CENTRE FOR HEALTH PROGRAM EVALUATION

TECHNICAL REPORT 8

The Burden of Illness and the Cost of Osteoporosis in Australia

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EXECUTIVE SUMMARY

The purpose of this study is to estimate the cost of illness associated with the treatment of osteoporosis in Australia in 1994. The economic cost of osteoporosis is largely associated with hip fracture but other fracture sites commonly associated with osteoporosis include the wrist, vertebrae, and the proximal humerus. Osteoporosis is particularly prevalent in older women. Over 75% of all hip fractures in 1994 were women. Osteoporotic fracture is associated with a loss of physical function often leading to dependency in older people. The burden of osteoporosis therefore will take the form of a reduction in the physical, emotional and social functioning of elderly men and women in Australia. It will also impose a burden on the wider community which has accepted the responsibility to treat fractures, to restore functioning as much as possible, and to provide services for the disabled. To a lesser extent there is also a commitment to prevent fractures either by maintaining bone mass or preventing falls. A primary aim of this paper is to estimate the current cost of those commitments.

This study estimates the direct costs of osteoporosis in Australia in 1994. The method is to use data on the incidence of fractures in Australia combined with the costs of ambulatory and in-patient care, rehabilitation, and long term care to estimate the total cost of those fractures. Data on the proportion of fractures which can be attributed to osteoporosis by fracture type are used to estimate the cost associated with osteoporosis. The approach taken is to estimate the direct medical and non-medical costs of treating osteoporosis and its clinical manifestation of fracture. Direct medical costs are defined as those primary health care, hospital emergency department, in-patient, out-patient and rehabilitation costs, which are incurred by the community and individuals to treat fractures associated with osteoporosis. Non-medical costs are the cost of care in the community or in institutions for those incapacitated by osteoporotic fracture. They include community care for the disabled and care provided in nursing homes. The study includes some discussion of the quality of life after a fracture, and an estimate of some of the indirect costs of osteoporosis associated with fractures among the working population.

The treatment of fracture may involve a combination of emergency treatment, in-patient hospital treatment, out-patient hospital visits, rehabilitation, and general practice or specialist medical care. The general approach to costing taken in this study is to estimate total costs of fracture treatment by combining national or state level data on service use by fracture type, with sample estimates of the average cost of each service type. For example, we estimate the total number of hospital separations for hip fracture after minimal trauma in Australia, and multiply this by the estimated average cost of in-patient treatment for hip fracture. Where national data is not available, extrapolations have been made from selective samples. For example, detailed patient level cost data for hospitals was obtained from five hospitals in Victoria and Queensland. It is well known that variations in medical practice and financial arrangements mean that costs vary considerably between hospitals. In most cases, however, we have chosen sources which were able to provide the most reliable and detailed cost and utilisation data.

We restrict our analysis to the four most common fracture sites. As an initial assumption all minimal trauma fractures admitted to hospital are assumed to be osteoporotic. Where we have no evidence of an absence of major trauma we use the population attributable risks from Seeley et al 1995. Thus, we assume in addition to those admitted to hospital, 50% of all hip fractures, 20% of all Colles' fractures, and 30% of all humeral fractures who present to emergency departments, and are not admitted, are attributable to osteoporosis.

The incidence of minimal trauma hip fractures is estimated as 4.32 for women and 1.47 per 1000 person years aged over 50. This represents 10,331 and 3,157 total hospital separations for hip fractures in 1994 for women and men aged over 50 respectively. The incidence of Colles' fractures is estimated as 6.04 per 1000 persons years for women, and 0.88 per 1000 person years for men aged over 50. This represents 14,421 Colles' fractures in women, and 1,878 fractures in men in 1994. The incidence of vertebral fractures is estimated as 5.14 and 1.77 per 1000 person years for women and men aged over 50 respectively. This represents 12,267 for women and 3,772 vertebral fractures in men in 1994. The incidence of proximal humerus fractures is estimated as 2.41 and 0.67 per 1000 person years for women and men respectively. This represents 5,763 and 1,425 proximal humerus fractures in women and men respectively in 1994. Whereas almost all hip fractures are hospitalised, it is estimated that only 22% of Colles' fractures, 8% of vertebral fractures, and 22% of proximal humerus fractures were admitted to hospital.

A multitude of studies have investigated mortality after hip fracture. Reported mortality has ranged from 2% to 17% one month after hip fracture, and from 6% to 53% one year after fracture. The wide variation probably relates to the time period in which the study occurred (i.e. mortality was higher in the 1970s than in the 1990s) and the way study subjects were selected (i.e. studies that excluded patients who lived in nursing homes found lower mortality rates than studies that included all patients with hip fractures).

In-hospital mortality after hip fracture is around 5% in Australia (Lord 1993). In the only Australian study to investigate mortality after discharge from hospital, 13% had died within six months after hip fracture and 22% within one year after fracture (Katelaris & Cumming ,1996). The latter figure is in close agreement with studies form the US and Scandinavia. It is clear that mortality is high after hip fracture. However, it is not clear how much of this mortality can be attributed to the actual hip fracture and its sequelae, rather than to the advanced age and poor pre-fracture health of many hip fracture patients.

Seeley and colleagues have recently calculated the population attributable risk for osteoporosis and various fracture types in a cohort study of 8,134 women in the USA (Seeley et al 1995). They used the recently agreed WHO definition of osteoporosis of a bone density more than 2.5 standard deviations below the mean in young women (Kanis et al 1994). They suggest that about half of all hip fractures, a third of proximal humeral fractures, and a fifth of wrist fractures are due to osteoporosis. This means that if a therapy was used only by women with bone density low enough to be classified as osteoporotic, and if the aim of the therapy was to raise bone density out of the osteoporotic range and no further, it could reduce the number of hip fractures in the population by 50%.

The total cost of the treatment of osteoporosis in Australia is estimated to be $226.72 million in 1994. This is similar to two of the previous estimates. It is, however, far lower than the most recent estimate of over $700 million by Randell et al (1995).

Almost three quarters of the cost of osteoporosis is estimated to be hospital treatment, and within acute hospital care hip fracture represents 85% of the total cost. The next largest category of cost is pharmaceuticals which account for 9% of the total cost in a year.

Summary of the Cost of Osteoporosis In Australia, 1994

Cost Category	Total Cost $	Percentage of Total Cost %
Community		
GPs	4.36	1.9
Community services	0.65	0.2
Subtotal	5.01	2.2
Hospital		
Ambulance	4.10	1.8
Emergency (non-admitted)	1.32	0.6
In-patient	141.23	61.2
Outpatient	2.91	1.3
Subtotal	149.56	64.8
Rehabilitation	23.09	10.0
Pharmaceuticals	19.46	8.4
Nursing Home	33.70	14.6
Total	**226.72**	**100**

The estimate of total treatment cost is based on a number of critical assumptions particularly in relation to the major component of costs - hospital treatment. First the total cost estimate assumes that all fractures after minimal trauma, admitted to hospital, are osteoporotic. This may represent an overestimate of the extent of osteoporosis, if recent estimates of the population attributable risk are accepted. On the other hand the dominance of hospitals with developed clinical costing systems in States with case payments may have biased cost estimates for

Australia as a whole downward. Not only is there a bias toward less expensive acute treatment but also towards rehabilitation. However, as these health system changes unfold, these lower cost hospitals may be seen as more relevant predictors of the future current cost of osteoporosis.

This study has estimated the additional indirect cost of osteoporosis as the value of the total number of days in hospital and additional days off paid employment associated with age specific atraumatic fractures in males and females in 1994. This is a conservative estimate of annual lost productivity associated with osteoporosis and ignores both unpaid work lost leisure time for both patients and informal carers. We calculate the total indirect costs of osteoporotic fractures based on the age specific number of days in hospital and additional days off work associated with recuperation. The number of days off work associated with the use of medical and hospital emergency services is also associated with a time cost. The value of total lost productivity from work absenteeism associated with hip fracture is $346,663 for females and $693,313 for males between the ages of 45 and 64. The value of lost productivity from work absenteeism associated with all hospitalised minimal trauma fractures for those between the ages of 45 and 64 is estimated as $9.99 million.

The current study re-affirms that osteoporosis represents a considerable health burden to the community, and its treatment represents a considerable economic burden on the health system in general, and the hospital system in particular. It is clear that the potential for resource savings in hospital treatment of hip fractures represents a considerable incentive to develop measures to prevent osteoporosis and fractures.

The Burden of Illness and the Cost of Osteoporosis in Australia

Introduction

Osteoporosis can be defined as ‘a systemic skeletal disease characterised by low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture’ (Consensus Development Conference 1993, p 646). It is a major cause of morbidity and mortality in Australia due to fractures and their complications. The clinical presentation of osteoporosis is usually from the symptoms caused by the resultant fractures. The most common fractures which can result from osteoporosis are: fractures of the neck of femur (hip fracture), vertebral fractures, and Colles’ fractures (wrist). Bone mineral loss occurs throughout the skeleton, however, and osteoporosis can also contribute to a lesser extent to fractures in other sites such as the proximal humerus and ribs. Women are more susceptible than men to developing osteoporosis for several reasons:

- they have smaller bones and therefore less bone mineral to lose than men;
- they attain peak bone mineral content (BMC) earlier; and
- they suffer an accelerated rate of loss immediately after the menopause associated with declining endogenous oestrogen.

Values for both bone mineral density and fracture are continuously distributed in the population. Therefore, a gradient of fracture risk is associated with bone density, so that the identification of a "fracture threshold" is arbitrary. Nevertheless the WHO has recently developed guidelines regarding bone density cutoff values for the diagnosis of increased bone fragility (Kanis et al, 1994). Osteopaenia (low bone mass) is defined as lying between 1 ad 2.5 standard deviations below the mean young adult value. Osteoporosis has been clinically defined as a value for bone density that is more than 2.5 standard deviations below the mean young adult value. Established or severe osteoporosis is reserved for patients with the same bone density in the presence of one or more fragility fractures.

A number of longitudinal studies have shown that lumbar spine and proximal femur bone density are predictive of fracture risk (Black et al,1992;Cummings et al, 1993; Melton et al 1993;Ross et al 1991). Each is the best predictor for the particular site being measured. Proximal femur bone density is the best predictor of hip fracture with each standard deviation reduction in bone density below the age and sex matched mean value increasing the risk of hip fracture 2.6 to 2.7 fold (Cummings et al, 1993), and the risk of any traumatic fracture 2.4 fold. This fracture risk is multiplicative for each further standard deviation reduction in bone density. Similarly, each standard deviation decrease in lumbar spine bone density increases the risk of vertebral fracture 1.9 - 2.3 fold. In addition, each prevalent vertebral fracture further increases the risk of subsequent vertebral fractures, 2.6 fold, independently of bone density (Ross et al, 1991). However, women with more than five prevalent vertebral fractures have a lower rate of subsequent fractures than those with less than five fractures.

Most deaths associated with osteoporosis result from hip fracture and its aftermath. Various overseas surveys report that between 12 and 40% of all patients with hip fractures die within six months[1]. The large range highlights the difficulty in establishing the cause of death in a group who are often frail, and hence have a higher risk of death from all causes. Factors associated with a higher risk of post-menopausal osteoporosis have been summarised by Larkins (1990, p 205):

Established:

- thin body habitus;
- premature menopause;
- physical inactivity;
- familial factors;
- Caucasian (as opposed to Negroid or Asian) race.

Possible:

- low calcium intake;
- tobacco use;
- alcohol use.

The direct costs to the Australian community have been variously estimated to be $172m for all osteoporotic fractures and $113 million for hip fractures in women in 1988 (Salkeld & Leeder 1990), $248 million for osteoporosis and associated fractures in 1989/90 (Crowley et al 1992), and $779 million for the direct medical costs of minimal trauma fractures in 1992 (Randell et al 1995). Differences in the estimates of costs largely reflect differences in methodology and the meaning of cost of illness in the context of osteoporosis.

[1] Table 14 shows the variation in reported mortality rates.

Burden of Illness

The burden of illness associated with osteoporosis is largely caused by fractures of the hip and spine. In 1994 there were an estimated 13,468 hospital separations for minimal trauma hip fracture in Australia (that is fractures which did not involve a major trauma). Fracture rates increase exponentially with age in both men and women. The result is that over 80% of hospital separations for minimal trauma hip fracture in Australia are for people aged 70 years or over.

Hip fracture is associated with long term disability and a decline in health status. Between 6% and 40% will die within one year, while around half of the survivors will be incapacitated, many of them permanently (Magaziner et al 1990). Osteoporosis induced vertebral fracture can cause back pain and consequent decrease in physical, emotional and social functioning.

The causality of the association between low bone mass and mortality following a minimal trauma fracture is controversial, however, and it has been suggested that low bone mass represents a marker for other factors associated with chronic disease or ill health (Browner et al 1991). The excess morbidity associated with hip (and to a lesser extent vertebral) fracture is well established however. Many never regain their pre-fracture capacity. Around a fifth of the elderly living in the community prior to a hip fracture are no longer capable of looking after themselves and are admitted to institutional care (Cumming, Klineberg & Katelaris (in press)).

At any given age the risk of fracture is about two times greater in women than in men, and in whites of North European ancestry than in Africans or Asians (Cooper et al 1993). As detailed below, an estimated 77% of hospital separations for hip fracture were women in 1994. Although hospital length of stay has been declining, and there is little evidence of an increase in age specific rates of osteoporotic fracture, an ageing population will ensure an increasing burden of illness associated with osteoporosis over time (Melton, O'Fallon , Riggs, 1987). That burden will take the form of a reduction in the physical, emotional and social functioning of elderly men and women in Australia. It will also impose a burden on the wider community which has accepted the responsibility to treat fractures, to restore functioning as much as possible, and to provide services for the disabled. To a lesser extent there is also a commitment to prevent fractures either by maintaining bone mass or preventing falls. The purpose of this paper is to estimate the current cost of those commitments.

Cost of Illness Studies

The economic cost of a disease such as osteoporosis can be defined as:

- the opportunity cost to the community of the resources foregone in diagnosing and treating the disease;
- the opportunity cost of the disease to the individual in terms of forgone health and its effects on individual welfare;
- the foregone welfare effects of any produced goods and services lost to other members of society.

The first is generally called the direct cost of the disease. The second, which can be seen as the impact of the disease on individual quality of life generally, and on health specifically, is generally called intangible costs. The third is the impact of that reduced quality of life on the productive potential available to the rest of society. In most cost of illness studies the latter category is called indirect costs and is generally estimated as the lost earnings of those in the workforce due to morbidity or premature mortality. Some studies have also included the lost output of carers and the lost non-paid output of home production and volunteer work.

While the methodology of cost of illness studies is more or less standard following Hodgson and Meiners (1982) and Hodgson (1983), there remain two controversial areas. Some have pointed to the difficulties of measurement and the problems of double counting, particularly with regard to intangibles and indirect costs (Richardson 1991; Koopmanschap & Ineveld 1992). More fundamentally some have questioned the value of doing cost of illness studies at all (Shiell, Gerard & Donaldson, 1987). The major criticism of cost of illness studies is that they can be subject to misuse. A disease with a high cost of illness suggests just that. A cost of illness study which suggests that a disease has a high social cost relative to other diseases or social problems implies that society would be relatively better off without that disease. While this is obviously true it does not imply that a higher priority should be given to treating that high cost disease. This is because treatment (or prevention) may be relatively ineffective or expensive. Priority setting should be based on the relative cost effectiveness of interventions and not on the cost of a disease alone. Many have argued that while cost of illness studies do not indicate where resources should be put in the short term, they do indicate where the greatest potential health improvements and health care resource savings could be made, if effective interventions were available.

The approach taken in this paper is to estimate the direct medical and non-medical costs of treating osteoporosis and its clinical manifestation of fracture. Direct medical costs are defined as those primary health care, hospital emergency department, in-hospital, out-patient, and the rehabilitation costs, which are incurred by the community and individuals to diagnose and treat fractures associated with osteoporosis. Non-medical costs are the cost of care in the community or in institutions for those incapacitated by osteoporotic fracture. They include community care for the disabled and care provided in nursing homes. The paper includes some discussion of the quality of life after a fracture, and the impact on productive output.

Outline of the Paper

The paper estimates the direct costs of osteoporosis in Australia in 1994. The method is to use data on the incidence of fractures in Australia combined with the costs of ambulatory and in-hospital care, rehabilitation, and long term care to estimate the total cost of those fractures. Data on the proportion of fractures which can be attributed to osteoporosis by fracture type are used to estimate the cost associated with osteoporosis. The critical assumption for this purpose made in the study is that all fractures of the hip, vertebrae, wrist, and humerus, admitted to hospital for reasons other than a major trauma such as a motor vehicle crash, are associated with osteoporosis. Indirect costs are estimated separately, and there is some discussion of intangible health outcomes following fracture.

Descriptive Epidemiology of Fractures in Older Australians

Estimating the number of fractures that occur each year in older Australians is difficult. With the notable exception of hip fractures, most fractures do not result in a hospital admission, hence hospital admission data is of limited value for estimation of fracture incidence. Identification of all fractures would require a very expensive, specially designed, national study involving hospitals, general practitioners, radiologists, orthopaedic surgeons, and a sample of the general population. Such a study is unlikely ever to be conducted.

Two studies of fracture incidence are currently under way in Australia: the Dubbo Osteoporosis Epidemiology Study and the Geelong Osteoporosis Study. Both studies are attempting to identify all fractures that occur in a geographically defined population. Only results from the Dubbo study have been published to date (Jones et al 1994). A problem with the Dubbo data is that the actual number of fractures observed was small, making age- and sex-specific fractures rates unreliable. Another problem is that the Dubbo study involves a country district, therefore the observed fracture rates may not be generalisable to the whole of Australia.

The Geelong study involves a population that is more likely to be representative of all of Australia. It has a medium sized urban population and is service centre for a large rural hinterland. It is also reasonably self contained in terms of health service use. Table 1 and Table 2 show the estimated incidence of fractures in Geelong for a 15 month period in 1994 and 1995 by age for females and males.

Table 1: Female Fracture Incidence Per 10,000 Population Barwon Statistical Division (Geelong), 15 Months 1994 And 1995

Age Group (years)	45-54	55-64	65-74	75-84	85+
Population	11,005	9,816	8,974	5,357	1,515
Proximal Femur - trochanter	0.00	0.83	12.69	44.04	220.15
Proximal Femur - cervical	0.00	4.97	9.06	48.59	80.54
Humerus	1.48	9.12	22.66	33.41	80.54
Vertebrae	5.17	13.26	30.82	56.19	64.43
Colles Forearm	3.70	9.12	28.10	31.89	64.43

Source: Sanders et al, (unpublished data) Geelong Osteoporosis Study ,

Table 2: Male Fracture Incidence Per 10,000 Population Barwon Statistical Division (Geelong), 15 Months 1994 And 1995

Age Group (years)	45-54	55-64	65-74	75-84	85+
Male population	11096	9414	7351	3505	641
Proximal Femur - trochanter	2.93	2.59	3.32	23.21	114.22
Proximal Femur - cervical	0.00	1.73	5.53	18.57	76.14
Humerus	3.67	3.46	6.64	6.96	25.38
Vertebrae	2.20	6.91	6.64	20.89	38.07
Colles Forearm	5.13	3.46	1.11	4.64	12.69

Source: Sanders et al, (unpublished data) Geelong Osteoporosis Study , This data may in time represent the best information on fracture incidence in Australia, given the size and nature of the population and a potentially high ascertainment rate. The collection is however incomplete and unpublished, making assessment of its methodology difficult. There are noticeable differences between the fracture rates and those given below from Rochester in the USA and from hospital data in Australia.

An alternative to using Australian fracture data is to apply observed fracture rates derived from other countries to the age and sex distribution of the Australian population. Several carefully conducted studies of fracture incidence have been conducted in Scandinavia and among the United States white population. Although there are differences in lifestyle, diet and environment between these countries we might expect fracture rates to be similar in Australia to the United States. This is especially so given the apparent similarities between Australian and the United States in bone mineral density among women. (Flicker et al, 1995; Pocock et al, 1988). Flicker et al (1995) compared data on bone density from 411 Australian volunteers with that of North American women compiled by Hologic . Results of the study are shown in Table 3 and Table 4. The Australian volunteers had on average 7% greater bone mineral density at the lumbar spine for the age range 25-55 years, but no significant differences in bone density measured at the femoral neck.

Table 3: Lumbar spine BMD of Australian and North American women

Age range (years)	North American			Australian		
	Age (mean)	Mean BMD ± 1 SD (g/cm^2)	*n*	Age (mean)	Mean BMD ± 1 SD (g/cm^2)	*n*
15-24	21.3	1.023 ± 0.13	14	19.1	1.057 ± 0.11	120
25-34	29.8	1.054 ± 0.12	43	30.4	1.333 ± 0.13	29
35-44	39.7	1.017 ± 0.10	70	40.3	1.131 ± 0.17	44
45-54	49.8	0.967 ± 0.13	131	49.9	1.061. ± 0.15	107
55-64	59.4	0.902 ± 0.11	180	60.4	0.944 ± 0.15	57
65-74	68.4	0.828 ± 0.12	137	69.5	0.867 ± 0.18	54
75-84	78.5	0.769 ± 0.12	30			

source: Flicker, Green, Kaymakci et al (1995)

Table 4: Femoral Neck BMD of Australian and North American women

Age range (years)	North American Age (mean)	Mean BMD ± 1 SD (g/cm^2)	*n*	Australian Age (mean)	Mean BMD ± 1 SD (g/cm^2)	*n*
15-24	22.4	0.913 ± 0.11	66	19.1	0.922 ± 0.11	120
25-34	29.2	0.878 ± 0.12	155	30.4	0.898 ± 0.10	29
35-44	39.2	0.845 ± 0.11	138	40.3	0.864 ± 0.12	44
45-54	49.4	0.808 ± 0.12	100	49.9	0.807 ± 0.11	107
55-64	59.5	0.746 ± 0.11	104	60.4	0.714 ± 0.09	54
65-74	69.6	0.671 ± 0.10	95	69.5	0.647 ± 0.10	52
75-84	80.2	0.605 ± 0.10				

source: Flicker, Green, Kaymakci et al (1995)

An ideal way of estimating fracture incidence in Australia does not exist. The approach adopted in this report is to use Australian hospital separations data supplied by the Australian Institute for Health and Welfare for hip fractures, and to use fracture rates from Rochester, Minnesota (the site of the Mayo Clinic) for other fracture types (Gallagher et al 1980). These rates have been used to estimate the number of fractures of wrist, proximal humerus and vertebrae that occur in older Australians.

For ease of comparison, all findings are reported in terms of the Australian population in 1994.

Method and Data

Because of the limitations of Australian data, fracture incidence rates from Rochester, Minnesota, were used to estimate the number of vertebral, wrist and proximal humeral fractures in Australia. The validity of this approach was assessed in two ways.

First, the Rochester rates were applied to the age and sex distribution of the Dubbo population and the number of fractures of various types estimated in this way (expected number of fractures) was compared to the actual number of fractures known to have occurred in Dubbo (observed number of fractures).

Second, Rochester hip fracture rates were applied to the age and sex distribution of the Australian population and the estimated number of hip fractures was compared to the known number of hospital separations for hip fractures in Australia (Australian Institute of Health and Welfare 1995).

A similar approach to that described in the previous paragraph was used to assess the validity of data from the Geelong Osteoporosis Study. In the future, the best data on fracture rates in Australia could come from this study.

Not all fractures are related to osteoporosis. The principal method used in this study to identify osteoporotic fractures is to exclude those fractures known to be caused by major trauma[2]. One method used to approximate the number of fractures likely to be caused by osteoporosis is to identify fractures by ICD-9-CM codes and further refine these fractures by the External Causes of Injury Supplementary Classification System (E-Codes). E-Codes were selected to reflect fractures not likely to be caused by major trauma and the relevant E-Codes are contained in Table A.2 of the Appendix A. Requested ICD-9-CM codes were restricted to "closed" fracture types as opposed to "open" fracture types, based on the premise that open fractures are more likely to be associated with traumatic injury.

Results

Results from Different Data Sources

There is reasonable accordance between the Geelong fracture rates and the Australian rates. For example, Table 5 shows the results of applying the Geelong hip fracture rates for women to the 1992/1993 Australian population. The expected number of hip fractures in Australia in women aged 55 years of 9,122 compared to the actual number of 10,684 hip fracture hospital separations this age group (Australian Institute of Health and Welfare, 1995).

Table 5: Comparison of the expected female hip fractures in Australia based on Geelong hip fracture rate in 1994/5 and observed hospital separations in 1992/93

	Geelong hip fracture rate per 10,000	Australian female population 1993	Expected hip fractures in 1992/3	Observed separations in 1992/93
55-64	5.8	732,934	425	468
65-74	21.75	659,580	1,435	1,683
75-84	92.63	388,718	3,601	4,658
85+	300.69	121,787	3,662	3,803
Total			9,122	10,612

Based on the application of the Rochester data to the Dubbo population, there was good agreement between the observed and expected numbers of hip, wrist, ankle and pelvic fractures in Dubbo; agreement for proximal humeral fractures was reasonable (see Table 6). The high discordance between observed and expected number of vertebral fractures could be due to a higher rate of radiological investigation of back pain in the US than in rural Australia.

[2] The Commonwealth Department of Human Services and Health (1995) adopted a similar criterion with respect to re-imbursement for the supply of calcitriol which is prescribed for "established osteoporosis in patients with fracture due to minimal trauma"

Table 6: Comparison of Observed Annual Fracture Incidence in Dubbo, New South Wales, and Expected Incidence, Based on Fracture Rates in Rochester, Minnesota

Fracture Type	Annual Number of Fractures in Dubbo	
	Observed*	Expected**
Hip	18	15
Wrist	16	15
Vertebral	5	16
Proximal humerus	10	7
Ankle	8	7
Pelvis	4	5

Notes: * Based on published fracture rates in Dubbo (Jones et al 1994).
** Based on application to the Dubbo population of age- and sex-specific fracture rates in Rochester, Minnesota, USA (Gallagher et al 1980).

Assuming that the Australian Institute of Health and Welfare (AIHW) Australian hospital separation data are accurate, the Rochester data appeared to overestimate the number of hip fractures in Australia by about 7% (see Table 7). Hospital separation data may underestimate the true incidence of hip fracture. The results are consistent with a recent US study which found that separation data underestimated hip fracture incidence by 6% (Fisher et al 1991).

Table 7: Comparison of Expected Number of Hip Fractures in Australia in 1992/93, Based on Fracture Rates in Rochester, Minnesota, and Actual Number of Hospital Separations for Hip Fracture in 1992/1993

Age Group	Expected Number of Hip Fractures*	Number of Hospital Separations for All Hip** Fracture	Number of Hospital Separations for Hip Fracture after minimal trauma
MALE			
50-59	311	208	140
60-69	635	550	442
70-79	784	1,089	943
≥80	1,783	1,585	1,446
Total	3,513	3,432	2,971
FEMALE			
50-59	496	231	196
60-69	1,793	901	805
70-79	3,560	3,053	2,779
≥80	5,741	6,499	6,050
Total	11,590	10,684	9,934
GRAND TOTAL	**15,103**	**14,116**	**12,856**

Note: Based on application to the 1992/1993 Australian population of age- and sex-specific fracture rates in Rochester, Minnesota, USA (Gallagher et al 1980).
Data supplied by the Australian Institute of Health and Welfare

Estimated Incidence of Fractures in Australia in 1994

Hip Fractures

With very few exceptions people who suffer a hip fracture in Australia are admitted to hospital. Hence, routinely collected hospital separation data should provide a good estimate of the number of hip fractures that occur in Australia. This data may not be entirely accurate because of double counting of people admitted twice for the same fracture (due to complications or transfer to another hospital) leading to an over-estimate of the actual number of fractures. Conversely a reason other than hip fracture may have been cited as the principal diagnosis for the admission, in which case this would not have been included in the total number, resulting in an underestimation. However for an acute problem such as a fractured hip, the latter scenario is less likely to be a problem.

Table 8: Estimated Incidence Of Hip Fractures And Hip Fractures After Minimal Trauma Among People
Aged 50 Years And Over In Australia, 1994

Age Group	Minimal trauma fractures	*Rate Per 1,000 Persons Per Year*	All hip fractures	*Rate per 1,000 person years*
MALE				
50-54	63	0.13	95	0.20
55-59	84	0.21	121	0.31
60-64	163	0.46	214	0.61
65-69	281	0.84	336	1.01
70-74	408	1.55	475	1.80
75-79	569	3.45	639	3.90
80-84	678	6.95	747	7.58
≥85	891	16.78	925	16.94
Total	3,137	1.47	3,552	1.65
FEMALE				
50-54	60	0.13	75	0.17
55-59	145	0.38	164	0.42
60-64	259	0.73	305	0.86
65-69	543	1.52	593	1.66
70-74	1,044	3.31	1,134	3.59
75-79	1,799	7.78	1,958	8.50
80-84	2,695	16.35	2,828	17.07
≥85	3,786	29.86	3,969	30.88
Total	10,331	4.32	11,026	4.57
GRAND TOTAL	**13,468**	**2.9**	14,578	**3.19**

Note: Based on application to the 1994 Australian population of the age- and sex-specific hip fracture rates in Australia in 1992/1993 (Australian Institute of Health and Welfare 1995).

Table 8 shows the number and rate of hospital separations for hip fracture by age in 1992/93. It compares the total number of separations with those coded as minimal trauma fractures according to the exclusions discussed above and detailed in the Appendix (Table A.2). The pattern of fractures by age and sex is as expected with a rising number of fractures with age and women representing more than two thirds of hip fractures over age 50 years. The number of expected fractures in 1994 was 14,578 of which 13,468 were subsequent to minimal trauma.

Wrist Fractures

Only a minority of patients who suffer wrist fractures are admitted to hospital and the majority of these admissions are probably for less than 24 hours. Hence, hospital separation data grossly underestimates the frequency of wrist fractures in older Australians. In the case of wrist fractures the total number of fractures exceeds the number of minimal trauma fractures considerably, particularly for men (see Table 9 and Table B.1).

Table 9: Estimated Incidence of Wrist Fractures Among People Aged 50 Years and Over In Australia, 1994

Age Group	All Fractures		Minimal Trauma Fracture Hospital Separations	
	Number*	Rate (Per 1,000)	Number**	Rate (Per 1,000)
MALE				
50-54	618	1.30	46	0.09
55-59	386	0.98	51	0.13
60-64	280	0.80	54	0.15
65-69	402	1.20	63	0.19
70-79	423	0.99	71	0.17
≥80	119	0.78	47	0.31
Total	1,878	0.88	332	0.16
FEMALE				
50-54	1,736	3.84	212	0.47
55-59	2,084	5.39	290	0.75
60-64	2,481	7.03	369	1.05
65-69	2,254	6.33	518	1.45
70-74	2,450	7.77	534	1.69
75-79	1,389	6.02	512	2.22
80-84	949	5.75	416	2.52
≥85	1,078	8.43	369	2.88
Total	14,421	6.04	3,220	1.35
GRAND TOTAL	**16,299**	**3.60**	**3,552**	**0.79**

Notes: * Based on application to the 1994 Australian population of age- and sex-specific fracture rates in Rochester, Minnesota, USA (Owen et al 1982).
** Based on application to the 1994 Australian population of age- and sex-specific hospital separation rates in Australia in 1992/1993 (Australian Institute of Health and Welfare 1995).

Vertebral Fractures

Vertebral fractures are very common among older people: Around 25% of women aged 50 years and over have at least one vertebral fracture (Melton et al 1993). The clinical importance of many of these fractures is uncertain and the focus of much current research. The authors of one recent US study suggested that the majority of vertebral fractures did not cause any pain or disability (Ettinger et al 1992), a finding disputed by others (Ross et al 1994). Estimates of the percentage of all vertebral fractures that cause symptoms severe enough to warrant medical attention vary from 35% in a US study (Cooper et al 1992) to 16% in a UK study (Kanis et al 1994); in these same studies, the percentages that required admission to hospital were 8% (US) and 2% (UK). The difference probably reflect differences in the US and British health systems, rather than difference in vertebral fracture severity. There are no comparable Australian data.

Table 10: Estimated Incidence of Vertebral Fractures Among People Aged 45 Years and Over in Australia, 1994

Age group	Clinically Diagnosed Fractures		Minimal Trauma Fracture Hospital Separations	
	Number*	Rate (Per 1,000)	Number**	Rate (Per 1,000)
MALE				
45-54	514	0.47	49	0.04
55-64	478	0.64	51	0.07
65-74	883	1.48	114	0.19
75-84	1,179	4.49	117	0.45
≥85	718	13.27	62	1.17
Total	3,772	1.77	393	0.18
FEMALE				
45-54	862	0.82	37	0.04
55-64	1,959	2.65	77	0.10
65-74	3,668	5.46	205	0.30
75-84	4,225	10.67	324	0.82
≥85	1,553	12.14	209	1.65
Total	12,267	5.14	852	0.36
GRAND TOTAL	**16,039**	**3.55**	**1,245**	**0.28**

Notes: * Based on application to the 1994 Australian population of age- and sex-specific fracture rates in Rochester, Minnesota, USA (Cooper et al 1992).

** Based on application to the 1994 Australian population of age- and sex-specific hospital separation rates in Australia in 1992/1993 (Australian Institute of Health and Welfare 1995).

The rate of minimal trauma fracture shown in Table 10 in the older age groups is not significantly different from the rate of all vertebral fractures shown in Table B.1. As expected however there are differences in the younger age groups due to the higher incidence of non minor trauma.

Fractures of the Proximal Humerus

Fractures of the proximal humerus occur frequently, but much less is known about their epidemiology than for hip and wrist fractures. As for fractures of the wrist and vertebra, most people who suffer a proximal humeral fracture are not admitted to hospital. However, the incidence of humeral fractures is much more strongly associated with age than the incidence of wrist fractures, hence the majority of people with proximal humeral fractures are over 70 years old. In this age group, even a relatively simple fracture like that of the proximal humerus (usually treated with a simple sling) can have a major impact on ability to cope in the community.

Table 11: Estimated Incidence of Fractures of the Proximal Humerus Among People Aged 50 Years and Over in Australia, 1994				
Age Group	**All Fractures**		**Minimal Trauma Fracture Hospital Separations**	
	Number*	**Rate (Per 1,000)**	**Number****	**Rate (Per 1,000)**
MALE				
50-59	585	0.67	50	0.06
60-69	354	0.52	68	0.10
70-79	316	0.74	92	0.22
≥80	170	1.12	80	0.53
Total	1,425	0.67	290	0.14
FEMALE				
50-59	1,095	1.31	89	0.11
60-69	1,418	2.00	189	0.27
70-79	1,962	3.59	431	0.79
≥80	1,288	4.39	556	1.91
Total	5,763	2.41	1,265	0.53
GRAND TOTAL	**7,188**	**1.59**	**1,555**	**0.34**

Notes: * Based on application to the 1994 Australian population of age-and sex-specific fracture rates in Rochester, Minnesota, USA (Rose et al 1982).

** Based on application to the 1994 Australian population of age- and sex-specific hospital separation rates in Australia in 1992/1993 (Australian Institute of Health and Welfare 1995).

The rate of hospital separation for minimal trauma fracture is less than half that of all separations for fractures of the humerus for both men and women (see Table 11 and Table B.1).

Trends In Osteoporotic Fractures

The number of osteoporotic fractures in Australia will increase in the future, simply because there will be more older people. The projected number of hip fractures in the year 2010 is shown in Table 12. The total of 20,855 hip fractures in the year 2010 is 55% more than in 1994.

Table 12: Projected Number Of Minimal Trauma Hip Fractures In Australia In 2010

Age	Males	Females	All
50-54	93	95	188
55-59	136	246	382
60-64	275	438	713
65-69	366	679	1,045
70-74	500	1,159	1,659
75-79	787	2171	2,958
80-84	1,126	3,816	4,942
85	1,899	7,070	8,969
TOTAL	5,181	15,674	20,855

The data in the table were calculated using 1992/93 Australian age - and sex specific hip fracture incidence rates applied to the 2010 population. In other words, it was assumed that there will be no change in age-specific incidence rates. The question of whether or not age-adjusted hip fracture rates are rising has been addressed in numerous studies, as reviewed by Obrant (1989) and by Melton et al (1987). The data for men are reasonably consistent, with evidence that age-adjusted hip fractures are rising in men. Studies in women are far less consistent. Data from North America suggest that age-adjusted hip fracture rates in women rose in the first half of this century but have been fairly constant since the 1960s. In contrast, several studies from the UK and Scandinavia have found a steady increase in age-adjusted hip fracture rates in women, without any levelling off.

Table 13 shows the number of hospital separations for hip fractures in Australia in 1989/90 and 1992/93. Two years of data is not sufficient to indicate a trend. A recent Australian study of changes in age-adjusted hip fracture incidence in the 1980s reported little change for women and increased incidence in men (Lau 1993).

Table 13: Total Number Of Hospital Separations For Hip Fractures In Australia In 1989/90 And 1992/93

	1989/1990	1992/1993	1989/1990	1992/1993
age	male		female	
50-59	237	208	292	231
60-69	470	550	970	901
70-79	1,042	1,089	2,998	3,053
80+	1,294	1,585	5,520	6,499
All	3,044	3,432	9,779	10,684

Outcomes After Fracture

Fractures in older people can have a number of adverse outcomes, including death, nursing home admission and reduced physical function. Hip fractures have been the focus of the majority of research on post-fracture outcome.

Hip Fractures

Mortality

A multitude of studies have investigated mortality after hip fracture. Reported mortality has ranged from 2% (Borgqvist, Ceder & Thorngren 1990) to 17% (Hempsall et al 1990) one month after hip fracture and from 6% (Weiss et al 1983) to 53% (Beals 1972) one year after fracture. The wide variation relates to the period when the study was done (mortality was higher in the 1970s than in the 1990s) and the way study subjects were selected (studies that excluded patients who lived in nursing homes found lower mortality rates than studies that included all patients with hip fractures).

In-hospital mortality after hip fracture is around 5% in Australia (Lord 1993). In the only Australian study to investigate mortality after discharge from hospital, 13% were dead six months after hip fracture and 22% were dead one year after fracture (Katelaris & Cumming (in press)). The latter figure is in close agreement with studies form the US and Scandinavia (see Table 14).

It is clear that mortality is high after hip fracture. However, it is not clear how much of this mortality can be attributed to the hip fracture and its sequelae and how much is explained by the advanced age and poor pre-fracture health of many hip fracture patients.

Table 14 shows how mortality among hip fracture patients compares to the expected mortality among people of similar age and sex. In most studies, mortality one year after hip fracture was three to four times higher than expected. It is clear that post-fracture mortality is not explained by the age of these patients.

Hip fracture patients tend to have poorer health (even before they have the fracture) than older people who do not have a hip fracture. Although poor pre-fracture health status is likely to explain much of the excess mortality after hip fracture, it is extremely difficult to quantify its contribution to mortality. Estimates of the percentage of deaths after hip fracture that are directly attributable to the hip fracture and its sequelae range from close to 0% (Browner et al, in press) up to 70% (Katelaris & Cumming,1996).

Table 14: Studies Published 1983-1993 Comparing Mortality After Hip Fracture to Mortality in Some Other Population

Author	Comparison Population	Mortality at One Year: Observed %	Mortality at One Year: Expected %
Weiss (1983)	Forearm fracture population	6	2
Kenzora (1984)	'General population'	14	9
McKenzie (1984)	Population, Scotland	34	9
Kreutzfeldt (1984)	Population, Denmark	26	5
White (1987)	Population, Quebec	22	8
Thorngren (1988)	'General population'	22	17
Elmerson (1988)	Population, Sweden	23	6
Magaziner (1989)	Population, USA	17	7
Dolk (1989)	'General population'	26	5
Clayer (1989)	Population, South Australia	24	8
Jalovaara (1991)	Control group, Finland	28	9
Parker (1991)	Population, UK	37	7
de Palma (1992)	Population, Italy	18	3
Jacobsen (1992)	Population, USA	20	5
Cooper (1993)	Population, Rochester, MN	20	10

Note: Only includes studies with follow-up of at least six months. For some studies, mortality rates were estimated from graphs.

Nursing Home Admissions

About 22% of patients with hip fractures in Australia are discharged to nursing homes (Australian Institute of Health and Welfare, 1995). However, many of these people will have lived in a nursing home prior to their fracture and so nursing home re-admission is not really an adverse outcome for them.

A recent Australian study of 131 older people who were living in the community at the time of their hip fracture found that 22% were permanently admitted to an aged care institution in the year after their hip fracture; another 5% were admitted to a hostel for the aged (Cumming, Klineberg & Katelaris (submitted)). In the same population, only 5% of people of similar age without a hip fracture were institutionalised over the same time period.

In the USA, since the advent of prospective payments to hospitals, the recuperative phase of treatment for acute conditions such as hip fracture has shifted to the nursing home. Hospital length of stay has decreased by 4-9 days, the number of physical therapy sessions has decreased by as much as 50%, and the number of nursing home admissions has more than doubled (Fitzgerald et al 1987; Fitzgerald, Moore & Dittus 1988).

Physical Function

Numerous studies in the US, UK and Scandinavia have found that around 50% of people who suffer a hip fracture never regain their pre-fracture level of physical function (Magaziner et al 1990; Marottoli, Berkman & Cooney 1992; Mossey et al 1989; Sernbo & Johnell 1993). There have been no relevant Australian studies but there is no reason to expect a different outcome in this country.

Other Fractures

There has been no research anywhere in the world on the contribution of non-hip fractures to nursing home admission. However, it would seem reasonable to assume that only a small proportion of non-hip fractures lead directly to institutionalisation.

Mortality after wrist and vertebral fractures was recently reported in a study from Rochester, Minnesota (Cooper et al 1993). Mortality after wrist fracture was identical to that expected on the basis of people's age and sex. Although mortality after vertebral fracture was increased, the researchers concluded that this was entirely explained by the poor pre-fracture health status of people who suffer vertebral fractures.

Studies of outcome after wrist fractures have concentrated on radiological position at the fracture site and, to a lesser extent, on wrist movement. There do not appear to have been any studies of the long-term effect of wrist fractures on performance of day-to-day tasks.

Severe vertebral fractures seem to be associated with difficulties in performing activities of daily living, such as bending over to pick something up off the floor (Ettinger et al 1992). However, the impact of less severe vertebral fractures on physical function is controversial (Ettinger et al 1992; Ross et al 1994).

There have been no studies of mortality or disability after fractures of the proximal humerus.

Residence at Time of Fracture

The impact of a fracture depends to some extent on the place of residence at the time of the fracture. People who live in a nursing home when they suffer a fracture tend to stay in hospital for shorter period than people living in the community, hence lowering the cost of treatment. Furthermore, the adverse outcome of nursing home admission is only relevant to people not living in a nursing home before the fracture.

There is wide international variation in definition, availability and utilisation of nursing nomes, hence data from other countries on residence at time of hip fracture are unlikely to be applicable to Australia. The only published Australian study to report place of residence at time of hip fracture found that 33% of hip fracture patients lived in a nursing home at the time of the fracture (Cumming & Klineberg 1994). This study involved 95% of all hip fracture patients living in a defined geographical area in Sydney's western suburbs. It is acknowledged that the figure of 33% may not be generalisable to Australia overall because of small area variation in the number of nursing home beds.

There are no readily available Australian (or international) data on place of residence at time of fractures other than hip fracture.

Population Attributable Risk

Fractures result from a combination of reduced bone strength and fall-related trauma. Osteoporosis is one, but not the only, determinant of bone strength. Hence, a treatment that led to fewer people having osteoporosis would not prevent all fractures. A reasonable question to ask is: what percentage of fractures of various types would be prevented by increasing the bone mass of all people with osteoporosis beyond the osteoporotic level? The appropriate epidemiological measure is the population attributable risk.

Seeley and colleagues have recently calculated the population attributable risk for osteoporosis and various fracture types in a cohort study of 8,134 US women (Seeley et al 1995). They used the recently agreed WHO definition of osteoporosis as being a bone density more than 2.5 standard deviations below the mean in young women (Kanis et al 1994). The prevalence of osteoporosis among women in the study (27%) was a little higher than in a recent survey of a representative sample of older US women (20%) (Looker et al 1995); hence, the population attributable risks reported may be slightly over-estimated. Unfortunately, vertebral fracture data are not yet available.

The data in Table 15 show that about half of all hip fractures, a third of proximal humeral fractures, and a fifth of wrist fractures are due to osteoporosis. This means that if a therapy was used only by women with bone density low enough to be classified as osteoporotic, and if the aim of the therapy was to raise bone density out of the osteoporotic range and no further, it would potentially reduce the number of hip fractures in the population by 50%.

Table 15: Population Attributable Risks for Osteoporosis and Various Types of Fractures in Women Aged 65 Years and Over

Fracture Type	Population Attributable Risk (%)
Hip	47
Wrist	19
Humerus	30
Ankle	3
Pelvis	46
Rib	27

Notes: Percentage of fractures due to osteoporosis, defined as femoral bone mass more than 2.5 standard deviations below the mean in young normal women.
Derived from graphs reported in Seeley et al (1995).

Summary

The number of hip, wrist, proximal humeral and vertebral fractures occurring in older Australians in 1994 was estimated using a combination of Australian and US fracture incidence rates. The authors believe these figures represent the best current estimates of the incidence rates and actual number of fractures in older Australians.

The most accurate epidemiological data is for hip fractures, the fracture associated with the greatest personal, clinical and economic burden. The data for wrist and proximal humeral fractures might be inaccurate by as much as 30%. However, greater accuracy would almost certainly require expensive surveys of representative Australian populations. In any case, the major cost is likely to be for those fractures requiring care in hospital, and the reported data for patients hospitalised for wrist and proximal humeral fractures are likely to be much more accurate than for all fractures of these types.

The least accurate data are for vertebral fractures. Vertebral fractures fall into three categories: asymptomatic fractures; symptomatic fractures not requiring hospital admission; and fractures requiring hospitalisation. The first category is not relevant to a study of the cost of osteoporosis and the third category, hospitalised patients, is small in number. Much more research is needed on category two: vertebral fractures causing pain and/or disability but not leading to hospital admission.

Outcomes after hip fracture are fairly well described in the international literature. However, there are few relevant Australian data. More local research is needed on mortality, institutionalisation and physical function after hip and other fractures.

Cost of Treatment for Osteoporosis

Method

The cost of treatment for osteoporosis is based on both treatment for recognised osteoporosis and the treatment of fractures attributable to osteoporosis. Recognised osteoporosis involves medical, surgical and pharmaceutical treatments. The treatment of fracture may involve a combination of emergency treatment, in-hospital treatment, out-patient visits, rehabilitation, and general practice or specialist medical care. The treatment pattern will vary with fracture type. People with hip fracture, for example, will usually be admitted through the emergency department of the hospital. Some will be discharged to a rehabilitation hospital while others will be discharged home and return for out-patient visits. Many elderly hip fractures may also be discharged to a nursing home or hostel. Only some symptomatic vertebral fractures will be treated in hospital while most will be managed in general practice or by a specialist often through a hospital out-patient department. Colles' fractures are most often treated by a GP or a hospital emergency department without any in-hospital treatment. Only hip fracture is likely to require rehabilitation or lead directly to nursing home placement or the need for community services such as meal on wheels or home nursing care.

We restrict our analysis to the four most common fracture sites associated with osteoporosis: hip, wrist, proximal humerus, and vertebra. As an initial assumption all minimal trauma fractures admitted to hospital are assumed to be osteoporotic. This is the approach taken by others (Randell et al (1995)). On the other hand where we have no evidence of an absence of major trauma we use the population attributable risks discussed above in Table 15. Thus we assume that 50% of hip fractures, 20% of Colles' fractures, and 30% of humeral fractures who present to emergency departments, and are not admitted, are attributable to osteoporosis.

An ideal costing of direct service provision would measure actual service use along the pathway of treatment in a random sample of patients across the country. This would be a large and expensive exercise. Given the state of many institutional financial and medical record systems it is unlikely that such an approach is feasible. An alternative is prospectively to follow a group of patients who fracture and collect data on resource use and prices. This would require good fracture ascertainment in a defined population which was also capable of generalisation nationally. This is the approach taken in Randell et al (1995) who examined the direct medical costs associated with 151 osteoporotic fractures occurring in a four year period in a large cohort of elderly men and women in Dubbo, a large rural town in New South Wales.

An alternative is to take a more aggregate approach and estimate total costs of fracture treatment by combining national or state level data on service use by fracture type with sample estimates of the average cost of each service type. This is the general approach taken in this study. For example, we estimate the total number of hospital separations for minimal trauma hip fracture in Australia and multiply this by the estimated average cost of in-hospital treatment for minimal trauma hip fracture. Where national data is not available extrapolations have been made from selective samples. For example, detailed patient level cost data for hospitals was only obtained from five hospitals in Victoria and Queensland. It is well known that variations in medical practice and financial arrangements mean that costs vary considerably between hospitals. In most cases, however, we have chosen data sources which were able to provide the most reliable detailed cost and utilisation data. In itself this makes generalisation problematic since there is likely to be a correlation between data quality and cost. For example, Victorian hospitals are able to provide detailed cost data in part because of the incentives offered by the payment system in that state. It is precisely the same incentives which have led to a reduction in cost in the last few years, perhaps biasing cost estimates based on Victorian hospitals in a downward direction. Issues relating to generalisation of data from samples are discussed in detail below.

Data and Results

Primary Medical Care in the Community

Data on the use of community medical services associated with osteoporosis is not readily available. The most obvious source of data is the Commonwealth Medical Benefits Schedule for items related to osteoporosis. Data has been requested on claims for non-in-hospital treatment of Colles', vertebral, humerus, and hip fracture treatments by sex and 5 year age group from age 50, by provider type, for 1993 and 1994. However this data is not available at the time of writing.

An additional source of data on the treatment of osteoporosis in the community is the Survey of Morbidity and Treatment in Australian General Practice 1990-91 conducted by the Family Medicine Research Unit at The University of Sydney (AMTS). This was a national survey over a 12 month period involving general practitioners documenting their patient consultations during a one week period. Detail was obtained on the number of patients encountered with a diagnosis of osteoporosis (L95) for at least one of the problems managed during the consultation. The information from the AMTS is summarised in Table 16.

Of the 98,796 encounters from the survey only 440 (0.4%) had a service related to osteoporosis. The estimated total cost of the items of service which were related to osteoporosis was $4.36 million. A problem with this data is that many patients had multiple problems managed at a single encounter. In order to calculate the cost of a service related to osteoporosis we have weighted the cost of each item of service for which osteoporosis was one of the problems managed by the inverse of the number of problems managed at each encounter. That is to say if osteoporosis was one of three problems managed by individuals who received a particular item of service we have attributed a third of the cost to each problem. The cost per visit of $11 is calculated as the weighted sum of the cost of each item where the weights are the not of persons who received each item of service. Costs are estimated using 91.4 % of the Medicare schedule fee as at November 1994.[3]

[3] Average fees charged in 1993/94 were 91.4% of the schedule fee - data provided by the Commonwealth Department of Human Services and Health.

Table 16: Survey of Morbidity and Treatment in Australian General Practice 1990-91

Total patient encounters from survey	98,796
Number of encounters for osteoporosis	440
% of encounters for osteoporosis	0.4%
1990-91 total HIC claims for GP items of service	96,687,566
Items of services in 1990-91 where osteoporosis managed (0.4% x 96,687,566)	38, 675,026
Weighted average cost per visit attributed to osteoporosis	$11.263
Total cost for items of service for osteoporosis	**$4,355,968**

Source: Family Medicine Research Unit (1992).

The total cost for medical services excludes those provided by specialists including diagnostic and investigational services such as X-rays and pathology, as well as pharmaceuticals. Prescription pharmaceuticals are included in a macro analysis of prescriptions presented below.

Ambulance

The number of patients arriving at emergency departments by ambulance was estimated using the Geelong Hospital emergency department database. The proportion of patients aged over 50 years with a Colles', humerus or vertebral fracture arriving at the emergency department via ambulance was calculated. These proportions were then applied to the numbers of patients treated in the emergency department. All patients attending the emergency department with a fractured neck of femur arrived by ambulance. The relevant proportions and numbers of patients are shown in Table 17 below. The average cost of an ambulance trip was calculated from the Ambulance Service Victoria Metropolitan Region 1994 Annual Report utilising the operating expenses[4] contained in the Report and the number of cases attended. The average cost of an ambulance transport in the 1993/94 financial year was calculated as $247. The total number of patients requiring ambulance transport was calculated as 16,581, thus the total cost of ambulance care was $4,095,507.

Table 17: Number of Patients Requiring Ambulance Care Arriving at the Emergency Department

Fracture Type	Proportion of Patients Arriving at the Emergency Department By Ambulance (%)	No of Patients Not Admitted to Hospital*	No of Patients Admitted to Hospital*	No of Patients Arriving at the Emergency Department Via Ambulance
Hip	100	0	13,468	13,468
Colles	15	1913	3,553	820
Humerus	67	389	1,555	1,302
Vertebral	74	94	1,245	991
Total				**16,581**

Notes: Based on Geelong Hospital.
Number of emergency department presentations in Australia is estimated below

4 Operating expenses includes operations (salaries, vehicles and equipment and indirect expenses such as electricity), administration, vehicle and property maintenance, and depreciation.

Emergency Department

Almost all patients with a hip fracture, and some patients with other fracture types would attend an emergency department of a hospital. Some would be admitted to hospital, while others would be treated and sent home. The latter may return to the hospital for further review and treatment at an out-patient clinic or be managed by their general practitioner.

Data on numbers attending emergency departments by casualty type is not generally available. Where it is available it relates to patients who are subsequently admitted. The in-hospital costing data shown below in Table 20 and in Appendix A includes the cost of emergency department treatment.

Geelong Hospital Emergency Department was able to provide details of fracture presentations in 1993 and 1994. Table 18 shows the number of patients with a wrist, vertebral or humerus fracture who presented to that emergency department and who were not subsequently admitted to hospital. It suggests that in fact the admission rate from this hospital emergency department in this age group for the three fracture types is very high (Colles' (65%); humerus (80%); and vertebral (93%)).

Cost data for emergency department treatment is also not generally available. We have estimated the emergency department average cost for a wrist, humerus and vertebral fracture by using data on the portion of the total cost of in-hospital treatment for one day stay patients which is attributable to the emergency department. Table 19 shows details of costs estimated for two Victorian hospitals. Details of the costing methodology for in-hospital treatment in a sample of Australian hospitals is discussed in the Appendix A.

Table 18: Estimated Number of Patients With a Wrist, Humerus or Vertebral Fracture Aged 50+ Years Not Admitted to Hospital but Presenting to an Emergency Department in Australia, 1994

Fracture Type	Sex	No of Patients Presenting to Emergency Department with Fracture[1]	No of Patients Admitted to Hospital[2]	Admission Rate[3]	Total Number of Hospital Separations for Australia[4]	Expected Number of Patients Presenting to the Emergency Department[5]	Calculated Number of Patients Not Admitted to Hospital[6]
Wrist	Females	118	78	.66	3,220	4,879	1,659
	Males	12	7	.58	332	572	240
	Total	130	85	.65	3,552	5,465	1,913
Humerus	Females	47	38	.81	1,265	1,562	297
	Males	13	10	.77	290	377	87
	Total	60	48	.80	1,555	1,944	389
Vertebral	Females	12	11	.92	852	926	74
	Males	15	14	.93	393	423	30
	Total	27	25	.93	1,245	1,339	94

Notes:
1 Based on fracture presentations to Geelong Hospital Emergency Department in 1993 and 1994.
2 Based on outcome as coded within the Emergency Department's database.
3 Admission rate calculated for a twelve month period, it is assumed that the admission rate for osteoporotic fractures will not differ to the admission rate for non-osteoporotic fractures for people aged 50+ years.
4 Based on application to the 1994 Australian population of age and sex-specific hospital separation rates in Australia in 1992/93 (Australian Institute of Health and Welfare 1995).
5 Calculation based on the admission rate in column 5.
6 These patients received emergency care within the Emergency Department and were then discharged to their usual residence.

Table 19: Average Costs for Non-admitted Patients Presenting to the Emergency Department (includes Emergency Department, Radiology, Pharmacy and Allied Health) for Those Patients With a Fracture Not Admitted to the Hospital (All Ages), 1994

Fracture Type	Allied Health $	Pharmacy $	Radiology $	Emergency $	Average $
Colles'	13	21	144	364	542
Humerus	13	14	174	389	591
Vertebra	12	11	111	411	544

Notes: Based on hospital cost data supplied by two Victorian hospitals. The length of stay for these patients was one day thus it was assumed that the variable costs associated with the emergency department, pharmacy, radiology and allied health would be the same for those patients not admitted to the hospital

We estimate that the number of patients with a minimal trauma fracture over the age of 50, who were seen in emergency departments, but not admitted to hospital in Australia in 1994, was 1,913 Colles', 389 humerus and 94 vertebral fractures. The total cost is of those presentations was $1.32 million.

In-patient Stay

The total number of inpatient stays by fracture type have been estimated using data from the AIHW on the total separations for osteoporotic fractures defined as fractures not associated with major trauma in men and women above the age of 50.

Appendix A gives details on the ICD 9-CM codes used to select cases related to osteoporosis. Tables 3-6 above show the total number persons discharged from hospital with an osteoporotic fracture. There were a total of 13,468 hip fractures, 3,553 wrist fractures, 1,245 vertebral fractures, and 1,555 proximal humerus fractures in men and women aged over 50 not associated with major trauma which resulted in hospitalisation in 1994.

The cost of each case is estimated using data from five hospitals: Royal Melbourne Hospital, Victoria; Monash Medical Centre, Victoria; Austin Hospital, Victoria; Geelong Hospital, Victoria, and Princess Alexandra Hospital, Queensland. These hospitals were chosen for their ability to provide detailed costing information on a large number of fractures treated in a range of large public hospitals. Victoria is heavily represented since clinical costing systems have been implemented earlier in that state, partly as a response to the introduction of a case payment system. This suggests that the treatment of fractures in Victorian hospitals is likely to be at the lower end of the cost range. Details of the costing procedure is given in the Appendix A.

Table 20 below summarises the average cost by fracture type from the sample of five hospitals.

Table 20: Summary of the Cost of Acute Care for Osteoporotic Fractures in Five Australian Hospitals, 1994

Fracture Type	No of Patients	Average Length of Stay days	Average Total Cost $
Hip	456	16.4	8,882 (95% CI ±1038)
Colles’	105	4.2	2,089 (95% CI ±577)
Humerus	69	10.3	4,075 (95% CI ±1480)
Vertebral	43	14.0	6,304 (95% CI ±1616)

Given the data presented in Section 0 on the population attributable risk for fractures it may be that this is an overestimate of the true number of osteoporotic fractures admitted to hospital. We discuss this further using sensitivity analysis below. The total cost of acute care for osteoporotic fracture is estimated as the average cost in Table 20 multiplied by the total number of separations. This is shown in Table 21. The total cost of acute care for osteoporotic fracture is estimated as $141.2 million, 85% of which is attributable to hip fractures.

Table 21: Total Cost of Acute Care of Osteoporotic Fractures in Australia, 1994			
Fracture Type	**No of Separations**	**Average Cost** **$**	**Total Cost** **$**
Hip	13,468	8,882 (95% CI ±1038)	119,622,776
Colles'	3,553	2,089 (95% CI ±577)	7,422,217
Humerus	1,555	4,075 (95% CI ±1480)	6,336,625
Vertebral	1,245	6,304 (95% CI ±1616)	7,848,480
All	**19,821**	**19,821**	**141,230,098**

An alternative to the use of Victorian hospital cost data is the Australian National Diagnostic Related Groups (AN-DRGs) average cost data published by the then Commonwealth Department of Health Housing Local Government and Community Services (1993). The relevant costs are shown in Table 22.

Table 22: National estimates of AN-DRG average cost by fracture type, 1994

AN-DRG[1]	Description	Av. total costs	Daily cost	Average length of stay[2]
		$	$	days
426	Fractures of hip & pelvis	3679	310	11.9
439	Fracture of forearm (includes sprain, strain & dislocation) age>9 wCC[3]	1108	535	2.1
441	Fracture of upper arm (includes sprain, strain, & dislocation and lower leg except foot (age>9) wCC[3]	3421	332	10.3
442	Fracture of upper arm (includes sprain, strain, & dislocation and lower leg except foot (age>9) w/oCC[4]	1563	354	4.4
432	Medical back problems	2312	393	5.9

Source: Commonwealth Department of Health, Housing, Local Government and Community (1993).
1 AN-DRG
2 Calculation based on dividing total average costs by average daily cost
3 wCC - with complications &/or comorbidities
4 w/oCC - without complications &/or comorbidities

Comparison of AN-DRG average costs and this study's average costs estimates shows that there is a considerable difference, 50% lower for hip and Colles' fractures and 15% lower for fractures of the humerus. One of the difficulties in utilising DRGs to cost particular illnesses is the non-specificity of the DRG. As a result, costs for the particular illness of concern may be over- or under-estimated, in some cases the direction and degree will not be clear. For example AN-DRG 426 includes the average cost of both hip and pelvic fractures, this cost is $3,679 as compared to $8,882 as calculated in the present study. Combining hip fractures with pelvic fractures is likely to underestimate the total cost of hip fractures, due to the increased complexity of hip fractures.

A second problem is that costs for patients in the present study were calculated for elderly patients over age 50 years, and for those with minimal trauma fracture. The AN-DRG study considered all patients over age 9 years (as described within the AN-DRG) to calculate the average total cost. Hip and pelvic fractures were also not differentiated on the basis of traumatic or minimal trauma causes. Treatment of elderly patients may increase average costs due to the higher likelihood of other health-related problems, or less ability to cope with injury, this may explain why the current study's average costs are higher. This is confirmed by a comparison of the average length of stays between the studies. The AN-DRG average length of stay is 11.9 days compared to 16.4 days in our study. This is in spite of an expected fall in length of stay in the last three years, particularly in Victoria.

For these reasons this study used 1995 Victorian and Queensland patient based cost estimates rather than national cost estimates based on DRG's.

Rehabilitation

In many hospital systems, including Victoria, costing data for rehabilitation is not included in the database for acute care. Often rehabilitation is carried out at separate institutions. Information on rehabilitation was obtained separately from a study commissioned by the Victorian Department of Health and Community Services (Coopers & Lybrand 1995). The average length of stay from a study group of 112 patients with a fractured neck of femur is 25.8 days. The average daily cost was $300.70 and the average total cost of an episode of care was $7,454.

Information on the number of patients likely to be discharged from an acute hospital to a rehabilitation facility was obtained by requesting discharge disposition from three of the hospitals. This data was not complete for all patients, however data provided from two hospitals was satisfactory. The mean likelihood of transfer to a rehabilitation facility was calculated as 11% using discharge data from two Victorian hospitals. However, as mentioned earlier, 23% of separations were coded as being discharged to another hospital. There were no further details available on those patients, and it is possible that some were treated in a rehabilitation facility.

Using Victorian data is likely to underestimate the cost of rehabilitation. The introduction of case payment in Victoria has led to considerable pressure to reduce length of stay in hospitals. This may, in turn, have led to an increase in hospital transfers and a reduction in rehabilitation within acute hospitals. Randell et al (1995) suggests that, in Dubbo, rehabilitation represents 49% of the total cost of fractures who were admitted. Acute care costs were only 60% of rehabilitation costs. This is in sharp contrast to rehabilitation costs of less than 10% of acute care costs in Victoria. Data from Princess Alexandra Hospital in Queensland suggests a discharge rate to another hospital of 11%, while 23% of patients had rehabilitation as part of their acute hospital stay.

It is clear from our data that over one third of patients with a hip fracture are discharged to another hospital or rehabilitation facility. Some may receive rehabilitation at the other hospital while some may be discharged from either facility to a nursing home. We have no details on patients once they are discharged from the original hospital. Therefore it may be that somewhere between 11% and 34% of patients receive rehabilitation. We assume that the Princess Alexandra Hospital in Queensland is more representative of the post acute care management of fractured neck of femur in Australia, and thus use a rate of 23% for rehabilitation.

Total separations for 1993/4 were 13,468, therefore 3,098 (23%) hip fracture patients would be expected to undergo rehabilitation, at a unit cost of $7,454 per stay. This gives a total cost of $23.1 million for rehabilitation.

Nursing Home

Cost of Long Term Nursing Home Care

The average cost of long term institutional care for the elderly with a hip fracture is unknown. We have based our estimate of the cost on the average reimbursement by the Commonwealth for an intermediate level of dependency (Resident Classification Index 2 and 3). The cost per day of long term nursing home care is therefore estimated as $70.71.

In a study of 412 Sydney residents aged over 65, Kateleris and Cumming (in press) found that 33% were resident in a nursing home prior to hip fracture. As discussed above Cumming, Klineberg & Katelaris (submitted) found an excess of 17% of older people, who were living in the community prior to a hip fracture, discharged to an aged care institution. This implies an the excess rate of discharge to a nursing home for all hip fracture patients of 11%.

Data from the Geelong Hospital Emergency Department database suggests a similar picture. All fractured neck of femur patients presenting to Geelong Hospital who were coded as being referred from a general practitioner with no category of origin, were individually assessed as to the usual place of residence. It is unlikely that any nursing home patient would be admitted to hospital without a referral. It was found that of the total number of people with a fracture neck of femur aged 65 years or more (n=118), 23% were from a nursing home. The excess rate of nursing home discharge is estimated as 13%. Princess Alexandra Hospital has a nursing home discharge rate of 29%.

In Australia at present persons admitted to a nursing home almost always stay there for the rest of their lives. Given that the majority of hip fractures are over the age of 80, and that the characteristics of those who fracture are usually predictive of nursing home admission, it seems unlikely that their prolonged nursing home stay is primarily due to fracture. Rather the fracture may tip the balance between a level of independence in the community and a level of dependence in an institution. Thus while those who enter a nursing home as a result of a fracture will stay there for the rest of their life, only some of that stay should be attributed to the hip fracture. For this reason, and the fact that the one year mortality rate is high, we make the assumption that the maximum length of nursing home stay that can be attributed to fracture is one year[5].

The total cost of nursing home care attributable to hip fractures in 1994 is estimated as 11% of all hip fracture separations over the age of 69 (11,870) for one year at a daily cost of $70.71. This give a total cost of $33.7 million.

[5] This is the same assumption made by the Office of Technology Assessment (1994) in the USA.

Post-discharge and Community Care Costs Following Fracture

There is no uniform pattern of treatment of fractures after discharge from hospital. Whether the patient is reviewed and what further diagnostic procedures or treatments they receive depends on the type of fracture, whether they live in a nursing home, the protocol of the hospital, and their insurance status.

Patients discharged home from hospital following a fractured neck of femur who live at home and who do not have rehabilitation treatment might have physiotherapy treatment at an out-patient clinic, and further review including X-rays.

Available evidence suggests that approximately 50% of patients with hip fractures are discharged from hospitals to either nursing homes (33%)[6], rehabilitation centres 11%[7], or discharged deceased (5%)[8]. Therefore approximately 50% of patients with hip fracture are discharged either home or to the home of a caregiver. These people will have at least one out-patient clinic appointment for physiotherapy and a further orthopaedic out-patient clinic visit for follow-up. Average cost of one hour for physiotherapy is $44.20[9] (Jackson et al, 1995). This cost includes salary, indirect costs, consumables, capital and equipment. Jackson et al (1995) estimate the average cost of an orthopaedic out-patient clinic visit including X-ray as $80.68[9]. Based on these assumptions, Table 23 shows the estimated cost of out-patient visits for hip fracture.

Table 23: Cost of Out-patients for Hip Fracture, 1994

Age Group	No of Separations	50% of Total	Total Cost Orthopaedic Clinic	Total Cost Physiotherapy	Total Cost for Out-patients
			$	$	$
50-59	352	176	14,200	7,779	21,979
60-69	1,246	623	50,264	27,537	77,801
70-79	3,820	1910	154,099	84,422	238,521
80+	8,050	4025	324,737	177,905	502,642
All	**13,468**	**6734**	**543,299**	**297,643**	**840,943**

Patients discharged home from hospital following a non-hip fracture tend to be reviewed once for undisplaced fractures. On the other hand, for a reduced fracture, a private patient may involve orthopaedic follow-up at two weeks, five weeks for plaster removal, and then a further review at 4-6 weeks later to check that mobility has returned. For many public patients, however, follow-up of non-hip fractures is the responsibility of the GP. We have no data on the distribution of treatments across Australia. It is unclear that the data used to estimate GP treatment discussed above fully captures the treatment of osteoporotic fractures. To the extent that we have already estimated the cost of GP treatment for osteoporosis, however, it would be double counting to include all of the follow-up of osteoporotic fractures managed by a GP. We therefore assume

6 Cumming & Klineberg (1994).
7 See page 26
8 Lord (1993)
9 The cost of an out-patient orthopaedic occasion of service in Victoria has been estimated from six hospitals with a well developed clinical costing system by Jackson et al (1995).

that patients with a non-hip fracture who are discharged from hospital receive one session of physiotherapy and one orthopaedic clinic visit. The total cost of physiotherapy is shown in Table 24.

Table 24: Cost of Physiotherapy for Non-hip Fracture, 1994

Age Group	Total Cost by Fracture Type			Total Cost of all Fractures
		$		$
	Vertebral	Humerus	Wrist	
50-69	371,982	72,475	148,853	593,310
70+	464,007	81,454	124,187	669,648
All	**835,989**	**153,929**	**273,040**	**1,262958**

Home Based Services

Meals on Wheels

Farnworth & Kenny (1992) estimate that 50% of patients discharged home will have an average of 10 meals in the first two weeks following hospital discharge - this is 25% of the total patient separations for fractured neck of femur from the AIHW data. It may be argued that part of this cost is a substitute for patients expenditure on food and meal preparation which would have occurred in the absence of fracture. While this is true, a major part of the cost of a meals on wheels service is distribution of the food. In the absence of more detailed costing and food expenditure data, and given the relative significance of this item of cost, we make the simple assumption that the whole cost of the service is an excess social cost attributable to fracture.

The average cost of a meal is $8.60 ('94/'95)[10]. The average total cost of Meals on Wheels in 1994 is estimated as $248,905.

Home Help (Domestic Assistance)

Farnworth and Kenny (1992) estimate that 25% of patients discharged home will require on average 14.5 hours of domestic assistance in the two weeks following discharge - this is 12.5% of the total patient separations for fractured neck of femur from the AIHW data.

The average cost of domestic assistance is $19.30 ('94/'95) per hour[10]. The estimated average cost is $279.85 per patient, giving a total of $404,978.

[10] Figures based on costs provided by a City Council in metropolitan Melbourne.

Pharmaceuticals

The cost of drug treatment for osteoporosis below provides an estimate of the cost of drugs prescribed by general practitioners for the treatment of osteoporosis in 1994. In summary, there were 1,178,200 scripts for the treatment of osteoporosis, with a total community cost of $19.5 million. The average cost per script (for all drugs) was $16.52. Calcium tablets were by far the most widely prescribed drug for this condition, with scripts contributing to 67 % of the total. Vitamin A and D combinations contributed to 12% of the total, with non-narcotic analgesics (8%) and oestrogens and combinations (5%) being the next most commonly prescribed drugs for this condition.

This cost to the community for the drug treatment of osteoporosis should be considered conservative for three reasons. First, the cost only related to drugs prescribed by general practitioners. It would be expected that a percentage of patients will be treated and prescribed drugs by specialists (e.g. gynaecologists and endocrinologists). Further to this it is also likely that specialists will prescribe the higher cost drugs, such as the bone calcium regulators. Secondly, a number of over-the-counter drugs that may be prescribed (e.g. pain relief) have not been included in the analysis. Thirdly, the cost of drug treatment for the prevention of osteoporosis has not been included (e.g. calcium tablets that have been prescribed in younger women to ensure an adequate calcium intake either to ensure peak bone mass or maintain existing bone mass levels).

To estimate the cost to the community we used prescribing data on the number of drugs prescribed for osteoporosis treatment provided by IMS Australia Pty Ltd., combined with the average 1994 community cost per script obtained from the Drug Utilisation Subcommittee (DUSC) of the Pharmaceutical Benefits Advisory Committee (PBAC).

Data on the number of general practitioner scripts for osteoporosis for 1994 was obtained by request from IMS Australia Pty Ltd. IMS audit the prescribing patterns of Australian GPs (Australian Medical Index). This survey provides prescribing data from 420 doctors in all states and aggregates the data to the total Australian doctor population. Participating GPs record details of all patients seen or contacted for any reason, including those for whom no prescription is written. A standardised form outlining the patient profile is filled in for each patient. Information recorded on the form includes patient age, gender, whether patient contact is an initial or subsequent consultation, drugs prescribed for a particular diagnosis, co-prescriptions, and any drug switching.

DUSC collect data on most drugs marketed in Australia. This data is published annually in the Australian Statistics on Medicine (ASM) the last date of this publication was 1993. Information on 1994 prescriptions was obtained by request. The data contained in the ASM are drawn from two sources. The first source is the Health Insurance Commission records or prescriptions submitted for payment of a subsidy under the Pharmaceuticals Benefits Scheme (PBS) and Repatriation Pharmaceutical Benefits Scheme (RPBS). The second source is an ongoing survey of a representative sample of community pharmacies by the Pharmacy Guild which provides an estimate of the non-subsidised use of prescription or medicines in the Australian community. These include private prescriptions and PBS prescriptions priced under the general patient co-payment. The use of prescription medicines dispensed in public hospitals is not available in this report.

Table 25: Cost of Drug Prescriptions (General Practitioners) 1994

			No Scripts ('000's)[1]	Average Price ($1994)[2]	Total Cost $1994 ('000's)[3]
1	**A12A**	**Calcium**			
		Caltrate	439.5	11.37	4,997.12
		Sandocal	251.7	13.80	3,473.46
		Caltrate 600+D	82.5	10.56	871.20
		Cal Sup	13.2	11.51	151.93
		Calcium Sandoz	0.1		0.00
	Total		787.0		9,493.71
2	**A14A**	**Anabolic Hormones**			
		Deca Durabolin	136.7	14.61	1,997.19
		Primobolan	4.3	37.62	161.77
		Durabolin	0.0	0.00	0.00
	Total		141.0		2,158.95
3	**A11C**	**Vit A+D incl.combinations**			
		Rocaltrol	91.6	62.32	5,708.51
		Ostelin	6.2	25.02	155.12
	Total		97.8		5,863.64
4	**N2B**	**Non-Narcotic Analgesics**			
		Panamax	34.6	7.33	253.62
		Panadeine	13.7	7.27	99.60
		Digesic	4.4	18.36	80.78
		Paradex	2.1	15.81	33.20
		Dymadon	1.3	7.33	9.53
		Capadex	1.3	17.08	22.20
		Codral Forte	1.1	7.28	8.01
		Dymadon Forte	0.0	7.29	0.00
		Act 3c	0.8	4.85	3.88
		Dolobid	1.3	13.00	16.90
	Total		63.1		527.72
5	**G3C**	**Oestrogens+Combinations**			
		Premarin	14.5	10.25	148.63
		Ogen	10.5	9.79	102.80
		Progynova	3.7	10.00	37.00
		Estraderm	16.0	22.9	366.40
		Estigyn	4.7	8.45	39.72
	Total		49.4		694.54
6	**G3D**	**Progestogens+Combs**			
		Provera	15.8	28.51	450.46
		Depo Provera	0.0	11.55	0.00
		Primolut	2.5	14.55	36.38
	Total		18.4		486.83

			No Scripts ('000's)[1]	Average Price ($1994)[2]	Total Cost $1994 ('000's)[3]
7	**N2a**	**Narcotic Analgesics**			
		Ms Contin	0.0	44.55	0.00
		Physeptone	3.0	12.62	37.86
		Endone	0.0	10.20	0.00
		Pethidine Hcl	2.7	8.77	23.68
	Total		5.7		61.54
8	**M1A**	**Antirheumatic N-Steroid**			
		Brufen	1.2	9.11	10.93
		Ecotrin	0.0	8.76	0.00
		Orudis	0.0	14.23	0.00
		Feldene	2.1	12.50	26.25
		Naprosyn	1.3	12.93	16.81
		Surgam	0.9	12.62	11.36
		Tilcotil	0.9	12.81	11.53
		Voltaren	2.4	10.28	24.67
	Total		8.7		101.55
9	**A12C**	**Other Mineral Supplement**			
		Hifluor	3.7	7.06	26.12
	Total		3.7		26.12
10	**N2C**	**Anti-Migrane Preps**			
		Sandomigran	1.0	16.80	16.80
	Total		1.0		16.80
11	**N5C**	**Tranquillisers**			
		Valium	2.3	6.24	14.35
	Total		2.3		14.35
12	**M5B**	**Bone Calcium Regulators**			
		Didrocal	0.1	189.74	18.97
	Total		0.1		18.97
	Total Selected (000's)		1,178.2		19,464.72

Table 25: Cost of Drug Prescriptions (General Practitioners) 1994

Notes:
1 Number scripts for each drug for the management of osteoporosis based on IMS data.
2 Average price based on data provided by the Drug Utilisation Subcommittee of the PBAC.
3 Total derived by multiplying number of scripts by the average price per script.

Indirect Costs

There are two principal methodologies for estimating the indirect cost of illness: the human capital method and the willingness-to-pay method. The former method, used in most of the studies undertaken, is called the human capital or output accounting approach because an employed person is seen as producing a stream of output over the years that is valued at the individual's earnings. The main criticism of this methodology is that it excludes intangibles, only counts earnings, and undervalues some groups relative to others because earnings may not accurately reflect one's ability to produce. Thus males are more highly valued than females, white persons more than black persons, and middle-aged people more than the young and elderly, with part of the difference a result of racial and sexual discrimination. While it is possible to include non-paid work, such as volunteer work or household production, as part of productivity this is unusual due to a lack of data and some conceptual difficulties with regard to the value of such output and the distinction between output and consumption.

This study has estimated the indirect cost of osteoporosis as the value of the total number of days in hospital and additional days off paid employment associated with age specific minimal trauma fractures in males and females in 1994. This is a conservative estimate of annual lost productivity associated with osteoporosis. In the context of osteoporotic fractures it is, in principle, possible to place a value on the lost output associated with medical treatment for osteoporosis and fracture and the consequent impairment and premature mortality. Output losses could include lost output for the society from paid employment, volunteer work, and household production. However, as discussed above, the majority of osteoporotic fractures with a major impact on health status is likely to occur in elderly women and men who would not be in paid employment, and in the older ages are unlikely to be heavily engaged in volunteer or home production to any great degree. Where there is substantial impairment there is a high probability of institutional care or death within the year. The former cost has been accounted for in the cost of nursing home care, and a separate costing of lost home production would run the risk of double counting. Where impairment leads to the supply of informal care usually from relatives there may be a further cost of lost productivity of the carer. The identification of the resource implications and valuation of such costs has not been attempted in this study, but it should be recognised that this may represent a substantial cost to the community. The attribution of excess mortality to osteoporosis alone is problematic. While it is true that there is excess mortality and impairment among the elderly who have had a hip fracture, it is difficult to attribute a causal connection to osteoporotic fracture rather than general fragility.

Given these factors it is our view that the direct output losses in paid production associated with osteoporosis are not likely to be large. Output losses from unpaid production and for carers may be larger, but without adequate data on those who fracture it is impossible to make an accurate estimate. We therefore take the conservative view that the output losses associated with osteoporosis are only attributable to the morbidity effects on paid employment. Only some of those who fracture will be in the labour force or in full time employment. The labour force participation rate in June 1994 for those aged 60-64 is 49% for men and 15% for women (Australian Bureau of Statistics 1994), while the unemployment rate was 19.6% and 2.6% respectively.

We calculate the total indirect costs of osteoporotic fractures based on the age specific number of days in hospital and additional days off work associated with recuperation. The number of days off work associated with the use of medical and hospital emergency services. Collins and Lapsley (1991) estimate that each hospital bed day use by a member of the workforce involves on average a further absence of two days work and that each medical service supplied to a member of the workforce involves on average a loss of half a day's work. Crowley, et al (1992) estimate an average loss of 0.37 of a day's work for each medical service based on the 1991/92 Australian National Health Survey. The latter proportion was used in this study. Time off work for the average patient by sex, age and fracture type is weighted by the labour force participation rate and unemployment rate for that group to estimate the expected lost output. A day of lost output is valued as a fifth of gross median full time earnings. Age specific full time gross weekly earnings were only available for 1993, and values for 1994 were estimated by using the ratio of median earnings in 1993 to those in June 1994. The total costs calculated for hospitalisation, medical and emergency services were summed to estimate total costs attributable to absenteeism (lost productivity from morbidity) for osteoporosis.

Table 26 shows an example of the methodology with respect to hip fracture. The total lost earnings due to hip fracture shown in column (f) is estimated by the weighted product of columns (a) through (e) as shown in the table.

Table 26: Lost Earnings Due to Hospitalisation and Recuperation as a Result of Hip Fracture in Those Under 65

Age	Unemployment Rate (a)		Participation Rate (b)		Weekly Earnings in Main Job $ 1993 (c)		Days Lost Due to Fracture (d)	No of Fractures (e)		Lost Earnings (f)=(a)x(1-b) x(c/5)x(d)x(e) Inflated to 1994 $	
	Female	Male	Female	Male	Female	Male		Female	Male	Female	Male
45-54	0.06	0.06	0.66	0.89	488	617	51.3	60	63	132,581	236,255
55-59	0.63	0.18	0.40	0.73	466	555	51.3	145	84	71,273	203,116
60-64	0.01	0.12	0.15	0.49	492	492	51.3	259	163	142,809	253,943
Total										**346,663**	**693,313**

The value of total lost productivity from work absenteeism associated with hip fracture is $346,663 for females and $693,313 for males between the ages of 45 and 64. The value of lost productivity from work absenteeism associated with all hospitalised minimal trauma fractures for those between the ages of 45 and 64 is estimated as $9.99 million.

Quality of Life

Wrist fractures are painful, usually require one or more reductions, and need 4-6 weeks in plaster. A proportion of patients do not recover function without physiotherapy (Wadsworth 1990). Fractures can result in considerable pain and suffering with a resulting loss of quality of life. Hip fracture in the elderly can lead to considerable immobility for extended periods. Many never recover full mobility. It can lead to a loss of independence and consequent depression. Physical and mental sequelae of hip fracture undoubtedly contribute to premature mortality. To our knowledge there have been no attempts to place a money or utility value on the loss of health associated with the various fracture types by age, however it is clear that hip fracture and possibly vertebral fracture represent a major loss of quality of life in the community.

Interventions to Reduce Osteoporotic Fractures

Risk Factors and Prevention

Bone mass is the major measurable determinant of the risk of minimal trauma fractures, however falls, age and existing fractures are predictors of fracture independent of bone mass. The magnitude of peak bone mass and the rate and duration of post-menopausal and aging associated bone loss determine the likelihood of developing osteoporosis. The prevention of minimal trauma fracture has focused on maximising peak bone mass, reducing post-menopausal bone loss and reducing falls.

Calcium supplementation to levels above habitual intake has been shown to increase bone mass in children and adolescents. The protective effect of calcium supplementation in the post menopausal period for women or among elderly men on fracture risk has not been shown. Nevertheless there is substantial sales of calcium supplements as well as vitamins in Australia part of which are the result of a belief in their protective effect against osteoporosis.

Mobility and Falling

Continuous weight bearing physical exercise has been shown to reduce fractures due to its effects on bone mass, mobility, muscle strength and agility. Improving mobility, muscle strength and agility may also have a secondary effect on preventing falls. Other risks of falling such as destabilising drugs and home hazards are important independent causes of hip and wrist fracture. Strategies to encourage exercise, reduce the risk of falls and protect from the shock of a fall could prevent minimal trauma fractures in the elderly.

Drug Therapies

Oestrogen or a combination of oestrogen and progesterone has been shown to reduce subsequent risk of hip and Colles' fracture by about 50% and vertebral fracture by up to 90% (Consensus Development Conference 1991) if taken by women for at least five years from around the climacteric period. However hormone replacement has not achieved a high degree of acceptability among women as a long term therapy due to other possible side effects of this therapy.

Conclusion

Table 27 summarises the estimated total cost of osteoporosis in Australia in 1994. The total cost of osteoporosis is estimated as $226.72 million dollars. The largest component is hospital care ($149.56 million). In-patient acute care is the single largest item ($141.23) accounting for almost two thirds of the total cost of osteoporosis in Australia. Within acute hospital care, hip fracture represents 85% of the total cost of osteoporosis.

Table 27: Summary of the Cost of Osteoporosis in Australia, 1994		
	Total Cost $million	**Percentage of Total Cost**
Community		
GPs	4.36	1.9
Community services	0.65	0.2
Subtotal	5.01	2.2
Hospital		
Ambulance	4.10	1.8
Emergency (non-admitted)	1.32	0.6
In-patient	141.23	61.2
Outpatient	2.91	1.3
Subtotal	149.56	64.8
Rehabilitation	23.09	10.0
Pharmaceuticals	19.46	8.4
Nursing Home	33.70	14.6
Total	**226.72**	**100**

The methodology used to estimate the cost of osteoporosis in this study has a number advantages over other studies of this type, as well as some limitations. The estimate is comprehensive in so far as we have captured costs from all of the major categories of treatment of osteoporosis and osteoporotic fractures: GPs, pharmaceuticals, ambulance services, emergency departments, in-hospital care, out-patient treatment, nursing homes, and community services. However, the utilisation of these services and their cost has been estimated from aggregate data or from non-random samples. This inevitably means that there are sources of error.

We have reasonable confidence in the accuracy of the clinical cost information from hospitals which probably represents the best that is currently available in hospital costing[11]. The data in the current study on the utilisation of hospital services is the best available, and is reasonably consistent with international estimates of the incidence of osteoporotic fracture. On the other hand we have less confidence in our ability to capture reliable data on the use of non-acute hospital services: rehabilitation services, out-patient services, GP and specialist services Most studies to date have not been able to account for such costs. In this study we have included rehabilitation costs, hospital out-patient clinic, meals on wheels, domestic assistance, and general practice medical costs associated with osteoporosis. However this is likely to underestimate the extent of community service costs. Indeed one recent study in Dubbo which examined rehabilitation and community costs in detail found that they represent a far greater proportion of overall costs (Randell et al, 1995). We have not been able to include such services as private physiotherapy, community care services for those not admitted to hospital, or informal care costs.

11 Randell et al (1995) estimate the direct cost of hip fracture in Dubbo NSW in 1993 as $15,984, only 33% of which is composed of acute hospital costs. This is substantially lower than our figure of $8,882 for five large public Australian hospitals in Victoria and Queensland. There are a number of possible explanations for this. First, the Dubbo hospital may simply treat hip fractures at lower cost than the hospitals in our sample. Second, the methodology used may differ in its attribution of costs (such as the joint costs of wards, pathology, pharmacy etc.) to individual patients. Third, their small sample size (26 hip patients) and consequent wide interquartile range of cost per fracture may explain some of the difference in the estimates. They do not include drug costs for non-hospitalised patients.

On the other hand, the current study includes a realistic component of costs for nursing home admissions attributable to osteoporotic fracture[12].

The estimate of $226.72 million is our best estimate. Clearly it would be possible to generate a range of estimates by making alternative assumptions regarding cost and utilisation of particular services. Perhaps the two crucial variables would be: the cost of treatment of hip fracture and the population attributable risk of fracture due to osteoporosis. There are wide confidence intervals around the mean cost of treatment for hip fracture. It is likely however that the variation in costs would fall with a larger sample size. We have therefore chosen not to undertake any formal sensitivity analysis on cost.

The current study assumes that all fractures after minimal trauma in the age group 50 and over are osteoporotic. For cases not admitted to hospital, where we have no evidence of an absence of major trauma we use estimates of population attributable risks applied to estimated fracture rates. Thus we assume that 50% of hip fractures, 20% of Colles' fractures, and 30% of humeral fractures who present to emergency departments, and are not admitted, are attributable to osteoporosis. It is possible that as few as a half of all hip fractures, a fifth of Colles' fractures, and a third of proximal humeral fractures, are actually primarily caused by osteoporosis. If this is the case, then the true costs would be significantly reduced.

The current study re-affirms that osteoporosis represents a considerable health burden to the community, and its treatment represents a considerable economic burden on the health system in general and the hospital system in particular. It is clear that the potential for resource savings in hospital treatment of hip fractures represents a considerable incentive to develop measures to prevent osteoporosis and fractures.

12 Randell et al (1995) report only three of the hospitalised patient were discharged to a nursing home. Even if all had a hip fracture that is still only a discharge rate of 11.5%.

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APPENDIX A

Method Used to Calculate the Costs of Patients Requiring Hospitalisation for Osteoporosis-Related Fractures

Identifying Fractures Caused by Osteoporosis for Calculating Average Costs

Detailed information on the length of stay, direct and indirect variable costs and total costs for the hospital stay was requested from selected Australian hospitals for individual patients with fractured neck of femur or another fracture type likely to be as a result of osteoporosis. Information on individual patients was used to estimate average length of stay (in days) and average variable and total costs of hospitalisation for acute care of each fracture type.

Fractures likely to be caused by osteoporosis were identified by International Classification of Diseases (ICD-9 CM) codes. Data requests for costing information on patients with these ICD-9-CM codes was made to the hospitals. Table A.1 contains a list of the ICD-9-CM codes which were utilised in the final report.

Table A.1: Relevant ICD-9-CM Codes

ICD-9-CM Code	Description
805 (all)	**Fracture of vertebral column without mention of spinal cord injury**
812 (as below):	**Fracture of humerus**
- 812.0	- upper end, closed
- 812.2	- shaft or unspecified part, closed
- 812.4	- lower end, closed
813 (as below):	**Fracture of radius & ulna**
- 813.0	- upper end, closed
- 813.2	- shaft, closed
- 813.4	- lower end, closed
- 813.8	- unspecified part, closed
820 (as below):	**Fracture of neck of femur**
- 820.0	- transcervical fracture, closed
- 820.2	- pertrochanteric fracture, closed
- 820.8	- unspecified part of neck of femur, closed

By requesting fractures by their ICD-9-CM code, only ‘closed’, as opposed to ‘open fractures’, were requested. ‘Open fractures’ are more likely to be related to traumatic injury, rather than non-traumatic injury, and are therefore are less likely to be as a result of osteoporosis. This is a relevant point in the calculation of the average costs of these fractures, as it is possible that the average cost for a patient with an open fracture may be greater than the average cost of a closed fracture, as a result of potential complications from the open wound to the fracture.

These fractures were further defined by the ICD-9-CM Supplementary Classification of External Causes of Injury (E-codes). Therefore only patients with a relevant fracture and one of the E-codes listed in Table A.2 were included in the final calculation of costs.

Table A.2: Relevant ICD-9-CM Supplementary Classification of External Causes of Injury (E- codes)

E-code	Definition	Comments
E880	Fall on or from stairs or steps	
E884.2	Accidental fall from chair or bed	
E885	Fall on same level from slipping, tripping, or stumbling	
E886	Fall on same level from collision, pushing, or shoving, by or with other person	Exclude E886.9 which relates to sports
E887	Fracture, cause unspecified	
E888	Other and unspecified fall	
E927	Accident caused by overexertion and strenuous movement	
E929.3	Late effects of accidental fall	

By further defining fractures by E-codes only non-traumatic fractures were included in the calculation of average costs. Non-traumatic fractures are more likely to be caused by osteoporosis as opposed to fractures caused by trauma. Hospital treatment for non-traumatic fractures may also be associated with lower average costs than traumatic fractures, due to other injuries which may have occurred at the same time as the trauma and potential for subsequent complications associated with the traumatic event.

As age may also make a difference in the calculation of average costs for the hospitalisation of specific fracture types, the following age groups were used in the calculation of average costs:

- 50-59 years;
- 60-69 years;
- 70-79 years;
- 80+ years.

Fracture costs for elderly people may be higher than for the younger population due to the increased likelihood of unrelated chronic conditions, or reduced mobility and muscle tone, thus increasing the length of healing time. It is difficult to determine whether increased average costs due to age are related to chronic conditions unrelated to osteoporosis and therefore should not be attributed as a cost of osteoporosis, or a more general decline in healing ability, or healing of fractures specifically related to osteoporosis and loss of bone mineral density.

Hospitals Selected

Initially data requests were made to one hospital in each of Western Australia, South Australia, and Queensland, two hospitals in New South Wales, and three hospitals in Victoria. All hospitals chosen were large metropolitan public hospitals. Unfortunately the hospitals in Western Australia, South Australia and New South Wales were unable to comply with the data request due to inadequacies in their clinical costing systems. The Queensland hospital and three Victorian hospitals were able to supply the data as requested. A further request was sent to a large Victorian regional hospital so that in the final study costs from five hospitals were used in the calculation of averages.

Time Period

Information on costs was requested for the 1994 calendar year. This was supplied by hospitals one, two and four. However hospitals three and five supplied costing information from the 1994/5 financial year due to a change in the allocation of costs from 1 July 1995, or the system not complete for early 1994. It is unlikely, however, that this would have a large effect on the calculation of average costs, thus all costs have been calculated in Australian $1994.

Hospital Clinical Costing Systems and Variable Costs

All Victorian hospitals and the Queensland hospital utilise 'Transition' for their clinical costing system, therefore budgetary units for variable costs are similar for most hospitals. However the method of allocating costs for individual patients differs.

Both total cost and a breakdown of variable costs into different Cost Centres was requested from each hospital for each individual patient. However each of the five hospitals whose data was included in the final report have slightly different methods of allocating variable costs and further attributing these costs to individual patients. For example, operating theatre costs may be allocated on the basis of time (in minutes) in theatre, or a weighted average per patient on the basis of the Commonwealth Medical Benefit Schedule (CMBS). A description of each hospital's method in allocating costs is given below.

As a result of the method differing between hospitals the final calculation of the average for each of the variable costs may not be accurate. An exception is Pathology and Radiology costs as each hospital bases the allocation of these costs on the actual test performed to the patient, therefore the average variable cost does provide some reliable information. Average length of stay has also been calculated and included in Table A..3 which shows details of the average cost of acute care in the five sample hospitals. The average length of stay is similar between hospitals, particularly for fractured neck of femur.

TABLE A.3: Average Costs of Acute Care for Osteoporotic Fractures in Five Australian Hospitals[1]

ICD-9 Code[3]	Description	Age Group (Years)	No of Patients (n =)	Average LOS[4] (Days)	Average Variable Costs[2] Medical ($)	Allied Health ($)	Pharmacy ($)	Pathology ($)	Radiology ($)	Theatre ($)	Ward ($)	Other[5] ($)	Indirect ($)	Average Total Cost ($)
805	**Vertebral**	50-69	9	11.6	742.2	132.2	291.0	222.8	282.1	674.1	1769.9	449	1879	6137
			95%CI	*6.1*	*480.7*	*72.9*	*180.0*	*157.0*	*172.8*	*844.4*	*1171.0*	*184.9*	*944.9*	*3724.2*
		70-79	17	10.6	971	138	211	150	214	44	1460	446	1189	4354
			95%CI	*4.7*	*680.7*	*60.0*	*116.5*	*99.5*	*96.9*	*74.7*	*740.5*	*177.8*	*427.2*	*1820.9*
		80+	17	18.7	1544	335	318	342	303	251	3202	600	3511	8342
			95%CI	*7.1*	*1138.1*	*219.3*	*245.5*	*161.7*	*154.2*	*543.9*	*1666.5*	*152.8*	*809.2*	*2570.3*
		All	43	14.0	1150	215	275	241	264	258	2214	508	2026	6304
			95%CI	*3.3*	*451.3*	*76.7*	*97.1*	*73.9*	*69.7*	*245.8*	*665.5*	*96.1*	*508.8*	*1616.1*
812	**Humerus[6]**	50-69	19	10.4	290.7	98.2	146.9	82.4	158.7	316.5	1462.6	361	974	3449
			95%CI	*7.5*	*178.4*	*57.2*	*115.9*	*69.3*	*65.0*	*249.7*	*1206.4*	*230.9*	*594.2*	*1955.6*
		70-79	28	13.2	1487	127	231	171	227	458	2097	443	765	5552
			95%CI	*1.1*	*8.3*	*73.6*	*83.8*	*105.8*	*104.9*	*93.3*	*331.0*	*199.3*	*217.3*	*3235.7*
		80+	22	6.5	502	85	133	95	138	190	717	405	882	2734
			95%CI	*2.9*	*325.2*	*41.4*	*86.3*	*58.8*	*68.5*	*238.0*	*484.4*	*151.5*	*288.1*	*1172.9*
		All	69	10.3	844	106	178	122	180	334	1482	408	871	4075
			95%CI	*4.1*	*615.6*	*39.5*	*60.2*	*50.5*	*47.6*	*168.8*	*689.5*	*112.3*	*209.2*	*1479.7*

813	**Colles'**	50-59	9	1.6	91	16	32	12	89	158	232	285	237	995
			95%CI	*.9*	*81.3*	*11.1*	*24.8*	*11.5*	*69.8*	*133.6*	*278.5*	*152.8*	*95.6*	*533.9*
		60-69	24	2.1	214	24	61	32	120	284	326	157	337	1429
			95%CI	*1.1*	*150.6*	*12.7*	*38.6*	*21.7*	*41.6*	*183.7*	*290.9*	*67.5*	*105.9*	*657.6*
		70-79	28	6.0	458	103	133	80	135	208	867	416	802	2819
			95%CI	*3.9*	*312.6*	*76.6*	*106.9*	*75.2*	*43.8*	*130.5*	*664.2*	*214.5*	*473.5*	*1634.2*
		80+	44	5.1	526	77	85	49	166	248	632	284	615	2358
			95%CI	*2.5*	*366.7*	*44.1*	*28.1*	*24.6*	*46.4*	*170.4*	*323.7*	*71.7*	*239.1*	*872.4*
		All	105	4.2	383	63	86	49	139	242	568	279	542	2089
			95%CI	*1.5*	*172.8*	*27.0*	*31.3*	*22.4*	*25.0*	*89.7*	*228.7*	*67.0*	*155.8*	*577.3*
820	**NOF**[7]	50-59	19	17.1	1513	355	487	323	401	1541	3198	612	3282	10624
			95%CI	*6.9*	*488.4*	*350.5*	*235.1*	*104.9*	*162.0*	*506.1*	*1729.0*	*212.2*	*1549.6*	*4091.0*
		60-69	48	15.3	1732	209	329	339	435	1191	3152	540	1793	9160
			95%CI	*4.2*	*770.9*	*54.5*	*131.8*	*168.1*	*139.0*	*319.4*	*1137.8*	*144.4*	*557.7*	*2496.8*
		70-79	132	16.8	1477	298	565	356	358	1277	3025	678	2589	9955
			95%CI	*3.4*	*512.2*	*107.2*	*293.4*	*132.7*	*65.7*	*168.8*	*1062.1*	*217.6*	*897.9*	*3120.7*
		80+	257	16.4	1140	244	358	295	285	1134	2466	610	2189	8151
			95%CI	*1.9*	*147.4*	*35.4*	*45.4*	*35.6*	*26.7*	*102.5*	*283.2*	*86.6*	*208.7*	*717.6*
		All	456	16.4	1315	261	418	319	327	1198	2731	622	2312	8882
			95%CI	*1.5*	*189.7*	*40.0*	*89.0*	*46.9*	*29.4*	*85.5*	*373.2*	*81.5*	*301.1*	*1037.7*

Notes: [1] As Victorian hospitals do not include rehabilitation costs in the costs of acute hospital care, these costs have not been included in the table of costs.

[2] Average variable costs; see this Appendix for details of how each hospital allocates costs

[3] ICD-9 Codes are those for closed fractures of non-traumatic origin; see this Appendix for the specific ICD-9 Codes requested.

[4] Average length of stay.

[5] Other costs include emergency department, catering and other ancillary costs.

[6] Proximal humerus.

[7] Neck of femur fractures include pertrochanteric and transcervical fractures.

The average costs for the operating theatre may also be inaccurate as, at the time of the data collection, hospitals were not attributing the cost of any prostheses used to the individual patient (e.g. for patients with fractured neck of femur). Instead these costs were averaged across all patients. Therefore the costs of the operating theatre may be understated.

Pharmacy costs for the Queensland hospital are included within the ward costs, whereas for the Victorian hospitals pharmacy is a separate Cost Centre. The calculation of the average cost of pharmacy does not include the data from the Queensland hospital and therefore is based only on the data provided by the Victorian hospitals. However pharmacy costs for the Queensland hospital have been included with the ward costs, therefore the average cost of ward stay is probably not accurate.

Another difference in the coding system between the Victorian hospitals and the Queensland hospital affects the calculation of the average length of stay. In Victorian hospitals patients who stay in the emergency department for four hours or longer while receiving treatment (ie does not include the waiting period) are coded as an admission. Therefore the length of stay for these patients may be one day even though they do not leave the emergency department. This is likely to have an affect on the calculation of average length of stay for wrist, humerus and vertebral fractures, possibly reducing the average length of stay for these fractures.

Possible Impact of Casemix Funding in Victoria

With the introduction of Casemix funding in Victoria in 1993 the method for funding hospitals has changed from global budgeting to a payment based on the type and number of patients treated by a specific hospital. Payment is based on Diagnostic Related Groups (DRGs), so that the weighting for a patient in each DRG is the same. Casemix funding has probably had two effects for the purpose of this study.

Firstly, Victorian hospitals now include only the component of the patient's acute hospital stay in their costing, thus patients requiring rehabilitation are discharged from the acute hospital or bed and readmitted to a specialist rehabilitation hospital or bed. Therefore costs for rehabilitation are not included within the cost of acute hospitalisation. In Queensland this is not the case, therefore all patients undergoing rehabilitation have their length of stay included in the total length of stay. As there was no simple way of determining the length of their acute hospitalisation, as opposed to rehabilitation, these patients had to be eliminated from the calculation of average length of stay and average total cost. Therefore only patients from Queensland who had had no rehabilitation were included in the calculation of average total costs.

It is difficult to determine whether these patients would be likely to affect the calculation of average total cost. It is possible that their fractures were less severe, therefore not requiring rehabilitation, in which case average total cost would be understated. Alternatively their fractures, or underlying chronic conditions, may have suggested that rehabilitation was not an option, in which case average costs may be overstated. Either way it is unlikely that, as average costs were calculated from all the hospitals supplying the data, one hospital's costs would have a great impact on the calculation of the average. The Queensland data was, however, utilised in calculating the proportion of patients with a fractured neck of femur who required rehabilitation.

Rehabilitation costs and average length of stay were included separately and were based on a study completed by Coopers and Lybrand (1995) for the Department of Health and Community Services in Victoria. Thus we were able to include the costs for rehabilitation in the study.

The second possible impact of Casemix funding in Victoria is that hospitals have an incentive to improve the technical efficiency of their patient care and this partly impacts on reducing the patient length of stay. In order to increase throughput, hospitals may try to minimise the patient's length of stay, therefore this will have an impact on both the calculation of the average length of stay and the average total costs (as total costs relate to bed days). There is a possibility, therefore, that the average costs for patients in Victorian hospitals are less than the average costs for patients with the same ICD-9-CM codes in other States. However it is difficult to determine whether this is the case without comparable costing data from other States. If the reduction in average costs experienced in Victoria are due to technical efficiency gains it raises issues of the meaning of hospital cost data for economic evaluation. If some hospitals are operating off the cost curve then financial cost data does not necessarily represent the true opportunity cost of resources.

Discharge Status for Fractured Neck of Femur

Discharge status was also requested from hospitals to gain some idea of the patient outcome post acute hospitalisation for a fractured neck of femur. Not all hospitals were able to supply this data. Discharge status for fractured neck of femur only was analysed from two Victorian hospitals and the Queensland hospital. It appears that a large proportion (22%) of patients from the Victorian hospitals were discharged to another hospital (no details of these hospitals was available without requesting data from the individual patient's record). However, in the Queensland hospital this was 11%. Discharge to a nursing home was higher for the Queensland hospital than the Victorian hospitals, and a higher proportion of patients had rehabilitation in Queensland than in the Victorian hospitals (22% as opposed to 11%). Without more details on the individual patients concerned it is difficult to determine the reason for this disparity, however it is possible that some of the patients coded as discharged to another hospital required rehabilitation or ultimately were admitted to a nursing home. This may be related to the Casemix funding system in Victoria as larger acute care hospitals especially attempt to reduce patient length of stay, therefore discharging patients to alternative institutions. However an alternative explanation may be related to differences in the number of nursing home beds per capita between States, or the demographic trends.

A further complication is that if these patients are admitted to another hospital (public or private) with the same ICD-9-CM code (eg 820 and one of the listed E-codes) they will be added to the AIHW database as a new patient from the Victorian admission data. In this case the statistics on hospital separations collected from the AIHW may be overstated. It is commonly accepted that the early part of a patient's admission to hospital comprises the highest cost portion of their stay, therefore attributing average total costs for a hospital stay to these patients would overestimate their true costs as it is likely that the costs of recuperative care would be less than the cost of the acute care of the fracture in the period immediately following the fracture. Relating the AIHW statistics suggests therefore that hospital costs of osteoporosis may be overstated in the final analysis. However the extent of this again is difficult to analyse. If patients do require further hospitalisation then the average cost predominantly calculated from the Victorian hospitals may be underestimated, thus the overall impact of the secondary admissions to another hospital is difficult to determine. On the other hand some patients may be given an alternative ICD-9-CM code which is different to their initial code in which case the costs of these patients further hospital stay will also be missed. In any event, given that the predicted incidence of hip fracture is higher than hospital separations, this is unlikely to be a major source of upward bias in the costing.

Methodology Used by Each Hospital in Allocating Costs

Hospital 1

Medical costs	cover the portion of medical salaries traced to in-hospital bed days;
Allied Health costs	cover salary and non-salary costs of occupational therapy, social work, physiotherapy and podiatry;
Pharmacy costs	include the identified costs of scripted drugs and a share of impress ward services;
Pathology costs	include salary and non-salary costs of biochemistry, microbiology, haematology, blood bank, anatomical pathology and cytology departments;
Radiology costs	include the salary and non-salary component of all imaging departments including ultrasound, CAT scan, nuclear medicine and cardiology;
Theatre costs	include surgeon, anaesthetist, nursing and technical salaries, as well as prosthesis and all other non-salary costs incurred in theatres (prosthetic costs are averaged over all patients undergoing surgery, therefore are not specific to those requiring a prosthesis);
Ward costs	include salaries of nurses, patient service attendants and ward consumable costs, including laundry;
Indirect costs	include electricity, engineering, cleaning, sterile services and environmental services;
Emergency costs	includes medical, nursing and other non-salary costs of the emergency department (averaged for all patients in a one month period);
Catering costs	includes salary and other non-salary costs of the food services department;
Other costs	for this hospital have been divided into emergency department and catering costs.

Hospital 2

Medical costs	allocated on the basis of patient bed days averaged for each specific specialty, medical costs for this hospital also includes anaesthetist's costs which were allocated on the basis of minutes in the operating theatre;
Allied Health costs	allocated on the basis of bed day in the clinical unit relevant to the allied health specialty;
Pharmacy costs	allocated on the basis of drugs prescribed to each patient and an average for each patient weighted by dependency for the ward impress system;
Pathology costs	allocated to each patient for each test;
Radiology costs	allocated to each patient for procedures performed;
Theatre costs	includes staffing costs allocated on the basis of minutes in theatre and consumables weighted by Commonwealth Medical Benefit Schedule (CMBS) codes, for example a patient likely to need a prosthesis would be given a high weighting;

Ward costs	allocated on the basis of a weighting for patient dependency and volume dependent on bed days, includes nursing and ward assistant salaries and laundry;
Indirect costs	are included in all costing rather than reported separately;
Emergency costs	averaged over all patients;
Catering costs	allocated on the basis of patient bed days;
Other costs	for this hospital will include costs of renal dialysis.

Hospital 3

Medical costs	allocated on the basis of the specific clinical unit bed days; anaesthetist's costs are also included and are allocated on the basis of the specific operation using the CMBS as an indicator of relative value;
Allied Health costs	physiotherapy, occupational therapy and dietetics are allocated on the basis of minutes with each patient, and allied health specialties are averaged for all patients on the basis of bed days;
Pharmacy costs	allocated on the basis of bed days for each ward impress system;
Pathology costs	allocated on the basis of bed days;
Radiology costs	allocated by specific test performed;
Theatre costs	includes salaries and consumables allocated on the basis of each operation weighted by CMBS codes, includes an average for prosthetics;
Ward costs	allocated on the basis of dependency bed days, includes catering;
Indirect costs	includes electricity, finance, engineering, etc averaged across all patients; Emergency costs are not included;
Catering costs	are not included;
Other costs	includes the costs of the ancillary departments, such as central sterilising department, stomal therapy, infection control and cardiac investigations averaged across all patients.

Hospital 4

Medical costs	are allocated on the basis of bed days and include the anaesthetic department;
Allied Health costs	the physiotherapy and occupational therapy departments have their own feeder systems, therefore allocate costs on the basis of minutes of care. other allied health departments allocate costs on the basis of bed days;
Pharmacy costs	allocated on the basis of bed days which are weighted for the individual ward;
Pathology costs	allocated on the basis of the individual test performed;
Radiology costs	allocated on the basis of the individual test performed;
Theatre costs	allocated by individual procedure weighted by CMBS codes;

Ward costs	are weighted by a dependency system for nursing costs, also includes intensive care and coronary care units where appropriate;
Other costs	catering costs are allocated on the basis of ward bed day, emergency department costs are not included;
Indirect costs	are allocated on a feeder system for the individual department or on the basis of bed days where a feeder system does not exist.

Hospital 5

Medical costs	allocated on the basis of bed days;
Allied Health costs	allocated for physiotherapy, occupational therapy, social work, dietetics and orthotics through a feeder system on the basis of minutes of care. Where a feeder system does not exist for the specific allied health department, bed days are used;
Pharmacy costs	are allocated to the individual ward, therefore are not included as a pharmacy cost, instead are included within the ward costs. Administrative and labour costs are included as indirect costs;
Pathology costs	allocated on the basis of the individual test performed;
Radiology costs	allocated on the basis of the individual test performed;
Theatre costs	90% of the costs are allocated on the basis of minutes spent in the operating theatre through a feeder system. Theatre costs include the actual operating theatre, recovery ward, day surgery, anaesthetic department and central sterilising department;
Ward costs	allocated on the basis of bed days, pharmacy costs are included in this hospital's ward costs;
Other costs	includes catering, electrocardiograph and autologous blood transfusions, allocated on the basis of bed days across all patients; and
Indirect costs	includes engineering, finance, cleaning, administration (including the pharmacy department), allocated on the basis of minutes where the department has its own feeder system, otherwise on the basis of ward bed days.

APPENDIX B

Hospital separations for four types of fracture

The AIHW has provided information on the total number of hospital separations for four types of fractures by age in 1992/1993 and 1989/90. This is reproduced in

.

Table B-1: Hospital separations for four types of fracture by age and sex Australia 1992/93

rates per 1000 population

age group	population 1993	no of fractures	rate per 1000
Hip fracture			
female			
50-59	808,939	231	0.29
60-69	713,880	901	1.26
70-79	534,688	3053	5.71
80-84	157,478	2696	17.12
85+	121,787	3803	31.22
all	2,336,772	10684	4.57
male			
50-59	840,109	208	0.25
60-69	685,800	550	0.80
70-79	413,873	1,089	2.63
80-84	93,490	708	7.58
85+	51,757	877	16.94
all	2,085,029	3,432	1.65

age group	population 1993	no of fractures	rate per 1000
Vertebral fracture			
female			
50-59	808,939	142	0.18
60-69	713,880	192	0.27
70-79	534,688	418	0.78
80+	279,265	514	1.84
all	2,336,772	1266	0.54
male			
50-59	840,109	225	0.27
60-69	685,800	206	0.30
70-79	413,873	253	0.61
80+	145,247	171	1.18
all	2,085,029	855	0.41
Humeral fracture			
female			
50-59	808,939	200	0.25
60-69	713,880	370	0.52
70-79	534,688	722	1.35
80+	279,265	854	3.06
all	2,336,772	2145	0.92
male			
50-59	840,109	168	0.20
60-69	685,800	186	0.27
70-79	413,873	196	0.47
80+	145,247	138	0.95
all	2,085,029	688	0.33
Wrist fracture			
female			
50-59	808,939	815	1.01
60-69	713,880	1430	2.00
70-79	534,688	1526	2.85
80+	279,265	1124	4.03
all	2,336,772	4895	2.09
male			
50-59	840,109	397	0.47
60-69	685,800	307	0.45
70-79	413,873	184	0.45
80+	145,247	94	0.64
all	2,085,029	981	0.47

source: Australian Institute of Health and Welfare, 1996