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Projecting the Fiscal Impact of Population Ageing on the Hospital System: A Distributional Analysis

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Keywords

system, hospital, analysis, ageing, population, impact, fiscal, distributional, projecting

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National Centre for Social and Economic Modelling
• University of Canberra •

**PROJECTING THE FISCAL IMPACT OF
POPULATION AGEING ON THE HOSPITAL
SYSTEM: A DISTRIBUTIONAL ANALYSIS**

**Linc Thurecht, Agnes Walker,
Jim Pearce and Ann Harding**

**32nd Conference of Economists, Canberra,
29 September 2003**

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Director: Ann Harding

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This study examines the socioeconomic status of NSW hospital patients in 1999-00 and projects likely hospital costs to 2009-10. It draws upon unique patient based datasets from NSW public and private hospitals that include hospital admissions, as well as the associated treatment costs in each of the four years to 1999-00. Using a novel method, we impute socioeconomic status to each patient, accounting for age, sex, family income, family size and the geographic area of the patient's residence at the Census Collector District level.

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Linc Thurecht is a Senior Research Fellow, Agnes Walker is a Principal Research Fellow and Ann Harding is the Director at the National Centre for Social and Economic Modelling, University of Canberra. Jim Pearse was Director of Funding and Systems Policy Branch, NSW Department of Health, at the time this paper was written.

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We would especially like to thank Andrew Gibbs and Durham Bennett from the NSW Department of Health for their valuable assistance in compiling and interpreting the datasets used in this study.

General caveat

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These estimates may be different from the actual characteristics of the population because of sampling and non-sampling errors in the microdata and because of the assumptions underlying the modelling techniques.

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1 Introduction

This paper is one of a series of publications reporting on findings from a three year Australian Research Council grant. The Industry Partners to this grant are the NSW Health Department, the Health Insurance Commission and the Productivity Commission. Among other endeavours, the project involves the building of two forecasting models. One concerns NSW public and private hospital usage and costs over the four years to 1999-00 – with key characteristics of patients being their age, sex, socioeconomic status (SES), and the main diagnostic and related treatment types and costs. Using a novel method, we imputed to each patient in these four yearly datasets socioeconomic status - accounting for age, sex, family income, family size and the geographic area of the patient's residence.

The other is a private health insurance (PHI) model – able to account for PHI membership by age, sex and SES, as well as the costs of PHI to members (including the cost impact of the government's PHI policies). In the final stage of the grant we plan to link the hospitals model with the PHI model to assess the impact of PHI policies on private versus public hospital usage.

In this paper we report on findings using the NSW hospitals model. We examine per patient treatment costs by socioeconomic status in 1999-00 and project likely public and private NSW hospital costs to 2009-10.

In our analyses draws upon a unique patient-based dataset from NSW public and private hospitals that includes hospital admissions, as well as the associated treatment costs.

First, we use the 1999-00 dataset to examine whether patients had treatments amounting to similar per patient hospital costs, regardless of the patient's socioeconomic status. As a case study involving patients with a similar principal diagnosis, differences in per patient treatment costs by SES were studied for coronary heart disease (CHD). CHD is a sub-set of cardiovascular disease, which is one of the National Health Priority Areas. AIHW (2001) identify cardiovascular disease as the most costly disease for the health system in Australia. NSW Health (2002) identifies CHD (along with stroke) as the leading form of cardiovascular disease in NSW. In 2000, 20.9 per cent of all deaths were related to CHD. The disease is also the largest cause of years of life lost due to premature death in NSW. While average costs per admission have previously been reported (eg see Table 6.2 in AIHW 2002a), the results presented in this paper are prepared on the basis of the average cost per patient for different socioeconomic groups.

Second, we studied the impact that population ageing and changes in treatment propensities were likely to have on NSW hospital usage and costs by 2009-10,

assuming that the 2009-10 per unit treatment costs were the same as 1999-00 costs. Third, we estimated the combined impact on hospital usage and costs of: population ageing; changes in treatment propensities; and increases in per unit costs in line with past trends.

2 Data description

The findings presented in this paper are based on separations from NSW hospitals over the 1996-97 to 1999-00 period. The data covers all in-patient separations from both public and private hospitals. The data was sourced from the NSW Health Inpatient Statistics Collection and the NSW Hospital Cost Data Collection. A key feature of this data is that separations have been linked at the patient level. It is therefore possible to trace at the individual patient level the cost of treatment — even where multiple separations may have been involved.¹ This enables average patient costs to be calculated and then aggregated by treatment, socioeconomic status or other variables of interest. A full description of the data, the patient linkage methodology and steps taken to maximise data integrity is provided in Thurecht *et al* (2003).

This source data was then adjusted in certain ways. First, separations from Statistical Local Areas (SLA) where there was a high proportion of interstate flows were excluded.² This is because the true provision of hospital services for residents of these SLAs would be misrepresented, given the high level of interstate separations. Second, the separations-based dataset was converted by NSW Health officials into a patient-based dataset, by a probabilistic linking of separation records by such variables as address and date of birth. The separations of patients who entered NSW hospitals more than once during the year for the same service type were thus

¹ Of around 1.2 million patients in 1999-00, nearly 30 per cent had more than one separation.

² If 30 per cent or more of the separations for patients from a particular SLA were from an interstate hospital then all separations from that SLA were removed.

amalgamated into a single patient-based record.³ Third, high cost outlier patients were removed.⁴ A summary of the source number of records and how many were removed at each stage of the process outlined above is provided in Thurecht, Walker, Pearse and Harding (2003).

In this paper socioeconomic status is measured by equivalent family income (EFI) quintiles. EFI is a measure of the economic resources available to a family. In particular, it reflects how the composition of a family unit affects the relative resources available for a given family income. For example, a single person with a gross income of \$50 000 and a couple with three children with a gross income of \$50 000 do not have the same level of resources, because the income of the second family is being used to support five people rather than just one. Applying an equivalence scale to the incomes of families of different size and composition is a widely used way of improving the accuracy of the measure of relative economic wellbeing (eg ABS, 2003a, page 13).

An EFI quintile was imputed onto each patient record within our datasets, based on a specially supplied matrix - by the ABS from its 1996 Census - on the distribution of EFI quintiles within each CD-sex-age group within the NSW population. For more details see Thurecht *et al* (2003).

Patients were identified as living in an urban or rural area according to the ARIA index of remoteness, with the ARIA score applied at the CD level (refer to DHAC (2001)).⁵ ARIA is based on the road distance between the CD and major service centres. Those patients with an ARIA score of 1.84 or less (highly accessible)

³ While the overwhelming majority of patients admitted to hospital more than once in the year were admitted for the same service type, separate patient records were created where patients were admitted to hospital on more than one occasion for *different* service types. Service type is based on the service related group value recorded for the patient, subsequently re-aggregated into one of four classes as outlined in Appendix C. As relatively aggregated service groups were used, this procedure affected only a very small number of patients. It should also be noted that the matching process may not have worked successfully to link the separation records of patients who were admitted to NSW hospitals more than once but who gave a different residential address upon each admission.

⁴ The top 0.4 per cent of patient records in each year were removed. This resulted in 455 to 475 patient records being removed from each year.

⁵ A CD is a spatial region defined in the Australian Standard Geographical Classification (ASGC) by ABS (1999). It is the lowest level of spatial aggregation used by the ABS and represents around 200 households. The ASGC is a hierarchical classification system consisting of six interrelated classification structures. The boundaries as they existed at the time of the 1996 Census are used in this paper.

were assigned urban status and the remainder assigned rural status. This resulted in 85.8 per cent of patients being classified as living in an urban area in 1999-00.

Patients were identified as being treated for CHD if their principal diagnosis was coded as ischaemic heart disease. In 1996-97 and 1997-98 the ICD-9-CM coding convention was used (principal diagnosis codes in the range 410 – 414). In 1998-99 and 1999-00 the ICD-10-AM coding convention was used (principal diagnosis codes in the range I20 - I25).

The cost of each separation was estimated from the NSW Hospital Cost Data Collection and the NSW Private Hospital Cost Collection. Section 2.2 of Thurecht *et al* (2003) provides full details of the way in which costs were calculated. Briefly, there are a number of different categories of separations with different approaches taken to estimate their cost. Generally the cost of each separation was either calculated at the separation level or based on an average cost in that facility for the treatment received by the patient.⁶ For private hospitals all cost estimates are the gross costs of treatment (ie not reduced for payments received from health insurance funds, third party insurers etc). For public hospitals, net costs were calculated by subtracting any revenue that the government may have received for treating the patient. In 1999-00, the revenue received in public medical facilities amounted to 5.2 per cent of the estimated gross costs expended by these facilities. Thus the public hospital treatment costs in our analyses will – within 5 per cent - be the gross cost of treatments. For this reason we consider that they are broadly comparable with the private hospital cost estimates.

These costs represent an estimate of the cost of providing the treatment that the patient received. As the estimates are based on average costs for similar separations from a similar medical facility, it is possible that they may over or under estimate the actual cost of treatment for an individual patient.⁷

⁶ Out-of-pocket expenses borne by the patient are not included.

⁷ As noted above, some hospitals use the 'cost modelling' approach to determine the cost of treatment of each patient with a particular type of DRG (diagnosis related group). This means that such hospitals assign the same average cost of treatment to all patients recorded with the same DRG. In such cases, patients from the lowest SES group within a particular DRG are automatically attributed the same cost of treatment as patients from the highest SES group with the same DRG. Where hospitals follow such a 'cost modelling' approach, there will obviously be no difference in the costs between high and low SES patients within each DRG. As a result, differences by SES in treatment costs will only occur when lower SES patients have more costly and severe diagnoses, when lower SES patients attend hospitals with different cost structures to higher SES patients, or when hospitals are patient-costing sites rather than cost-modelling sites.

For public hospitals the cost estimates can be interpreted as the net cost to government of providing the treatment and for private hospitals as the gross cost of providing the treatment. However, due to the nature of health financing in Australia, assignment of who ultimately bears this cost is problematic. While funding for public hospitals remains a highly topical issue of contention between the states and the Commonwealth, resources to public hospitals are clearly provided by both levels of government. While it is generally true that no direct funding is provided to private hospitals by government⁸, indirect subsidies exist through such mechanisms as the PHI rebate and reimbursement of certain costs under the Medical Benefits Schedule, which mitigate the overall cost borne by the patient. Furthermore, while the cost of treatment in a private hospital may initially be considered as a cost to the patient, some or all of this cost may be covered by private health insurance.

Taken together these issues highlight the problematic nature of determining actual patient costs and the extent to which they are subsidised by government. However, this is not a problem unique to this paper and must be accepted in an attempt to better understand the distributional differences in hospital services at the patient level.

The projections using the NSW hospitals datasets are in part based on the population projections of the Australian Bureau of Statistics (2000a). These forecasts are as at 30 June and are based on the Series II assumptions of ABS (2000b).⁹ They are made at the SLA, sex and five year age group level. The projections initially produced by the model developed in this paper were then calibrated to the NSW Health Activity Projections Plus Interventions (APPI) version 5.1. APPI is an activity projection tool utilised by NSW Health in which age and sex standardised trends in acute inpatient activity are used to project activity for 2006-07 and 2011-12. These projections can be analysed by age, sex, service related group or enhanced service related group¹⁰, area health service of residence or treatment, local government area (LGA)¹¹ or hospital of treatment. Activity projections for 2009-10 were interpolated, based on the annual compound growth in the APPI projections between 2006-07 to 2011-12.

⁸ Exceptions include privatised repatriation hospitals and private hospitals contracted to provide public services.

⁹ The Series II assumptions are 'low' fertility (a total fertility rate of 1.60 births per women from 2008), 'medium' overseas migration (an annual net overseas migration gain of 90,000) and 'medium' interstate migration.

¹⁰ Service related groups (SRGs) and enhanced service related groups (ESRGs) are a method of classifying hospital services by grouping together patient episodes that are clinically similar and use similar levels of resources.

¹¹ An LGA is another spatial region defined in the ASGC. On average there are around 66 CDs in each LGA.

3 Methodology

3.1 Measuring health inequalities by socioeconomic status

In the literature, a frequently used method of allocating SES is through the geographic area of a patients' residential address (e.g. Furler *et al* 2002). In Australia the most frequently used such indicators are the Socioeconomic Indexes for Areas (SEIFA), published by the ABS. The SEIFAs generally indicate the worst health for the 20 per cent of persons living in NSW's most disadvantaged areas (Quintile 1) and the best health for the 20 per cent in the least disadvantaged areas (Quintile 5) (e.g. Mathers, Vos and Stevenson (1999, page 39).). Because of this a standard way of measuring health inequalities in the literature is through the Quintile 1/Quintile 5 (Q1/Q5) ratio.

For purposes of comparison with earlier studies we have adopted this measure in this study. However, because with the equivalent family income indicator of SES Q1 people do not always have the worst health, and Q5 people the best health, we have supplemented the Q1/Q5 measure with an additional measure accounting for all of the quintiles. This is the ratio of (Q1+Q2), relative to the rest of the hospital patient population (that is, Q3+Q4+Q5).

In Section 5.2 inequalities will be measured in terms of per patient hospital treatment costs across the Q1/Q5 and (Q1+Q2)/(Q3+Q4+Q5) ratios.

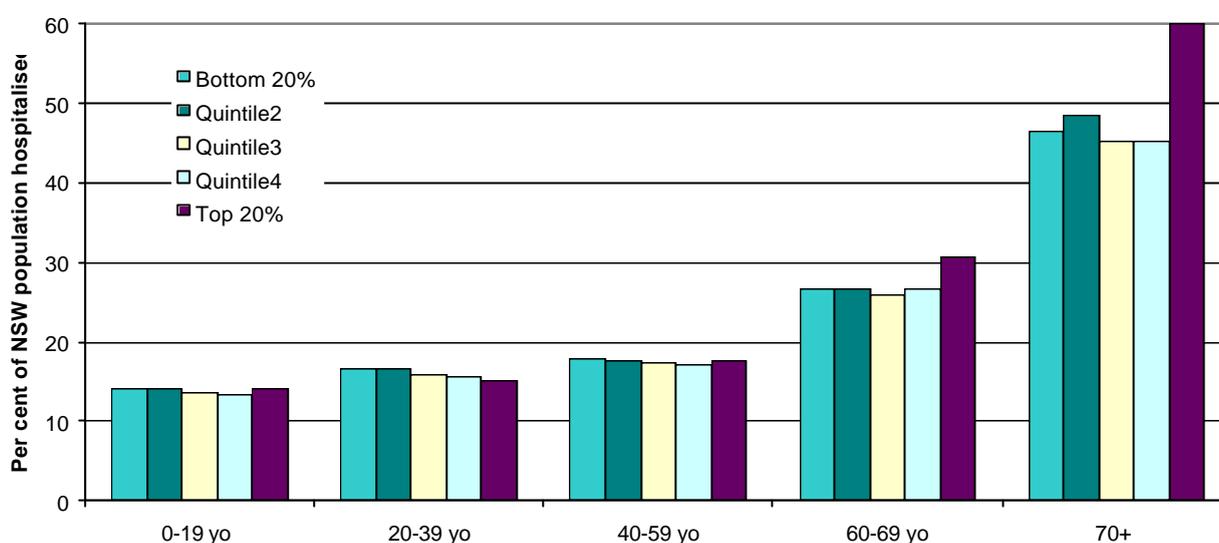
3.2 Controlling for age and other confounding factors

Controlling for age

Numerous studies have indicated that age is a key determinant of health, with SES being considerably less important. The rapid increase in hospitalisation rates with age in NSW, and the relatively small impact of SES, confirm these earlier findings (see Figure 1). Thus, controlling for age is of particular importance in the context of this project.

For this study we have chosen to control for age by analysing hospital usage and estimated average patient treatment costs within broad age groups. Comparisons across SES *within* these age groups can then be seen as having been controlled for age.

Figure 1: Hospitalisation rates per 100 NSW population by age and EFI quintile, 1999-00



Sources: Enhanced NSW hospitals data for 1999-00 and ABS extract from the 1996 Census

Controlling for other confounding factors

When considering hospital expenditures, in studies of this kind confounding factors tend to arise from the following:

- (a) total cost is the product of two factors – the number of patients/services and the per unit costs of each service (thus the analyst is uncertain as to which of these components was the main contributor to the observed expenditure effects);
- (b) per unit costs vary with the services provided (ie are a function of the illness patients have been admitted for); and
- (c) per unit treatment costs may depend on the severity of the patient's illness.

With respect to (a), we were able to make use of the unique patient-based nature of the NSW hospitals datasets and study hospital costs on a per patient basis (by age group and SES quintile). This way we were able to control for the 'usage' (ie 'number of patients') variable in the expenditure estimates.

With respect to (b), we chose coronary heart disease (CHD) as a case study. Because CHD patients all had records with a principal diagnosis code relating to ischaemic heart disease, the assumption that patients of similar age with CHD had broadly the same illness – and thus needed similar treatment – seemed reasonable.

With respect to (c), studying patterns by age groups was seen as a reasonable way of controlling for severity of diseases. This is because severity generally increases with age (see additional discussion in Section 5.2).

3.3 Projecting hospital usage in 2009-10

The methodology for projecting hospital usage in 2009-10 is based on two factors – forecast population growth and change in the propensity to utilise particular hospital services. The interaction of these two factors is then used to produce weights that are attached to the patient record. While a detailed description of the methodology is provided in Thurecht *et al* (2003), an overview of the approach is provided below.

The forecast population was taken from ABS (2000a). These projections are at the SLA, sex and five year age group level. The ratio of the forecast population in 2009-10 and estimated resident population in 1999-00¹² was taken to produce a population weight for each cell in 2009-10. For example, if the population in a particular SLA-sex-age cell was projected to increase by half, the population weight for that patient record in 2009-10 would be 1.5. By using these population projections, we are able to directly build into the weights the effect of ageing in the population.

The propensity for service usage was then separately calculated for each SLA-sex-age-service cell for each of the years from 1996-97 to 1999-00. The propensity for service usage was taken as the number of patients at the SLA-sex-age level for each service, divided by the underlying estimated resident population for that cell in that year. This produced four observations for each cell from which a linear trend was then projected to estimate the propensity for service usage in each cell in 2009-10.¹³ Figure 2 demonstrates this approach. This estimate was then divided by the actual propensity for service usage within each cell in 1999-00 to produce a service propensity weight for each cell in 2009-10.

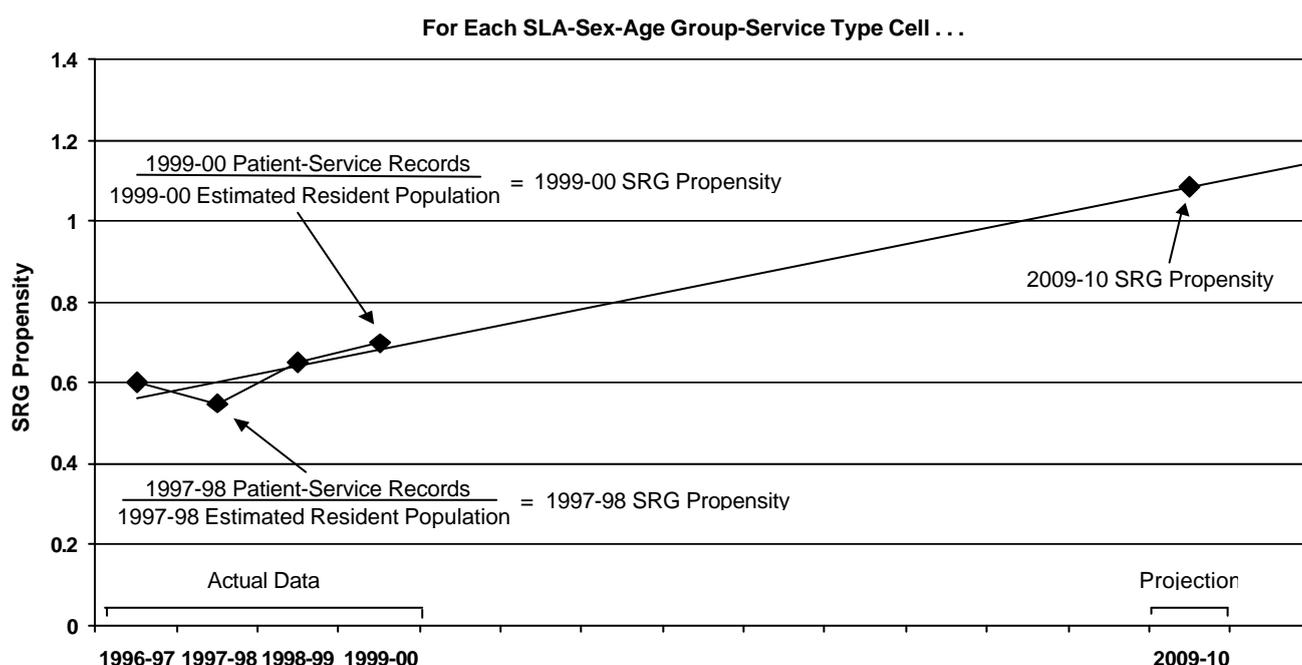
¹² The estimated resident population was taken from ABS (2001a), including earlier issues of the publication.

¹³ If a negative propensity was produced (which has no economic meaning) then the estimated 2009-10 propensity was based on the actual 1999-00 propensity reduced by 10 per cent per annum. Testing other rates of reduction showed that the final set of weights was not sensitive to this arbitrary level of deflation. This is to be expected given the circumstances that could have produced a negative propensity from a linear projection of the trend ie there must have been a sharp fall in propensities over the in-sample period and/or the actual 1999-00 propensity must have already been very low.

The weight for each patient record in 2009-10 was then taken as the product of the 2009-10 population and service propensity weights. The total number of separations implied by the weights was then found to be 7.6 per cent higher than the more meticulously prepared APPI projections. The weights attached to each patient record were therefore calibrated against the aggregate projected number of separations from the APPI database.

The weights produced by this approach are separations based — ie they are a projection of the number of separations in 2009-10. However, for analytical purposes it is useful to know the number of patients represented by these separations (eg to produce average patient costs). To derive the number of patients implicit within the separations projections, the weight attached to each patient record in 2009-10 was divided by the number of separations associated with that patient record in 1999-00. This was interpreted as an implied number of patients in 2009-10.

Figure 2: Projecting SRG propensity



Note: Similar estimates of SRG propensity were taken for 1996-97 and 1998-99 as shown here for 1997-98 and 1999-00.

The final adjustment made was to the net patient costs to take account of likely increases in the costs of hospital services over the projection period. This was based on an OLS forecast from the Australian Bureau of Statistics weighted average of eight capital cities health component of the quarterly Consumer Price Index (refer to Table 5 of ABS (2003b)).¹⁴ The compound increase in hospital costs produced by this

¹⁴ This simple linear forecast produced an R^2 of 89.2 per cent. The series encompasses the September 1989 to March 2003 period.

method was 3.0 per cent per annum. Consideration was also given to using the 'Sydney only' element of the health component of ABS (2003b) and to using the Hospital and Medical Services element of the health component of ABS (2003b) (only available as a weighted average of eight capital cities - refer to Table 7F). However, these series both produced higher forecasts of annual compound increase in hospital costs of 5.0 per cent and 4.0 per cent per annum respectively. In the interests of conservatism, the forecast from the first mentioned series was therefore taken.

By projecting the trend propensity we make some important implicit assumptions. First, that trends in patterns of disease do not change over the projection period. Note that we do not hold the pattern of disease static, but merely assume that the changes that occurred over the four year sample period will continue over the projection period. Second, that there is no change in health policies that impacts on the hospital sector. One area in which this assumption is problematic relates to the introduction of Lifetime Health Cover for PHI in July 2000. In these projections, we have implicitly assumed that the current public-private hospital mix will only change in line with population and service propensity weights. The impact of the various government policies introduced in recent years relating to PHI — and the flow-on effect to hospitals — is the subject of separate research currently underway. Third, trends in the supply of hospital services over the sample period are assumed to be the same over the projection period. Finally, trends in the move towards the provision of out-patient treatments that have occurred over the four years to 1999-00 are assumed to continue over the projection period.

4 Description of Scenarios

As discussed in Section 3.3, the projection of hospital usage and costs in 2009-10 is driven by ABS population forecasts, trends in service usage and by the rises over time of the per unit cost of medical treatment.

In preparing the projections, we simulated three Scenarios, which allowed the effects of these three factors to be identified separately.

Scenario 1: population ageing only. The ABS population forecast is for the NSW population to increase to 7,067,930 by June 2010. This represents an 8.9 per cent increase in the population from June 2000.

Scenario 2: population ageing plus projected trends in hospital service use (eg decline in recent years in average hospital stays for many operations).

Scenario 3: population ageing, plus projected trends in hospital service use, plus rising hospital treatment costs (projected to increase in line with the historical trend in health costs).

5 Findings

5.1 Overall patterns

Analyses

In this section we examine our 1999-00 to 2009-10 projections (Scenario 3) with a view to establishing the likely magnitude and characteristics of the extra demands that an ageing population will inevitably place on the hospital system.

As noted in Section 3.3, in our projections we assume that the health policies prevailing over the 1996-97 to 1999-00 period will remain unchanged during the projection period. Under this - and the other assumptions detailed in Section 3.3 - the projections indicate that, in the 10 years between 1999-00 and 2009-10:

- the number of patients in public hospitals will increase from 736,000 to 742,000 (by 0.8 per cent) - the greatest increases being in the 60+ age group;
- the number of patients in private hospitals will increase from 432,000 to 463,000 (by 7.2 per cent) - the greatest increases being in the 60+ age group and especially the 60-69 age group;
- average per patient costs (in current dollars) will increase by just under 50 per cent in both public and private hospitals. This result arises primarily from our assumptions that in future costs will increase in line with past trends (Section 3.3). In public hospitals the average cost per patient will increase from \$3,821 to \$5,695, and in private hospitals from \$2,784 to \$4,130; and
- total expenditures (current dollars) in public hospitals (net of revenue received by the government) will increase from \$2.8 billion to \$4.2 billion (by 50 per cent) and in private hospitals from \$1.2 billion to \$1.9 billion (by 59 per cent).¹⁵ The greater

¹⁵ Note that this estimate is not for the full hospital population, but for the sub-group we consider here. This excludes from the full hospital population certain types of medical facilities, out-patients and high interstate flow SLAs, among other types of separations. Refer to Section 2 and Thurecht *et al* (2003).

increase in private hospitals arises from the projected greater increase in usage in such hospitals (7.2 per cent compared with 0.8 per cent in public hospitals).

Conclusions

The above findings suggest that, relative to the number of patients in 1999-00, the extra burdens placed on NSW hospitals by 2009-10 due to population ageing alone will be relatively small, and will mainly affect private hospitals (0.8 per cent increase in the number of public hospital patients and 7.2 per cent for private hospitals).

However, unless GDP also grows in the forecasting period by around 50 per cent, considerable strains are likely to occur in terms of expenditures. In the absence of policy change, the projected 50 per cent rise in total expenditures in public hospitals will be the responsibility of government, and the greater rise of 59 per cent in private hospital costs the responsibility of patients themselves. In this respect it is worth noting that, contrary to popular belief, private hospitals are not only used by the rich. As shown in Appendix A, in 1999-00 a considerable number of older, low SES Australians were admitted to private hospitals.

Because by 2009-10 only the first wave of the baby boomers will have reached retirement age, the impact of population ageing is expected to be significantly greater in the 10 years beyond 2009-10.

5.2 Inequalities of health treatment by SES

Public versus Private Hospitals

A recent paper investigated the possibility that the 'inverse care law' may apply to GP services in Australia (Furler *et al* (2002)). That 'law' was described in the 1970s by a UK general practitioner, essentially stating that "the availability of good medical care tends to vary inversely with the need for it in the population served" (Hart (1971)). Furler *et al* found that those living in the least disadvantaged postcode areas were significantly more likely to receive long or prolonged consultations with their doctor. They concluded that this represented an example of care provision in inverse relationship to 'need'. Other Australian studies with similar conclusions included Hall and Holman (2003) - finding that women in higher SES groups were significantly more likely to receive breast reconstructive surgery after surgery for breast cancer than lower SES women - and Robertson *et al* (1998) - finding that the likelihood of receiving the CHD related hospital treatments of angiography and revascularisation was significantly greater for residents of high SES locations than elsewhere (page 14).

In this paper we investigate whether the inverse care law applies in the NSW hospital system generally, and in connection with CHD related treatments in particular. In 1999-00 CHD patients made up 3 per cent of the NSW patient population. The variable indicating inequality was the average annual cost per hospital patient.

Table 1 shows that, in 1999-00 when considering all patients, average patient costs were almost 20 per cent higher for low SES patients than for high SES patients in public hospitals (a ratio in the order of 1.2). In private hospitals, average patient costs for the lowest quintile were also around 20 per cent per cent higher than for the highest quintile. Appendix A shows the differences in patient numbers and average treatment costs between public and private hospitals by age group and SES.

Table 1: Differences in average cost of treatment per patient, public versus private hospitals, all patients by SES quintile and age group, 1999-00

	Average cost per patient		Q1/Q5	(Q1+Q2)/ (Q3+Q4+Q5)
	Q1	Q5		
	\$	\$	ratio	ratio
<u>All patients</u>				
Public Hospitals				
0 - 9 yo	2,492	2,456	1.01	1.01
10 - 19 yo	2,552	2,639	0.97	0.99
20 - 29 yo	2,345	2,501	0.94	0.96
30 - 39 yo	2,572	2,662	0.97	0.97
40 - 49 yo	3,372	3,144	1.07	1.04
50 - 59 yo	4,107	4,232	0.97	0.97
60 - 69 yo	5,467	5,672	0.96	0.99
70+ yo	6,340	6,561	0.97	0.99
All	4,151	3,511	1.18	1.16
Private Hospitals				
0 - 9 yo	2,073	2,139	0.97	0.98
10 - 19 yo	1,517	1,526	0.99	0.96
20 - 29 yo	1,835	1,904	0.96	0.98
30 - 39 yo	1,989	2,022	0.98	0.99
40 - 49 yo	2,018	2,027	1.00	1.01
50 - 59 yo	2,455	2,497	0.98	1.01
60 - 69 yo	3,278	3,405	0.96	1.00
70+ yo	4,355	4,716	0.92	0.96
All	3,091	2,507	1.23	1.19

Such differences between the average cost of treatment of high and low SES patients are of relevance to scholars of income distribution and the distributional impact of

government outlays. Although the ABS used a very different methodology in their recent analysis of the distribution of government hospital outlays, they found that the bottom quintile of households received an average hospital benefit that was 24 per cent higher than the average hospital benefit received by the top quintile of households (ABS 2001b, page 12). An important caveat, however, explored further below, is that such aggregate studies mask the significant links between age and income.

Interestingly, when we isolated CHD patients from the general patient pool, this pattern of higher per patient outlays towards the bottom quintile of all CHD patients was reversed (refer to Table 2). For all CHD patients, our analyses showed a modest difference between the average per patient cost of treatment for low and high SES groups, with the top quintile of patients costing on average 1 to 4 per cent more than the bottom quintile.

Table 2: Differences in average cost of treatment per patient, public versus private hospitals, CHD patients, by SES quintile and age group, 1999-00

	Average cost per patient		Q1/Q5	(Q1+Q2)/ (Q3+Q4+Q5)
	Q1	Q5		
	\$	\$	ratio	ratio
Public Hospitals				
0 - 39 yo	4,067	5,012	0.81	1.01
40 - 49 yo	5,907	5,468	1.08	1.05
50 - 59 yo	6,054	6,392	0.95	0.95
60 - 69 yo	6,736	7,137	0.94	1.05
70+ yo	5,535	5,723	0.97	0.98
All	5,882	6,191	0.95	0.99
Private Hospitals				
0 - 39 yo	5,452	6,737	0.81	0.77
40 - 49 yo	9,494	8,172	1.16	1.12
50 - 59 yo	7,369	7,933	0.93	0.95
60 - 69 yo	7,988	7,713	1.04	1.02
70+ yo	7,497	8,408	0.89	0.94
All	7,671	8,013	0.96	0.97

While the above results are interesting, they do not take any explicit account of the impact of age. As noted earlier, there is a systematic relationship between hospital usage and age — and also between age and equivalent family income, due to lifecycle effects. For example, a much higher proportion of all those aged 70 or more are in the lowest equivalent family income quintile compared with those aged 40 to 59 years, simply because most of the former have retired and are on low incomes (often pensioners), while many of the latter are still in the work force (for example,

see Thurecht *et al* (2002), page 15). This means that, when aggregating all age groups in public hospitals, for example, there will be more patients costing around \$6,000 in quintile 1 than in quintile 5 (ie the 70+ year olds), and less costing around \$4,000 in quintile 1 than in quintile 5 (ie the 40-59 year olds). Hence the higher cost estimate in Table 1 for low SES patients than for high SES patients (ie 20 per cent higher). This is a reflection that the average costs per patient discussed above have not been age-standardised.

The within age group results of Tables 1 and 2 suggest that, when age is controlled for, there is very little difference in the average per patient cost by SES. On the face of it this appears to be a very positive result for the NSW hospital system suggesting that, once in hospital, the rich and the poor receive broadly equal treatment, once the impact of age is accounted for. However, there remains the well documented issue of earlier onset of diseases amongst people of low SES – and thus the often greater severity of illness of the poor within a particular age group (Walker *et al* (2003)). If greater severity resulted in more costly treatment – including longer stay in hospital – then our findings would imply somewhat greater expenditures for higher SES patients than for lower SES persons – indicating that the ‘inverse care law’ may apply.

While overall the differences in the average cost of treatment within each age group by SES were relatively minor, there were some differences. For example, in the case of patients aged 70 years and over, those in public hospitals in the top SES quintile received treatment worth \$6,561 on average compared with \$6,340 for those in the bottom quintile (3.5 per cent more). For 70 year old plus patients in private hospitals, the difference was somewhat greater, at 8.3 per cent more per high SES patient.

The 1999-00 results for coronary heart disease (Table 2) – for which it seems appropriate to assume that those hospitalised have a health status independent of SES – suggest similar within age group inequality patterns to the full patient population patterns (Table 1). The exception is the 0-39 age group – for which the results are not robust due to the very low number of patients being treated for CHD and the presence of outliers. Appendix B shows the differences in CHD patient numbers and average treatment costs between public and private hospitals by age group and SES.

However, a striking difference between Tables 1 and 2 is that, for CHD patients, the inequality findings for the full patient population are broadly in line with the within age group inequalities. Table 2 shows that the average treatment cost for poorer CHD patients was generally 1 to 5 per cent lower than for richer CHD patients. Notwithstanding the difficulties associated with linking patients and estimating the cost of treatment previously discussed, the direction of these findings is broadly in line with those reported in Robertson *et al* (1998). These authors suggested that one

reason for this pattern could be that the more costly, newer technology treatments tended to be taken up by better off Australians – especially those with private health insurance.

Conclusions

Our conclusions are as follows:

- If one examines the average costs of treatment for all patients by their socioeconomic status, then such costs are some 20 per cent higher for those in the lowest quintile than for those in the highest quintile. For all patients with coronary heart disease the pattern is reversed, with average per patient treatment costs being up to 5 per cent less for patients in the lowest quintile than for those in the highest quintile;
- However, the above conclusions are driven almost entirely by the systematic variation between our measure of socioeconomic status and age, with older patients tending to occupy the lower quintiles and working age adults the higher ones;
- Once age is controlled for, there appear to be only minor variations in the average per patient cost of treatment by socioeconomic status; and
- These findings do not definitively prove or disprove the ‘inverse care law’. This is because, within each age group, low income people are likely to have more severe forms of a particular illness than higher income people (Walker *et al*, 2003, page 3). It is thus possible that low income people may require more costly care once age is standardised for and once patients have been admitted to hospital.

Urban versus Rural Patients

It is well known that those living in rural and remote areas generally have poorer health outcomes than those in urban areas. For example, AIHW (1998) show that those living in rural and remote locations have higher rates of hospitalisation for some morbidities and higher mortality rates. Moore and Jorm (2001) reported that from 1994-98 death rates from ischaemic heart disease (or 'heart attack') increased progressively with remoteness, while those living in remote and very remote areas are also reported as having higher alcohol consumption (a risk factor for many diseases) and difficulties in obtaining required health care.

While the health of indigenous people is widely recognised as being poorer than that of non-indigenous Australians, health differentials between those living in urban and rural areas cannot be simply attributed to this segment of the population. For example, AIHW (1998) also report that the proportion of the population of indigenous origin is not great enough to explain the reported health differential.

In our analysis of average per patient cost of treatment in NSW hospitals, when considering patients treated in 1999-00 before controlling for age, Table 3 reveals that there is a clear difference in favour of lower SES urban patients, with this group having larger average patient costs of treatment of between 22 per cent and 29 per cent (depending on the metric used). However, for rural patients the difference between low and high SES patients without controlling for age is up to 8 per cent. Furthermore, average costs of treatment for lower SES patients are 16 percent higher for urban patients than for rural patients, while for those of higher SES average costs of treatment for urban patients is 9 per cent less than for rural patients.

Table 3: Differences in average cost of treatment per patient, urban versus rural patients, all patients by SES quintile and age group, 1999-00

	Average cost per patient		Q1/Q5	(Q1+Q2)/ (Q3+Q4+Q5)
	Q1	Q5		
	\$	\$	ratio*	ratio*
Urban Patients				
0 - 9 yo	2,420	2,357	1.03	1.02
10 - 19 yo	2,316	2,197	1.05	1.02
20 - 29 yo	2,217	2,285	0.97	0.98
30 - 39 yo	2,406	2,364	1.02	1.01
40 - 49 yo	2,882	2,559	1.13	1.08
50 - 59 yo	3,452	3,235	1.07	1.04
60 - 69 yo	4,643	4,464	1.04	1.03
70+ yo	5,711	5,796	0.99	1.00
All	3,901	3,020	1.29	1.22
Rural Patients				
0 - 9 yo	2,491	2,489	1.00	0.98
10 - 19 yo	2,238	2,155	1.04	1.03
20 - 29 yo	2,191	2,306	0.95	0.99
30 - 39 yo	2,266	2,460	0.92	0.97
40 - 49 yo	2,619	2,628	1.00	1.03
50 - 59 yo	3,062	3,269	0.94	1.02
60 - 69 yo	4,259	4,413	0.96	1.01
70+ yo	4,978	5,099	0.98	1.00
All	3,352	3,322	1.01	1.08

When considering differences in average patient costs by age group, while there are a range of inequality estimates, lower SES urban patients generally have higher average costs of treatment. However, for rural patients the various measures of inequality by age group are less conclusive, tending to cluster around unity indicating greater equality of treatment based on rural locality.

Table 4 provides a similar analysis of average costs of treatment by urban-rural locality for those patients treated for CHD. Before controlling for age, urban patients of lower SES have up to 9 per cent lower average costs of treatment than patients of higher SES. For rural patients, lower SES patients have only slightly larger average costs of treatment than higher SES patients.

Table 4: Differences in average cost of treatment per patient, urban versus rural patients, CHD patients by SES quintile and age group, 1999-00

	Average cost per patient		Q1/Q5	(Q1+Q2)/ (Q3+Q4+Q5)
	Q1	Q5		
	\$	\$	ratio*	ratio*
Urban Patients				
0 - 39 yo	4,408	5,260	0.84	0.91
40 - 49 yo	6,644	6,225	1.07	1.06
50 - 59 yo	6,482	7,101	0.91	0.95
60 - 69 yo	7,039	7,501	0.94	1.02
70+ yo	6,135	6,977	0.88	0.94
All	6,401	7,001	0.91	0.96
Rural Patients				
0 - 39 yo	3,564	5,414	0.66	0.98
40 - 49 yo	6,387	5,359	1.19	1.11
50 - 59 yo	6,047	5,993	1.01	0.94
60 - 69 yo	7,181	6,348	1.13	1.06
70+ yo	5,409	5,260	1.03	1.03
All	5,943	5,745	1.03	1.02

However, when controlling for age, we once again find some mixed results on inequality of treatment with higher SES urban patients generally having larger average costs of treatment, although this is reversed for patients between 40 and 49 years of age and is dependent on the metric used for those between 60 and 69 years of age. For rural patients, those of lower SES generally have larger average costs of treatment than higher SES patients, with this inequality being largest for those between 40 and 49 years of age. The average cost of treating urban CHD patients is systematically higher than for rural patients across age groups and SES. Once again, caution is required in interpreting the results for the two 0 – 39 year old age groups due to the comparatively small number of CHD patients represented in these ages.

Conclusions

Our conclusions are as follows:

- Before controlling for age, the average cost of treatment for urban patients is larger for lower SES patients by up to 29 per cent. For rural patients, evidence of inequality is more dependent on the metric used with average patients costs being up to 8 per cent greater for lower SES patients.
- While those living in rural localities may have higher rates of hospitalisation for some morbidities and higher mortality rates as previously discussed, for lower SES patients the average cost of treatment is lower for rural patients than for urban patients. However, this is reversed for high SES patients with urban patients having lower average costs of treatment than rural patients.
- However, when considering inequality by age group the results are more mixed. For urban patients the inequality estimates generally suggest that the average cost of treatment is larger for lower SES patients, although the extent varies with age. For rural patients, assessment of inequality also varies by age and with the metric used. However, the general clustering of inequality estimates around unity in most age groups suggests that any differences in the average cost of treatment by SES for rural patients may not be significant.
- For patients treated for CHD, before controlling for age, higher SES patients in urban localities have higher average patient costs. However, for rural patients the average cost of treatment for lower SES patients are slightly larger than for high SES patients.
- When considering differences by age group, higher SES status urban patients have generally larger average patients costs whereas for rural patients it is generally lower SES patients that have larger average costs of treatment.
- The average cost of treatment for CHD patients is systematically higher for urban patients than for rural patients, regardless of age or SES.

5.3 Effect of population ageing and trends in service usage (Scenarios 1 and 2)

In this Section we examine the effect of population ageing on future hospital usage and costs, with and without the impact of the trends in hospital service type patterns (Scenario 1).

The first panel of Table 5 shows the projected increase in hospital costs over the ten year period for all patients and for CHD patients alone. The middle column in 2009-10 shows the effect of population changes only on the projected cost of hospital

Table 5: Effect of population ageing and trends in service usage on hospital costs and patient numbers (no adjustment for changes in medical costs), 2009-10

	1999-00	2009-10	
		Scenario 1: Population Changes Only	Scenario 2: Population and Service Trend
<u>Hospital Costs¹</u>		<u>All Patients (\$m)</u>	
Public Hospitals	2,811	3,071	3,146
Private Hospitals	1,202	1,362	1,424
Total	4,013	4,433	4,570
		<u>CHD Patients (\$m)</u>	
Public Hospitals	150	184	155
Private Hospitals	82	101	90
Total	232	285	245
<u>Patient Numbers¹</u>		<u>All Patients²</u>	
Public Hospitals	735,600	768,100	741,900
Private Hospitals	431,700	469,400	462,900
Total	1,167,300	1,237,500	1,204,800
		<u>CHD Patients²</u>	
Public Hospitals	25,100	29,300	24,800
Private Hospitals	10,400	12,300	10,700
Total	35,500	41,600	35,500

¹ Note that these projections are based on costs to the government after revenue received (ie net costs) and are not for the full hospital population, but for the sub-group we consider here (refer to footnote 15).

² Note that patient numbers have been rounded to the nearest hundred.

³ Patients who had separations from both public and private hospitals for the same service group in the year were randomly assigned to either sector. This affected just under 36,000 patients, out of the 1.2 million patients in our dataset.

services (i.e. assuming that the propensity for service usage remains the same over the projection period and that no adjustment is made for changes in the cost of providing hospital services). The final column shows the combined effect of population changes and trends in service usage over the projection period (also with no adjustment for changes in the cost of hospital services). The second panel of Table 5 provides the same information except that projected patient numbers are shown.

The results in Table 5 reveal that when considering all patients over the ten year projection period, there is only a relatively modest increase in hospital costs of 13.9 per cent, or 1.3 per cent compound per annum. Of this, the bulk is attributable to the increase in the population (10.5 per cent in total and 1.0 per cent compound per annum respectively). For public hospitals, the predicted growth in total costs over the period is 11.9 per cent, whereas for private hospitals it is 18.5 per cent. This is consistent with the trend in recent years of relatively flat growth in public hospitals expenditure but stronger growth in private hospitals ones. This is confirmed by the projected patient numbers in the lower panel of Table 5, where public hospital patient numbers are projected to increase over the ten year period by 0.9 per cent compared with 7.2 per cent for private hospitals.

However, when considering only those patients treated for CHD, a more mixed picture emerges. Overall costs are projected to increase by 5.6 per cent over the ten years, with public hospitals projected to experience a 3.3 per cent increase and private hospitals 9.8 per cent.

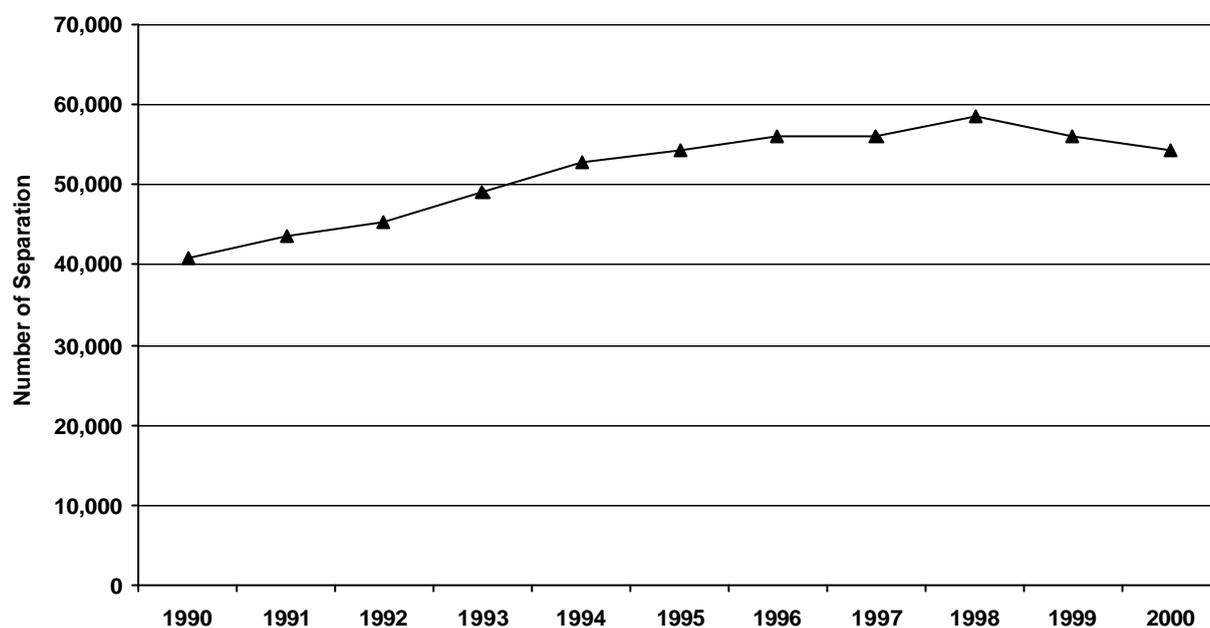
However, in this case the separate contributions of population growth and changes in service propensity move in opposite directions. Population growth alone suggests an increase of 22.8 per cent in the cost of treating CHD patients. Trends in service usage subsequently pull this growth back to only 5.6 per cent above the base projection year (or 0.6 per cent compound per annum). This is associated with a stabilisation in the number of patients projected to be treated for CHD. As can be seen from Figure 3, it is a matter of some conjecture how the trend in CHD patient numbers will unfold over the forecast period.¹⁶

5.4 Adding rising treatment costs (Scenario 3)

The previous Section discussed projected costs taking into account population growth and changes in service usage propensities *but excluding* the impact of changes in hospital costs. Table 6 updates these cost estimates to include the expected increase in treatment costs over the projection period. As discussed in Section 3.3, this was based on a linear projection of the health component of the Consumer Price Index from September 1989 to March 2003. As noted earlier, our cost inflator appears to be relatively conservative.

¹⁶ Note that while the number of patients treated for CHD over the projection period decreased, the projected number of separations has slightly increased. This reflects a small increase in the number of separations per patient over the projection period.

Figure 3: CHD separations, NSW, 1990 - 2000



Source: NSW Health (2002).

Note that this chart shows separations, not patients. The comparable number of underlying separations for CHD projected for 2009-10 is 53,240.

When the effect of the expected increase in hospital costs is included, total costs are projected to increase by 52.9 per cent over the ten year period, or 4.3 per cent compound per annum. The increase for public hospitals is slightly lower at 50.3 per cent compared to 59.1 per cent for private hospitals. This equates to annual compound growth of 4.2 per cent and 4.8 per cent respectively. While the combined impact of an increasing population and changes in service usage patterns adds around \$0.5 billion to projected costs in 2009-10, the effect of the rising costs of hospital treatment contributes in the order of an additional \$1.5 billion, or three times as much.

The projected increase in cost for treating CHD patients is 42.2 per cent, with public hospitals showing a 38.7 per cent increase and private hospitals 48.8 per cent.

While there is a stabilisation in the projected number of CHD patient numbers (refer to Table 5), the overall increase in projected expenditure is primarily brought about by an increase in the cost of medical treatments.¹⁷ Given the larger increase in private hospital costs over the projection period, this is consistent with evidence provided by Robertson *et al* (1998), in which differences in treatments between

¹⁷ Note that we have not attempted to separately project the costs of treating CHD patients. The reader is reminded that a conservative estimate of future increase in treatment costs was selected.

insured and uninsured patients suffering acute myocardial infarction¹⁸ are documented with several suggestions forwarded to explain the finding along with associated cost implications.

Table 6: Effect of population ageing, trends in service usage and changes in hospital costs, 2009-10

	1999-00	2009-10 Scenario 3: Population, Service Trend and Rising Costs
	<u>All Patients (\$m)¹</u>	
Public Hospitals	2,811	4,225
Private Hospitals	1,202	1,912
Total	4,013	6,136
	<u>CHD Patients (\$m)¹</u>	
Public Hospitals	150	208
Private Hospitals	82	122
Total	232	330

¹ Note that these projections are based on costs to the government after revenue received (ie net costs) and are not for the full hospital population, but for the sub-group we consider here (refer to footnote 15).

How do our estimates of projected hospital costs compare with those from other sources? From 1990-91 to 2000-01 government funding of recurrent health expenditure for public hospitals grew at average annual rate of 3.7 per cent (refer to Table 14 of AIHW (2002b)).¹⁹ This suggests that the projections presented here are a little higher than the long term average. Against this, total health expenditures in NSW public non-psychiatric hospitals have grown by 5.4 per cent over the four years to 1999-00 (refer to Tables B1-B4 of AIHW (2002b)). Furthermore, the ratio of health expenditure to GDP has grown from 7.9 per cent to 9.0 per cent from 1990-91 to 2000-01 (refer to Table 3 of AIHW (2002b)).²⁰ The Treasury Intergenerational Report also predicts a modest increase in the cost of hospital services as a proportion of GDP over the four decades to 2041-42 (Treasury 2002, page 38). With health costs

¹⁸ CHD consists mainly of acute myocardial infarction (or 'heart attack') and angina.

¹⁹ The comparable figure for private hospitals is 30.7 per cent. However, this was off a low base.

²⁰ Note that this figure is for all health services, not just hospitals, and is for the whole of Australia. From 1990-91 to 1999-00 public hospitals accounted for 18.8 per cent of the growth in recurrent health expenditure while private hospital accounted for 11 per cent (source: Figure 4 of AIHW (2002b)).

representing an ever growing share of GDP, the projections presented here suggest that the rate of growth in hospital costs may be set to increase from recent levels.

Interestingly, while there is considerable policy concern about the effect of an ageing population and the pressure this will exert on public outlays, our analysis suggests that this is not the key source of the problem. Instead, it is the rising cost of providing hospital services that is having the largest impact on projected costs. This is consistent with the findings of the Health and Medical Research Strategic Review (1999) in which it was reported that population growth and ageing would only account for 0.9 per cent and 0.5 per cent respectively of the 3.9 per cent projected annual compound increase in health expenditure from 1997 to 2016. It is also consistent with the Treasury's analysis, which suggested that population growth and the changing age structure caused less than half of the growth in total Commonwealth health outlays from 1984-85 to 2000-01 (Treasury 2002, page 36). DHAC (2000) provides a further discussion on the relationship between health expenditures and new technology.

6 Summary of findings

This study utilised patient-based NSW hospital administrative data, augmented in various ways, to examine the costs of hospital treatment by socioeconomic status (with socioeconomic status being proxied by the equivalent family income quintile of the patient). The initial results suggested that the average treatment cost per patient for those in the lowest income quintile was about one-fifth to one-quarter higher than for those in the highest quintile. This seemed in line with the findings of earlier separations-based studies that NSW hospitals were 'pro-poor' in their impact.

However, further investigation revealed that this finding was almost entirely driven by the strong relationships between, first, treatment costs by age and, second, between age and income quintile. For both public and private hospital patients the results suggested that, once age was controlled for, those with low socioeconomic status were found to have very similar per patient treatment costs to those with high socioeconomic status. This conclusion held both for all hospital patients and for those treated for coronary heart disease.

Those from the lower income quintiles were more likely to be admitted to NSW hospitals than those from the higher income quintiles (Figure 1 and Thurecht *et al* (2002)). This current study suggests that, once admitted and once age is controlled for, the costs of treatment do not vary in any significant way by socioeconomic status.

Similarly, when examining differences in average patient cost of treatment by urban or rural locality, before controlling for age, urban patients of lower socioeconomic status have greater average costs of treatment than those of higher socioeconomic status. However, when examining differences between age groups, evidence of inequality becomes less clear, with both urban and rural patients showing little consistent disparity in average costs of treatment.

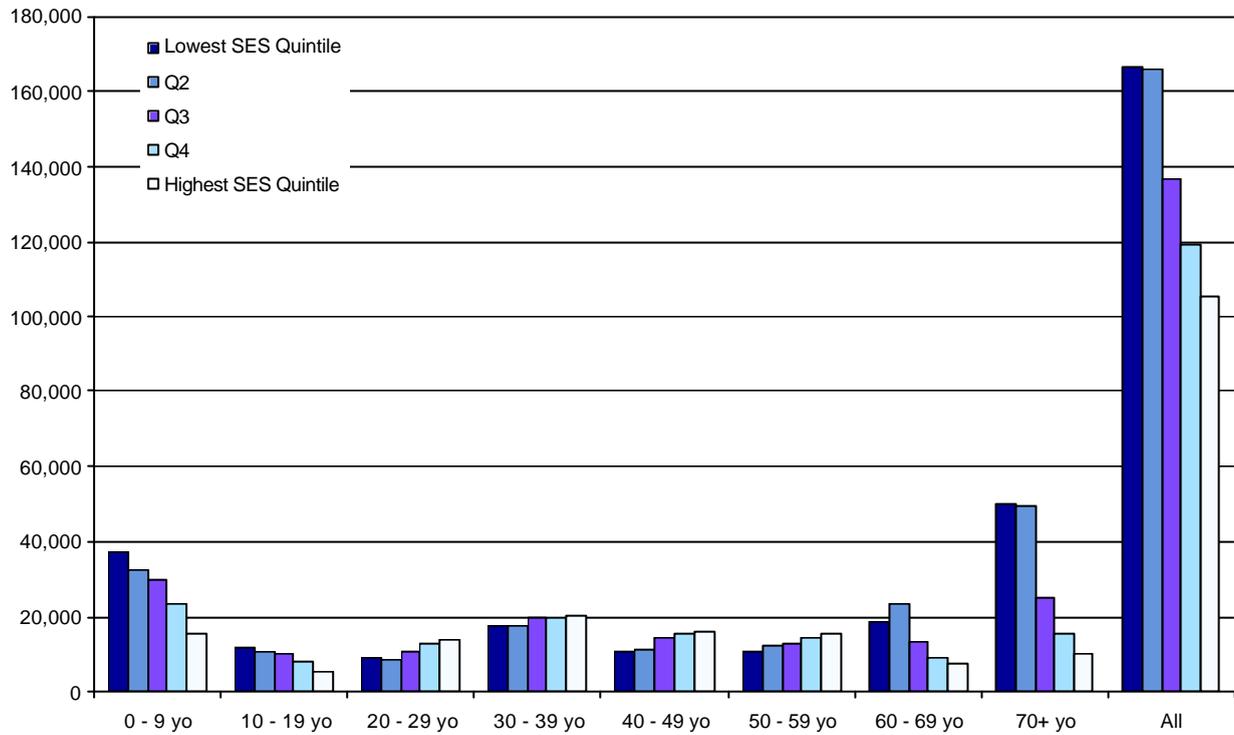
This study also attempted to forecast the impact of population ageing, changing hospitalisation treatment patterns and likely increases in per unit hospital costs upon the total cost of hospital services in NSW over the ten years to 2009-10. While there is always some uncertainty attached to attempting to forecast the likely increase in the costs of actually delivering a particular hospital service, we used a relatively conservative price inflator of three per cent per annum based on historical trends. On this basis, for the hospital patient population we considered, if the underlying state population aged without any changes in per unit treatment costs, then ageing would account for only one-fifth of the total \$2 billion increase in costs projected between 1999-00 and 2009-10. Changing hospital service use patterns made a negligible difference to likely cost increases over these ten years.

The key driver of the projected 52 per cent increase in total hospital services costs over these ten years was the likely increase in the cost of providing hospital treatments, with this element resulting in three-quarters of the total forecast cost increase. Thus, while population ageing is often regarded by the public as the main culprit in rising health costs, this analysis suggested that it would play a relatively minor role in the overall 'rising future costs' equation. However, it is important to note that the major beneficiaries of the cost increases – which often arise from the emergence of new and more effective technologies – are mainly older people, because they are the group most in need of hospital services.

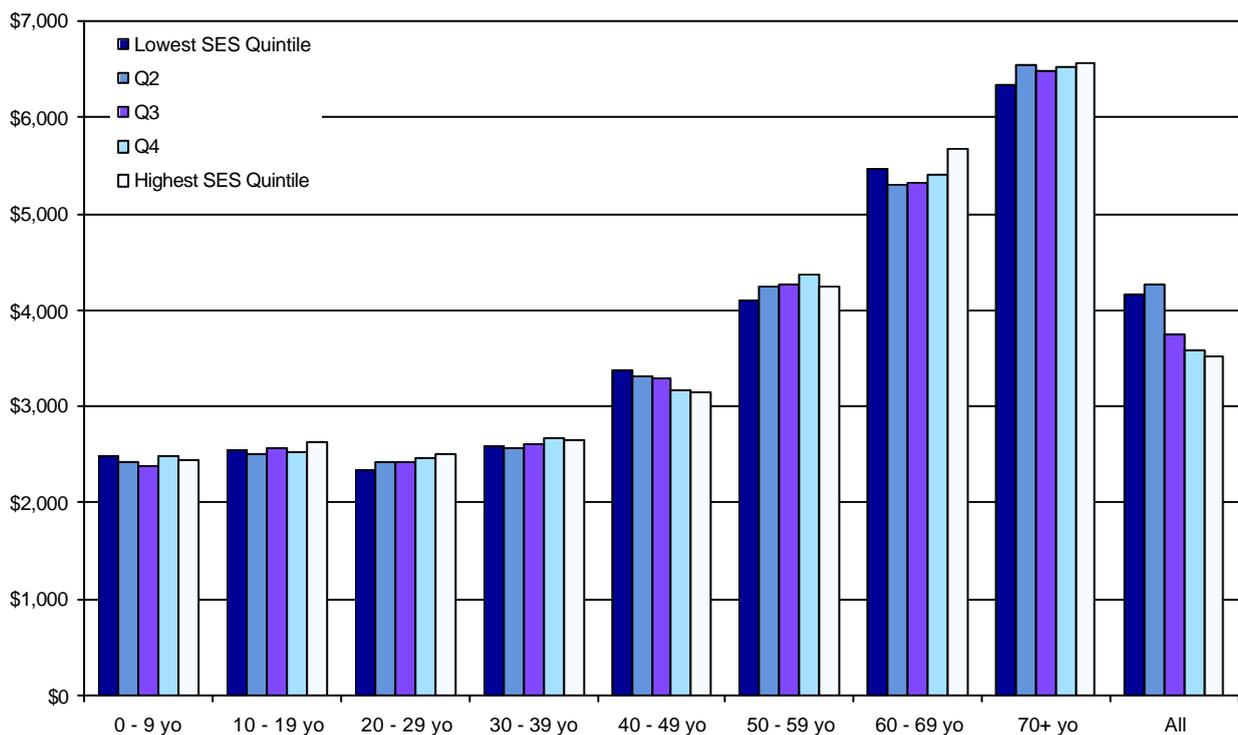
Our forecasts also indicated that the private hospital sector was likely to experience greater increases in patient numbers and related expenditures than public hospitals. We projected a 7.2 per cent increase in patient numbers for private hospitals over the ten year period, and only a 0.9 per cent increase for public hospitals. The corresponding expenditure forecasts were 59.1 per cent higher expenditures in 2009-10 in private hospitals compared with 50.3 per cent in public hospitals. Because our analysis only extends to 2009-10, which is just prior to the mass of the baby boomers reaching old age, the impact of population ageing on hospital usage and expenditures is expected to be significantly greater in the ten years beyond 2009-10 than what is reported in this paper.

A Average patient numbers and average cost per patient by age and SES – All patients, 1999-00

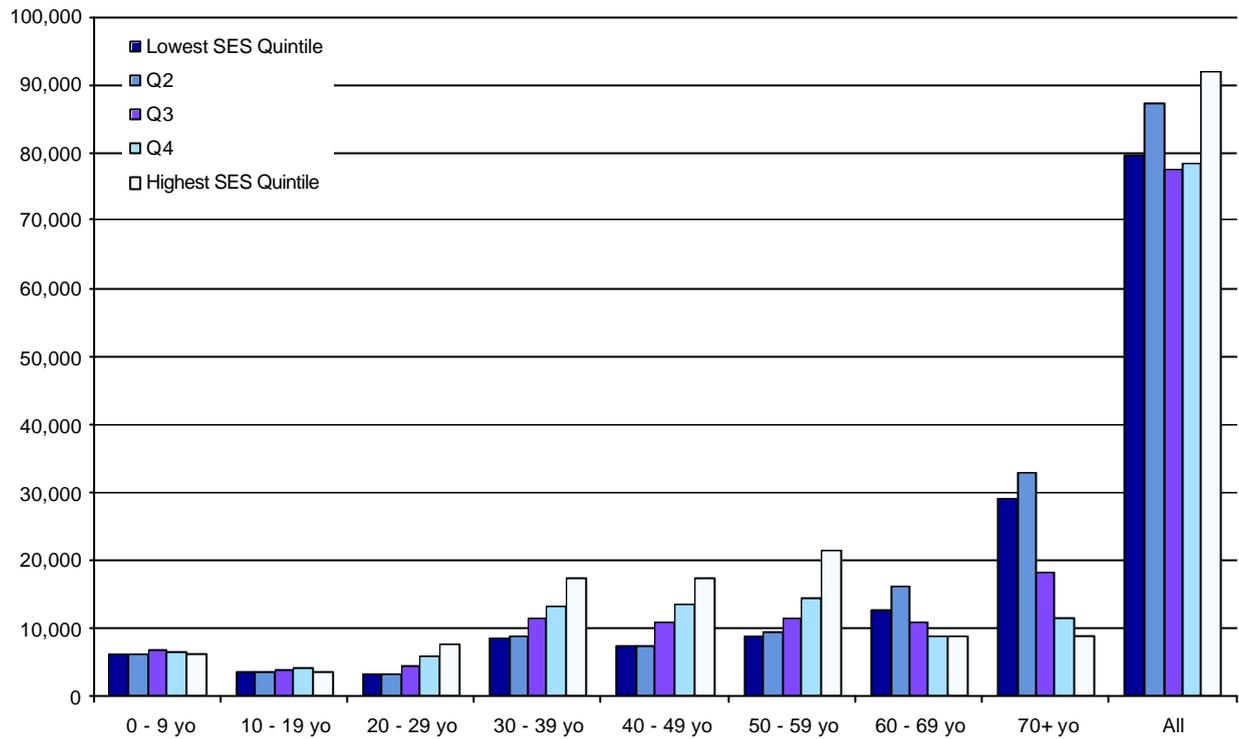
Public Hospitals – Patient Numbers



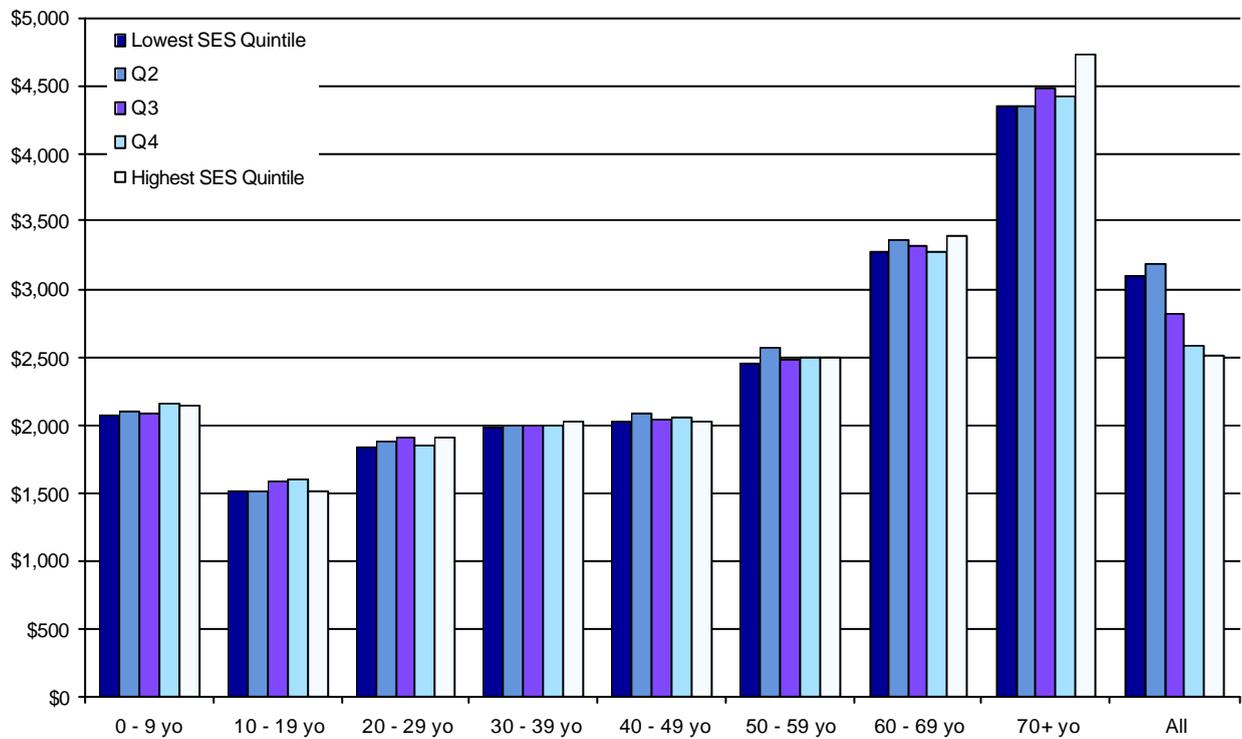
Public Hospitals – Average Cost per Patient



Private Hospitals – Patient Numbers

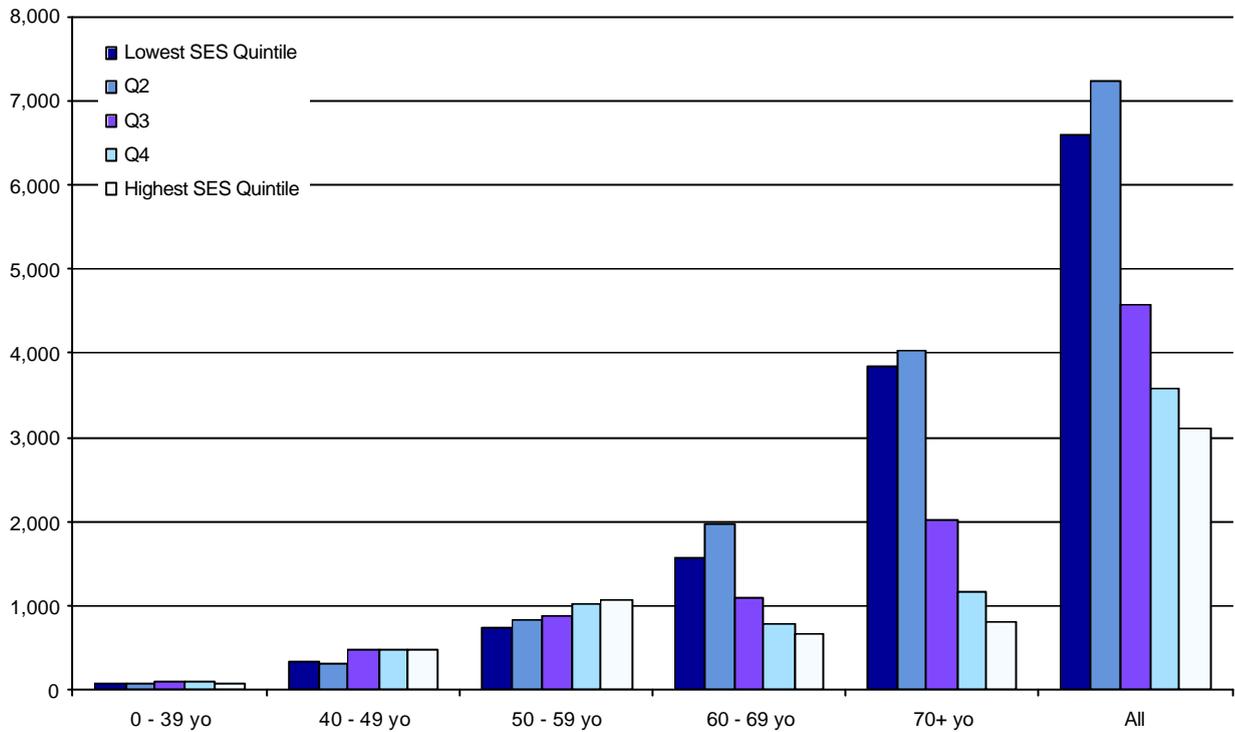


Private Hospitals – Average Cost per Patient

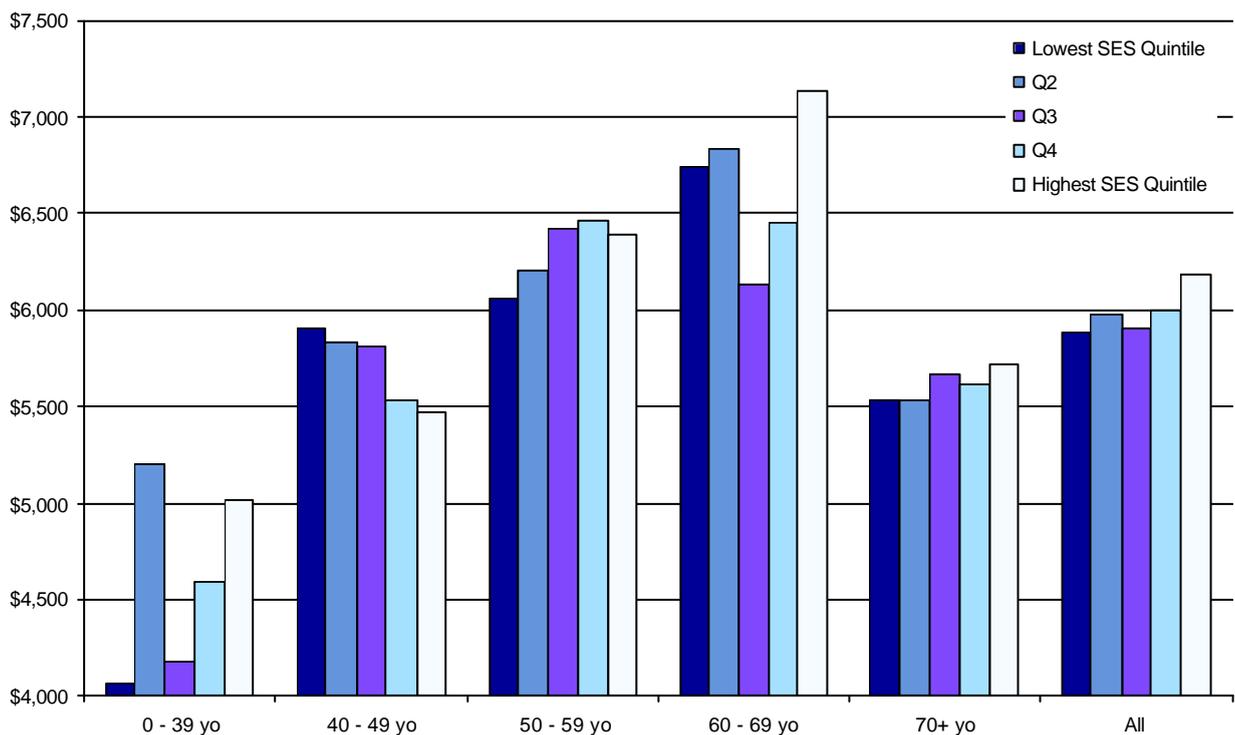


B Average patient numbers and average cost per patient by age and SES – CHD patients, 1999-00

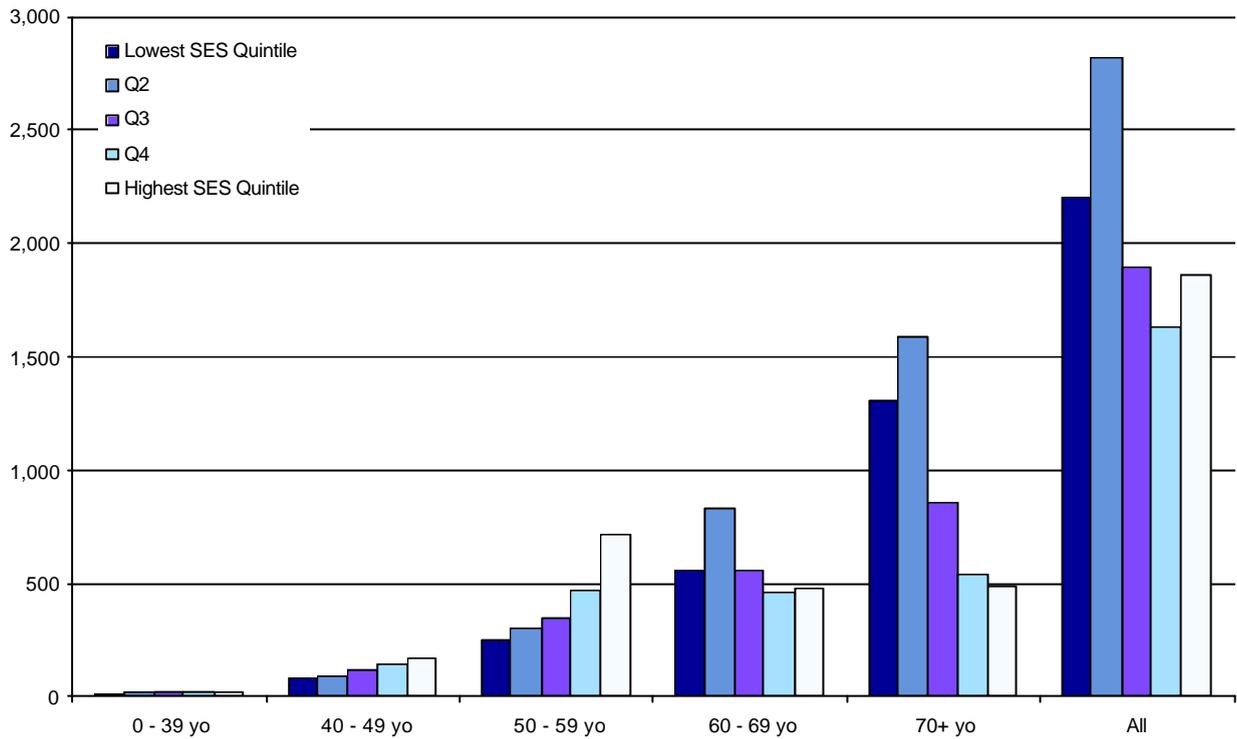
Public Hospitals – Patient Numbers



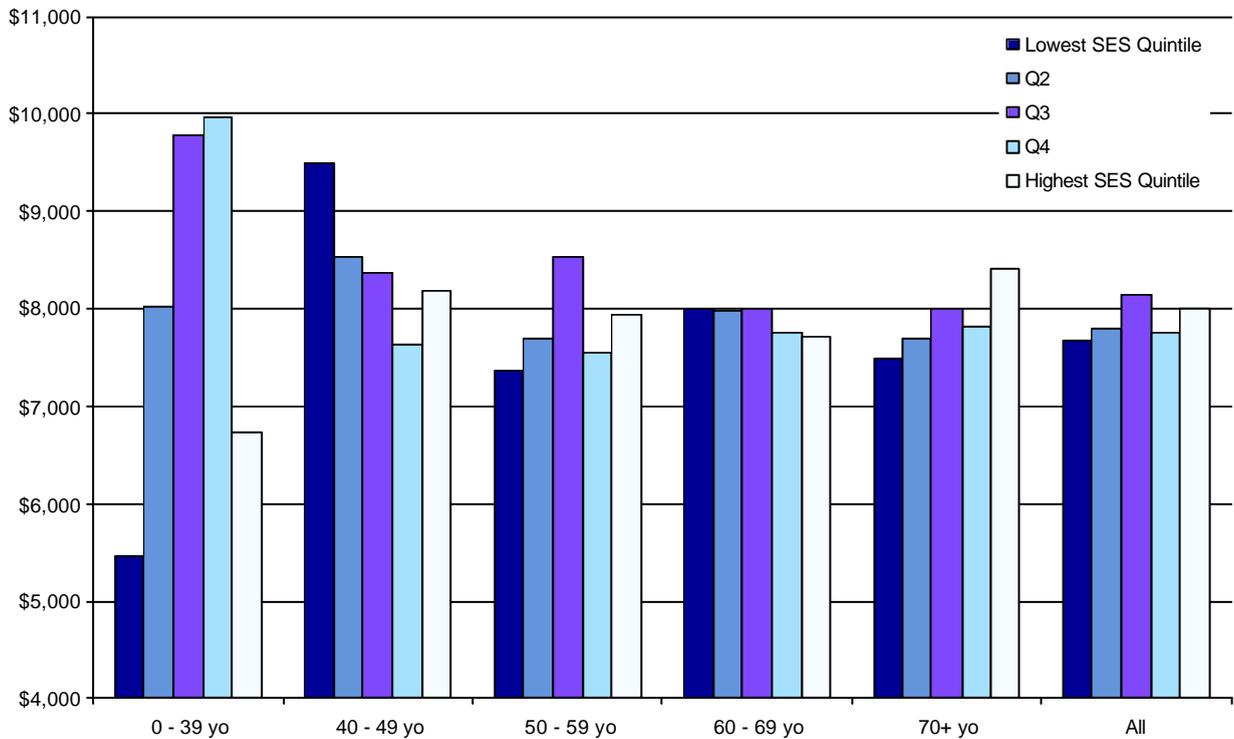
Public Hospitals – Average Cost per Patient



Private Hospitals – Patient Numbers



Private Hospitals – Average Cost per Patient



C Aggregation of service related groups

One of the items of information attached to each separation record is the service related group (SRG) relating to the treatment received by the patient. To make the process of projecting service usage more manageable and reduce sensitivity to small numbers, the SRG variable was initially aggregated from forty to eight categories. Coronary heart disease was then created as a separate category to demonstrate how analysis of a specific morbidity could be performed. This brought the total number of new SRG categories to nine. The mapping of SRGs and coronary heart disease to these new classes is shown in Appendix E of Thurecht *et al* (2003).

However, for the purposes of this paper, the SRG codes were further aggregated to four classes. Details of this aggregation process are shown in the following table.

SRG Class	Former SRG Class*
Acute Services	General Medicine and Subspecialties
	General Surgery and Subspecialties
	Other Specialities
	Special Service List
Obstetrics and Gynaecology	Obstetrics and Gynaecology
Other Services	Mental Health and Substance Abuse
	Non-Acute Services
	Paediatrics and Perinatology
CHD	Coronary Heart Disease

* As shown in Appendix 5 of Thurecht *et al* (2003).

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