

Mental disorders, cancer, infectious disease and maternal conditions are projected to decrease as a proportion of GDP over the period 2002–03 to 2032–33. The other projected conditions will increase as a proportion of GDP with diabetes and dementia & Parkinson's disease showing the largest increases over the same period (Figures 10a and 10b).

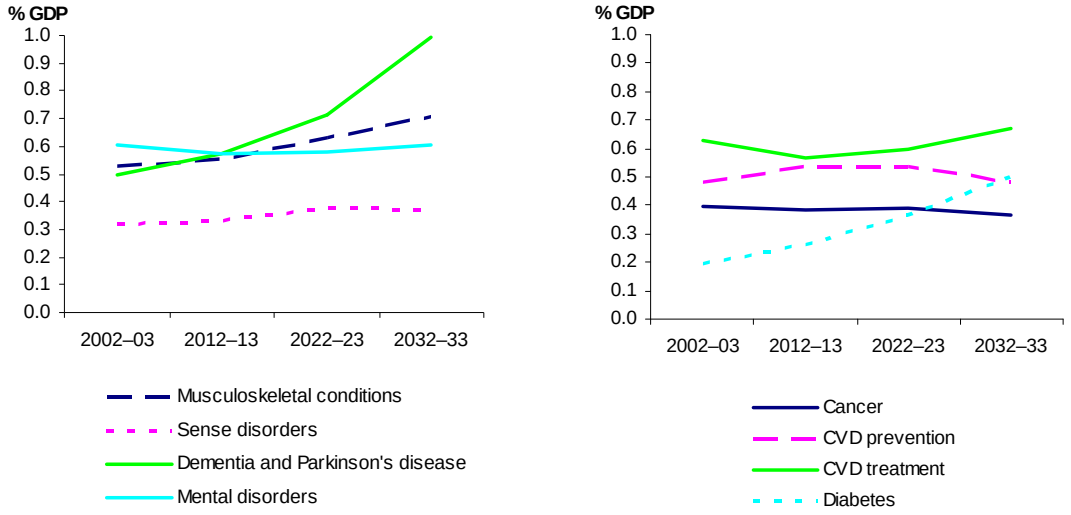

Figure 10a: Per cent of GDP for selected disease groups 2002–03 to 2032–33

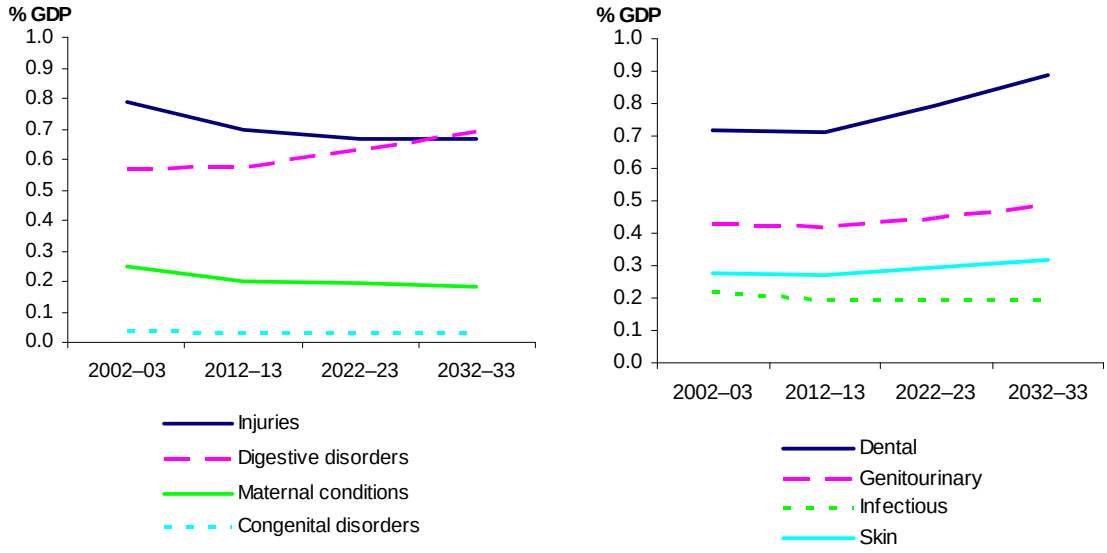

Figure 10b: Per cent of GDP for selected disease groups 2002–03 to 2032–33

Our estimate of growth in health expenditure as a proportion of GDP is considerably lower than that estimated in the Intergenerational Report for Australian Government health expenditure only [7], and than that estimated by the Productivity Commission for Australian and state government health expenditure [6] (Figure 11).

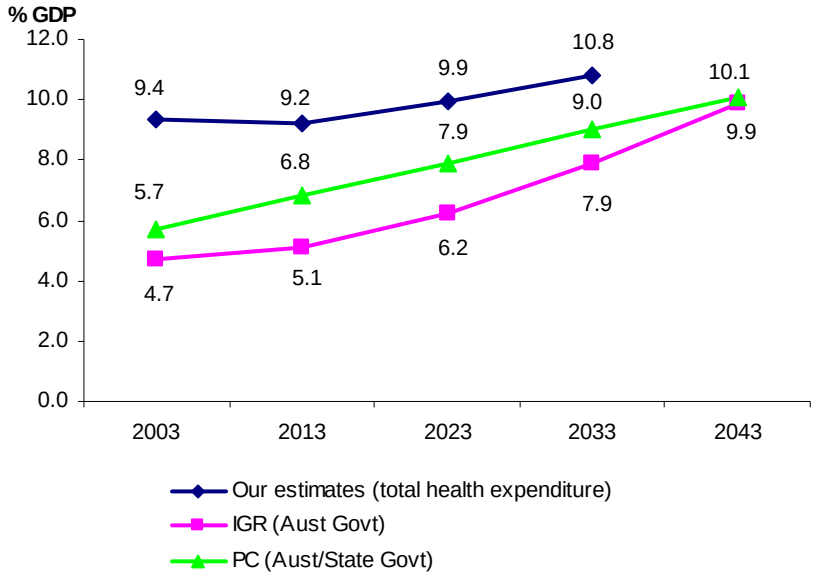

Figure 11 Projected change in percent of GDP, 2003 to 2043

Notes:
IGR - Intergenerational Report 2002-03
PC - Productivity Commission 2005

Residential aged care expenditure is projected separately from the rest of health expenditure. Health expenditure (excluding aged care) is projected to increase by 114%, whereas the high care portion of residential aged care is projected to increase by 242%. Residential aged care is dominated by dementia, which is part of neurological disorders, and it is the large increase in dementia due to the ageing of the population which results in the $8.9 billion (294%) increase in neurological expenditure in high care residential aged care (Table 6).

Table 6 Projected health expenditure, 2002–03 and 2032–33 ($ billions of 2002-03 dollars)

	Health (excluding residential aged care)			Residential aged care (high care)			Health		
	2002–03	2032–33	Change	2002–03	2032–33	Change	2002–03	2032–33	Change
Cardiovascular	6.62	13.18	99%	1.28	3.00	133%	7.91	16.18	105%
Respiratory	5.76	12.01	108%	0.16	0.61	279%	5.92	12.62	113%
COPD	*0.57*	*0.75*	*32%*	*0.03*	*0.06*	*90%*	*0.60*	*0.81*	*35%*
Other respiratory	*5.19*	*11.25*	*117%*	*0.13*	*0.56*	*324%*	*5.32*	*11.81*	*122%*
Injuries	5.44	8.97	65%	0.15	0.39	153%	5.59	9.36	67%
Dental	5.10	12.43	144%				5.10	12.43	144%
Mental	3.85	7.28	89%	0.45	1.20	167%	4.30	8.48	97%
Digestive	3.99	9.47	137%	0.05	0.19	274%	4.04	9.66	139%
Neurological	0.96	3.22	235%	3.02	11.90	294%	3.98	15.13	280%
Dementia & Parkinson's	*0.56*	*2.24*	*297%*	*2.97*	*11.68*	*294%*	*3.53*	*13.91*	*294%*
Other neurological	*0.40*	*0.99*	*147%*	*0.05*	*0.23*	*326%*	*0.45*	*1.21*	*168%*
Musculoskeletal	3.09	7.53	144%	0.65	2.33	259%	3.74	9.86	164%
Genitourinary	3.04	6.73	121%	0.02	0.07	223%	3.06	6.80	122%
Cancer	2.78	5.08	83%	0.03	0.08	194%	2.81	5.17	84%
Sense disorders	2.25	4.98	122%	0.04	0.15	260%	2.29	5.13	124%
Endocrine, Nutritional & Metabolic	2.15	4.09	91%	0.02	0.05	166%	2.17	4.14	91%
Skin	1.94	4.38	126%	0.02	0.07	285%	1.96	4.45	127%
Maternal	1.78	2.51	41%				1.78	2.51	41%
Infectious	1.53	2.66	73%	0.01	0.04	223%	1.55	2.70	75%
Diabetes	1.32	6.61	399%	0.07	0.36	431%	1.39	6.97	401%
Neonatal	0.52	0.74	42%				0.52	0.74	42%
Congenital	0.25	0.38	53%	0.01	0.02	126%	0.26	0.40	55%
Other	11.67	25.02	114%	1.33	4.56	242%	13.01	29.58	127%
Total	64.06	137.29	114%	7.32	25.03	242%	71.38	162.32	127%

Note: All numbers including 2002-03 are projected from the 2000-01 base level. Actual total health expenditure in 2002-03 was $73.1 billion. 'Other' includes diseases not included above. Expenditure for aids & appliances, ambulances, community health services and capital goods which could not be allocated by disease is allocated proportionally across all categories.

Decomposition of projected expenditure to underlying drivers

The projected change in expenditure for health expenditure in Australia between 2003 and 2033 of $91 billion would have been higher by $1.3 billion if disease trends were ignored. Favourable trends in the disease rates of cardiovascular disease, COPD, cancers, injuries and other diseases over the period led to lower expenditure of $5.0 billion which was countered by the steep increase in projected cases of diabetes and an increase for other diseases giving a treatment expenditure increase of $3.7 billion, and a net impact of disease rate changes of $1.3 billion. Ageing ($29 billion) and normal (overall) population growth ($28 billion) are the main causes for the overall increase projected for the period. Excess health price inflation ($19 billion), changes in volume of health services provided per case ($14 billion) and, to a lesser extent, treatment proportion ($1.3 billion) also contribute to the projected increase in expenditure (Figure 12 and Table 7).

(Note: Data from a preliminary version of this report was used in the United Nations World Economic and Social Survey 2007 report on 'Development in an Ageing World'.

The preliminary version of this report included estimates that favourable changes in disease rates would decrease expenditure by $5.5 billion, and that increases in disease rates would result in expenditure increases of $4.0 billion. These are the numbers included in the UN report. The correct numbers are the $5.0 billion and $3.7 billion listed above).

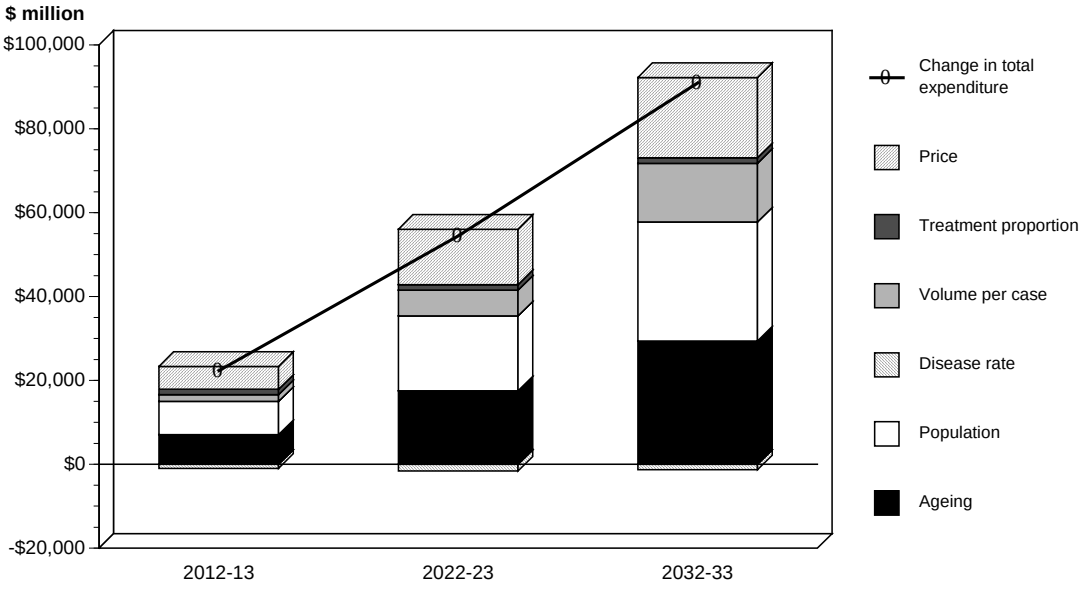

Figure 12 Decomposition of projected change in health expenditure for all projected conditions.

Table 8 provides an overview of the decomposition of the projected change in admitted patient, medical and pharmaceutical expenditure due to the different factors for each of the projected disease groups.

Unlike the other conditions projected, the increase in expenditure for diabetes is attributed to increases in all six components of the model (Table 7). The growth in dementia and Parkinson's disease is mostly driven by ageing (Table 7). The growth in expenditure for musculoskeletal conditions is driven by the two demographic factors of general population growth and the aging of the population (Table 7). Decreases in the projected disease rates for, cancer, cardiovascular disease, COPD and injuries slow the growth in expenditure for these diseases (Tables 7 and 8).

Table 7 Change in total health expenditure due to different factors, 2002–03 to 2032–33 ($ billion)

	Total health expenditure (billions of 2002–03 dollars)			Components of change ($b)					
	2002–03	2032–33	Expenditure change	Ageing	Population	Disease rate	Volume per case	Treatment proportion	Price
Cardiovascular	7.91	16.18	8.27	4.86	2.91	-2.44	0.41	0.59	1.94
Respiratory	5.92	12.62	6.70	0.33	2.75	0.18	1.62	0.00	1.83
COPD	0.60	0.81	0.21	0.27	0.16	-0.38	0.07	0.00	0.10
Other respiratory	5.32	11.81	6.48	0.06	2.59	0.56	1.54	0.00	1.73
Injuries	5.59	9.36	3.77	0.90	1.93	-1.34	1.04	0.00	1.23
Mental	4.30	8.48	4.18	-0.03	1.68	0.15	1.31	0.00	1.08
Digestive	4.04	9.66	5.62	1.11	1.95	0.25	1.08	0.00	1.23
Neurological	3.98	15.13	11.14	6.29	2.32	0.50	0.61	0.00	1.42
Dementia & Parkinson's	3.53	13.91	10.38	6.37	2.05	0.43	0.30	0.00	1.23
Other neurological	0.45	1.21	0.76	-0.08	0.27	0.07	0.31	0.00	0.19
Musculoskeletal	3.74	9.86	6.12	2.60	1.56	0.20	0.74	0.00	1.01
Genitourinary	3.06	6.80	3.74	1.75	0.99	0.14	0.37	0.00	0.49
Cancer	2.81	5.17	2.36	1.46	0.85	-0.46	-0.05	0.00	0.57
Sense disorders	2.29	5.13	2.84	1.75	0.46	0.01	0.29	0.00	0.33
Endocrine, Nutritional & Metabolic	2.17	4.14	1.98	-0.16	0.93	0.12	0.51	0.00	0.59
Skin	1.96	4.45	2.50	0.20	0.96	0.17	0.55	0.00	0.62
Maternal	1.78	2.51	0.73	-0.35	0.50	0.01	0.26	0.00	0.30
Infectious	1.55	2.70	1.15	0.06	0.55	0.04	0.18	0.00	0.33
Diabetes	1.39	6.97	5.58	1.29	0.93	1.57	1.13	0.11	0.55
Neonatal	0.52	0.74	0.22	-0.12	0.16	0.00	0.08	0.00	0.10
Congenital	0.26	0.40	0.14	-0.05	0.09	0.00	0.04	0.00	0.05
Other	18.10	42.01	23.91	7.52	6.86	-0.42	3.82	0.61	5.51
Total	71.38	162.32	90.94	29.40	28.37	-1.31	14.00	1.31	19.17

'Other' includes diseases not included above, including dental expenditure. Expenditure for aids & appliances, ambulances, community health services and capital goods which could not be allocated by disease is allocated proportionally across all categories.

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Table 8 Per cent change in health expenditure due to each factor by disease, 2002–03 to 2032–33.

	Components of change (%)						
	Ageing	Population	Disease rate	Volume per case	Treatment proportion	Price	Total
Cardiovascular	59%	35%	-29%	5%	7%	23%	100%
Respiratory	5%	41%	3%	24%	0%	27%	100%
COPD	126%	74%	-181%	35%	0%	47%	100%
Other respiratory	1%	40%	9%	24%	0%	27%	100%
Injuries	24%	51%	-36%	28%	0%	33%	100%
Mental	-1%	40%	4%	31%	0%	26%	100%
Digestive	20%	35%	4%	19%	0%	22%	100%
Neurological	56%	21%	5%	5%	0%	13%	100%
Dementia & Parkinson's	61%	20%	4%	3%	0%	12%	100%
Other neurological	-11%	36%	9%	41%	0%	25%	100%
Musculoskeletal	42%	26%	3%	12%	0%	17%	100%
Genitourinary	62%	36%	-19%	-2%	0%	24%	100%
Cancer	47%	27%	4%	10%	0%	13%	100%
Sense disorders	62%	16%	0%	10%	0%	12%	100%
Endocrine, Nutritional & Metabolic	-8%	47%	6%	26%	0%	30%	100%
Skin	8%	38%	7%	22%	0%	25%	100%
Maternal	-47%	69%	1%	36%	0%	41%	100%
Infectious	5%	47%	3%	16%	0%	29%	100%
Diabetes	23%	17%	28%	20%	2%	10%	100%
Neonatal	-56%	73%	2%	37%	0%	44%	100%
Congenital	-34%	63%	2%	31%	0%	38%	100%
Total	32%	31%	-1%	15%	1%	21%	100%

Residential aged care expenditure is expected to show the greatest growth (242%) in the period 2002-03 to 2032-33, due primarily to the ageing of the population in this period. Pharmaceutical expenditure is expected to show the next highest growth (145%). Admitted patient expenditure in hospitals is expected to show a similar growth to health expenditure as a whole, and medical services expenditure growth is expected to show a somewhat lower growth (97%) (Table 9).

Table 9 Per cent change in health expenditure for each area of expenditure, 2002–03 to 2032–33, %

	2002-03 to 2012-13	2012-13 to 2022-23	2022-23 to 2032-33	2002-03 to 2032-33
Admitted patient services	26%	34%	31%	121%
Medical services	26%	27%	23%	97%
Pharmaceutical scripts	37%	37%	31%	145%
Residential aged care (high care)	43%	49%	60%	242%
Other health	22%	27%	27%	97%
Total	**28%**	**33%**	**33%**	**127%**

Decomposition of projected expenditure to underlying drivers by disease

Cardiovascular disease

The projected change in expenditure for the period 2002–03 to 2032–33 for cardiovascular disease (both treatment and preventive expenditures) is $8.3 billion (105%), from $7.9 billion in 2002–03 to $16.2 billion in 2032–33 (Figure 13).

The decline in the cardiovascular disease incidence of 64% expected in this period means the expenditure increase is $2.4 billion lower than it would be if the disease rate had been constant. Factors that will act to increase expenditure are ageing ($4.9b), overall population growth ($2.9b), extra volume of services per case of disease ($0.4b), extra proportion of those with hypertension and hyperlipidemia treated ($0.6b) and excess health price inflation ($1.9b).

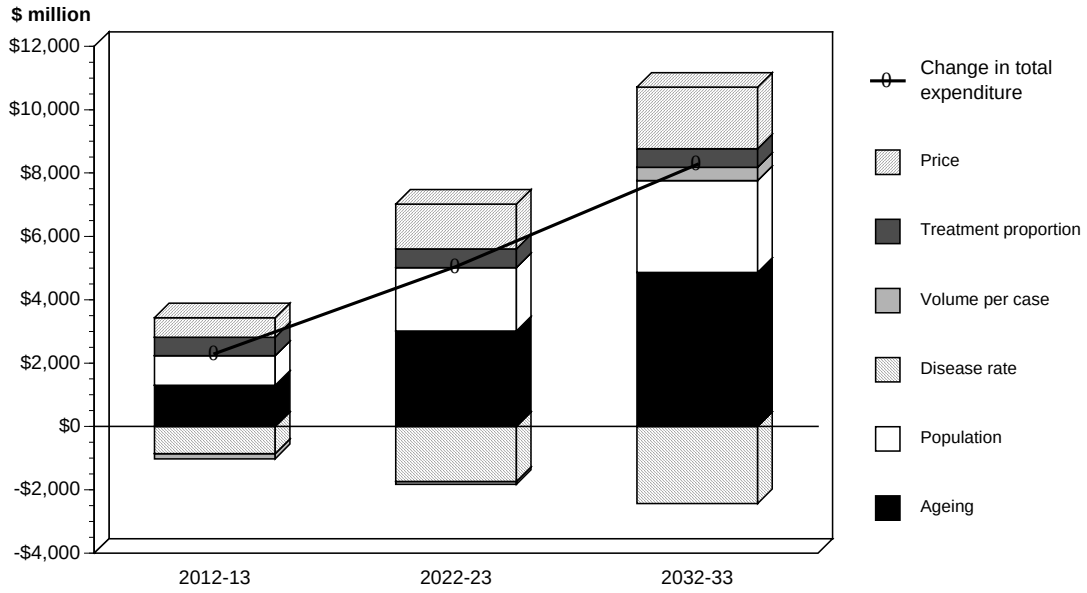

Figure 13 Decomposition of projected change expenditure for cardiovascular disease

Injuries

Expenditure on injuries is projected to increase by 67% ($3.8 billion) in the period 2002–03 to 2032–33 (Figure 15). The change is a result of projected increases in expenditure due to general population growth ($1.9 billion), an expected increase in the volume of services per case ($1.0 billion), excess health price inflation ($1.2 billion), an ageing population ($0.9 billion) and a predicted decrease in the incidence rate of injuries ($1.3 billion).

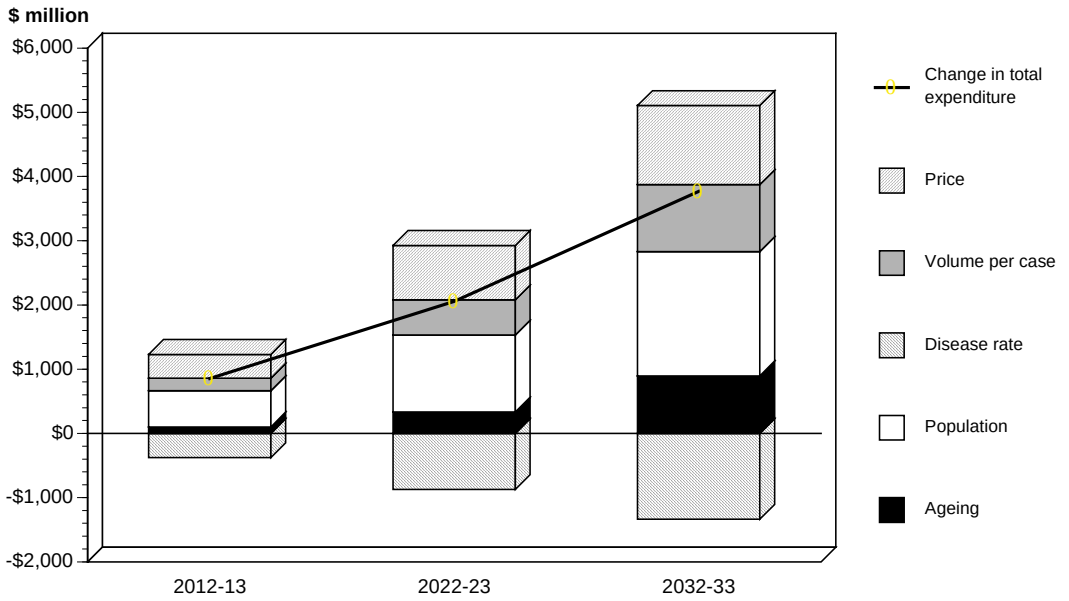

Figure 14 Decomposition of projected change in health expenditure for injuries

Mental disorders

The projected change in expenditure for people with mental disorders is $4.2 billion (97%) for the period 2002–03 to 2032–33 from $4.3 billion to $8.5 billion (Figure 16). The change is a result of projected increases in expenditure due to general population

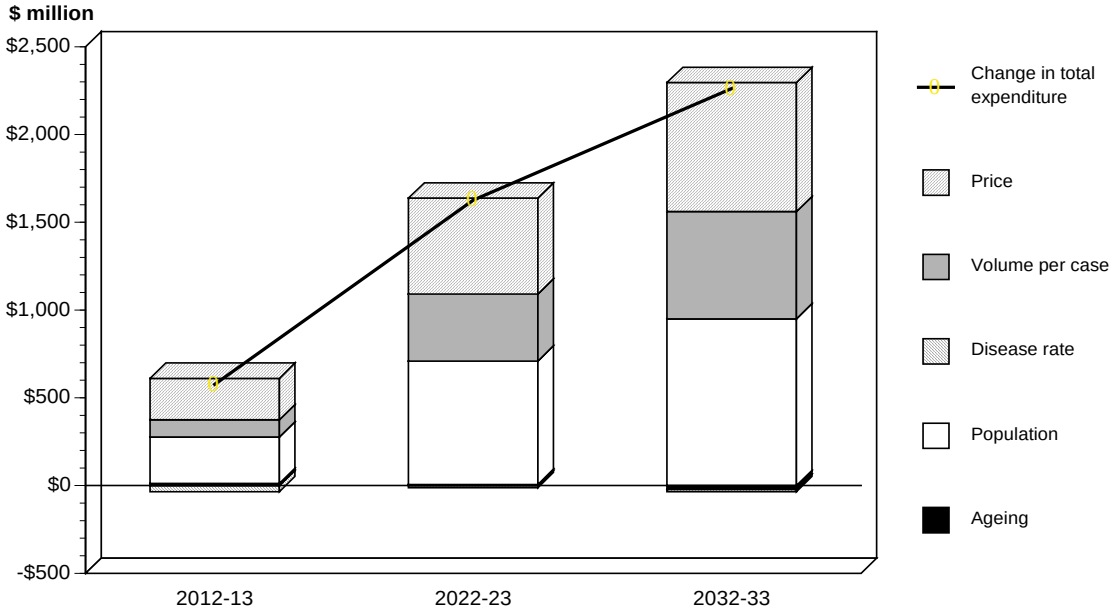

Figure 15 Decomposition of projected change in health expenditure for mental disorders

growth ($1.7 billion), an expected increase in the volume of services per case ($1.3 billion), excess health price inflation ($1.1 billion) and a predicted increase in the incidence rate of disease ($0.2 billion) and a slight decrease in expenditure as a result of an ageing population ($37 million).

Dementia and Parkinson's disease

The projected change in health expenditure for people with dementia and Parkinson's disease for the period 2002–03 to 2032–33 is $10.4 billion, from $3.5 billion in 2002–03 to $13.9 billion in 2032–33 (Figure 17). Over half of the increase in total expenditure is due to ageing ($6.4 billion). Additional factors that contribute to the projected increase are excess health price inflation ($1.2 billion), volume per case ($0.3 million) and population growth ($2.0 billion).

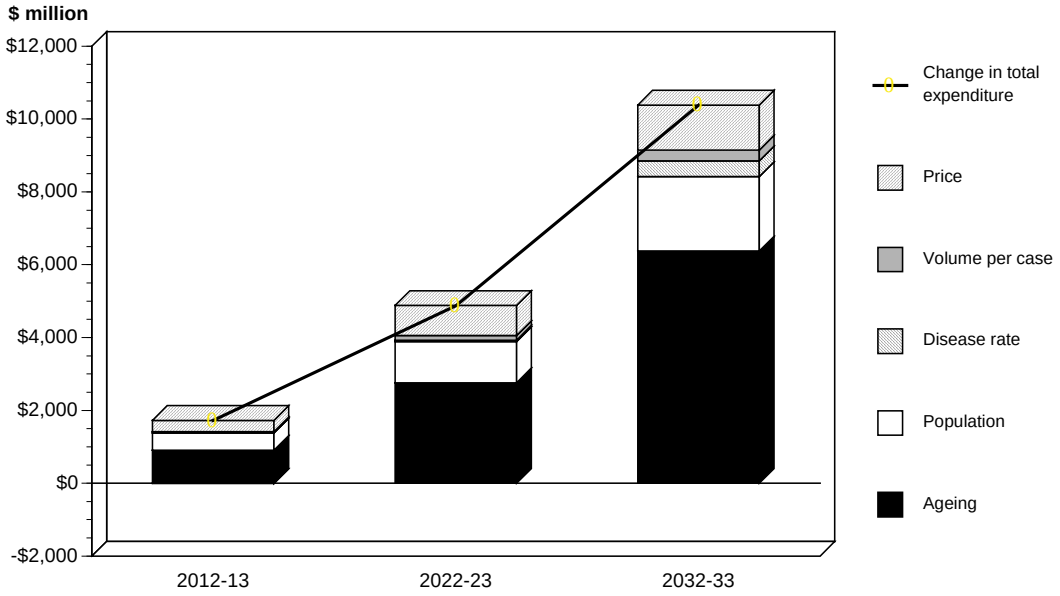

Figure 16 Decomposition of projected change in health expenditure for dementia and Parkinson's disease

Musculoskeletal disorders

Expenditure on selected musculoskeletal disorders is projected to increase by 164% ($6.1 billion) in the period 2002–03 to 2032–33 (Figure 18). Ageing ($2.6 billion), general population increase ($1.6 billion), an increase in volume of treatment per case ($0.8 billion), a predicted increase in the incidence rate of disease ($0.2 billion) and excess health price inflation ($1.0 billion) are the factors that contribute to the projected increase.

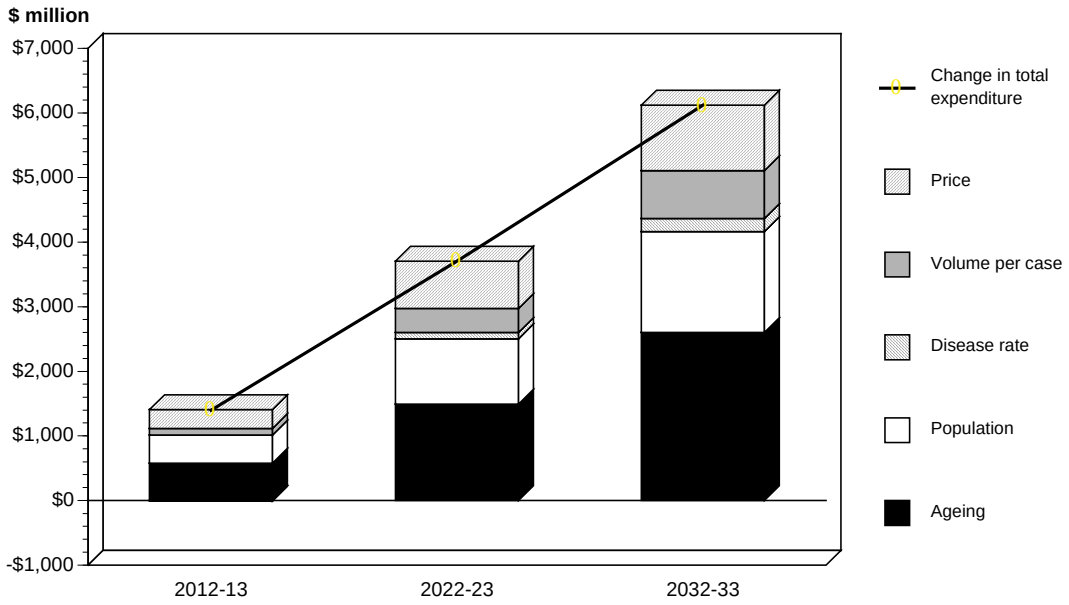

Figure 17 Decomposition of projected change in health expenditure for musculoskeletal disorders

Cancer

The projected expenditure on cancer in the period 2003 to 2033 shows an increase of $2.4 billion from $2.8 billion in 2003 to $5.2 billion in 2033 or 84%. (Figure 19). This expenditure increase would have been $0.5 billion higher if cancer disease rates had not decreased. Population growth ($0.9 billion) and the ageing of the population ($1.5 billion) are the main factors in the growth of total expenditure for cancer. The other factor that produces an increase in this projection is excess health price inflation ($0.6 billion).

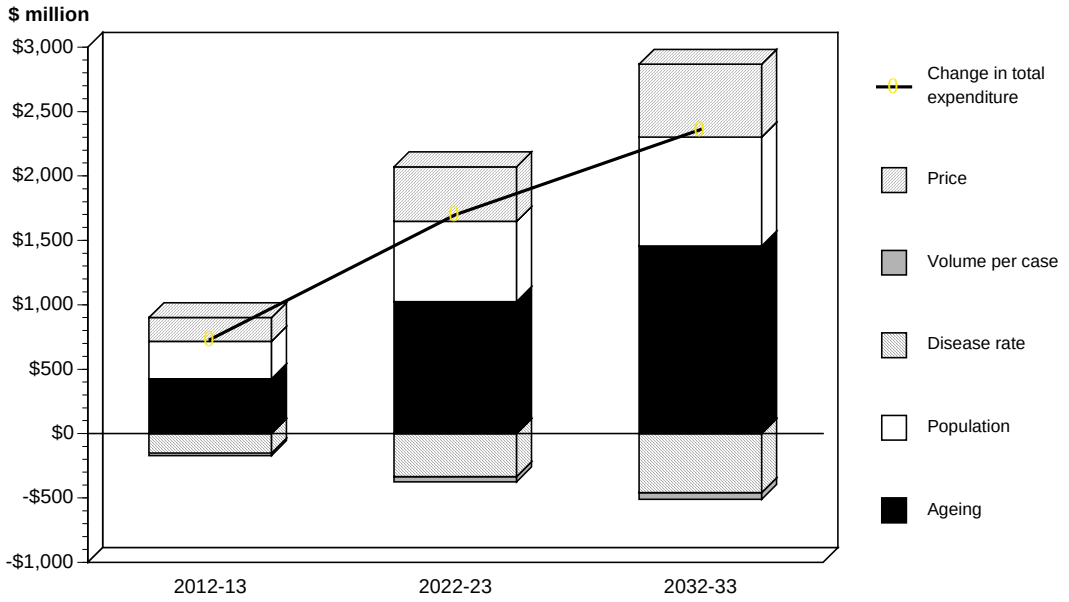

Figure 18: Decomposition of projected change in health expenditure for cancer

Diabetes

Overall in the period 2002–03 to 2032–33 it is projected that the cost of treatment of people with diabetes (type 1 and type 2 diabetes) will increase by 401% from $1,.4 billion to $7.0 billion (Figure 19). Factors that will act to increase expenditure are ageing ($1.3 billion), overall population growth ($0.9 billion), an increase in the prevalence rate of diabetes ($1.6 billion), extra volume of services per case of disease ($1.2 billion) and excess health price inflation ($0.6 billion).

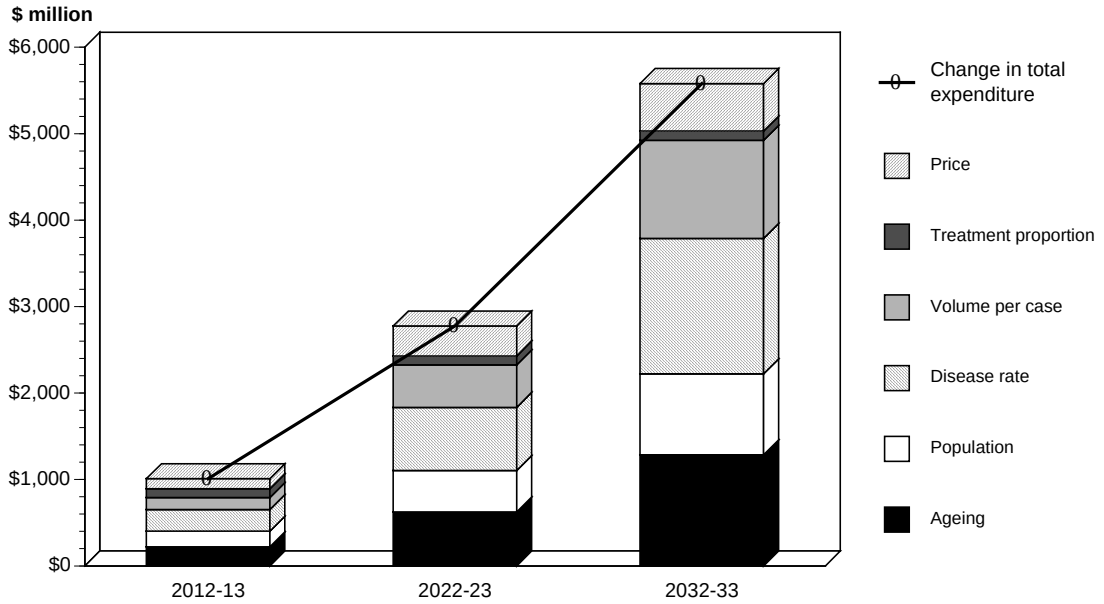

Figure 19 Decomposition of projected change in health expenditure for diabetes

2.3 Discussion

2.3.1 The Australian case study

Our projections are based on a careful analysis of past trends in population growth, disease rates and shifts in health expenditure, combined with judgment on how these observations from the past are likely to apply over the projection period. There is no inevitability about these scenarios. In most cases the changes into the future have been estimated according to what has happened with a particular disease in the past, but the future does not necessarily repeat the past. For instance, developments in health technologies and health service utilisation may drastically alter the outlook for some diseases. Advances in prevention and treatment similar to those that precipitated the spectacular decline in cardiovascular disease rates over the last three decades may become possible in other disease areas and alter our projections. Nevertheless, it is important for government to anticipate changes in health expenditure as the cost of health care is rising faster than other sectors of the economy and this is expected to continue for quite a while as the population ages.

Many factors contribute to expenditure change and we have a considerable body of knowledge on how these factors have changed in recent years.

Demographic factors

First there are demographic factors. There is some uncertainty around the assumptions of changes in fertility, migration and mortality, but we can be reasonably confident about the projected changes in population. The two demographic factors – ageing and overall population increase – contribute two-thirds of the projected increase in health care costs. Ageing (i.e. the change in the age structure of the population) accounts overall for 32% of the growth in expenditure. For some diseases, ageing accounts for more than 40% of the growth in expenditure (for example neurological disorders, sense disorders, cancer, musculoskeletal disorders, cardiovascular treatment and COPD).

Much of the impact of ageing concerns a large increase in expenditure for long-term aged care services. For mental health services, ageing will have little impact, and in fact from 2013 to 2033 ageing will tend to reduce expenditure for mental illness. This is because mental disorders are most prevalent among young and middle aged adults and less so in the elderly.

Overall population growth accounts for 31% of the expected growth in expenditure, with considerable variation from disease to disease. Those diseases where population growth accounts for over 50% of expenditure growth are maternal conditions, neonatal and congenital disorders and injury. Due to its high immigration rates, Australia expects a relatively high population growth of 34% in next 30 years. This is higher than that of the USA (24% over the next 30 years) and is in contrast to a population decline in Europe (5% over the next 30 years).

Disease rate changes

Then there are changes in disease incidence and prevalence. Changes in disease rates account for a 2% reduction in the expenditure growth in expenditure in net terms only. This is a reduction in expenditure of $1.6 billion. Increases in disease rates mostly in diabetes ($1.7 billion) are expected to increase expenditure by $4.0 billion and decreases in disease rates (mostly in cardiovascular disease, tobacco related cancers, COPD and injury) would reduce expenditure by $5.5 billion.

Health system practice and policy changes

Finally, there are changes in treatment and prevention practices, including:

1. an increase in the proportion with disease who are treated;
2. changes in the pattern of treatment with a shift in emphasis from hospital to medical and pharmaceutical services;
3. changes in the pattern of services delivery, especially the provision of more services to older people who are increasingly receiving similar levels of health services as the middle aged with similar disease;
4. changes in technology such as new drugs, new procedures and application of old drugs in new ways; and
5. changes in prices paid for health industry inputs.

We have tried to capture the combination of these factors influencing treatment practices by quantifying changes in health expenditure over time and added judgment by explicitly estimating an expected increase in treatment coverage, particularly in preventive treatments for cardiovascular disease and for diabetes. For instance, with

lipid lowering drugs there has been a large increase in expenditure in the last decade, but as the drugs go off patent, it is likely the price per prescription will decrease.

In the case of cancer treatment, the volume of services provided per patient has been fairly constant in the last decade and in these projections that trend is assumed to continue. However, given the genetic revolution, it is not unlikely that the resources applied per cancer patient will increase in the future.

The change in treatment practices is reflected in our model in the assumptions about the increase in intensity of care (volume per case) and excess health price inflation.

The projected increases in expenditure vary significantly for each disease area. Maternal conditions expenditure is projected to grow by 41%, congenital diseases expenditure by 55%, cancer by 84%, cardiovascular treatment by 111%, dementia and Parkinson's by 294% and diabetes by 401%. These different growths have implications for health services planning especially workforce planning. For example, to increase the supply of obstetricians at the same rate as the supply of geriatricians and endocrinologists would be unwise.

2.3.2 Comparison with other Australian projection estimates

We estimate an increase in federal, State and private spending for health from 9.4% of GDP in 2002–03 to 10.8% of GDP in 2032–33. This is an increase of 15% in the health to GDP ratio (or an annual growth of 0.5% greater than growth in GDP). The Treasury's 2002 Intergenerational Report [7] estimated Australian Government spending on health (including aged care) would rise from 4.7% of GDP in 2002–03 to 7.9% of GDP in 2032–33, an increase of 68% (or an annual growth of 1.7% greater than growth in GDP). The Productivity Commission [6] estimated all government health expenditure to increase from 5.7% of GDP in 2002-03 to 9.4% of GDP in 2034-35, an increase of 65% (or an annual growth of 1.6% greater than growth in GDP). The OECD [3] estimated government health expenditure in Australia to grow from 5.3% of GDP in 2000 to 8.5% in a 'cost-containment' scenario using a country specific residual for non-demographic growth, an increase of 60% (or an annual growth of 0.9% greater than growth in GDP). In a 'cost pressure' scenario growth would rise to 9.7% of GDP, an increase of 83% (or an annual growth of 1.2% greater than growth in GDP).

These various estimates are not directly comparable as they cover different projection periods and have different inclusion criteria for including federal, all government or total health expenditure. The differences in growth rates, however, indicate that much of the difference must be due to variations in model assumptions. The OECD and Productivity Commission adjust their projection models to allow for proximity to death costs but conclude that this has only a minor downward impact on projections. The OECD makes an optimistic assumption about 'healthy ageing', i.e. years gained from improvements in life expectancy are equivalent to years in full health. Results from our recent burden of disease study indicate that life expectancy increases at a faster rate than health-adjusted life expectancy (ratio of increase=1.3) [14] confirming that healthy ageing does occur but at a somewhat less optimistic pace than in the OECD assumptions. Of interest also is the finding that increases in length of life over the age of 80 are matched with a greater amount of health-adjusted time lost due to disability [14]. OECD's optimistic healthy ageing assumption would lead to somewhat lower

projection estimates and therefore also cannot explain their higher expenditure growth estimates in comparison to ours.
This leaves the non-demographic growth factors as the main explanation for the different estimates. OECD, Treasury and the Productivity Commission use estimates of non-demographic expenditure growth of around 2.6% per year. Our estimates are about 1.2% per year growth due to non-demographic factors. Our estimates are a summation of estimates made disease-by-disease and specified as excess health price inflation, volume per case, increased treatment proportion and disease rate increases. We make the same assumption of excess health price inflation for all diseases. Our inclusion of disease trends is not a sufficient explanation for the differences. We estimate that disease trends on balance have only a minor downward impact on estimates (by 1%). It is our estimates of increases in volume of services per case of disease, therefore, that explains much of the difference in expenditure estimates.

The volume per case estimates are based on matching historical trends in expenditure by disease and epidemiological estimates of incident or prevalent cases over the last decade. Introduction of new technologies and changes in treatment practices are the main contributors to changes in volume per case. Judgements were made as to whether trends in particular technologies would continue or whether a saturation point had been reached with certain technologies or drugs. Also in the period 1993-94 to 2000-01 there were some changes in treatment practices as services that had previously only been applied for the middle-aged were now supplied to older age groups. These changes are of a one-off nature, so in general these changes were not projected to continue. So in estimating the growth for the future, the previous growth in volume of services per case for the middle-aged was applied to all age groups, rather than using the previous growth for the older population. The observation window of less than 10 years for which we have expenditure and incidence/prevalences data estimates by disease is rather short. While it is an advantage to be able to look at these changes disease-by-disease and thus take into account differences in medical advances between diseases, there is considerable uncertainty whether trends observed over a short period will continue to affect expenditure in future years. Of course, the same issue arises if an assumption on non-demographic growth is made regardless of underlying disease patterns, as is traditionally done in expenditure projection studies.

We believe that the disease-by-disease method is more likely to give accurate predictions as it takes into account recent technological advances, which have differed greatly between diseases. For instance, the decline in cardiovascular disease burden over the last three decades has been largely due to health system interventions [16], some having put a lesser strain on health budgets (e.g. tobacco control measures), others substantially increasing expenditure (e.g. surgical interventions, intensive medical treatments and prevention with blood pressure lowering and cholesterol lowering drugs). There remains considerable scope for further reductions in cardiovascular disease – the burden of disease study [14] estimates that another two-thirds of cardiovascular disease burden is potentially avoidable – and this is likely to lead to growth in costs which we try to capture in our 'volume per case' and 'treatment proportion' estimates. Similar arguments can be made about long sustained downward trends for other diseases (e.g. COPD, injuries and some cancers) which at least in part are due to better but more expensive care per individual. The link with increased health expenditure is more obvious for diseases with increasing trends. The steep increase in diabetes incidence due to the steady increase in body weight, together with the

improved survival of diabetics, results in considerably greater expense to the health system.

2.3.3 Comparison with projection estimates from other countries

For most of the expenditure projection studies summarised in Table 1, the projected growth in health expenditure can be expressed in percentage points above projected growth in GDP. This is calculated by annualising the growth in expenditure as a proportion of GDP, thus allowing more meaningful comparisons between studies that used different projection periods. The only exception is the study from the Netherlands which provides insufficient detail in its report. Our expenditure growth estimates for Australia are comparable to European Union and New Zealand estimates. The highest estimates are from the Hong Kong, US and previous Australian studies with OECD estimates lying in between (Table 12).

Table 10 Health expenditure growth as percentage points above projected GDP growth for selected country studies

Country studies	Health expenditure annual growth as percentage points above GDP growth
Australia	
2002 Intergenerational Report	1.7%
Productivity Commission	1.6%
OECD – cost containment scenario	0.9%
– cost pressure scenario	1.2%
Our study	0.5%
Other countries	
European Union countries – average	0.5%
– low (Portugal)	0.2%
– high (Spain)	0.6%
US	2.3%
OECD average – cost containment scenario	0.9%
– cost pressure scenario	1.4%
Hong Kong	1.9%
New Zealand	0.5%

If the growth predicted by other Australian studies for federal and/or state government health expenditure were to apply to total health expenditure it would increase health expenditure to more than 15% of GDP in 2033 rather than our more modest estimate of 10.8%. Applying the highest growth estimated for the US would mean an increase to more than 18% of GDP. Different assumptions lead to markedly different end results when projecting out 30 years.

Only a few of the studies have quantified the contribution of demographic and non-demographic factors driving the estimates. In some studies it is provided as qualitative statements, e.g. 'Health status of elderly, not age per se determines increase in expenditure' from the European union report [4]. The OECD study estimates that population ageing contributes a similar proportion as the non-ageing residual effect in their cost-containment scenario while it is about half the residual effect in the cost-pressure scenario [3]. The New Zealand report estimates for the period between 2020 and 2040 (when the baby boom generation are moving into the very old ages) an impact

of ageing of a similar magnitude as the estimate of non-demographic growth [5]. These estimates – apart from those in OECD's cost-pressure scenario – are similar to our findings. The combination of excess price inflation, treatment proportion and volume per case is estimated to explain 37% of projected growth in our estimates as compared to 33% explained by population ageing. The remaining 30% estimated to be driven by population growth is left out of this comparison as it is a particular feature of a high immigration country such as Australia (and New Zealand) but less so in most other OECD countries.

2.3.4 Further work

This study has used limited assumptions with the main purpose being to explore the impact of changing disease incidence and prevalence on projected health expenditures. However further work needs to be done to explore the impact on projected health expenditures of varying the key assumptions of growth in 'excess health price inflation' and 'volume per case of disease'. For 'excess health price inflation' this study assumes uniform growth in all areas of health apart from dental services. This assumption should be modified to see the impact of different growths in 'excess health price inflation' for different areas of expenditure. The impact of varying the 'volume per case of disease' assumptions should be assessed. Previous work doing projections for just 9 areas of disease showed that varying the 'excess health price inflation' and 'volume per case of disease' assumptions led to 107% growth in real expenditure for the period 2000-01 to 2030-31 with the low assumption, 155% growth with the central assumption and 206% growth with the high assumption [8]. Another area for future work is testing the impact of last year of life expenditure assumptions.

2.3.5 Conclusions

A large rise in health care costs is expected over the next 30 years in Australia. Ageing and the non-demographic growth factors (mainly increases in the volume of services per case and excess health price inflation) each account for about a third of projected changes in expenditure. The absolute increase in population, mostly driven by net immigration, contributes another 30%. Changes in disease rates on balance reduce expenditure projections, but only by about 2% or $2.4 billion.

We believe our disease-specific approach is an improvement over previous work that made uniform assumptions across all diseases treated in the health care system. This is because it enables a much better understanding of the factors driving health and aged care expenditure. It also has led to lower estimates of growth in total health expenditure than estimated for government health expenditure in previous studies. The main difference between our estimates and estimates from previous studies is the use of disease-specific estimates of the non-demographic growth factor for each type of service, and in particular the element we identify as the 'volume per case' or intensity of treatment. Thus, while the impact of changing disease rates per se has only had a marginal influence on our results, the disease-by-disease projection method has had a much larger impact on the results via the 'volume per case' assumptions.

A rich database of cost estimates has been generated by area of expenditure, disease, age and sex. This amount of detail is useful to government planning to resource health services in the future as it indicates which parts of the health system and for which specialty areas, expenditure is likely to grow most. As the factors driving the

expenditures for each disease are different, policies for each disease need to be tailored to ensure appropriate levels and equity of expenditure.

The database is also a valuable resource for health economists who want to model the cost-effectiveness of health interventions, particularly preventive interventions. An important element in such studies is to estimate the cost of treating disease in scenarios with and without a preventive intervention in place.

3. Implications for less developed countries

It is not possible in a paper such as this for us to make projections of future health expenditure in less developed countries. What we can do, however, is look at what is known about demographic and health status projections in these countries and speculate about the potential impact of these factors on health expenditure by drawing on the information gathered in the Australian case study and the comparison thereof with other projection studies from more developed nations.

3.1 Population ageing in less developed countries

Population ageing is not only affecting the more developed countries. Many of the less developed countries have seen rapid fertility declines and reductions in mortality rates over the last few decades. The demographic transition and population ageing is least prominent in the least developed countries of the world which continue to have high fertility rates and high childhood and adult mortality rates (Figure 22)

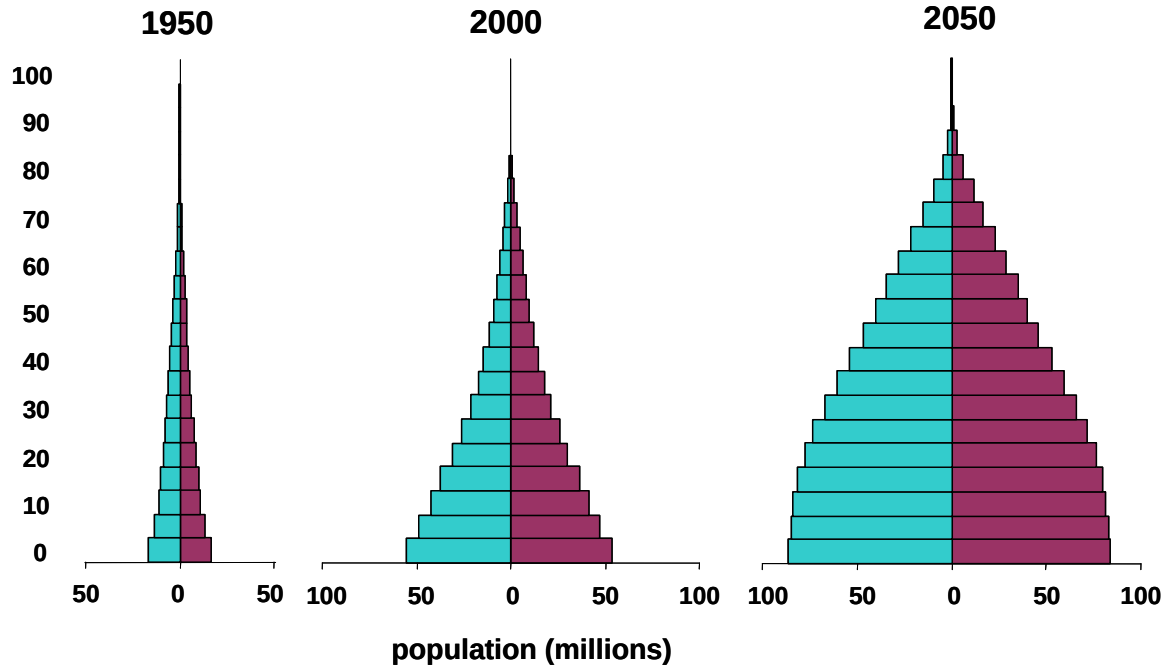

Figure 20 Population pyramids least developed countries, 1950, 2000 and 2050 (data from: UN Population Division, http://esa.un.org/unpp/)

The population pyramids for less developed countries minus the least developed countries and China indicates a greater impact of ageing (Figure 23). The proportion of middle aged and older people will increase rapidly between 2000 and 2050.

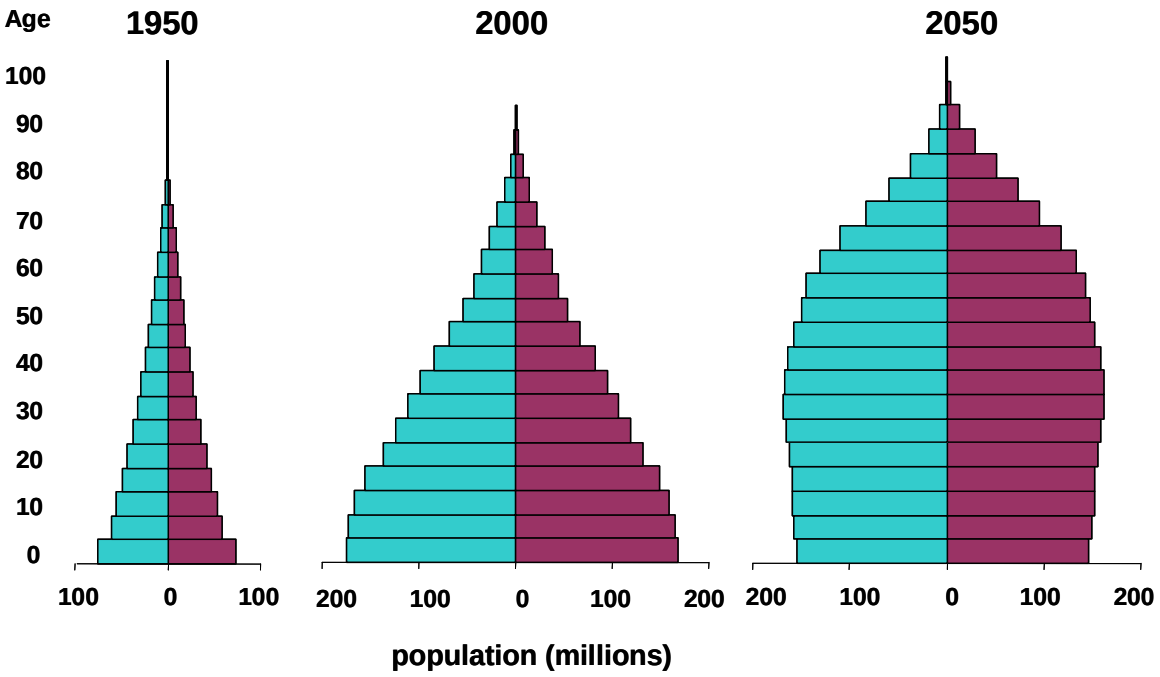

Figure 21 Population pyramids less developed countries, excluding the least developed countries and China, 1950, 2000 and 2050 (data from: UN Population Division, http://esa.un.org/unpp/)

Demographic developments in China are more rapid still due to the large reduction in fertility over the last 2 to 3 decades coupled with relatively low mortality rates. In 2050, the last generation from before the one-child policy will enter old age indicated by the bulge in the population pyramid at those ages akin to the bulge of the baby boom generation currently affecting the population pyramids in more developed countries.

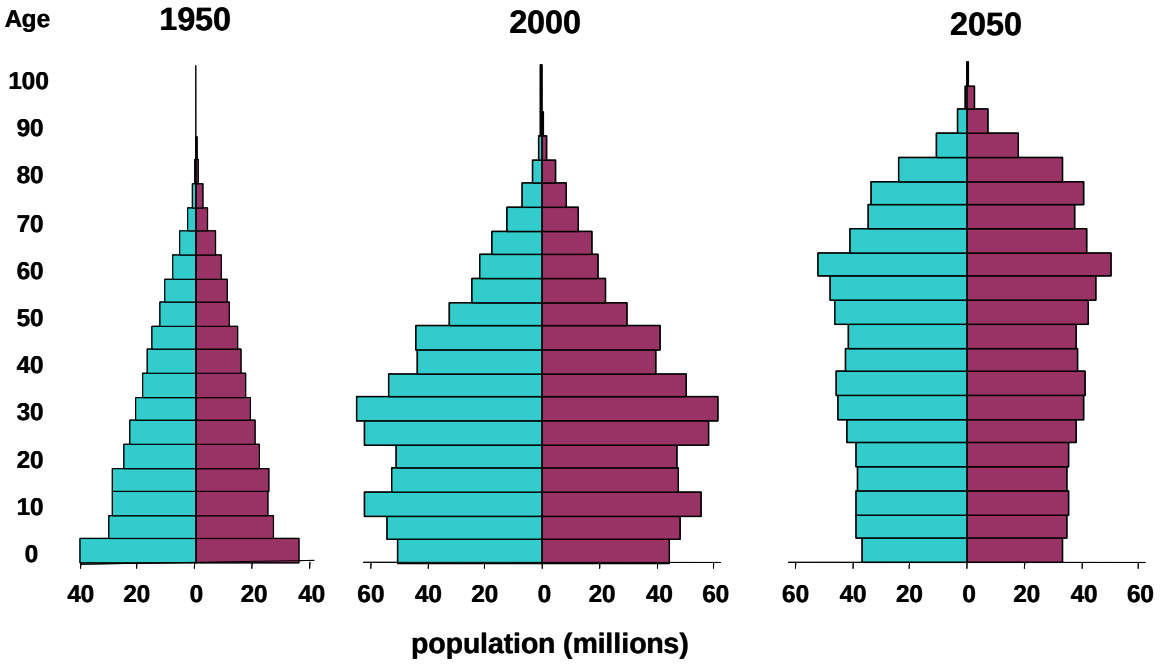

Figure 22 Population pyramids China, 1950, 2000 and 2050 (data from: UN Population Division, http://esa.un.org/unpp/)

While the proportion of elderly persons in the population in less developed countries is well below that of the more developed countries, their rate of increase in the proportion of elderly persons in the total population is much higher (Figure 25). During the first half of this century South East Asian countries will experience the highest rate of growth in the older population. [27]

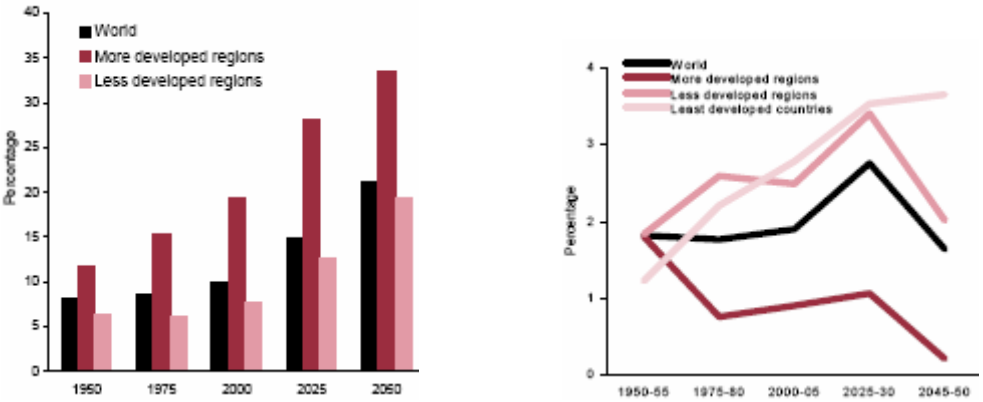

Figure 23 The proportion of the population aged 60 and over and the average annual growth in the proportion of the population 60 and over by world regions (source: [28])

3.2 Projected disease burden

WHO recently published projections of global mortality and disease burden from 2002 to 2030 [29]. The main findings are:

a dramatic shift in deaths from younger to older ages;
a shift in deaths and disease burden from infectious disease, maternal and neonatal conditions and nutritional deficiencies to non-communicable disease;
a large increase in deaths from HIV/AIDS (2.8 million to 6.5 million) in a baseline scenario that assumes coverage with antiretroviral drugs reaches 80% by 2012;
yet, a larger number of people dying from tobacco than from HIV/AIDS;
HIV/AIDS, depression, ischaemic heart disease and road traffic accidents as the leading causes of disease burden
a large increase in injuries, and particularly road traffic injuries, in all but the high income countries with the largest increase predicted for South Asia.

These large shifts in disease patterns will have an obvious impact on demand for health services. The projected continued decline in infectious disease, maternal and neonatal conditions and nutritional deficiencies (in global burden of disease terminology called 'group I' conditions which are strongly linked to poverty) requires not just maintenance of current disease control efforts but actually an expansion of this effort. Some of these improvements are brought about through development outside the health sector in areas such as housing, education and employment. However, the contribution of health services in prevention and treatment of these conditions is considerable. What is needed to ensure a continued decline of disease burden from group I conditions is an increased

effort to increase the coverage of effective intervention strategies such as vaccination programs, adequate treatment of infectious disease in childhood, antenatal and delivery care and treatment of HIV/AIDS and tuberculosis.

Population health in the least developed countries will continue to be dominated by these group I conditions but increasingly they will also have to face the 'double burden' from increasing levels of non-communicable disease. The shift towards non-communicable disease dominating demand for health care is more pronounced in middle-income countries in the less developed world. The concept of the 'double burden' indicates that continued investment in the control of group I conditions is required as well as a response dealing with chronic long-term care for non-communicable disease. Difficult planning decisions are to be made whether to focus on responding to the demand for resource-intensive care to sick individuals or to focus on known cost-effective measures of prevention. There is an increasing body of evidence to guide these decisions, most notably the second edition of the Disease Control Priorities (DCP) in Developing Countries project undertaken as a joint effort between the Fogarty International Centre of the National Institutes of Health, the World Health Organization, the World Bank and the Population Reference Bureau [30].

In order to achieve the greatest health gain in controlling non-communicable disease with available health resources, less developed countries can look at what has been most successful in recent decades in more developed countries. In the Australian Burden of Disease study we have observed that almost all of the gains in life expectancy in recent decades have occurred through gains made in just two areas: tobacco-related disease and cardiovascular health [14]. Less developed countries are at an early stage of the 'tobacco epidemic' and often at the start of the kind of sustained prevention effort (through taxation, regulation, awareness and smoking cessation aid) that has been required in the more developed countries to curb the tobacco health burden and associated expenditure on health services to deal with tobacco-related disease. In Australia, it has been a sustained effort over at least 30 years to reduce smoking prevalence to 17% of the adult population, the lowest figure in OECD countries. However, it still means that almost 3 million Australians continue to smoke. In part, tobacco control measures have also contributed to the gains in cardiovascular health but other preventive measures have also been key, particularly in addressing blood pressure and cholesterol as major risk factors through pharmacological and non-pharmacological interventions. For example, the DCP indicates that in developing countries the "poly-pill" – a combination drug of aspirin, blood pressure lowering and cholesterol lowering agents and produced cheaply as a generic – would be an affordable and cost-effective intervention with a sizeable impact on reducing disease burden. The contribution of surgical and emergency medical interventions has had far less of an impact on addressing cardiovascular health. The difficulty in convincing policy makers to invest in prevention rather than clinical services is that the potential gains from prevention are 'invisible' while the benefits to an individual receiving a high-tech surgical intervention are more 'tangible'.

With the growing problem of injuries some analysts talk about the 'triple burden' affecting less developed countries (and some have coined the term 'quadruple burden' by adding HIV/AIDS). Road traffic fatalities are projected to double in South Asia and sub-Saharan Africa between 2002 and 2020 and to increase by more than 50% in all less developed countries over the period [29]. This will be accompanied by a large

increase in injuries of survivors of road traffic accidents requiring emergency and rehabilitation care.

An effective response at the population level to most of these health problems relies on a functional health system that is accessible and affordable to the whole population. How less developed countries respond to these demographic and epidemiological challenges will depend on many factors, including the way in which health care is provided and financed between the government and private sector, the level of development and political will. There is a growing body of evidence to assist policy makers in these countries with information on the future impact of demographic and epidemiological change on demand for health care as well as guidance on what the most cost-effective intervention strategies are.

The decision making on what health services to fund and to provide these to whom in the population is critical to what will happen with health expenditure. Commercial, professional and political interests may influence this decision-making away from priorities suggested by evidence. There is an important task for international public health researchers with demography, epidemiology and health economic background to collect and process evidence to help policy makers set more rational priorities and hence make optimal use of resources available for health. This will become more urgent as expenditure on health continues to grow at a greater pace than other parts of the economy.

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Appendix A

Table A1: Principal data sources for epidemiological modelling

Primary data source[a]	Prevalence/ Incidence	Reference period	Disease and injury categories	
A. Disease registers, surveillance and notification systems				
National Notifiable Diseases Surveillance System: includes	Incidence	2003	A1	Tuberculosis
	Incidence	2003	A2a	Syphilis
Notifications; and	Incidence	2003	A2b	Chlamydia
Reports: Annual report & Communicable Diseases	Incidence	2003	A2c	Gonorrhoea
Intelligence	Incidence	2003	A5a	Diptheria
	Incidence	2000-03	A5b	Pertussis
	Incidence	2003	A5c	Tetanus
	Incidence	2003	A5d	Poliomyelitis
	Incidence	2003	A5e	Measles
	Incidence	2003	A5f	Rubella
	Incidence	2003	A5g	Haemophilus influenza type B
	Incidence	1993-96	A5g	Hib B sequela
	Incidence	2003	A8	Arbovirus infections
	Incidence	2003	A9a	Hepatitis A
	Incidence	2003	A9b	Hepatitis B
	Incidence	2003	A10	Malaria
HIV/AIDS National Registry	Incidence	2003	A3	HIV/AIDS
National Perinatal Data Collection	Incidence	2003	D2	Low birth weight
VIC Perinatal Data Collection Unit	Incidence	2001-02	D2	Low birth weight
QLD Perinatal Data Collection	Incidence	2002	D2	Low birth weight
National Cancer Statistics Clearinghouse	Incidence	2001	F	Malignant neoplasms
State and Territory cancer registries	Incidence	1997	F12	Breast cancer
Breast Screen Australia	Incidence	2001-02,1997	F12	Breast cancer
National Diabetes Register	Incidence	2001	H	Diabetes mellitus
Australian and New Zealand Register of Dialysis and Transplant Patients	Incidence	2002	H	Diabetes mellitus sequela
	Incidence	2002	O1	Nephritis and nephrosis
Victorian Cystic Fibrosis Screening program	Incidence	1989-1998	I2	Cystic Fibrosis
ABS Causes of death dataset	Incidence	2003	K5	Motor Neurone disease
	Incidence	2003	R1	Anencephaly
WA Intellectual Disability Exploring Answers database	Incidence	1983-1996	K9	Intellectual disability
Victorian Perinatal Data Collection Unit Birth Defects Register	Incidence	2001-02	R2	Spina Bifida
	Incidence	2001-02	R5	Digestive system malformation
	Incidence	2001-02	R6a	Renal Agenesis
Congenital malformations, Australia	Incidence	2001-02	K9	Intellectual disability
	Incidence	1997	R3	Congenital heart disease
	Incidence	1997	R5	Digestive system malformation
	Incidence	1997	R6b	Other urogenital tract malformations
	Incidence	2001	R7	Abdominal wall defect
Western Australian Birth Defects Registry	Incidence	2003	R6b	Other urogenital tract malformations
B. Health service utilisation data				
National Hospital Morbidity Database (diagnoses or procedures)	Incidence	2002-03	A2b	Chlamydia sequale
	Incidence		A2c	Gonorrhoea sequale
	Incidence		A4	Diarrhoea
	Incidence		A5e	Measles sequela
	Incidence		A6	Meningitis
	Incidence		A7	Septicaemia
	Incidence		A8c	Dengue fever sequela
	Incidence		A9a	Hepatitis A
	Incidence		A9c	Hepatitis B sequela (D)[1]
	Incidence		A9c	Hepatitis C sequela (D)
	Incidence		C1	Maternal haemorrhage (P)[2]
	Incidence		C3	Hypertension in pregnancy (P)
	Incidence		C4	Obstructed labour (P)
	Incidence		C5	Abortion (P)

1 (D) refers to distributions which are used to estimate incidence to underlying causes

2 (P) refers to hospital data on procedures – may or may not be in addition to information on principal diagnosis

Primary data source[a]	Prevalence/ Incidence	Reference period	Disease and injury categories	
	Incidence		C6	Other maternal conditions (P)
	Incidence		D1	Birth trauma & asphyxia
	Incidence		D3	Neonatal infections
	Incidence		G	Benign neoplasms (P)
	Incidence		H	Diabetes sequela (P)
	Incidence		I1a	Haemolytic anaemia
	Prevalence		I1b	Other non-deficiency anaemia
	Incidence		K8b	Cataract related blindness (P)
	Incidence		L2	Ischaemic heart disease – AMI
	Incidence		L3	Stroke
	Incidence		L7	Aortic aneurysm
	Prevalence		L8	Peripheral vascular disease (P)
	Incidence		L8	Peripheral vascular disease sequela
	Prevalence		N2	Cirrhosis of the liver (D)
	Incidence		N3	Appendicitis (P)
	Incidence		N4	Intestinal obstruction (P)
	Incidence		N5	Diverticulitis (P)
	Incidence		N6	Gall bladder and bile duct disease (P)
	Incidence		N7	Pancreatitis
	Incidence		N8	Inflammatory bowel disease (P)
	Incidence		N9	Vascular insufficiency of intestine (P)
	Incidence		O2	Benign prostatic hypertrophy (P)
	Incidence		Ooth	Other genitourinary diseases (P)
	Incidence		Q4	Slipped disc (P)
	Incidence		R3	Congenital heart disease (P)
	Incidence		R4	Cleft lip and or palate (P)
	Incidence		T	Unintentional injuries
	Incidence		U	Intentional injuries
Bettering the Evaluation And Care of Health	Incidence	2000-01	B1	Lower respiratory tract infections
	Incidence	2000-1	B2	Upper respiratory tract infections
	Incidence	2000-01	B3	Otitis media
	Incidence	2000-01	N1	Peptic ulcer disease
	Incidence	2003-04	P4	Skin ulcers
Alcohol and Other Drug Treatment Services National Minimum Data Set	Prevalence	2002-03	J1c	Stimulant dependence
WA Data Linkage System	Incidence	1990-2003	L1	Heart Failure
	Incidence	1990-2003	L2	Ischaemic heart disease
	Incidence	1990-2003	L3	Stroke
Victorian Linked Admitted Episodes Database	Incidence	1996-2002	L	Heart failure
	Incidence	1996-2002	N9	Vascular insufficiency of intestine
C. Population health surveys				
2001-02 National Gastroenteritis Survey	Incidence	2001-02	A4	Diarrhoea
1980 National Trachoma and Eye Health Program	Prevalence	1976-78	A11	Trachoma sequela
	Incidence		B3	Otitis media
National Health Survey	Incidence	1995	B2	Upper respiratory tract infections
	Incidence	2001	B3	Otitis media
	Prevalence	2001	K10	Migraine
	Prevalence	2001	P1	Eczema
	Prevalence	2001	Poth	Other skin diseases
	Prevalence	1995	Q3	Chronic back pain (U[3])
	Incidence	2001	Q7	Gout
	Prev. & Inc.	2001	Qoth	Other musculoskeletal disorders
	Prev. & Inc.	1995	Qoth	Other musculoskeletal disorders
Australian Diabetes, Obesity and Lifestyle Study (AusDiab)	Incidence	1999-2000	E2	Deficiency anaemia
	Prevalence	1999-2000	H	Diabetes mellitus
Risk Factor Prevalence Study, 1989	Incidence	1989	E2	Deficiency anaemia
2002 National non-melanoma skin cancer survey	Incidence	2002	F11	Non-melanoma skin cancer
National Mental Health and Well-being Survey, 1997	Prevalence	1997	J1a	Alcohol dependence
	Prevalence	1997	J1c	Benzodiazepine dependence
- adult component, Low prevalence (psychotic) disorders component & child and adolescent component	Prevalence	1997	J1d	Cannabis dependence
	Prevalence	1997	J2	Psychotic disorders
	Prevalence	1997	J3	Anxiety and depression
	Prevalence	1997	J4	Bipolar disorder
	Prevalence	1997	J5	Personality disorders (isolated)
	Prevalence	1997	J7a	ADHD

3 Proportion by underlying cause or type of problem (recent vs long-term).

Primary data source[a]	Prevalence/ Incidence	Reference period	Disease and injury categories	
Australian Child to Adult Development Study	Incidence	1990-96	K9	Intellectual disability
Australian Longitudinal Study on Women's Health[4]	Prevalence	1996-2002	O3	Urinary incontinence
	Prevalence	1996-2002	Ooth	Menstrual problems
Survey of Disability, Ageing and Carers	Prevalence	1998	O3	Urinary incontinence
	Prevalence	2003	Q3	Chronic back pain
	Prevalence	2003	Q5	Occupational overuse syndrome
	Prevalence	1993	Qoth	Other musculoskeletal disorders
Child Dental Health Survey, Australia	Incidence	2000	S1	Dental caries
National Oral Health Survey of Australia	Prevalence	1987-88	S1	Dental caries
	Prevalence	1987-88	S2	Periodontal disease
South Australian Dental Longitudinal Study	Incidence	1991-1996	S1	Dental caries
The Adelaide Dental Study of Nursing Homes	Incidence	1998-1999	S1	Dental caries
	Prevalence	1998	S3	Edentulism
The Longitudinal Study of Dentists' Practice Activity	Incidence	1998-99	S4	Pulpal infection
National Dental Telephone Interview Survey	Prevalence	2002	S3	Edentulism
	Incidence	2002	S4	Pulpal infection
D. Epidemiological studies				
GBD study	Incidence		A2	STDs (apart from HIV/AIDS)
	Incidence		A5b	Pertussis sequela
	Incidence		A10	Malaria – sequela
	Incidence		B3	Otitis media – sequela
	Incidence		C2	Maternal sepsis – sequela
	Incidence		C3	Hypertensive disorders in pregnancy - sequela
Australian epidemiological studies	Incidence		A6	Meningitis sequela
	Prevalence		A9b	Hepatitis B
	Prevalence		A9c	Hepatitis C sequela
	Incidence		D4	Other neonatal causes
	Prevalence		E2	Deficiency anaemia
	Incidence		H	Diabetes Mellitus sequela
	Prevalence		I3	Haemophilia
	Prevalence		J1b	Heroin dependence
	Prevalence		J6b	Anorexia
	Incidence		J7b	Austism and Asperger's syndrome
	Prevalence		K4	Multiple sclerosis
	Incidence		K6	Huntington's disease
	Incidence		K7	Muscular dystrophy
	Prevalence		K8	Sense organ disorders
	Incidence		K9	Intellectual disability
	Prevalence		L3	Stroke
	Prevalence		M1	Chronic obstructive pulmonary disease
	Prevalence		M2	Asthma
	Prevalence		N2	Cirrhosis of the liver
	Prevalence		O4	Infertility
	Prevalence		P1	Eczema
	Prevalence		Poth	Other skin diseases
International epidemiological studies	Incidence		A2b	Chlamydia sequela (i.e. childwish)
	Prevalence		A9b	Hepatitis B sequela
	Incidence		A9c	Hepatitis C sequela
	Incidence		D1	Birth trauma & asphyxia – sequela
	Incidence		D2	Low birth weight – sequela
	Incidence		J6a	Bulimia
	Incidence		K2	Epilepsy
	Incidence		K10	Migraine
	Prevalence		M2	Asthma
	Incidence		N8	Inflammatory bowel disease
	Prevalence		O3	Urinary incontinence
	Incidence		Q1	Rheumatoid arthritis
	Incidence		Q2	Osteoarthritis
	Incidence		Q4	Slipped disc
	Prevalence		Z2	Chronic fatigue syndrome
Meta-analyses of epidemiological studies	Prevalence		K1	Dementia
	Prevalence		K3	Parkinson's disease

4 The research on which this report is based was conducted as part of the Australian Longitudinal Study on Women's Health, The University of Newcastle and The University of Queensland. We are grateful to the Australian Government Department of Health and Ageing for funding and to the women who provided the survey data.

Appendix B

Table B1 Change in standardised incidence rates (per 1,000 population) by disease, 1994 to 2031

Cause	Reference year (2003)	% change from reference year 1994	2003	2013	2023	2033
Communicable diseases, maternal and neonatal conditions						
Infectious and parasitic diseases						
Tuberculosis	0.0	-0.4	0.0	0.5	0.7	0.8
Sexually transmitted diseases (excluding HIV/AIDS)						
Syphilis	0.1	0.1	0.0	0.1	0.2	0.4
Chlamydia	2.0	0.1	0.0	0.1	0.2	0.3
Gonorrhoea	0.3	0.2	0.0	0.0	0.2	0.4
HIV/AIDS	0.0	0.5	0.0	0.1	0.4	0.7
Diarrhoeal diseases	878.1	0.0	0.0	0.0	-0.1	-0.1
Childhood immunisable diseases						
Diphtheria	0.0	0.0	0.0	0.0	0.0	0.0
Whooping cough	0.4	-0.1	0.0	0.0	0.0	-0.1
Tetanus	0.0	-3.4	0.0	5.7	10.6	14.2
Poliomyelitis	0.0	0.0	0.0	0.0	0.0	0.0
Measles	0.0	0.0	0.0	0.0	0.0	0.0
Rubella	0.0	-0.1	0.0	0.0	0.1	0.1
Haemophilus influenzae type b (Hib)	0.0	-0.4	0.0	0.2	0.1	0.0
Meningitis	0.1	-0.1	0.0	0.1	0.1	0.1
Septicaemia	1.0	-0.7	0.0	0.6	1.0	1.2
Arbovirus infection						
Ross River virus	0.4	-0.1	0.0	0.0	0.0	-0.1
Barmah Forest virus	0.1	-0.1	0.0	0.1	0.1	0.1
Dengue	0.0	0.0	0.0	0.0	0.1	0.1
Hepatitis						
Hepatitis A	0.1	-0.1	0.0	0.1	0.2	0.3
Malaria	0.0	0.1	0.0	0.0	0.1	0.2
Trachoma	0.0	0.0	0.0	0.0	0.0	0.0
Acute respiratory infections						
Lower respiratory tract infections	103.0	-0.1	0.0	0.1	0.2	0.2
Upper respiratory tract infections	1,319.7	0.0	0.0	0.0	0.0	0.0
Otitis media	59.1	0.0	0.0	0.0	0.1	0.0
Maternal conditions						
Maternal haemorrhage	2.2	0.0	0.0	0.0	0.0	0.0
Maternal sepsis	0.7	0.0	0.0	0.0	0.0	0.0
Hypertensive disorders of pregnancy	3.3	0.0	0.0	0.0	0.0	0.0
Obstructed labour	1.1	0.0	0.0	0.0	0.0	0.0
Neonatal causes						
Birth trauma and asphyxia	0.0	0.0	0.0	0.0	0.0	0.0
Low birth weight	0.1	0.0	0.0	0.0	0.0	0.0
Neonatal infections	0.5	0.0	0.0	0.0	0.0	0.0
Nutritional deficiencies						
Deficiency anaemia	47.3	-0.5	0.0	0.0	-0.1	-0.3
Non-communicable diseases						
Malignant neoplasms						
Mouth and oropharynx cancers	0.1	7.9	0.0	-12.5	-25.0	-37.5
Oesophagus cancer	0.1	3.2	0.0	-9.4	-19.5	-30.8
Stomach cancer	0.1	44.5	0.0	-27.5	-50.9	-67.7
Colorectal cancer	0.7	21.2	0.0	-19.0	-37.1	-52.8

Cause	Reference year (2003)	% change from reference year 1994	2003	2013	2023	2033
Gallbladder cancer	0.0	31.1	0.0	-22.4	-42.5	-58.6
Pancreas cancer	0.1	4.1	0.0	-8.9	-19.3	-30.8
Lung cancer	0.4	11.8	0.0	-13.0	-25.1	-36.4
Bone and connective tissue cancer	0.0	8.1	0.0	-11.4	-23.0	-34.7
Melanoma	0.5	3.5	0.0	-8.9	-17.8	-26.8
Non-melanoma skin cancers	19.2	7.0	0.0	-13.0	-25.6	-38.4
Breast cancer	0.6	18.6	0.0	-19.5	-37.7	-53.6
Cervix cancer	0.0	44.5	0.0	-34.3	-57.3	-72.2
Corpus uteri cancer	0.1	15.2	0.0	-10.6	-20.8	-28.7
Ovary cancer	0.1	11.1	0.0	-14.6	-27.5	-39.2
Prostate cancer	0.6	9.3	0.0	-10.5	-24.4	-38.9
Testicular cancer	0.0	19.0	0.0	-4.0	-14.6	-24.1
Bladder cancer	0.2	17.3	0.0	-15.8	-31.5	-45.9
Kidney cancer	0.1	7.5	0.0	-11.3	-22.7	-34.3
Brain cancer	0.1	2.1	0.0	-7.6	-16.1	-25.7
Thyroid cancer	0.1	10.6	0.0	-13.8	-26.7	-38.7
Lymphoma	0.2	7.9	0.0	-10.2	-20.9	-31.7
Multiple myeloma	0.1	2.1	0.0	-8.2	-16.6	-26.3
Leukaemia	0.1	10.8	0.0	-13.7	-26.7	-39.4
Larynx cancer	0.0	5.8	0.0	-11.5	-23.6	-36.2
Eye cancer	0.0	6.8	0.0	-12.1	-23.8	-35.2
Other neoplasms						
Uterine myomas	1.9	0.0	0.0	0.0	0.0	0.0
Benign neoplasms of meninges and brain	0.1	0.1	0.0	-0.1	-0.1	-0.3
Cardiovascular disease						
Rheumatic heart disease	0.1	41.1	0.0	-25.1	-47.1	-63.6
Ischaemic heart disease	1.9	44.4	0.0	-22.6	-37.2	-45.7
Stroke	1.0	32.7	0.0	-17.9	-31.4	-40.2
Inflammatory heart disease	0.2	19.3	0.0	-13.7	-25.1	-33.8
Hypertensive heart disease	0.0	24.2	0.0	-14.9	-27.8	-37.3
Non-rheumatic valvular disease	0.2	-0.3	0.0	0.3	0.6	0.7
Congenital anomalies						
Anencephaly	0.0	-0.1	0.0	-0.1	-0.1	-0.1
Spina bifida	0.0	0.0	0.0	0.0	0.0	0.0
Congenital heart disease	0.1	0.0	0.0	0.0	0.0	0.0
Cleft lip and/or palate	0.0	0.0	0.0	0.0	0.0	0.0
Digestive system malformations						
Anorectal atresia	0.0	0.0	0.0	0.0	0.0	0.0
Oesophageal atresia	0.0	0.0	0.0	0.0	0.0	0.0
Urogenital tract malformations						
Abdominal wall defect	0.0	0.0	0.0	0.0	0.0	0.0
Down syndrome	0.0	0.0	0.0	0.0	0.0	0.0
Injuries						
Unintentional injuries						
Road traffic accidents	1.3	47.3	0.0	-24.0	-45.9	-60.1
Other transport accidents	0.8	0.1	0.0	0.1	0.2	0.3
Poisoning	0.6	0.0	0.0	0.0	0.0	0.0
Falls	6.3	28.4	0.0	-13.2	-26.0	-36.0
Fires, burns and scalds	0.3	0.1	0.0	0.0	0.1	0.1
Drowning	0.0	0.6	0.0	-0.1	-0.1	0.1
Sports injuries	0.5	0.2	0.0	0.0	0.0	0.1
Natural and environmental factors	0.4	0.1	0.0	0.0	0.1	0.1
Machinery accidents	0.5	0.1	0.0	0.1	0.4	0.7

Cause	Reference year (2003)	% change from reference year 1994	2003	2013	2023	2033
Other unintentional injuries	2.7	0.2	0.0	0.0	0.1	0.2
Intentional injuries						
Suicide and self-inflicted injuries	1.2	9.0	0.0	-8.1	-18.8	-29.2
Homicide and violence	0.9	15.1	0.0	-9.0	-20.6	-30.7
Legal intervention and war	0.0	0.3	0.0	0.3	0.7	1.0

Table B2 Change in standardised prevalence (per 1,000) by disease, 1994 to 2033

Cause	Reference year (2003)	% change from reference year				
		1994	2003	2013	2023	2033
Diabetes mellitus						
Type 1 diabetes	4.9	0.0	0.0	0.1	0.1	0.2
Type 2 diabetes	54.0	-11.8	0.0	17.0	37.7	62.3
Endocrine and metabolic disorders						
Haemolytic anaemia	1.2	0.0	0.0	0.0	0.0	0.0
Cystic fibrosis	0.2	0.0	0.0	0.0	0.0	0.0
Haemophilia	0.1	0.0	0.0	0.0	0.0	0.0
Mental disorders						
Substance use disorders						
Heroin or polydrug dependence and harmful use	2.4	0.4	0.0	0.1	0.4	0.4
Benzodiazepine dependence and harmful use	2.5	0.1	0.0	0.0	0.1	0.0
Cannabis dependence and harmful use	11.6	0.5	0.0	0.3	0.5	0.5
Schizophrenia	4.4	0.2	0.0	0.0	0.1	0.1
Anxiety and depression	88.8	-0.1	0.0	0.0	-0.1	-0.2
Bipolar disorder	4.4	0.1	0.0	0.0	0.0	0.0
Personality disorders (isolated)	20.8	0.1	0.0	0.1	0.1	0.2
Eating disorders						
Anorexia nervosa	0.6	0.0	0.0	0.0	-0.4	-0.6
Bulimia nervosa	1.2	0.1	0.0	0.2	-0.1	-0.2
Childhood conditions						
Attention-deficit hyperactivity disorder	6.5	-0.3	0.0	-0.3	-0.3	-0.1
Autism spectrum disorders	4.1	-0.1	0.0	0.2	0.5	0.8
Nervous system and sense organ disorders						
Dementia	8.4	0.4	0.0	-0.6	-1.3	-1.1
Epilepsy	2.8	0.0	0.0	0.0	0.0	0.0
Parkinson's disease	2.3	-0.4	0.0	0.4	0.9	1.3
Multiple sclerosis	0.7	0.0	0.0	-0.1	-0.2	-0.4
Motor-neuron disease	0.1	-0.3	0.0	0.1	0.3	0.4
Huntington's chorea	0.1	0.2	0.0	-0.1	0.0	0.0
Muscular dystrophy	0.0	-0.2	0.0	0.0	0.0	0.0
Sense organ disorders						
Glaucoma-related blindness	0.9	0.2	0.0	-0.1	0.0	0.2
Cataract-related blindness	3.1	0.4	0.0	-0.4	-0.2	0.0
Macular degeneration	2.7	-0.2	0.0	0.0	0.0	0.6
Adult-onset hearing loss	111.8	-0.8	0.0	0.8	1.4	1.6
Refractive errors	13.4	0.0	0.0	0.1	0.2	0.3
Migraine	54.8	-0.4	0.0	0.0	-0.2	-0.4
Cardiovascular disease						
Rheumatic heart disease	0.5	30.1	0.0	-26.3	-47.0	-62.8
Ischaemic heart disease	15.6	34.1	0.0	-26.4	-43.0	-52.6
Stroke	7.1	12.7	0.0	-12.9	-23.6	-31.6
Inflammatory heart disease	1.3	8.6	0.0	-9.4	-17.8	-24.9
Hypertensive heart disease	0.2	9.3	0.0	-9.9	-18.7	-26.2
Non-rheumatic valvular disease	0.7	0.0	0.0	0.1	0.2	0.3
Aortic aneurysm	0.0	22.8	0.0	-14.4	-26.8	-36.0
Peripheral vascular disease	3.0	16.0	0.0	-15.3	-27.9	-37.7
Chronic respiratory disease						
Chronic obstructive pulmonary disease (COPD)	19.5	21.9	0.0	-23.8	-43.0	-56.9
Asthma	68.2	0.0	0.0	-0.1	-0.2	-0.2
Diseases of the digestive system						
Peptic ulcer disease	8.4	-0.4	0.0	-0.3	-0.6	-0.7

Cause	Reference year (2003)	% change from reference year				
		1994	2003	2013	2023	2033
Appendicitis	0.1	-0.1	0.0	0.0	0.0	0.0
Intestinal obstruction	0.1	-0.3	0.0	0.3	0.4	0.4
Diverticulitis	0.3	0.0	0.0	0.1	0.2	0.3
Gallbladder and bile duct disease	0.1	-0.2	0.0	0.1	0.0	-0.1
Pancreatitis	0.0	0.0	0.0	0.1	0.2	0.3
Inflammatory bowel disease	3.6	-0.1	0.0	0.1	0.1	0.2
Vascular insufficiency bowel	0.0	-0.2	0.0	0.0	0.1	0.2
Genitourinary diseases						
Benign prostatic hypertrophy	8.8	0.0	0.0	0.1	0.2	0.5
Urinary incontinence	11.5	-0.1	0.0	-0.2	-0.5	-0.9
Infertility	5.7	0.0	0.0	-0.2	-0.2	-0.3
Skin diseases						
Eczema	8.3	-0.2	0.0	-0.1	-0.1	0.0
Acne	3.9	0.0	0.0	0.1	-0.1	-0.2
Psoriasis	10.6	0.0	0.0	0.2	0.4	0.5
Ulcers	3.3	1.1	0.0	-1.1	-1.8	-2.1
Musculoskeletal diseases						
Rheumatoid arthritis	4.1	0.3	0.0	-0.2	-0.3	-0.5
Osteoarthritis	15.1	0.7	0.0	-0.6	-0.9	-0.9
Back pain (acute and chronic)	50.0	-0.3	0.0	0.3	0.4	0.5
Slipped disc	3.7	-0.1	0.0	0.2	0.3	0.5
Occupational overuse syndrome	1.8	-0.5	0.0	0.1	-0.1	-0.3
Gout	14.3	-0.8	0.0	0.8	1.4	1.9
Oral conditions						
Dental caries	31.8	0.0	0.0	0.0	0.0	0.0
Periodontal disease	50.3	-0.1	0.0	0.1	0.1	0.1
Edentulism	59.0	0.6	0.0	-0.2	-0.2	-0.2
Pulpitis	8.4	0.0	0.0	0.0	0.0	0.0