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# Ageing and Health Care: Inexorable Costs versus Modest Adaptation

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# ABSTRACT

This “Working Paper” consists of two documents. The first is a submission to the Productivity Commission inquiry “Implications of an Ageing Australia”. The second is a Research Note “Why Ageing is Unlikely to be a Problem for the Health Sector”. This was the key document submitted to the Productivity Commission. Its abstract is as follows:

This note summarises and elaborates some of the results obtained by Richardson and Robertson (1999). It focuses upon an issue which many still find paradoxical, viz, that while older people spend much more upon health than younger people, this does not imply that health expenditures in the next half century will necessarily become a major problem. The reason for this is two-fold. Firstly, there is no necessary relationship between cross sectional and time series data. Secondly, any effect which might arise from ageing per se will be quantitatively small in relation to GDP growth. An important caveat is that ageing may accentuate the cost impact of new technologies in the health sector.

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# Part 1: Submission to the Inquiry: Implications of the Ageing of Australia's Population

## 1.1 Introduction

Comments below are intended to parenthesise and extend the arguments in the attached document "Why ageing is unlikely to be a problem for the Health Sector: Research Note July 2004". It comments specifically on the issues raised by Ralph Lattimore and Helen Owens during our meeting on 28 July 2004.

An additional theme is that there is a serious risk of attaching too much credence to the results of analysis which are "pseudo-rigorous"; results of quantitative procedures that are based and depend upon (stated or unstated) assumptions which are counter-historical and of extreme uncertainty. The risk of these procedures (coupled with precision and elegance of graphical presentation) is that they may convey an impression of inevitability – that there are "inexorable consequences" of ageing. This may obscure the full extent of the choices which are available and the types of policy conclusions which, I believe are appropriate for this inquiry.

## 1.2 Ageing and Health Care Costs

The relationship between ageing and national expenditures shown in Figures 2, 3 and 4 of the attached research note (pp 15-17) demonstrate why, as a matter of *strict logic* ageing and health expenditures may not be associated at the national level and why it is so common for commentators to draw the incorrect conclusion that, historically, ageing must – and in the future, Australia's ageing population must – increase expenditures significantly. Figure 3 is used to illustrate that population ageing is, in principle, consistent with falling national health expenditures. In summary, drawing time series conclusions from cross sectional data is problematical. The reason for this apparent paradox (increasing health expenditures with the age of an individual but little or no relationship between population age and aggregate expenditures) is that health expenditures are primarily determined by the *level of expenditure within* every age cohort and not by the *difference between* cohorts (and thus by the relative number of persons per cohort).

**Conclusion 1:** *There is no necessary nexus between the age of a population and aggregate health expenditures.*

The above conclusion deals with the logic of cross-sectional and time series analyses. The historical evidence upon the relationship between population, age and health expenditures is incontrovertible. There is little or no relationship. This is demonstrated in the data presented in the research note. This reveals the following:

- ageing explains little (and possibly none) of the increase in Australia's increasing health expenditures over time;
- there is little or no relationship between GP service use across Australia and the age profile of statistical subdivisions;

- age explains little or none of the difference in the growth of health expenditures between OECD countries; and
- there is little or no relationship between national health expenditures and the demographic profile of OECD countries.

In 2002 Australia had a significantly younger population but higher per capita health expenditure than Denmark, Belgium, Sweden, Italy, Austria, Japan, UK, Ireland and Finland.

**Conclusion 2:** *As a matter of historical fact, average health expenditures in population groups have had little to do with the age of the* population groups.

## 1.3 Quantitative Significance of Rising Expenditures

For reasons summarised below, health expenditures are likely to rise. But there is no reason why this should be regarded as a problem. In a properly run economy rising expenditures on health care for the aged or for any population cohort should be of no greater concern than increased expenditures upon tourism or personal computers.

**Conclusion 3:** *The reason for exaggerated concern over future health expenditures is that commentators commonly underestimate the impact of a compound rate of economic growth upon GDP.*

A doubling of present health expenditures could (arithmetically) be accommodated by 4 to 5 years of GDP growth. More realistically, a doubling of health expenditures over a larger period of time could be accommodated by the redirection of the equivalent to 4 to 5 years of economic growth over the same time period, without any reduction in average consumption. A similar point has been recently made in the USA by Reindhardt et al (2004).

## 1.4 Approaches to Modelling

Historically there have been two broad approaches to the prediction of future health expenditures and the need for health resources. These two approaches are the "deterministic, needs based" (or epidemiological) and the economic modelling approaches. Neither of these is, at present, a satisfactory basis for prediction. The most comprehensive needs based approach ever completed, the US Graduate Medical Education National Advisory Commission (GMENAC, 1980) was discredited. More ad hoc needs based approaches to GP requirements resulted in a reduction in their training in Australia which resulted in the present (apparent) shortage of GPs.

Economic modelling has a number of advantages over deterministic models. However, no such model, incorporating a detailed description of the health sector exists for Australia and, to my knowledge is in use anywhere in the world except for the Netherlands. Nevertheless, this approach should be fully explored for a number of obvious reasons and the Centre for Health Economics is currently awaiting the result of an NHMRC application to develop such a model and for its integration with the general equilibrium model and national simulation model of the Centre of Policy Studies (Monash University) and NATSEM (Australian National University).

**Conclusion 4:** *Workforce and expenditure modelling of the health sector is rudimentary and highly unreliable. However for a number of reasons projections must be made and, consequently, it is desirable for there to be a significant national effort to develop a state of the art forecasting model.*

The reason for the failure of needs based modelling is that there is a highly variable relationship between illness – medical "need" – treatment and the use of medical resources. Despite the incontrovertible evidence of huge discrepancies in the type of health care received by different population groups, this simple "needs model" appears to have an irresistible attraction for modellers. It is for this reason that I have described the cohort based projection of health care needs as having "pseudo-precision". This comment does not deny the desirability of developing a system which incorporates evidence based medical care and a nexus between illness and resource use. However this presently does not exist.

As noted above, some form of projection is necessary. In the absence of a validated model for the Australian health sector, the best ad hoc approach probably is the amalgamation of a cohort based needs model and an econometric projection of health expenditures. This conclusion does not contradict the earlier conclusions which were designed to point out the highly contestable nature of this default method. Trends do tend to continue in the short run due to "historical momentum". More accurately, expenditures generally depend upon institutions and funding formula which change slowly and therefore ensure a continuation of the past.

**Conclusion 5:** *Simple modelling is justified but it is imperative in the formulation of policy to recognise that the results reflect little more than the embedding of present institutions and not a reflection of inevitable outcomes. Rephrased, there is no gold standard. We cannot judge whether particular projections are " right or wrong" (an issue I was asked to comment upon). Each method is as accurate as its assumptions and each of the analyses, to date, is highly contestable.*

Within the present institutional framework shortages, queuing and imbalances occur but this does not imply the inevitability of these shortages in the long run. It is just as likely to reflect the sclerosis of the funding channels and the paucity of system reform in the past two decades.

## 1.5 The Building Blocks of Modelling

During discussions I was asked to comment upon several modelling related issues. These were:

i. *the stability or otherwise of aged cost profiles;*
ii. *the issue of "older but healthier" and its implications;*
iii. *the importance of costs close to time of death; and*
iv. *evidence about age specific disability rates.*

The first of these has been discussed above. Age cost profiles are highly variable and in the future will depend very largely upon technologies which we cannot accurately predict.

The remaining three issues are of second order importance. The key theme of this submission is that ageing per se will have a minimal quantitative impact and an impact which can easily be absorbed by GDP growth. Consequently, a relatively minor adjustment to an already small impact factor is of little quantitative significance for the capacity to fund future health expenditures.

**Conclusion 6:** *As ageing per se is unlikely to have a significant effect on the cost burden of future health services, it is even less likely that incremental changes in the timing of ill health and the relative health costs of different age cohorts will be of importance.*

## 1.6 Productivity of the Health Sector

It is very difficult to quantify the efficiency of the Health sector relative to its potential as this is not known. Nevertheless there are reasons for believing it is poor and, in parts, abysmal. (The commonly made comparison between Australia and other countries' performance is possibly misleading. To use one facetious aphorism: "10,000 lemmings can be wrong!" It is little comfort to those who suffer the effects of a suboptimal system to know that the quality of life and longevity of patients in other health systems is also less than what is achievable.) The reasons for this conclusion are discussed in Section 4 of my article "Priorities of Health Policy: Cost Shifting or Population Health" (Richardson 2004). This section particularly highlights the apparent disregard of relatively straightforward systemic changes which have had the potential to significantly reduce death and disability arising from the epidemic of adverse events in Australia.

**Conclusion 7:** *There is almost certainly a huge potential for improving the productivity of Australia's health system. But "National Health Policy" at the political level has focussed primarily upon cost containment and cost shifting. It has failed to address the quantitatively largest issues for population health and the productivity of the health sector.*

One of the obstacles in the achievement of technical and allocative efficiency is the paucity of system research. Australia has a wealth of administrative databases which could be employed to investigate and improve system performance. As noted earlier service use is very uneven across Australia. To the extent that this violates the usual notion of "equity" this information should be an important input into policy formulation. It does not appear to be used for this purpose outside NSW. However the quality of the data also present other opportunities. The effect of different treatments, such as the varying rates of angiography and revascularisation observed between public and private hospitals could be traced through time if record linkage were possible. This would allow an assessment of downstream costs, mortality and morbidity associated with the two patient groups. There are clearly many opportunities for longitudinal research of this sort. A further option which may be piggy-backed on administrative data is the routine provision of information to different groups of patients who have been identified by their service mix. Information of this sort is probably a highly effective way of "empowering patients"; that is, enabling patients, and particularly those with a chronic disease, to take greater control of their disease management.

These developments have not occurred for a variety of reasons. First, for a $70,000 million industry, research funding for "product development and marketing" – health services research – is astonishingly small. In the USA six Federal agencies alone spent $US 1,658 million in 2002 upon HSR. (The agencies and their expenditures are as follows: Agency for Health Care Research and Quality $US 300 million; National Centers for Health Statistics $US 127 million; Extra Mural Prevention Research CDC $US 18 million; Centers for Medicare and Medicaid Services $US 55 million; Veterans Health Administration $US 371 million; National Institute of Health $US 787 million.) Significant US funding is also obtained from the US network of foundations which does not exist in Australia. Benchmarking against the federal agencies alone, at an exchange rate of $US 0.70 = $AUS 1.0 (0.65) and scaling these expenditures down in relation to the size of the US and Australian economies, Australia should be spending about $AUS 120 million on HSR. Australia does not currently spend a fraction of this amount. As a major initiative, the NHMRC is to provide $10 million per annum for HSR – or about 7.7 percent of the US Federal benchmark.

A second and possibly related reason is that there is no dedicated instrumentality, similar to the AIHW, which has taken "ownership" of the need to provide and periodically to review the need for information generated by HSR. Funding is currently inadequate but also ad hoc.

Thirdly, concern over the confidentiality of records has been elevated to such a level that easy and routine data linkage to observe the outcome of different service patterns does not seem to be a possibility. It is extremely doubtful that this concern in the bureaucracy over privacy would reflect the preferences of a well informed population. Patients almost certainly suffer and die because of the interpretation and implementation of our confidentiality laws in a way which seriously inhibits the capacity to investigate the outcome of system performance and differences in individual treatments.

***Conclusion 8**: Routinely collected administrative data should be fully used to monitor system performance. In particular it should be employed to regularly monitor equity of access to services and to provide disease related information to population groups identified as having particular needs and interests. A statutorily independent National Institute for Health Services Research should be established whose Terms of Reference require the achievement of these objectives.*

## 1.7 Pharmaceuticals

Pharmaceuticals were an issue of particular interest to the Commissioners and particularly the question "*To what extent are there interdependencies between the different expenditure types that need to be taken into account when projecting future health care costs? For example, would increased expenditure on the PBS reduce the rate of growth of hospital care costs?"*

Recent policy has been based upon an apparent assumption that the opposite may be true, and that national health care costs (at least to the Commonwealth government) can be limited by copayments for pharmaceuticals subsidised on the PBS. This latter issue is discussed in Section 3 of my policy paper. There it is concluded that copayments on pharmaceuticals violates an important principle of allocated efficiency, namely, that relative prices should reflect the relative cost and benefits (supply and demand) of different products. The high rates of pharmaceuticals coinsurance is likely to discourage the use of the product which may well be the most cost effective part of the system and which, probably, has the greatest potential for increasing population health at a relatively low cost (because of the low labour component in the cost of pharmaceutical production and distribution).

This does not directly address the Commissioners' question. With respect to cost saving, it is self-evident that antibiotics and psychotropic drugs have dramatically reduced the use of hospitals and significantly increased health outcomes. Similar substitution effects are likely in the future. However, I am unaware of research which demonstrates the potential for further reducing health system expenditures by the increased use of existing pharmaceuticals.

## 1.8 Policy Conclusions

The chief analytical conclusion from this submission is that the impact of ageing per se upon health costs, ie the effect when every other variable is held constant, is likely to be very small. However, the impact of these other variables and, in particular, cost enhancing technologies are likely to be very significant and, consequently, the interaction of ageing and new technologies may generate high levels of expenditure. A second conclusion, however, is that there is at present no demonstrably valid method for forecasting the impact of these other variables on

health costs. For this latter reason there is a significant risk that the use of a (legitimate) hybrid model incorporating the economic and epidemiological age cohort based methods of analysis might lead to an altogether unjustified conclusion that ageing per se will have a relatively large effect and that the relentlessness of the ageing process compels particular policy conclusions.

However, as argued earlier, the quantitatively largest effect of such modelling would arise from the projection of past trends and future GDP growth. These do not lead to relentless cost pressures. They are consistent with a variety of policy responses.

The second danger associated with these projection methodologies is that with an aura of pseudo precision they will deflect attention away from what should be the chief focus of the analysis. This is the achievement of a health sector which maximises flexibility, substitution opportunities and, in economic terminology, achieves allocative and technological efficiency. There is universal agreement that this does not currently occur. The real significance of ageing is that it accentuates the fracture lines between the major service sectors used by the elderly – primary and acute care and nursing home accommodation. Efficient substitution between these is of enormous significance for efficiency, ie for community costs and the quality of life of the elderly.

One of the Terms of Reference of the recent review of the Tasmanian hospital system, which I chaired, was an examination of this problem of the interface between services for the elderly and the problem of so-called “bed blockers” – elderly “near patients” filling acute care beds because Commonwealth funding for approved nursing home facilities had not been forthcoming (Expert Advisory Group 2004). The problem was exacerbated by the poor co-ordination of primary health care provided by Commonwealth funded general practitioners and other State funded services. Efficiency requires a seamless transition between all of the services provided for the aged. For well-known reasons a necessary but not sufficient condition for achieving this is the creation of a single fund holder responsible for all of the services provided to a patient. This was recommended in the Tasmanian review and accepted by the Tasmanian State government.

In sum, the ageing of the population highlights the need for a comprehensive and independent inquiry into aged and health care services.

**Conclusion 9:** *The Productivity Commission should consider the following recommendations:*

i. *that priority should be given to all possible means for increasing the flexibility of the health system and particularly the substitution possibilities between the various services provided to the aged;*

ii. *that there should be a national, independent and comprehensive inquiry into health and aged care services with the chief terms of reference being the achievement of allocative efficiency between these services; and*

iii. *that there be an endorsement of the Tasmanian inquiry’s recommendation that Tasmania should be given the opportunity to pool health and aged care funds from the Commonwealth and the State and, subject to Commonwealth regulation, be encouraged to experiment with the reorganisation of these two sectors.*

# Part 2: Research Note: Why Ageing is Unlikely to be a Problem for the Health Sector

## 2.1 Introduction

In an earlier study Richardson and Robertson (1999) argued that 'pure ageing effects' will have little effect upon health expenditures. The study supported this argument with the analysis of five sets of data. These were:

(i) Demographic projections of population growth, ageing and cohort specific health expenditures;

(ii) Australian time series expenditure and demographic data;

(iii) Australian cross sectional data on GP service use and demographic data;

(iv) OECD cross national expenditure and demographic data;

(v) OECD national time series data.

None of these data revealed a quantitatively significant relationship between changing health expenditures and the ageing of the population.

Comments below refer primarily to the first of these data sets, viz, the changing demographic structure in Australia and the impact upon health expenditures of *this variable alone*.

## 2.2 Cross Sectional versus Time Series Data

The well known relationship between age and rising health expenditures is shown in Figure 1. The base data are not readily available and were obtained from the analysis of AIHW data reported by Badham (1998). The steep rise in expenditures after the age of 60 may suggest that, as a larger percentage of the population reaches this age, national health expenditures will rise steeply. However even a visual perusal of Figure 1 should suggest that the magnitude of the effect is questionable. The relationship between age and expenditure is comparatively weak between the ages of 25 and 55 and most Australians for the next 50 years will remain in this age range. While the *percentage* of Australians aged 70 and above will rise sharply the *absolute* increase will be more modest.

Of greater importance, however, there is no necessary correspondence between the shape of the curve in Figure 1 and the movement of health expenditures through time. At best the relationship is easily misunderstood and the effect of ageing may easily be confounded with other effects.

This is illustrated in Figure 2 which depicts two age-expenditure relationships $t_1$ and $t_2$ which correspond with different levels of health technology and service supply. With the initial technology, the ageing of the population from $A_1$ to $A_2$ will raise average expenditures from B to

C. With new technology and/or an increased supply of medical services the initial cross sectional profile will rise from $t_1$ to $t_2$ and the observed path will be BE. This may lead to the wrong conclusion that this path is attributable to ageing. The correct conclusion is that in this scenario ageing plays a very limited role either before or after the introduction of new technology. Along the curve $t_2$ the age-expenditure relationship is (by construction) the same shape as the initial age technology profile. Technology is 'age neutral'.

Figure 3 depicts two alternative, cross sectional profiles in which there is a synergistic effect between ageing and technology. In the first, $t_3$, technology increases all costs in proportion to the initial costs in $t_1$. In this case ageing will have a greater effect as it moves expenditures to the path HFG where the effects of technology are more age-specific. With the second profile, $t_4$, technology has a disproportionate impact upon the cost of treating the elderly. This raises the cross section profile to HJ and, the effect of ageing in this case is more significant.

Figure 3 may be used to demonstrate three conclusions. First, and repeating the earlier point, the effects of ageing and technology may be confounded. The historical path may be BEGJ and this trend may be wrongly identified as the effect of ageing. Secondly, the 'pure ageing' effect may be calculated prospectively or retrospectively, and these two options may result in different conclusions. With the initial profile $t_1$, the increase in expenditure is relatively small. Ageing raises expenditures from B to C to D. A retrospective analysis, using the age-expenditure profile $t_3$ or $t_4$ would result in a quantitatively larger increase in expenditures.

This second conclusion has no particular policy relevance but highlights the possibility of ambiguity in the calculation of age effects.

Thirdly, an apparently paradoxical outcome is possible. Ageing may be associated with a decrease in average costs through time while simultaneously expenditures rise with age at *any point in time*. The four profiles $t_1$-$t_4$ each represent a fixed level of expenditure in different time periods. If government controlled budgets were reduced then it is possible that the profiles could be forced down with the chronological order now represented by $t_4$, $t_3$, $t_2$, $t_1$. The historical path observed would be HED.

This scenario is cited primarily to illustrate the difference between cross sectional and time series analyses. However it is not dissimilar to the historical experience in Victorian hospitals in the period 1991/92-1995/96. During this time the real budget for Victorian hospitals declined despite a significant increase in throughput (Richardson 1998).

## 2.3 Australian Data

Selected data from Richardson and Robertson (1999) are reproduced in Table 1. In Scenario A there is no increase in population and the absolute value of cohort expenditures remains unchanged. This scenario, $t_1$ in Figure 2, represents the 'pure ageing effect' where only the number of people in each cohort changes. The effect of ageing from $A_1$ to $A_3$, ie the movement BC, results in an additional expenditure of $15.07 billion by 2051. The effect is negligible. Inclusion of population growth – Scenario B – increases expenditures to $75.96 billion. Of this 15.06 may be attributed to the changing age profile (Scenario A) and the remaining 60.9 percent may be attributed to population growth.

Scenario D assumes that expenditures in each age cohort continue at their trend rate of growth and that the effects of ageing are added to the resulting expenditures. Scenario E is similar except that future expenditures by people over 65 is double the trend rate of people aged less

than 65. As noted above, these scenarios are an amalgam of ageing, new technologies and/or an increased supply of services per capita.

These scenarios approximately correspond with the profiles $t_3$ and $t_4$ in Figure 3. From Table 2 the pure ageing effect (Scenario A) explains 10 percent and 5 percent of the increase respectively.

These data are used to part-calibrate the age expenditure profiles in Figure 4. Costs on the vertical axis correspond with the costs in Table 3.

## 2.4 Other Results

In the Introduction it was noted that there is little or no relationship between ageing and observed health expenditures in four other sets of data. The erratic relationship between age and total expenditures illustrated in the figures and tables above provides a simple explanation for the apparently paradoxical empirical results. Through time, very little of the increase in the Australian health expenditures can be attributed to ageing. Across Australia there is likewise no close relationship between GP expenditures and the demographic profile of different statistical sub-divisions. In both cases the effect of age, if any, is dominated or fully absorbed by the effects of technology and the supply of services. Similarly the absence of an observed relationship between national health expenditures and the demographic profile of OECD countries both cross sectionally and through time is fully attributable to the respective importance of age and technology/supply.

## 2.5 Adding GDP

Prima facie, even without technology and increasing supply, future health expenditures may appear to be very large and a potentially serious economic problem. This widespread belief is probably due, in part, to an underestimation of the impact of compound growth and, specifically, compound growth of the GDP over a 50 year period. Table 3 reproduces some of the results reported in Richardson and Robertson (1999). Unsurprisingly the compound growth of GDP outpaces the effects of population ageing. At an achievable average GDP growth rate of 2.1 percent per anum health expenditures would fall to 5.3 percent of GDP by 2051. The sharp increase in health expenditures predicted by other Australian studies occurs in scenarios D and E where GDP growth is assumed to be relatively low. Importantly, however, these results are almost entirely driven by the assumption that cohort growth in expenditures will continue at their historical trends rates of growth. But this indicates that it is the assumption of trend growth, not ageing per se, which generates these results.

## 2.6 Policy Significance

The distinction between expenditure growth driven by ageing and by technology-supply is important. The ageing of the population implies a relentless inevitability of rising expenditures and, it is certainly true, that it would be politically difficult to reduce cohort expenditures to offset population ageing. However technology and supply induced costs are less relentless. While current technologies and those for the immediate future are likely to drive per capita expenditures upwards it is more difficult to extrapolate this result beyond 10-15 years. The genetics revolution may well introduce pharmaceuticals and other procedures which reduce or stabilise costs in the same way as the introduction of penicillin and various vaccines reduced the cost of treating some

diseases. Additionally, technology and service supply are more amenable to the influence of health and economic policy than the short run effects of ageing.

Even with the most pessimistic scenario with respect to future technologies, the 'problem' of ageing may be overstated. If health services are providing benefits which exceed their opportunity cost then new technology should be welcomed. Rising 'cost' is no more of a problem than the rapid increase in expenditures on tourism or the purchase of electronic software.

With the most conservative of the scenarios above – GDP growth of 2.1 percent (including population growth), a trend growth rate of cohort expenditures which does not absorb the effects of ageing and with an improbably high doubling of the growth rate for cohorts above the age of 65, health expenditures rise to 34.54 percent of the GDP (similar to a projection in the US made by the Health Care Financing Agency). This does not bankrupt the nation. To the contrary, even with this low rate of economic growth the GDP per capita, after subtracting health expenditures would rise by 155 percent by 2051. With a less extreme set of assumptions, GDP growth of 2.6 percent per annum and a continuation of trend expenditures per age cohort, the increase in health expenditures to 14.5 percent of GDP in 2051 could be comfortably financed by several years GDP growth.

These results do not imply the Panglossian conclusion that all is, and will be, well in the health sector. Noting the anxieties related to ageing are exaggerated is not equivalent to saying there will be no major challenge. As health expenditures rise it is increasingly important to ensure that they are used efficiently. The institutions and systemic incentives to achieve this do not currently exist.

**Table 1 Predicted future health expenditures ageing and population growth (1994 $billion)**

| Scenario | | 1995 | 2006 | 2051 |
|---|---|---|---|---|
| A. Ageing only | Health cost (A$ billion) | 37.53 | 46.27 | 52.60 |
| B. Ageing plus population growth | Health cost (A$ billion) | 37.53 | 52.14 | 75.96 |
| GDP growth [a] 2.1% pa | Health % GDP | 8.40% | 9.28% | 5.31% |
| GDP growth 3.1% pa | Health % GDP | 8.40% | 8.26% | 3.04% |
| D. Ageing + population growth + uniform cohort trend | Health % GDP | 37.53 | 65.66 | 274.63 |
| GDP growth 2.1% pa | Health % GDP | 8.40% | 11.69% | 19.19% |
| GDP growth 3.6% pa | Health % GDP | 8.40% | 9.81% | 8.36% |
| E. Ageing population growth + differential cohort trend | Health % GDP | 37.53 | 69.07 | 494.35 |
| GDP growth 2.1% pa | Health % GDP | 8.40% | 12.29% | 34.54% |
| GDP growth 3.6% pa | Health % GDP | 8.40% | 10.32% | 15.04% |

Source: Richardson & Robertson (1999)

**Table 2 Health Expenditures (1994) Total, per capita**

| | 1995 | 2051 | Increase | % Attributable to Ageing |
|---|---|---|---|---|
| Population (m) | | | | |
| Scenario A | 18.1 | 18.1 | | |
| Scenario DE | 18.1 | 26.1 | | |
| Total Health Expenditure ($b) | | | | |
| Scenario A | 37.53 | 52.60 | 15.07 | 100 |
| Scenario D | 37.53 | 274.63 | 237.10 | 6.3 |
| Scenario E | 37.53 | 494.35 | 456.82 | 3.30 |
| Per capita expenditure | | | | |
| Scenario A | 2,108 | 2955 | 847 | 100 |
| Scenario D | 2,108 | 10,522 | 8,414 | 10.0 |
| Scenario E | 2,108 | 18,940 | 16,832 | 5.0 |

Source Richardson & Robertson (1999)

**Table 3 Predicted future health expenditures calculated from population size, ageing and historical trends (1994 $billion)**

| | | 1995 | 2006 | 2021 | 2036 | 2051 |
|---|---|---|---|---|---|---|
| **A.** Ageing only | Health cost (A$ billion) | 37.53 | 46.27 | 49.36 | 51.67 | 52.60 |
| | Health % GDP | 8.40 | 10.35 | 11.05 | 11.56 | 11.78 |
| **B.** Ageing plus population growth | Health cost (A$ billion) | 37.53 | 52.14 | 62.51 | 71.03 | 75.96 |
| GDP growth **a**2.1% p.a. | Health % GDP | 8.40% | 9.28% | 8.15% | 6.78% | 5.31% |
| GDP growth 2.6% p.a. | Health % GDP | 8.40% | 8.75% | 7.14% | 5.52% | 4.02% |
| GDP growth 3.1% p.a. | Health % GDP | 8.40% | 8.26% | 6.26% | 4.50% | 3.04% |
| GDP growth 3.6% p.a. | Health % GDP | 8.40% | 7.79% | 5.49% | 3.67% | 2.31% |
| **C.** Ageing + population growth + excess inflation | Health cost (A$ billion) | 37.53 | 52.14 | 62.51 | 71.03 | 75.96 |
| GDP growth 2.1% p.a. | Health % GDP | 8.40% | 9.92% | 9.71% | 9.15% | 8.24% |
| GDP growth 2.6% p.a. | Health % GDP | 8.40% | 9.59% | 9.05% | 8.22% | 7.14% |
| GDP growth 3.1% p.a. | Health % GDP | 8.40% | 9.28% | 8.44% | 7.40% | 6.20% |
| GDP growth 3.6% p.a. | Health % GDP | 8.40% | 8.99% | 7.89% | 6.67% | 5.39% |
| **D.**Ageing + population growth + uniform cohort trend | Health cost (A$ billion) | 37.53 | 65.66 | 107.86 | 172.82 | 274.63 |
| GDP growth 2.1 % p.a. | Health % GDP | 8.40% | 11.69% | 14.06% | 16.49% | 19.19% |
| GDP growth 2.6% p.a. | Health % GDP | 8.40% | 11.02% | 12.32% | 13.43% | 14.52% |
| GDP growth 3.1% p.a. | Health % GDP | 8.40% | 10.40% | 10.80% | 10.95% | 11.01% |
| GDP growth 3.6% p.a. | Health % GDP | 8.40% | 9.81% | 9.48% | 8.94% | 8.36% |
| **E.**Ageing population growth + differential cohort trend Growth >65 = 2*growth <65 | Health cost (A$ billion) | 37.53 | 69.07 | 124.94 | 238.38 | 494.35 |
| GDP growth 2.1% p.a. | Health % GDP | 8.40% | 12.29% | 16.28% | 22.75% | 34.54% |
| GDP growth 2.6% p.a. | Health % GDP | 8.40% | 11.59% | 14.27% | 18.53% | 26.14% |
| GDP growth 3.1% p.a. | Health % GDP | 8.40% | 10.94% | 12.52% | 15.11% | 19.82% |
| GDP growth 3.6% p.a. | Health % GDP | 8.40% | 10.32% | 10.98% | 12.33% | 15.04% |

**a** GDP growth is assessed to commence at the rate shown in each row and then is reduced as the participation rate of the workforce declines. Predicted costs (C) = costs based on 1995 costs for each population cohort which increases each year by ½ (0.1 + % growth of GDP/capita)

Source: Richardson and Robertson (1999), Table 13.4 p335.

**Figure 1** **Best estimate simulated health care cost per capita by age 1994/95 (Male and Female)**

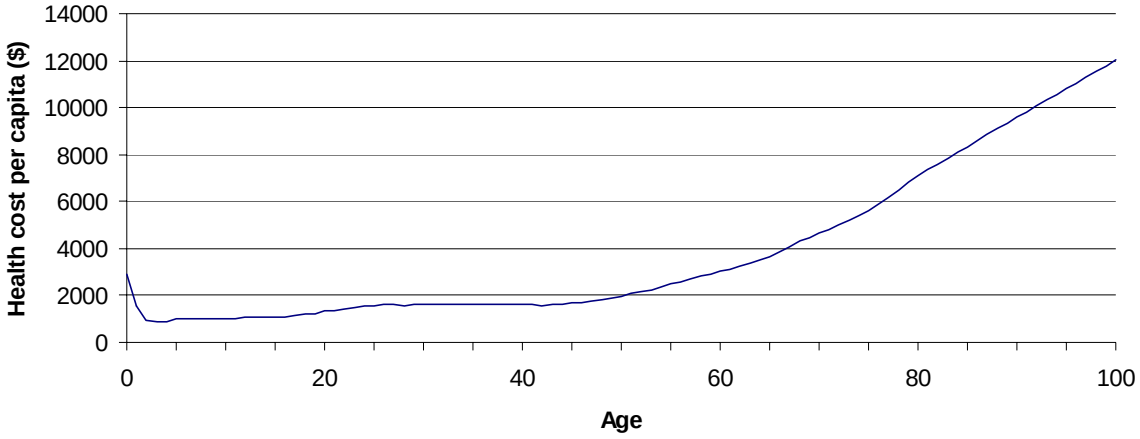



**Figure 2** **Health Expenditures: Cross Sectional vs Time Series**

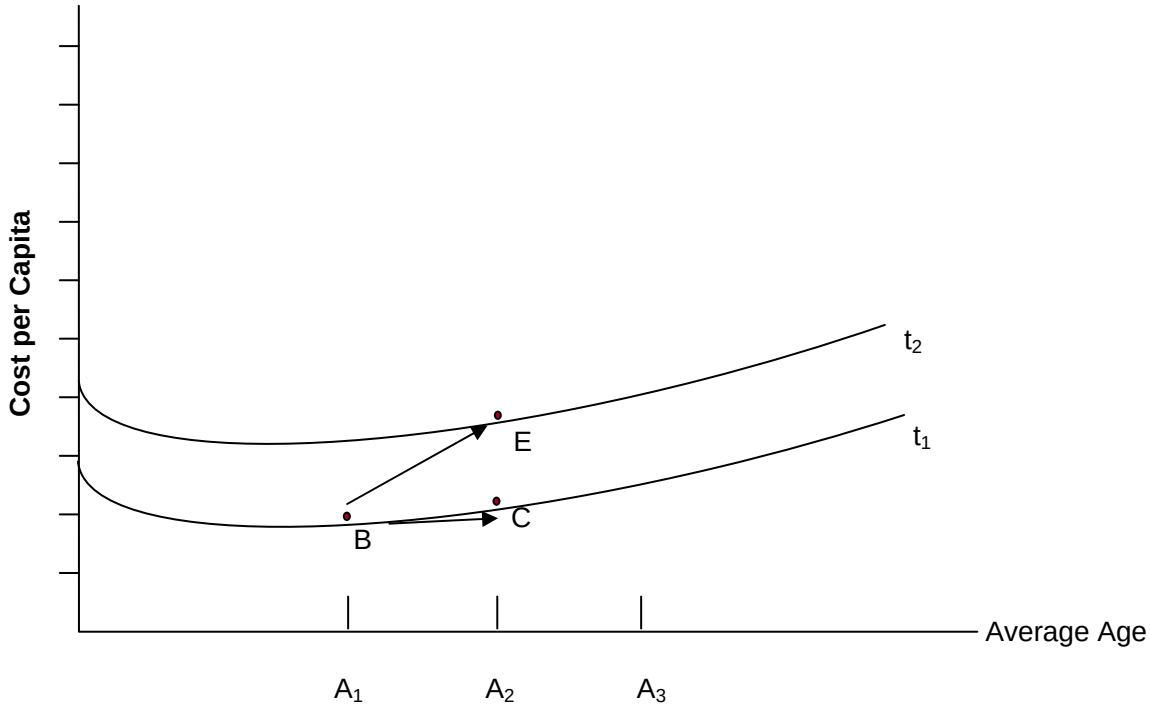
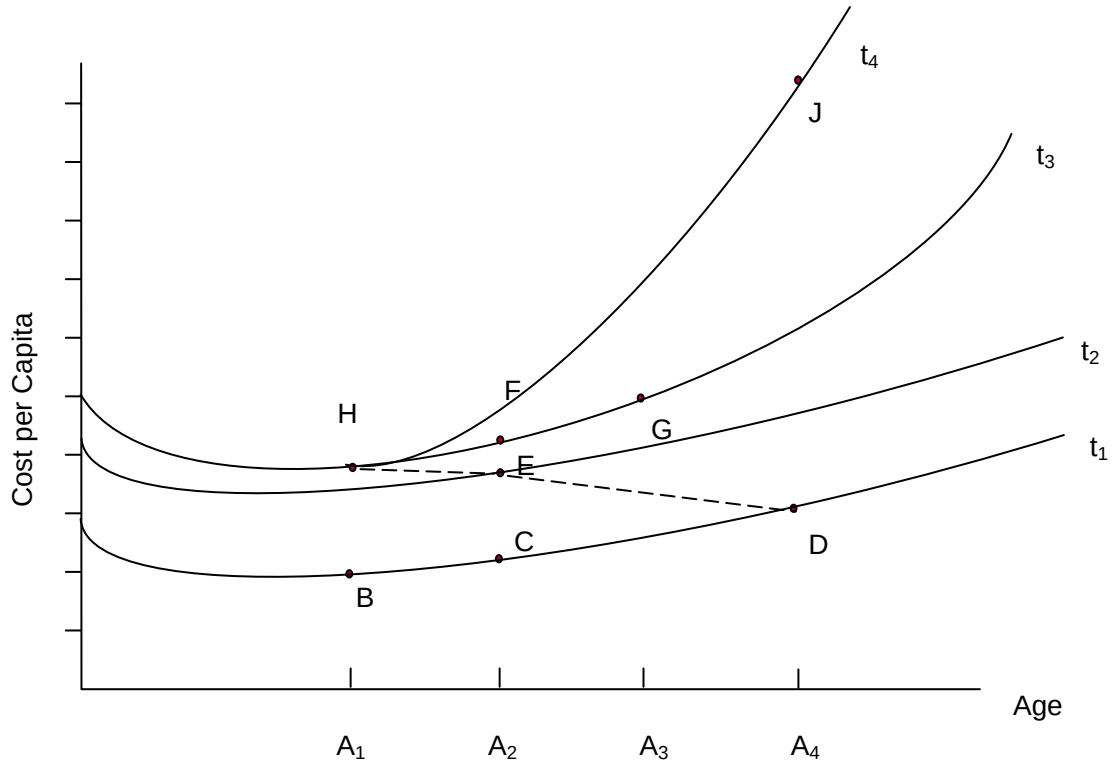
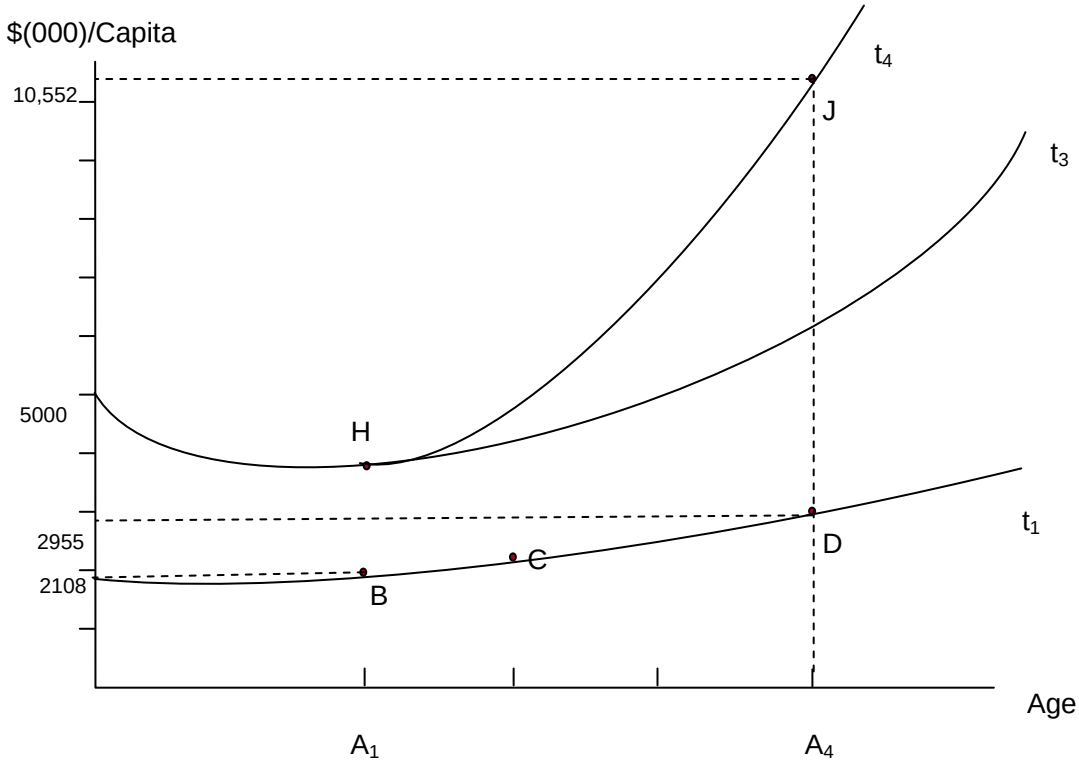


**Figure 3 Health Expenditures: Cross Sectional vs Time Series**




Note: H E D represents hypothetical falling costs as ageing shifts the average age from $A_1$ to $A_4$.

**Figure 4 Health Expenditures: Cross Sectional vs Time Series**



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