

The Burden of Brittle Bones: Costing Osteoporosis in Australia

Prepared for
Osteoporosis Australia

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Executive Summary

- ❖ Osteoporosis is largely preventable—essentially “the disease we *don’t* have to have”. Like killer diseases of the past, targeted health interventions now could drastically curb the incidence of osteoporosis and fracture morbidity, which currently stands at a fracture every eight minutes, and is increasing annually.
- ❖ Already in 2001, nearly two million Australians have osteoporosis related conditions—three quarters of whom are women.
 - If nothing is done, this will increase to three million people by 2021, with a fracture every 3½ minutes.
- ❖ Moreover, osteoporosis is an expensive disease in relative terms. It costs \$1.9 billion per annum in health costs, with a heavy burden (68%) on hospitals and nursing homes. There are a further \$5.6 billion in indirect costs—lost earnings, volunteer carers, modifications and equipment.
 - In total, this represents 1.2% of GDP in 2000-01, or \$389 for every Australian.
 - There is over \$1 billion in lost potential tax revenue because of the disease.
 - Osteoporosis is more expensive than either diabetes or asthma, both of which are National Health Priorities.
- ❖ Osteoporosis also cost Australians 25,000 years of healthy life in 2000-01, with over half of these years lost due to premature death, and the remainder due to the disability burden of the disease.
 - More years of healthy life are lost in Australia due to osteoporosis than to Parkinson's disease, HIV/AIDS, rheumatoid arthritis or cervical cancer.
 - Osteoporosis is more prevalent than high cholesterol, allergies or the common cold.
- ❖ These statistics are comparable with the prevalence and costs of osteoporosis identified in the US and Europe. The international osteoporosis epidemic has become widely acknowledged, with the International Bone and Joint Decade (2000-10) launched to counter the burgeoning problems of the disease.
- ❖ Effective prevention and treatments are available, from an effective nutrition program including adequate calcium and Vitamin D intakes (eg, from dairy products); and from drug therapies including bisphosphonates (such as alendronate and risedronate), the new SERM drug raloxifene, and hormone replacement therapy, which have been shown to diminish fracture risks and increase bone mineral density. Other emerging treatments include fall prevention strategies and hip protectors.
- ❖ Although the major fracture burden is seen later in life, osteoporosis is sometimes referred to as a paediatric disease, because peak bone mass (a major predictor of bone mass at any age) is achieved during growth and adolescence. The osteoporosis epidemic is similar—if preventive action is taken now, the health burden of Australians can be significantly reduced in the future.
- ❖ In view of the enormous costs and health burden of osteoporosis, it is recommended that:
 - osteoporosis is adopted by the Federal Government as a national health priority area by 2002, with commensurate funding; and
 - commitment to a National Strategic Plan for osteoporosis in Australia should be announced by the Federal Government and Osteoporosis Australia on World Osteoporosis Day (20 October 2001).

1 Australian Osteoporosis—the Size of the Problem

1.1 Symptoms, Causes and Diagnosis

1.1.1 What is osteoporosis?

Osteoporosis, meaning “porous bones”, is a serious and insidious form of musculoskeletal disease, the major cause of disability and handicap in Australia. In osteoporosis, bone density and structural quality deteriorate, leading to weakness and fragility of the skeleton and increased risk of fracture, particularly of the spine, wrist, hip, pelvis and upper arm. Collapsed vertebrae cause severe back pain, spine deformities (kyphosis) and loss of height. Osteoporosis is a global problem that is increasing in significance with demographic change. Bone loss is often gradual and without warning signs until the disease is advanced. For these reasons, osteoporosis has become known as “the silent epidemic”. Men, as well as women, suffer from osteoporosis, a disease that can be prevented and treated.

Figure 1: Micro-architecture of bone



Normal bone (left) compared with osteoporotic bone (right).
Photos courtesy of Prof. BEC Nordin¹

Boning up... Bone is living, growing tissue made mostly of the protein *collagen*, and calcium phosphate, a mineral that strengthens and hardens the framework. The outside is usually a dense rind of *cortical* bone. The inside is usually spongy-looking *trabecular* bone. 99% of the body's calcium is in the teeth and skeleton (the remainder in the blood), where a constant *remodelling* process occurs depending on calcium intake, usage and stores. *Osteoclast* cells break down old bone (*resorption*), while *osteoblasts* build it (*formation*). Bones become larger, heavier and denser in our first three decades, until *peak bone mass* is reached. After that, resorption begins to exceed formation. Osteoporosis occurs when there is too little formation (during youth), or too rapid resorption, or both.

1.1.2 Causes

Osteoporosis is caused by a combination of age-related, hormonal, dietary, lifestyle and genetic factors. The key factor is low bone mass.

Age: Bone strength is measured by *bone mineral density (BMD)*, with maximum or “peak bone mass” achieved by the mid 20s. Adolescence is a critical period for optimising BMD. After the mid 30s, bones gradually lose strength. The outer shell becomes weaker and the inner material (which resembles honeycomb) develops larger holes until a danger level is reached. Hence, the longer we live, the more likely we are to develop osteoporosis.

Hormones: For women in the 5-10 years following menopause there is sharp decline in oestrogen – the hormone that helps maintain bone mass balance. During this time, women lose bone two to four times faster than they did before menopause. By 65, some women have lost half their skeletal mass. Early or surgically induced menopause, or amenorrhea increases risks. The male equivalent hormone,

¹ Osteoporosis Australia, “About osteoporosis”, www.osteoporosis.org.au/about_osteoporosis.htm

testosterone, has a similar effect on bone health, but declines in testosterone with aging are less sudden and severe. This is one of the reasons that women are more prone to osteoporosis than men.

Diet: Inadequate calcium intake² or calcium absorption, which requires Vitamin D, is a major risk factor for osteoporosis. Calcium is found primarily in dairy foods—milk, yoghurt, cheese—with rich sources also in bony fish, almonds, dried fruits, and leafy green vegetables. Calcium supplements are helpful, although some are not well absorbed by the body. They are useful in older populations who do not get enough dietary calcium, particularly those in residential care. Vitamin D (RDA 400-800IU daily), mainly synthesized through the skin from sunlight, can be lacking in elderly or housebound people. Excessive dieting, anorexia nervosa or bulimia exacerbate risks as does an excessive intake of alcohol, salt, proteins/phosphates and caffeine (eg, cola, coffee).

Lifestyle: Weight bearing and resistance-training exercise during childhood and adolescence maximises peak bone mass development and may protect against osteoporotic fractures in later life. Sedentary lifestyle, prolonged bed-rest and smoking are important risk factors here.

Other: The upper limit of bone mass is genetically determined, so family history is important. Caucasians and Asians, people who are slim and have small bones with low weight-to-height ratio, can be more at risk. Other risk factors include thyroid, liver, kidney and bowel disorders, as well as some medications including corticosteroid treatments (eg, for asthma, rheumatoid arthritis), anti-convulsants (eg, for epilepsy), hormonal contraceptives (eg, Depo Provera). Specifics are listed in the box below.

The silent thief

Osteoporosis steals more than bone. It's the primary cause of hip fracture, which can lead to permanent disability, loss of independence and sometimes even death. Collapsing spinal vertebrae can produce stooped posture and a "dowager's hump". Lives collapse too. The chronic pain and anxiety that accompany a frail frame make people curtail meaningful activities, because the simplest things can cause broken bones. Stepping off a curb. A sneeze. Bending to pick up something. A hug. "Don't touch mom, she might break" is the sad joke in many families.³

1.1.3 Types of osteoporosis

- **Post-menopausal**—Declining ovarian function and oestrogen production are associated with increased osteoclastic activity resulting in a loss of trabecular bone. Vertebral and hip fractures are typical.
- **Age-associated (senile)**—This diagnosis, in men and women over 65, is due to the extended *period* of bone loss (35+ years). Clinical features and diagnosis are similar to post-menopausal, with occasional upper arm, shin and pelvic fractures and dorsal kyphosis (dowager's hump).
- **Idiopathic**—Cause is unknown, for example in men under 65.
- **Secondary**—Decreased bone mass caused by an identifiable agent (such as pharmacological agents) or disease, shown in the box following.

² Calcium intakes vary with age, gender and pregnancy/lactation needs. The US National Academy of Science base rates (1997) range from 210mg/day at birth to 1300mg in adolescence, reducing in midlife to 1000mg, then rising to 1200mg after 50. NIH estimates (1994) are slightly higher.

³ Strange, C.J., (1996).

Factors underlying secondary osteoporosis

Hemiplegia (stroke), cystic fibrosis, chronic obstructive pulmonary disease, osteogenesis imperfecta, homocystinuria, neoplastic disease, rheumatoid arthritis, ankylosing spondylitis, chronic diseases that affect the kidneys, lungs, stomach, intestines, or alter hormone levels.

Early oophorectomy (in women)—removal of the ovaries, which produce oestrogen.

Hypogonadism (in men)—inadequate gonadal function, which produce testosterone, progesterone and small amounts of oestrogen.

Hyperthyroidism—abnormally increased and uncontrolled secretion of the thyroid gland.

Hypercalcinuria—a disorder where too much calcium is lost through the urine.

Subtotal gastrectomy—partial removal of the stomach, and *gastrointestinal disorders*.

Systemic mastocytosis—mast cell infiltration of the system.

Bone metastases—a bone tumour that is invasive and resistant to treatment.

Thyroxine—active iodine used for synthetic thyroid gland secretions.

GnRH analogs—oestrogen-suppressing hormone for treating endometriosis and fibroid tumours.

Anticonvulsants (hypnotics and barbiturates)—drugs for preventing or arresting convulsions.

Loop diuretics (furosemide)—treatment for oedema associated with congestive heart failure, cirrhosis of the liver and renal disease.

Heparin (long-term)—anticoagulant used to treat clogged blood vessels and coronary illnesses.

Glucocorticoids—steroids used for the reduction of inflammation, such as in rheumatoid arthritis (accounts for around 17% of osteoporosis in men).

1.1.4 Diagnosis

Clinical diagnosis (World Health Organisation) is if *bone mineral density (BMD)* >2.5 standard deviations (SD) below the young normal mean or if there is a previous fragility fracture. BMD provides a static picture of the bone status at a point in time. As a complementary tool, biochemical testing can provide a picture of the rates of change in bones, although its use is more common in the US than in Australia.⁴

Bone densitometry tests: Routine x-rays cannot detect osteoporosis until it is quite advanced. However, low radiation bone mineral density (BMD) tests—commonly DEXA⁵ scans—can measure BMD in different parts of the skeleton and compare the readings to standards for the patient's age, sex and size ("age-matched"), as well as to "young normal" standards (for peak BMD) and to previous test results. This provides an indicator of fracture risk as well as measurement of the severity of bone loss over time. Measurements at central body sites (eg, spine, hip) are more sensitive than measurement at peripheral sites (eg, wrist, heel) where changes occur more slowly.⁶ Serial BMDs are funded under Medicare usually only every two years with the risk of significant bone losses during this interval. Ultrasound techniques can also be used to measure bone stiffness, although more research is required.

Biochemical "cross-link" tests: Circulating by-products of bone remodelling metabolism are found in the bloodstream and urine, which provide a measure of bone turnover rates and the effects of anti-resorptive therapy. Pathology tests which measure these by-products, typically N-telopeptides, (NTx) C-telopeptides (CTx) and deoxypyridinoline (see Panel 2 of Figure 2 on p3), are newer (FDA approved and introduced in Australia in the last few years), less invasive and faster.⁷ However, the lack of precision of the tests at this stage can necessitate multiple repeat tests in

⁴ See Jackson, D.A., (2001).

⁵ DEXA—Dual Energy X-ray Absorptiometry- is currently claimed to be the most reproducible and accurate (1% precision) of the radiographic BMD techniques, with low radiation exposure.

⁶ The precision of BMD can vary 2-3% due to different technicians, different machines, body positioning and so on. While 2-3% "noise" is quite good for many medical tests, it should be borne in mind that the aim is to detect bone loss of 3-5% per year. The imprecision of cross-link tests is significantly higher (30-50%).

⁷ Pathology tests have an MBS schedule fee around A\$24, significantly less costly than BMD tests (\$79.80 for Items 12306, 12309 and 12321). One such pathology test, "Osteomark", introduced in Australia in 1996, detects NTx through a urine sample or serum within two hours. A faster "point of care" test also manufactured by Ostex is available to US GPs but is not yet in Australia.

order to identify and monitor patients who are losing bone rapidly, so cost-effectiveness is questionable. Biochemical tests may be more useful in the future.

1.2 Treatment and Management

There is no cure for osteoporosis, but it can be identified and managed. It cannot be prevented outright, but onset can be delayed, and severity diminished. Before 1995, the only medication choices were oestrogen (and, overseas, calcitonin). Improving technology has meant that rapid progress is being made in the diagnosis, treatment evaluation and prognosis of osteoporosis. Early intervention can prevent further fractures and significantly improve quality of life, and has been shown to be cost-effective, yet there is still a high degree of lack of awareness and failure to treat diagnosed patients.⁸

- **Nutrition:** Adequate intakes of calcium and Vitamin D are essential - from foods, sunlight and supplements, with a balanced diet to optimise body weight. Dairy foods are a major source of calcium in the Australian diet and are the most naturally bioavailable source of calcium for the body.
- **Exercise:** Specific treatment exercises aim to increase muscle strength, coordination and balance, without sudden or excessive strain on bones. The preventative role of regular, active and weight-bearing exercise is probably most important during adolescence.⁹
- **Lifestyle changes:** Avoid smoking and excessive alcohol and caffeine intakes. Practise fall prevention strategies, eg, rubber-soled shoes, carpet runners, canes, night lighting, grab rails and so on. Use of hip protectors for elderly.
- **Preventive medical:** Recognise and treat or counter any underlying medical conditions or use of medications that affect bone health or cause bone loss. Regular screening for high-risk category patients.
- **Hormonal Medications:** must demonstrably preserve or increase bone mass and maintain bone quality, to meet approval criteria for prevention and/or treatment.
 - **Oestrogen/hormone replacement therapy (ERT/HRT):** ERT in the form of a pill, skin patch, gel or implant is effective in prevention of bone loss (less so for hips) in post-menopausal women, but oestrogen alone can increase the risk of some cancers (eg, endometrial). Progestin with oestrogen (HRT) addresses the latter risk, while maintaining the beneficial effects of relieving menopause symptoms and benefiting the skeleton. Despite numerous studies of its effects on bone mass, there is limited randomised controlled trial data on the effects of HRT on fractures. Another side effect can be deep vein thrombosis (DVT). Examples: Premarin, Ogen, Estrace, Estraderm, Estratab, Prempro, Provera.
 - **Selective Estrogen Receptor Modulators (SERMs):** A new class of drug—*Raloxifene* (eg, "Evista")—for prevention and treatment, which can halve the incidence of vertebral fractures, with breast cancer benefits also. Side effects are rare, but include DVT and hot flushes. Research is ongoing.

⁸ Seeman, E. (2000) p245 estimates that 80-90% of patients with fractures go untreated because of lack of awareness. Torgerson, D.J and Dolan, P. (1998) found that 60% of women with a diagnosis of vertebral fracture did not receive any pharmaceutical therapy within 12 months of diagnosis. See Chapter 5 for comparative effectiveness of interventions.

⁹ Weight-bearing exercise is where bones and muscles work against gravity. This includes walking, jogging, racquet sports, stair climbing, team sports, lifting weights, and using resistance machines. Twisting motions and impact activities, such as those used in golf, tennis, or basketball, may need to be curtailed.

- **Calcitonin:** A non-sex peptide hormone used in post-menopausal women, available overseas as an injection or nasal spray, the former with possible allergic side effects. It inhibits osteoclast function, eg. "Miacalcin".
- **Active Vitamin D metabolites.** Vitamin D administration suppresses the increased secretion of PTH (parathyroid hormone) in menopausal women and increases intestinal calcium absorption (eg. "Calcitriol").
- **Non-hormonal Medications:**
 - **Bisphosphonates:** potent inhibitors of bone resorption. *Alendronate*¹⁰: For prevention or treatment for men and women, or for glucocorticoid-induced osteoporosis, eg. "Fosamax". *Risedronate*: For prevention or treatment of glucocorticoid-induced osteoporosis, or for post-menopausal women, eg. "Actonel". Side effects of both are uncommon, provided the medication is taken on an empty stomach with water in the morning, followed by half hour upright with no further intake. Others: Pamidronate ("Novartis"), Etidronate ("Didronel").
 - **Calcium supplements:** Calcium therapy for post-menopausal women has had mixed results, as calcium alone cannot usually prevent bone loss. However, supplements for older populations with a poor diet who may also be in residential care, is often recommended.
- **Education/counselling programs:** Education is fundamental to preventive and disease management strategies—including awareness and information about osteoporosis, risk factors, nutrition, exercise, pharmacological interventions, tests, psychological support, helpful devices and aids, patient groups, and so on. Chapter 4 outlines the work of Osteoporosis Australia in this area.

1.3 Information Gap or Action Gap?

Unfortunately, despite the preventability of severe osteoporosis, and the vast progress made over the past decade in research and treatment options, bone loss is still not being detected early enough to prevent increasing numbers of fractures. The toll of this neglect is high—in terms of health dollars, suffering, and lives. Even after fracture, diagnosis & treatment rates are very low.

The IOF conducted a study in 2000¹¹ of women (average age 60) that indicated:

- Although awareness of the disease was high (93%), 80% did not feel personally at risk, although 50% will likely suffer an osteoporotic fracture. Of the Australian women who participated, only 15% were aware they were at risk prior to diagnosis and only 12% regarded osteoporosis as their main health concern.

Conclusions: Understanding of personal risk is alarmingly low. Many women currently at risk of osteoporosis are not being identified early enough to fully benefit from preventive or treatment measures.

- Only half of women with osteoporosis had discussed the long-term health risks of the disease with their physician. Only 2% reported discussing medication options. 33% are still not on any medication to treat the disease. 72% said they would have taken preventative therapy earlier if they had known they were at risk.

¹⁰ *Alendronate sodium*: FDA approved in September 2000 to increase bone mass in men.

¹¹ International Osteoporosis Foundation (2000b). 1630 women and doctors from 11 countries participated, including Australia, Brazil, Canada, France, Germany, Italy, Jordan, Lebanon, Mexico, Spain and the UK. 25% of the women were diagnosed with osteoporosis. The survey was conducted March-May 2000.

Conclusions: Doctor-patient conversation is not motivating women to identify personal risks or take action. Women with osteoporosis recognise the importance of early intervention and wish they had taken action earlier.

Other key findings of the IOF study were that a gap exists between physicians' desire to prevent fractures, and what is actually happening in practice. Two thirds of doctors cited osteoporosis as a key health concern for post-menopausal women, more so than heart disease and cancer. However, preventative medication is often only post-fracture. Key barriers that limit doctors' ability to detect bone loss early, and their decision to prescribe medication include:

- lack of time;
- limited access to and funding for BMD testing;
- lack of reimbursement for medication; and
- concerns of women about safety of medication, with constraints to counselling.

The US National Institute of Health also advocates that more research is required to effectively reduce the incidence and prevalence of osteoporosis:

"Medical experts agree that osteoporosis is highly preventable. However, if the toll of osteoporosis is to be reduced, the commitment to osteoporosis research must be significantly increased. It is reasonable to project that with increased research, the future for definitive treatment and prevention of osteoporosis is very bright."

NIH-ORBD-NRC, October 2000.¹²

1.4 Morbidity and Mortality: Bone Fractures

The main morbidity of osteoporosis is the fracture that occurs. Around 25% of Australian women and 17% of men will develop osteoporotic fractures.¹³ Of those over 60 years, 1 in 2 women and 1 in 3 men will sustain an osteoporotic fracture.¹⁴ Of diagnosed fractures, 46% are vertebral¹⁵, 16% hip and 16% wrist, with fractures of the spine, ribs, arms and legs occurring in younger individuals than hip fractures.

The occurrence of one fracture is associated with increased risk of further fracture, called the "cascade effect". After one vertebral fracture, the risk of another fracture within 12 months increases over four fold. There is also a large increase in fracture risk after the first hip fracture, making the prevention of first fractures a key objective of preventive health policies. From middle age onwards, osteoporotic fractures cause increasingly significant morbidity, since the skeletal deformity may be permanent.¹⁶

Hip fractures are most likely to be disabling, with complications that can result in death. The Royal Australian College of Physicians estimates indicate that 50% of people with hip

By 2020 - 1 in
3 Australian
hospital beds
occupied by
women with
fractures...?

¹² National Institute of Health, Osteoporosis and Related Bone Diseases, National Resource Center, Washington DC. www.osteoporosis.org

¹³ Estimate of the Dairy Research and Development Corporation, Australian Dairy Corporation and Australian Dairy Industry Council, see www.dairypage.com.au/archive/community/ffOsteoporosis.htm

¹⁴ Garvan Institute, based on evidence from the Dubbo Osteoporosis Epidemiology Study, which involved a large cohort of elderly men and women studied from 1989 longitudinally. The study showed 60% of women and 30% of men over 60 suffer osteoporotic fracture.

¹⁵ Moreover, the WHO (1999a) estimates that only one third of vertebral fractures come to clinical attention, although all are associated with back pain and disability.

¹⁶ Medical Journal of Australia (1997) "What is osteoporosis?" p1.

fractures will require long term nursing care, while the North Sydney Health Service Study showed 17% of people with hip fractures die within four months.¹⁷ Other research has shown that 20% of people who suffer hip fracture die within six months of sustaining the fracture. Hip fractures occur around 15 years later than vertebral or wrist fractures, and are one of the leading causes of hospitalisation for women.¹⁸ Moreover, hip fracture rates are steadily increasing¹⁹, to such an extent that the Garvan Institute projects that by 2020, 1 in 3 beds will be occupied by elderly women with fractures.

20% of people
with hip
fractures die
within six months

Although a 1996 Gallup Poll showed there is a tendency to think of osteoporosis as a "woman's disease", the importance of osteoporosis in men is becoming recognised, particularly in view of forecasts of the numbers of men over 70 in coming decades.²⁰

Additional morbidity from osteoporosis can be either symptomatic (eg, pain, deformity) or asymptomatic (eg, fear of falling leading to social isolation, being bed-ridden, anxiety about fracture which can lead to emotional disturbances such as depression and impair activities).²¹

"Osteoporotic fractures cause untold suffering and may result in long term physical debilitation. Many osteoporosis sufferers experience repeat vertebral fractures. These are not only extremely painful and immobilising, but also cause gradual physical alterations such as loss of height and kyphosis... It is not surprising that patients also report depression and poor self-image. But by far the most serious outcome of osteoporosis is hip fracture. Up to 20% of people who have hip fracture die within one year and only half regain their mobility. These people can no longer live independently but must rely on caregivers either within the family or in nursing homes."

International Osteoporosis Foundation (2000a), p6.

1.5 Prevalence: Today and Tomorrow

The numbers and claims in the previous section in relation to fractures are from a variety of worthy sources. However, establishing the prevalence of osteoporosis is notoriously difficult, due to the lack of awareness and diagnosis of the disease, and the fact that symptoms can be hidden across statistical categories. To establish

1.9 million
Australians with
osteoporosis in
2001

a solid estimate of prevalence, this paper relies primarily on the Australian Bureau of Statistics (ABS) National Health Survey (NHS) 1995,²² including "musculoskeletal" categories as well as fractures from "injuries and poisoning", as well as the Australian Institute of Health and Welfare (AIHW) National Hospital Morbidity Database. Table 1 shows that 1.9 million Australians currently suffer from osteoporosis including osteoporotic fractures.

¹⁷ Osteoporosis Australia. A recent Russian study showed 6 month mortality at 32%, 12 month at 44% and 24 month at 54%: Lesnyak et al (2000).

¹⁸ The Garvan Institute (based on data from the Dubbo Osteoporosis Epidemiology Study, *op. cit*) estimate that 17,725 women are hospitalised with hip fractures each year, pushing hospital costs for osteoporosis over \$800 million per annum.

¹⁹ The National Research Institute of Gerontology and Geriatric Medicine, Melbourne, forecasts an 83% increase in hip fractures by 2011.

²⁰ "Osteoporosis in Men", NIH (2000) p1, estimates that the number of men over 70 will double between 1993 and 2050 in the US.

²¹ Leplege, A. (2000), Abstract.

²² National Health Surveys have been collected in Australia in 1989-90 and 1995. The ABS is currently undertaking a third survey with results due to be released in September 2002.

Table 1: Prevalence of osteoporosis

<i>Musculoskeletal diseases, 1995</i>			Total osteo
	('000)	%osteo	('000)
Osteoporosis	257.4	100.0%	257.4
Back problems (unspecified)	783.1	11.6%	90.6
Curvature of the spine	60.8	15.9%	9.7
Other (inc. path. fractures)	1,550.1	63.1%	977.3
Total musculoskeletal	4,783.0	28.3%	1,335.0
Fractures (from Injuries)	98.4	41.5%	40.9
Total musculoskeletal & fractures	4,881.4	28.6%	1,375.9
Osteo from secondary sources			412.8
Total osteoporosis prevalence 1995			1,788.7
Total osteoporosis prevalence 2001*			1,913.9

*Assumes a demographic projection factor '95-'01 of 7.0%.

Sources: ABS NHS (1997), pp21-22, ABS (2000), p72, the AIHW National Hospital Morbidity Database and expert advice on the allocation and distribution of items within categories with thanks to A/Prof. Peter Ebeling, Royal Melbourne Hospital, A/Prof Terry Diamond, St George Hospital Sydney, and Prof. Graeme Jones, Menzies Centre Hobart.

Table 2 shows how prevalence increases with age, with over three times the prevalence in women. 32.5% of osteoporosis sufferers are women aged 45-64, while a further 37.5% are women aged 65 and over. 1 in 10 Australians has osteoporosis.

Table 2: Prevalence by age group

Age group	Females % of Age- group with osteo.	Females 2001*	Males % of Age- group with osteo.	Males 2001*	Persons 2001*
Under 15	0	0	0	0	0
15-24	0.5	7,124	0.2	2,682	9,807
25-34	1.9	28,155	1.5	21,686	49,840
35-44	6.0	89,147	2.0	29,977	119,125
45-54	17.6	232,387	1.9	24,824	257,211
55-64	43.6	390,186	6.6	60,570	450,756
65-74	51.6	348,964	28.3	178,069	527,033
75 and over	55.4	368,744	30.4	131,367	500,110
Total Australia	15.0%	1,464,708	4.6%	449,175	1,913,882

Source: ABS special data request for demographic distribution. *AE estimate based on demographics.

The numbers of fractures are increasing at a rate of 4.0% per annum. 64,514 Australians were hospitalised with osteoporotic fractures in 2000-01. This equates to 177 hospitalisations per day, or one every 8.1 minutes (see Table 3). Half of these were lower limb fractures, 37% were upper limb fractures, and the remaining 13% were fractures of the neck and trunk (including vertebral and pelvic fractures).

Table 3: Osteoporotic fractures hospitalized

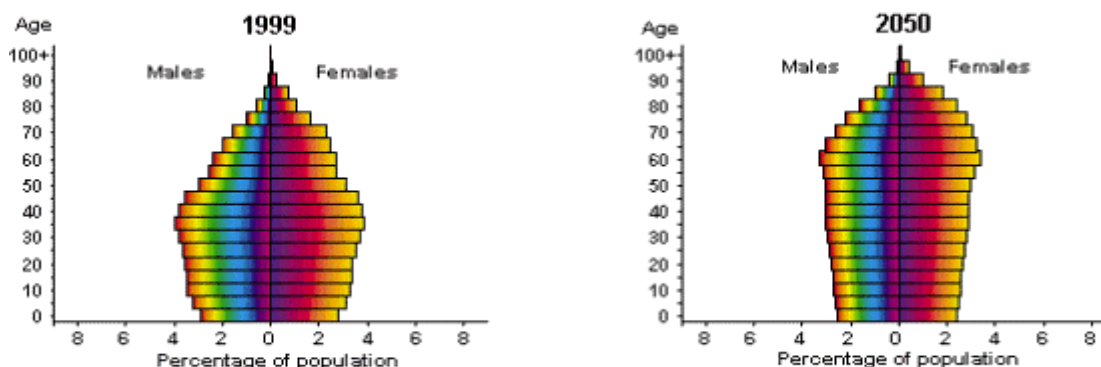
Year	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01
Fractures pa	49,445	51,999	54,362	55,456	57,354	59,648	62,033	64,514
Fractures/day	135.5	142.5	148.5	151.9	157.1	163.4	169.5	176.8
Every ? Minutes	10.6	10.1	9.7	9.5	9.2	8.8	8.5	8.1

Source: AIHW National Hospital Morbidity Database to 1997-98 (AE estimates thereafter) with expert advice on the distribution of fracture items with thanks to A/Prof. Peter Ebeling, Royal Melbourne Hospital, A/Prof Terry Diamond, St George Hospital Sydney, and A/Prof. Graeme Jones, Menzies Centre Hobart.

Demographic projections

Like other developed nations, the structure of Australia's population is changing as a result of longer life expectancies, lower birth rates and the post-war baby boom. Chart 1 below, compiled by the United Nations, shows the increased importance of post-menopausal women in future decades.

Chart 1: Age structure for developed regions, 1999 and 2050



Source: United Nations (2000).

Ceteris paribus, the prevalence of osteoporosis will continue to increase as the population ages over the next two decades – to 2.2 million (10.6% of the Australian population) in 2006, 2.4 million (11.4%) in 2011 and 3.0 million (13.2%) in 2021. This represents nearly a 60% increase in the next two decades. Table 4 provides projections for men and women.

Table 4: Prevalence projections, 2006-21, by gender and age

2006	0-14	15-24	25-34	35-44	45-54	55-64	65-74	75&over	Total
Men	-	2.8	21.8	30.5	26.4	75.3	192.9	155.7	505.4
Women	-	7.3	28.0	90.8	251.5	488.9	369.6	413.8	1,649.8
Persons	-	10.1	49.8	121.2	276.2	562.5	564.4	573.6	2,157.7
2011	0-14	15-24	25-34	35-44	45-54	55-64	65-74	75&over	Total
Men	-	2.8	21.8	31.2	27.8	85.9	232.4	173.0	575.0
Women	-	7.5	28.0	92.4	265.3	569.4	436.7	443.0	1,842.2
Persons	-	10.3	49.8	123.7	290.9	648.4	673.2	623.6	2,419.9
2021	0-14	15-24	25-34	35-44	45-54	55-64	65-74	75&over	Total
Men	-	2.7	22.8	31.3	29.0	96.9	335.7	239.2	757.7
Women	-	7.3	29.2	91.5	274.9	651.7	640.9	557.2	2,252.7
Persons	-	10.0	52.1	123.4	302.4	736.8	980.2	816.7	3,021.6

Source: AE projections based on maintained prevalence distributions within demographic groupings applied to ABS (2001) population projections for each demographic group.

The number of fractures requiring hospitalisation will also increase, in absolute terms and relative to the population, if action is not taken. Table 5 shows the numbers of fractures per capita nearly doubling over the two decades, to 387 per day or a fracture every 3.7 minutes.

Table 5: Projections of fractures requiring hospitalisation

	Fractures pa	Pop'n ('000)	Rate per '000	Fractures per day	Every ? Mins
2001	64,514	19,421	3.32	176.8	8.1
2006	78,488	20,394	3.85	215.0	6.7
2011	95,488	21,321	4.48	261.6	5.5
2021	141,334	22,938	6.16	387.2	3.7

Source: AE forecasts based on continued 4.0%pa fracture growth applied to ABS (2001) population projections, with no change to current policy.

1.6 Medico-social impact of Osteoporosis in Australia

Disability: In 1998, 85,100 Australians were classified as disabled due to their osteoporosis, according to the 1998 Survey of Disability, Ageing and Carers. This represents 4.7% of the total with osteoporosis at this time.²³ Of these, 44% were severely disabled, and 34% were moderately disabled.

Time off work: The 1998 Survey also showed that 18,400 people with osteoporosis had specific restrictions on their employment or schooling:

- Of those aged 15-64 who were in the workforce, there were 139,971 (1.6%) with osteoporotic conditions;
- However, 2.7% (322,303) of this age group in the total population had osteoporotic conditions—the under-representation of people with osteoporosis indicates that osteoporosis is a significant cause of people leaving the workforce (primarily through early retirement of women); and
- In addition, 6,244 Australians reported in the National Health Survey (NHS) that they had days of reduced activity due to osteoporosis.

Low incomes: 80% of people with osteoporosis in the NHS earned less than \$15,000 per annum, largely due to age factors.

Rural-urban factors: Osteoporosis is over 50% more prevalent (relative to the population) in urban areas than in rural areas.

Health Actions: In the two weeks prior to the NHS:

- 1.8% of people with osteoporosis visited their doctor (sometimes multiple times);
- 0.5% consulted another health practitioner;
- 9.3% took vitamin and mineral supplements;
- 1.1% took natural or herbal medications;
- 3.2% took pain relievers;
- 2.2% took other prescription drugs; and
- 0.1% visited casualty/outpatients.

10.3% of all adult Australian women are using HRT. The usage rate increases with age as shown in Table 6, with one quarter of menopausal aged women, and 30% of immediately post-menopausal women using HRT.

Table 6: HRT usage rates for adult women, 1995

Age Group	HRT rate per '000
18-24	5.4
25-34	13.8
35-44	49.8
45-54	247.7
55-64	303.0
65-74	127.0
75+	36.8
Total (all ages)	102.5

Source: ABS (1997), derived from Table33, p60.

²³ Survey Data supplied by ABS. Proportional estimates by Access Economics, based on NHS data.

Osteoporosis and musculoskeletal disease generally are leading causes of visiting a doctor, of prescriptions, of allied health consultations and of nursing home residency. The National Health Survey revealed that musculoskeletal disorders were:

- the second most common reason for hospitalisation (exceeding childbirth and antenatal) and for visits to casualty, outpatients or emergency (behind injuries and poisoning);
- the second most common reason for visiting a doctor (behind respiratory disorders i.e., colds and flu primarily);
- the third most common reason for using medication (behind respiratory disorders and circulatory disorders); and
- by far the most common reason for consultation with other health practitioners.

2 Costs and Burdens of Osteoporosis to Australians

There are three types of costs associated with diseases such as osteoporosis:

- Direct financial costs to the Australian health system include the costs of running hospitals and nursing homes (buildings, nursing, consumables), GP and specialist services reimbursed through Medicare and private funds, the cost of pharmaceuticals (PBS and private) and of other medications, allied health services, research and other "direct" costs (eg, health administration).
- Indirect financial costs tend to be borne primarily by people with the disease and those who care for them. These include the income forfeited due to sickness and early retirement, equipment and devices that are required to help cope with the illness, and the cost of care, which is often provided on a voluntary basis by a spouse or other family member but is nonetheless an economic cost.
- Non-financial costs from loss of health are also important—the pain, suffering and premature death that results because of the disease. This is the most difficult to measure, but can be analysed in terms of the years of healthy life lost, both quantitatively and qualitatively. It is known as the "burden of disease".

Costing methodology is detailed as an appendix.

2.1 Direct Financial Costs

The Australian Institute of Health and Welfare has utilised DCIS prevalence-based methodology to estimate the direct costs of disease in the base year 1993-94. This report extends the AIHW work to identify and estimate those costs attributable to osteoporosis and osteoporotic fractures in 1993-94, and then project the estimates to 2000-2001. The methodology is detailed in the Appendix.

Direct health costs are \$1.9 billion

Total health system costs of osteoporosis are estimated at \$1.9 billion in 2000-2001, with over half in hospital costs (nearly 1 billion)—see Table 7.

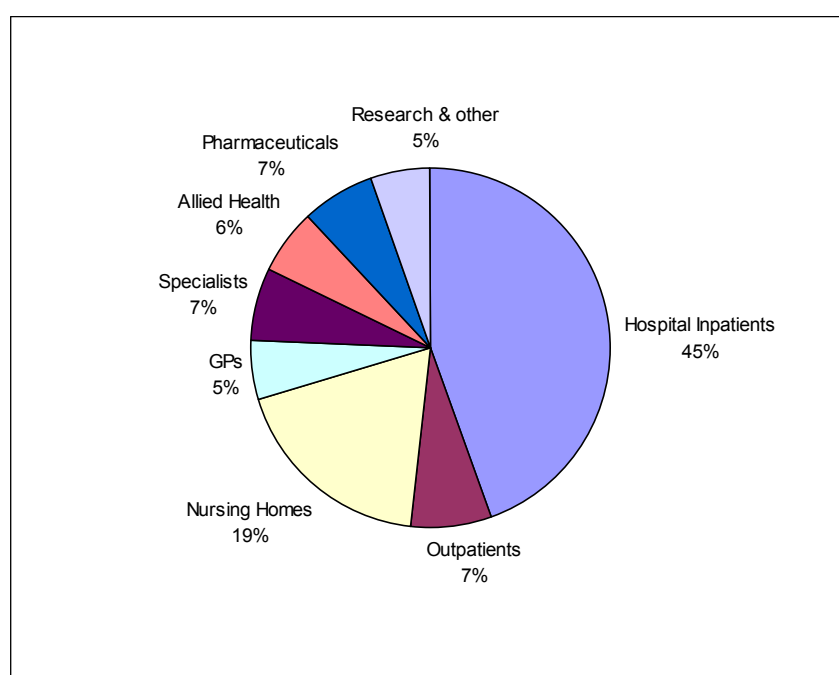
Table 7: Health system costs (\$ million)

1993-94	Hospital Inpatients		Non- Nursing		Medical services		Allied Health
	Public	Private	inpatients	Homes	GPs	Specialists	
Osteoporosis, direct	3.2	2.4	3.2	22.3	5.4	4.1	3.7
Osteoporotic fractures	149.3	25.3	37.5	28.7	11.5	16.9	4.0
Other osteoporotic	208.5	192.1	51.7	194.7	49.8	65.8	68.1
Total osteoporotic	361.0	219.7	92.3	245.8	66.7	86.8	75.9
2000-2001							
Total osteoporotic	513.9	312.8	131.4	349.9	95.0	123.6	108.0
1993-94	Pharmaceuticals				1993-94 Total Costs	2000-01 Total Costs	%GDP
	Prescrip- tion	Over-the- counter	Research	Other			
Osteoporosis, direct	10.9	1.2	0.5	2.5	59.5	84.7	
Osteoporotic fractures	2.0	2.0	6.3	12.5	296.1	421.5	
Other osteoporotic	41.8	28.3	8.2	40.7	949.5	1,351.7	
Total osteoporotic	54.6	31.5	15.0	55.7	1,305.0	1,857.8	
2000-2001							
Total osteoporotic	77.8	44.8	21.3	79.3	1,857.8		

AE estimates based on distribution of service utilisation items, Mathers and Penm (1999), population increase and the Health and Community Services GDP deflator. Other osteoporotic includes kyphosis, back problems and all osteoporosis from secondary sources.

Nursing homes (\$350m) are a further 19% of costs, while GPs are quite low at \$95m (5%). Allied health (including rehabilitation and physiotherapy) is just above the GP bill, at \$108m (6%), and specialist care (orthopaedic surgery, rheumatology and endocrinology) represents \$124m (7%). Pharmaceuticals, mainly prescription, are also 7% (\$123m). The remaining 5% is in research (\$21m) and other costs (eg, administration). Chart 2 shows the distribution of health costs, which total about one quarter of one per cent of GDP.

Chart 2: Sectoral shares of osteoporotic direct costs, 2000-01



The direct costs of musculoskeletal diseases are estimated per treated case by Mathers and Penh (1999) for different gender-age groups (see Table 8). Osteoporosis is a key component of the most expensive "Other musculoskeletal" category, costing \$1,819 per treated case, but notably higher for women in the 65+ category (where the osteoporotic cases would dominate) at \$2,818 per case.

Table 8: Health system costs per treated case (\$pa), 1993-94

Gender-age group	Arthritis	Back problems	Other musculoskeletal (inc. osteoporosis)	All musculoskeletal
<i>Males</i>				
Less than 25 years	320	428	2,149	1,547
25-64 years	710	1,090	1,593	1,325
65 years and over	1,382	2,249	2,342	2,029
<i>Females</i>				
Less than 25 years	91	688	1,385	1,152
25-64 years	642	995	1,493	1,229
65 years and over	1,296	4,255	2,818	2,349
Persons, all ages	973	1,291	1,819	1,562

Source: Access Economics (2001), p11, based on Mathers and Penn (1999), p26.

Extrapolating this to the prevalence data would suggest that, if every osteoporosis case were treated, direct costs would be in the vicinity of \$4 billion per annum, supporting other evidence that a large proportion of osteoporosis goes untreated.

2.2 Indirect Financial Costs

Indirect financial costs of osteoporosis are primarily from the early retirement of women from the workforce, as well as carer costs. Loss of earnings due to absenteeism, as well as modifications and devices purchased due to the disease, are other smaller indirect costs. Each of these is estimated separately in this paper, within the context explained in the Appendix that indirect costs represent conservatively three times the direct costs (that is, \$5.57 billion in 2000-2001). An estimate is also provided of the tax revenue sacrificed as a result of lower earnings.

Early retirement and absenteeism

People aged 15-64 with osteoporosis participate in the labour force less than healthy people of the same age (see Section 1.6). If they participated at the same rate, there would have been an extra 113,057 people in the workforce in 2000-2001, earning an average of \$663.10 per week (ABS, Average Weekly Earnings, May 2001). This would have produced \$3,898m in extra income. This estimate incorporates a factor for those who would reduce their workload, rather than stop work completely, as a result of the health impacts of their osteoporosis.

In addition, extrapolating out the data from the two weeks prior to the NHS, there would have been 162,344 cases off absenteeism from work in 2000-2001 due to osteoporosis, with an average of 2.9 days off for each case. The loss of production and earnings due to this absenteeism is also estimated using AWE as \$20.7 million over the year.

In total then, the lost of earnings from early retirement and absenteeism is estimated for 2000-2001 as \$3,919m.

Potential tax revenue sacrificed

There are two sources of lost tax revenue which result from the lost earnings itemised above—the potential income tax foregone and the potential indirect (sales) tax foregone. The latter is lost because, as income falls, so does consumption of goods and services. Table 9 summarise the tax losses of \$1.12 billion in 2000-01, comprising \$0.80 billion (71%) of personal income tax and \$0.32 billion of indirect tax (29%).

Table 9: Potential tax revenue lost due to osteoporosis, 2000-01

Potential Earnings Lost	\$3,919 million
Average personal income tax rate#	20.45%
Potential personal income tax lost	\$801.4 million
Average indirect tax rate#	15.18%
Potential indirect tax lost	\$323.4 million
Total potential tax revenue lost	\$1,124.9 million

Source: AEM Model, Access Economics.

The value of volunteer carers, modifications and devices

People with osteoporosis make modifications to their homes and purchase a variety of aids specifically designed to maximise independence and quality of life, ranging from non-stick hall runners, grab rails and stair lights to hip pads and walking frames. US studies have estimated the cost of these modifications and devices to be 4.4% on top of total direct costs. Using this estimate, in Australia for 2000-2001, the indirect cost of equipment and devices was \$81.7 million, or around \$43 per person with osteoporosis per annum.

In this study, the cost of volunteer carers is estimated as a residual of the indirect costs, as:

$$\begin{aligned} \text{Volunteer carers cost} &= \text{Total indirect costs} - \text{Earnings lost} - \text{Modifications/Devices} \\ &= \$5,574\text{m} - \$3,919\text{m} - \$82\text{m} \\ &= \$1,573\text{m or } \$822 \text{ per person with osteoporosis in 2000-01.} \end{aligned}$$

Further research is recommended to verify the carer cost component in Australia.

2.3 The Burden of Disease

Disease imposes burdens on patients that go well beyond the financial costs. There are over 1000 deaths each year from osteoporosis and associated falls.²⁴ There is no objective way to ascertain a financial value for the pain, suffering and premature death from diseases such as osteoporosis. However, the internationally developed "Burden of Disease" methodology (see Appendix) has become popular in Australia and overseas as a way of estimating the years of healthy life lost due to a disease, called the DALYs—or "disability adjusted life years".

DALYs have two components, the years of life lost (YLL) due to premature death, and the years of healthy life lost due to disability (YLD). DALYs, YLLs and YLDs provide an indicator that is useful in measuring the impact of disease and in making comparisons between diseases for health intervention purposes. The Australian Institute of Health and Welfare has provided some excellent analysis in this area.

Table 10: DALYs, YLLs and YLDs for osteoporosis, 2001

DALYs	Male	Female	Total
Osteoporosis (direct)	333	2,369	2,702
Chronic back problems	256	236	493
Other musculoskeletal	2,310	2,846	5,157
Falls (over 55 years only)	4,609	6,882	11,491
Secondary sources	2,253	3,700	5,953
Total	9,762	16,034	25,796
% of total DALYs	0.69%	1.29%	0.97%
YLL	Male	Female	Total
Osteoporosis (direct)	82	511	593
Chronic back problems	3	3	6
Other musculoskeletal	879	1,826	2,704
Falls (over 55 years only)	3,250	3,969	7,220
Secondary sources	1,264	1,893	3,157
Total	5,479	8,202	13,680
% of total YLL	0.69%	1.30%	0.96%
YLD	Male	Female	Total
Osteoporosis (direct)	250	1,858	2,109
Chronic back problems	253	233	487
Other musculoskeletal	1,432	1,021	2,453
Falls (over 55 years only)	1,360	2,912	4,272
Secondary sources	988	1,807	2,796
Total	4,283	7,832	12,116
% of total YLD	0.70%	1.27%	0.99%

Source: Mathers, Vos and Stevenson (1999) Annex tables for 1996 data with AE allocation to categories and forecast growth as per prevalence estimates.

²⁴ Mathers, C., Vos, T. and Stevenson, C. (1999), Annex Table E, pp216-217. Includes falls only for those over 55 years of age.

Mathers, Vos and Stevenson (1999) estimate the burden of disease in 1996 for a variety of disease and injury categories. Osteoporotic conditions are estimated here for 2001 from both musculoskeletal and injury categories as shown in Table 10 (on the previous page) which shows that 25,796 Disability Adjusted Life Years are lost due to osteoporosis. This represents 1% of the total burden of disease and injury in Australia. 62% of the burden of disease for osteoporosis is borne by women (16,034 DALYs), which is 1.3% of the total disease and injury burden of Australian women. The YLL due to premature death is largely a result of falls and osteoporotic fractures. Where osteoporosis is a result of secondary sources (such as rheumatoid arthritis and the drugs used to treat it) the mortality burden can be thought of as that proportion allocated to osteoporosis, although the primary cause of death is not osteoporosis.

Over half of the disease burden (53%) is due to premature mortality—13,680 Years of Life Lost—with the remaining 12,116 healthy Years Lost due to Disability (47% of the DALYs). Women bear a slightly higher proportion of the disability burden (65%) than of the mortality burden (60%). The disability burden (YLD) can be thought of as measuring suffering while still alive.

3 Australian Osteoporosis in Context

3.1 Comparisons with other Diseases

Musculoskeletal disorders are the third leading cause of health system expenditures in Australia, with an estimated total expenditure of \$3.0 billion in 1993-94, behind circulatory and digestive diseases (each about \$3.7 billion). Injury, which includes many osteoporotic fractures, is fourth (\$2.6 billion), ahead of mental illness (\$2.6 billion), respiratory disorders (\$2.5 billion) and disease of the nervous system (\$2.4 billion).

Table 11 shows the major categories and compares them with the costs of osteoporosis and osteoporotic disorders. Hospital and nursing home costs are relatively the most significant components. Osteoporotic costs, as a subcomponent of musculoskeletal and injury costs, are higher than those of diabetes (contained within the endocrine category) and of asthma (contained within the respiratory category), both of which are National Health Priority areas.²⁵

Table 11: Comparison of direct costs of disease and injury, '93-94

Disease category (ICD-9 chapter)	Total Costs	Dental &					
		Hospitals	Medical	Pharma- ceuticals	Allied Health	Nursing Home	Other
Circulatory#	3,719	1,657	503	715	40	587	218
Digestive	3,715	1,070	284	275	1,849	35	202
Musculoskeletal	3,002	1,207	518	276	416	430	154
Injury#	2,601	1,663	393	127	160	112	146
Mental#	2,586	1,007	432	198	83	718	147
Respiratory (inc. asthma#)	2,521	833	624	784	37	107	135
Nervous system	2,334	766	431	248	227	503	159
Cancer#	1,904	1,327	261	53	12	32	219
Genito-urinary	1,662	997	383	143	17	32	90
Symptoms*	1,334	478	426	302	57	5	66
Osteoporotic	1,305	673	154	86	76	246	71
Complications of pregnancy	1,051	941	32	11	6	0	60
Endocrine (inc. diabetes#)	966	235	222	309	54	47	98
Skin	956	336	247	259	56	6	53
Infectious	849	246	316	193	15	13	65
Perinatal	239	221	1	0	0	3	14
Blood	192	101	42	24	1	5	18
Congenital	159	116	18	2	0	13	8
Other	1,607	859	505	122	44	0	77
Total	31,397	14,062	5,640	4,042	3,075	2,647	1,932

National Health Priority areas * This category is for symptoms, signs and ill-defined conditions, including headaches, insomnia, abdominal pain, dizziness, virus and allergies, with no or trivial primary cause.

Source: Mathers and Penm (1999), p2 and AE estimates.

Comparing osteoporosis with the National Health Priority areas, in terms of prevalence, the NHS shows asthma to comprise only 30% of the respiratory category. High cost items within respiratory would also be the medical and pharmaceutical costs of colds, coughs, flu and hay fever, as well as the total costs of bronchitis, emphysema and sinusitis. Within endocrine disorders, total diabetes comprises 18% of prevalence; thyroid disease, gout, obesity and high cholesterol would be big-ticket

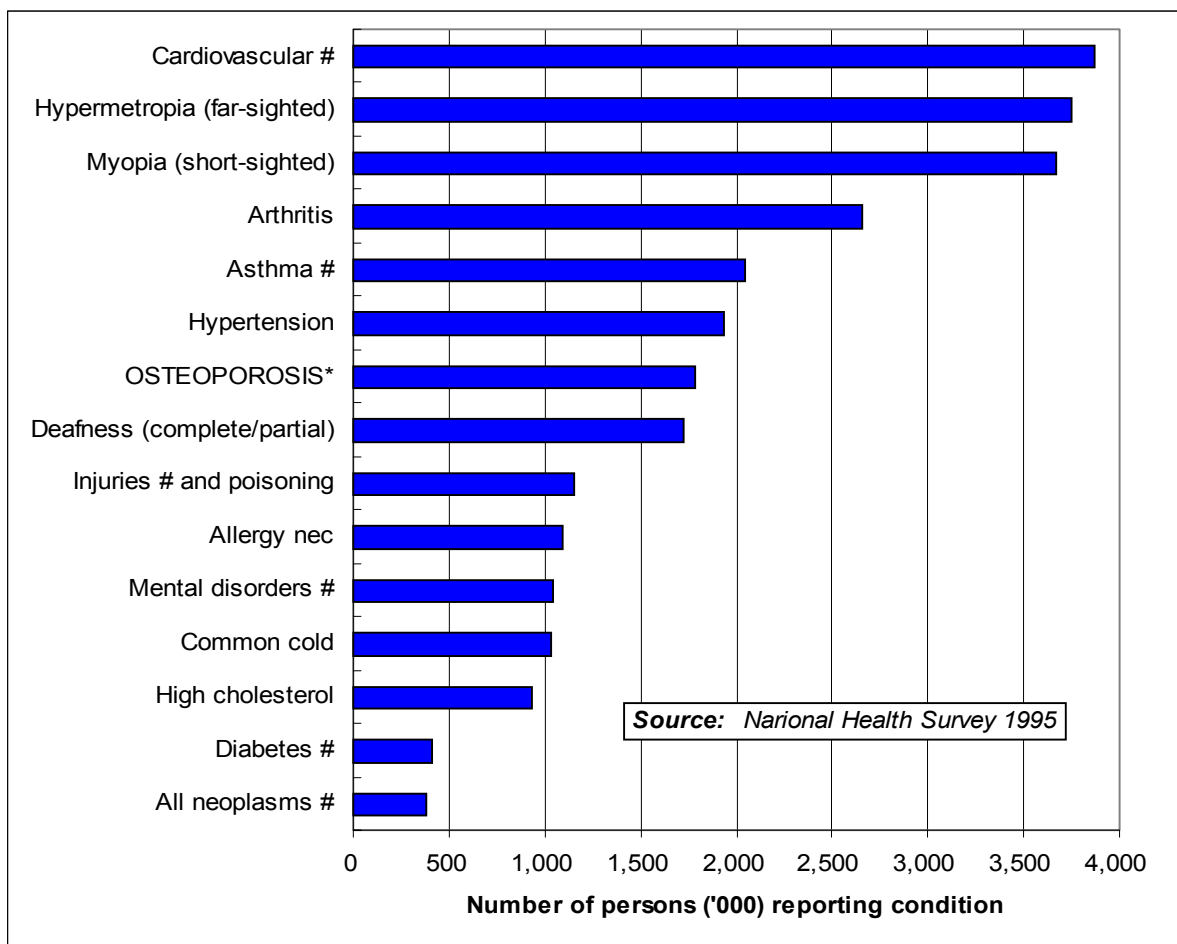
²⁵ There are six National Health Priority areas, cardiovascular disease, cancers, mental health, injury, diabetes and asthma.

items within this category also. Moreover, even though cardiovascular disease is the most prevalent condition, only 16% is due to heart disease and stroke, with the lion's share comprised of less serious disorders such as varicose veins and haemorrhoids. In fact, osteoporotic conditions are nearly as common as high blood pressure, and more common than high cholesterol, allergies and the common cold.²⁶

Osteoporosis is more common than the common cold...

Chart 3 compares the reporting of selected health conditions, including osteoporotic conditions.

Chart 3: Prevalence of selected conditions, 1995

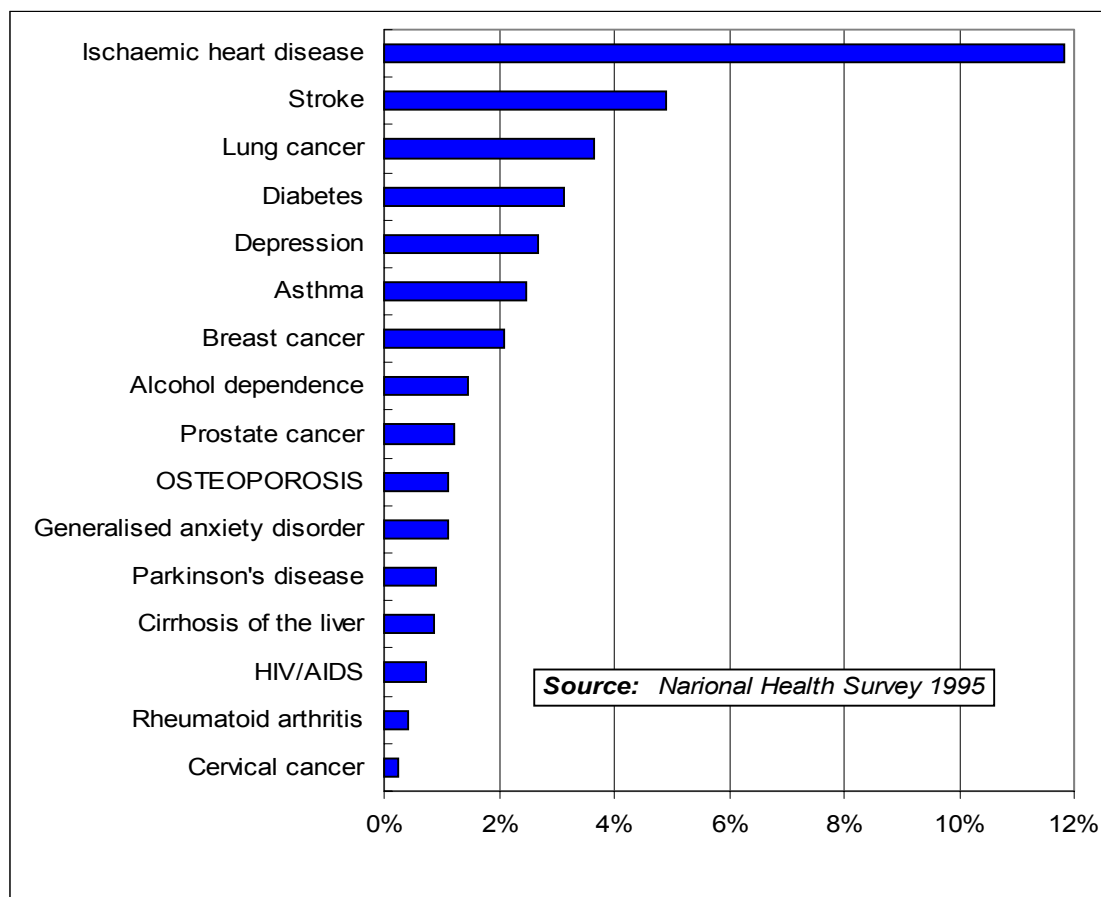


National Health Priority areas * AE estimate of prevalence including fractures and secondary sources.

In terms of the burden of disease, cardiovascular diseases (notably heart disease and stroke) account for over 20% of total Australian DALYs, with malignant neoplasms a further 19%. Mental illness is third (11.5% of DALYs) with injuries a close fourth (11.4%). However, the contribution of osteoporotic fractures to total injuries is relatively small, especially in comparison to the direct health system costs of osteoporotic conditions. This could be partly due to AIHW under-weighting of the disability burden of osteoporosis (see Appendix). Chart 4 compares osteoporotic conditions with other disease burdens.²⁷

²⁶ Hypertension prevalence was also 1.9 million, although for 1995. Source for comparisons is ABS (1997) p19-21.

²⁷ Undiscounted DALYs are used in this comparison.

Chart 4: Disease burden of selected conditions, 1996—% of total

Undiscounted DALYs. AE estimate for osteoporosis including osteoporotic fractures and secondary sources.

Chart 4 shows that osteoporosis has a greater disease burden in Australia than Parkinson's disease, HIV/AIDS, rheumatoid arthritis or cervical cancer, among others. Cervical cancer is an important comparison, as so much has been done towards its prevention, especially in terms of promoting Pap smear screening. Osteoporosis is over twice the disease burden, and could benefit from similar preventive efforts.

3.2 International Comparisons

Statistics from Europe and the US are comparable with the prevalence and cost estimates presented in this paper, showing diagnosed osteoporotic (i.e., low bone mass) conditions at around 10% of the population, with just under half of these diagnosed osteoporosis. Fractures occur to about 0.5% of the population per annum, with about two thirds of these hospitalised, and about 20% hip fractures. About 0.2-0.3% of GDP is spent on direct costs, with at least half of these in hospitals and nursing homes. Male-female ratios, mortality and morbidity are also comparable.

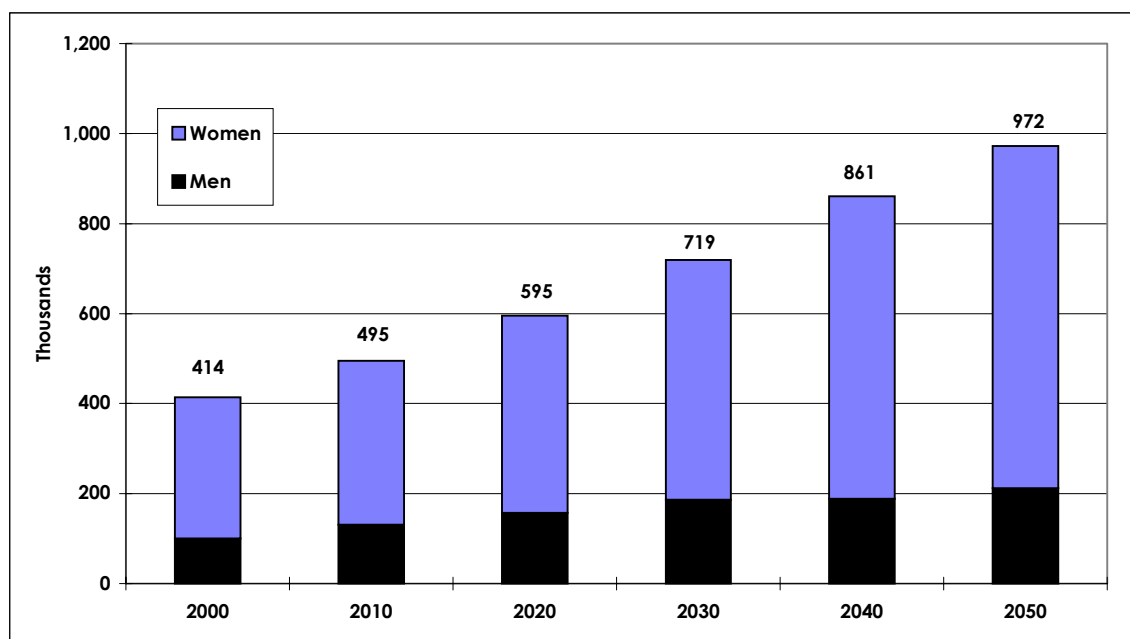
In response to these burgeoning problems, there has been a concerted public health response in Europe and the US. There has been nothing comparable in Australia.

Europe

The European Commission²⁸ (EC) reports that:

- Each year EC doctors treat over 1 million patients with osteoporotic fractures, including 414,000 hip fractures, with a fracture every 30 seconds²⁹;
- One in eight EC citizens over 50 will fracture their spines;
- Osteoporosis hip and spine fracture patients occupy 500,000 EC hospital beds costing national treasuries over 3,500 million ECU annually; and
- In the next 50 years, the number of hospital beds required is expected to double as hip fractures rise to 972,000 (see Chart 5).

Chart 5: 50 year forecast for hip fractures in the EU ('000)



The European Parliament has recognised that, despite considerable progress in understanding the causes, diagnosis and treatment of osteoporosis, many Europeans remain undiagnosed and untreated, and many EU member states still have poor diagnostic facilities and care.

“Osteoporosis is being put on the political agenda as a health issue...”

Dr Caroline Jackson, Member of the European Parliament³⁰

In view of the costs of osteoporosis (Chart 6 over the page), the EC Public Health directorate invited a multi-disciplinary team of experts to analyse the situation and report on action for osteoporosis prevention³¹, with recommendations summarised as follows:

1. The EC and member governments should explicitly adopt osteoporosis prevention as a major health care target and establish awareness campaigns. Prevention of osteoporosis should be a priority in health promotion, education and training of health care professionals.

²⁸ European Commission (1998).

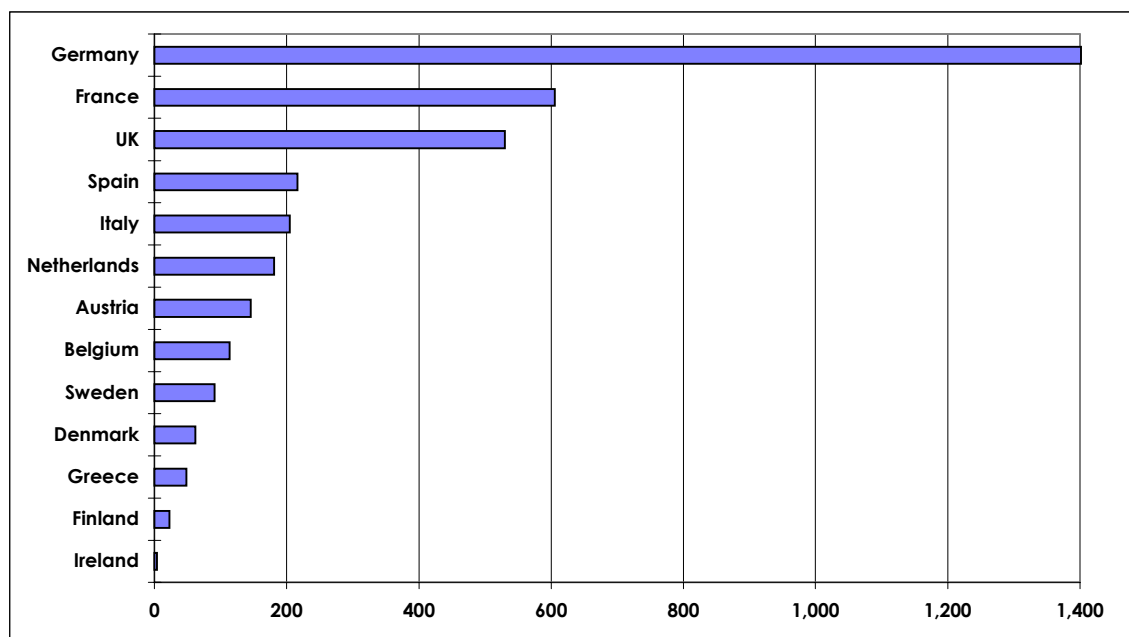
²⁹ Latter figure from WHO (1999b).

³⁰ IOF programmes and special projects, EC Report, on www.osteofound.org. Dr Jackson's mother died from complications of osteoporosis.

³¹ European Commission (1998). See also the specific recommendations of European Institute of Women's Health (1997).

2. The EC and member governments should establish co-ordinated data systems for monitoring fracture rates through information collection, causal research, assessment of preventive and treatment strategies, and cost estimations.
3. National systems should be co-ordinated throughout the EU to plan effectively for increasing demands on health care due to fracture increases and to institute appropriate resource reallocation.
4. Develop, integrate and implement policies to advise the public and health professionals about calcium and vitamin D nutrition, at all stages of life, as dietary deficiency is common, particularly in older people.
5. Make bone density measurements accessible and reimbursable for high-risk individuals, as access to and resources for these measurements in the EU member states are inadequate.
6. Develop and co-ordinate guidelines on criteria for standard treatment strategies (including non pharmacological and pharmacological interventions). Reimbursement should be available for approved treatments.
7. Promote national patient and scientific societies by providing financial support and helping them to publicise osteoporosis issues throughout the European Community.
8. To devise and implement better preventive strategies, fund further research in key areas including the effects of exercise, calcium and vitamin D on bone mass, prediction of fracture risk, osteoporosis screening, and causes and treatment of osteoporosis in men.

Chart 6: Hospital costs of hip fractures, 1996 (ECU'000)



Note: No national data were available for Portugal or Luxembourg. Austrian figures are based on German costs. Direct Hospital costs include surgery and post operative stay. Longer rehabilitation is not included. For Sweden and the UK where there are data available for additional hip fracture costs (e.g. primary care, outpatient care, institutional care), the total figure is 2.5 times greater than the direct hospital costs.

The UK has taken the EC recommendations to heart. In March this year national standards were set in the National Service Framework (NSF) for Older People, following impetus provided through the UK National Osteoporosis Society³². In the UK:

³² National Osteoporosis Society (2000), p5.

- There are 3 million people (5% of the population) with diagnosed osteoporosis and over 200,000 osteoporotic fractures per annum (0.34% population)—a fracture every 3 minutes;
- Hip osteoporotic fractures cost £1.7 billion per annum or £5 million per day (0.20% GDP for fractures only);
- One in three women and one in 12 men over 50 will have an osteoporotic fracture, while one in two women has a fracture before turning 70;
- Hip fractures account for more than 20% of orthopaedic bed occupancy;
- 50% of hip fracture patients lose the ability to live independently;
- up to 20% of hip fracture patients die within six months (14,000 people per year);
- 60% of UK women with vertebral fractures are not treated, although this predisposes them to further fractures;³³ and
- the number of fractures is increasing—hip fractures have increased from 10,000 a year in the 1960s to 70,000 a year now.

“Implementing the framework across primary care groups throughout England would cost only a fraction of what it currently costs to treat fractures.”

National Osteoporosis Society³⁴

The United States

The US National Institute of Health estimate that:

- 28 million Americans (10% of the population) are threatened by osteoporosis, including 10m who already have it and 18m more who have low bone mass;
- 80% are women;
- 1 in 2 women and 1 in 8 men over 50 will have an osteoporosis-related fracture in their lifetime;
- more than 2 million US men have osteoporosis, with 80,000 men suffering a hip fracture annually, of which one third will die within a year;³⁵
- there are over 1.5 million (0.54% of the population)³⁶ osteoporotic fractures annually including around 300,000 hip fractures, 700,000 vertebral fractures, 250,000 wrist fractures and 300,000 at other sites;
- direct costs for hospitals and nursing homes for osteoporosis and related fractures is \$US13.8 billion per annum—0.15% of GDP, or US\$38 million per day—and rising;³⁷
- in comparative terms, a woman's risk of hip fracture is equal to her combined risk of breast, uterine and ovarian cancer;
- one quarter of Americans who were ambulatory before a hip fracture require long term care afterwards;
- fear, anxiety and depression are frequently reported in women with established osteoporosis.

³³ NOS, “New £Billion Osteoporosis is a Burden”, Press Release, 8 December 2000.

³⁴ NOS, “First Ever Government Framework on Older People Tackles Costly Bone Disease” Press Release, 27 March 2001.

³⁵ Of US men who suffer hip fractures, over half are discharged to a nursing home or intermediate care facility, with 79% of those alive after a year still being there. See “Osteoporosis in Men”, NIH-OBDR-NRC (National Institutes of Health, Osteoporosis and Related Bone Diseases, National Resource Center) on www.osteoporosis.org/R615i.htm

³⁶ The estimate in Table 3 of 64,514 fractures hospitalised per annum would be 0.33% of the population.

³⁷ Assumes US GDP to be \$9.5 trillion. Other data from “Fast facts on osteoporosis” www.osteoporosis.org

The National Institutes of Health developed a consensus statement³⁸ on Osteoporosis Prevention, Diagnosis and Therapy in March 2000, which concludes that:

- Osteoporosis occurs in all populations and at all ages. Though more prevalent in white post-menopausal females, it often goes unrecognised in other populations. Osteoporosis is a devastating disorder with significant physical, psychological and financial consequences.
- The risks for osteoporosis, as reflected by low bone density, and the risks for fracture overlap but are not identical. More attention should be paid to skeletal health in persons with conditions known to be associated with secondary osteoporosis. Clinical risk factors have an important, but as yet poorly validated, role in determining who should have BMD measurement, in assessing risk of fracture, and in determining who should be treated.
- Adequate calcium and vitamin D intake are crucial to develop optimal peak bone mass and to preserve bone mass throughout life. Supplementation of these two components in bio-available forms may be necessary in individuals who do not achieve recommended intake from dietary sources. Gonadal steroids are important determinants of peak and lifetime bone mass in men, women and children. Regular exercise, especially resistance and high impact activities, contributes to development of high peak bone mass and may reduce the risk of falls in older individuals.
- Assessment of bone mass, identification of fracture risk and determination of who should be treated are the optimal goals when evaluating patients for osteoporosis. Fracture prevention is the primary goal in the treatment of patients with osteoporosis. Several treatments have been shown to reduce the risk of osteoporotic fractures. These include therapies that enhance bone mass and reduce risk or consequences of falls. Adults with vertebral, rib, hip or distal forearm fractures should be evaluated for the presence of osteoporosis and given appropriate therapy.

Future directions in the US include the following strategies and research goals:

- Strategies to maximise peak bone mass in girls and boys; research into risk factors (such as calcium and Vitamin D deficiency, gonadal steroid insufficiency, pubertal delay) and early interventions (eg, bisphosphonates for children);
- Identifying genetic risk factors including pharmacogenetic approaches;
- Research into the mechanisms and impacts of secondary and especially glucocorticoid-induced osteoporosis, with a view to development of glucocorticoids that do not adversely affect the skeleton;
- Epidemiological studies to more accurately identify fracture risks, including bone-dependent and bone-independent factors, to construct an algorithm for symptomatic and asymptomatic identification and treatment;
- Research and development of surrogate markers of bone turnover as a diagnostic tool for osteoporosis and fracture risk;
- Incorporation of quality of life measures as an outcome in clinical trials evaluating fracture risk and therapy;
- Research into the two-way links between neuropsychiatric disorders (including depression and anorexia nervosa) and osteoporosis or fracture risk;
- Development of a diagnostic and management paradigm for fractures, including their impact on the non-skeletal system and actions to prevent further fractures;

³⁸ National Institutes of Health (2000).

- Assessment of anabolic agents that stimulate bone formation, including growth hormones, PTH peptides (promising) and fluoride (not so promising);
- An urgent need for randomised clinical trials of combination therapy, including pharmacologic, dietary supplements and lifestyle interventions, to establish cost-effectiveness, and cost-effectiveness of bone health encouragement programs;
- Improved access to treatment regardless of income and geography, including through ongoing education of public and health care professionals and through improvements to the reporting of BMD and fracture risk so it is more communicable to medical personnel and patients;
- Study of the influence of nutrition on micro-nutrients and non-patentable medical interventions; and
- Further studies on the efficacy and safety of long-term administration of various drug interventions in maintaining BMD and preventing fractures.

3.3 Initiatives of The International Bone and Joint Decade

The World Health Organisation has defined osteoporosis as a priority health issue³⁹, affecting 150 million people worldwide, and filling more hospital beds than any other disease.⁴⁰ The International Osteoporosis Foundation (IOF) worked with WHO to develop the WHO's *Strategy for Osteoporosis* and Interim Report launched in 1999.

In Geneva in January 2000, WHO launched the International Bone and Joint Decade, 2000-2010—initiated because of “the epidemic of musculoskeletal disease that is occurring worldwide as the population ages.”⁴¹ Momentum for such an initiative has been building since the 1990 Global Burden of Disease Study revealed that musculoskeletal conditions represent more than half of all chronic conditions worldwide and are the most common cause of severe long-term pain and physical disability. The Bone and Joint Decade—which was launched in Australia in April—is largely a medical initiative seeking worldwide recognition for the prevalence and priority of musculoskeletal disease. The BJD covers more than 750 patient and professional member organisations worldwide.

In December 2000, the Second International Meeting on Social and Economic Aspects of Osteoporosis and Bone Disease was held in Liege, Belgium. The International Osteoporosis Foundation (IOF), at its Conference in Naples in May this year, articulated strategies for building on the political will in many countries to improve treatment access and reimbursement, and initiate osteoporosis prevention plans.⁴²

"Twenty-five years ago, the world's leading experts in cardiovascular diseases warned of an impending epidemic of heart disease in developing countries. This warning was largely ignored and we are now seeing a dramatic increase in prevalence of cardiovascular diseases in the developing countries. We must not allow the same thing to happen for osteoporosis. We must act now."

*Dr Gro Harlem Brundtland, Director-General of WHO*⁴³

³⁹ IOF, www.osteofound.org/what/ citation.

⁴⁰ IOF (2001), p1.

⁴¹ Hazes, J.M. and Woolf, A.D. (2000), p1.

⁴² IOF (2001).

⁴³ WHO (1999b).

4 Osteoporosis Australia: Mission, Vision, Directions

Osteoporosis Australia was established in 1995 in response to community demand for information about Osteoporosis. It is a national organisation with state offices in each capital city and is now the peak body representing consumers and professionals who have an interest in osteoporosis & fractures. Over the past 12 months Osteoporosis Australia (OA) has completely restructured with the appointment of a new CEO, board, Medical & Scientific Advisory Committee, Ambassadors and other committees.

Our vision—*'Healthy Bones for All Australians for Life'*

Our mission—*'to Reduce the incidence of Osteoporotic Fractures in the Australian Community by 20%, by the year 2010'*

Key objectives—

- To establish osteoporosis as a major health issue by 2002;
- To increase awareness of osteoporosis in all ages and genders;
- To improve prevention & management strategies; including increased access to diagnosis & treatment;
- To improve GP & other health professional awareness and knowledge of prevention and management strategies;
- To be an effective lobby voice in federal Government; and
- To directly support research initiatives investigating osteoporosis & fractures.

Awareness, Education, Prevention, Management, Advocacy, Research

The Imperative to Prevent and Treat

The burden of brittle bones that is evidenced in this paper requires that Government, business, corporations and community all work together to implement and fund initiatives that will prevent and treat fractures. We now have comprehensive statistical evidence of the enormous costs and burden that is due to osteoporosis and fractures. Specific programs must now be implemented to prevent that 'first fracture'.

Once the first fracture has occurred, the risk of another fracture within 12 months is about 30%. Bone loss predisposes to fractures and as we age the rate of bone loss accelerates. Considering current fracture statistics and our rapidly ageing population in Australia, the imperative to treat is vital. We now have medications that can prevent this progressive loss of bone in older persons. Some of these can reduce the risk of fracture (or further fracture) by as much as 50% within 12-18 months of commencing treatment.

Osteoporosis Australia—Achievements

- Implementation of a hugely successful National Media Campaign, through TV, print media and popular press;
- Launch of new national consumer magazine (with medical insert)—OSTEOBLAST. Going to every GP throughout Australia;
- Co-operation with state Osteoporosis Foundations to implement national programs & strategies, in particular, Self-Management Programs for consumers;
- 1800 national hotline number—in the marketplace for over 5 years;

- Production of new Falls Prevention Exercise Video;
- Winning the IOF-Lilly Policy Initiative Award for our Lobbying Strategy (Naples, May 2001);
- 'Bones & Joints' schools kit for primary age children;
- 'Falls & Fractures' kit for Retirement Villages & residential care;
- Position Papers for 'Osteoporosis & Men' and 'Corticosteroid Induced Osteoporosis'. Produced by the OA Medical & Scientific Committee and first published in AFP, August 2001;
- Co-hosting The Australian Fracture Prevention Summit, September, 2001, with the National Prescribing Service;
- Production of eight new fact sheets;
- Proposal for OA & NHMRC Joint Research Fellowship in 2001; and
- National Healthy Bones Week: an awareness raising program run every year in August in conjunction with the Australian Dairy Corporation.

Osteoporosis Australia—Strategic Plan

- Establish '1st Fracture clinics' in all teaching hospitals to identify this high-risk group of people with osteoporosis, and increase efforts to prevent future fractures, improve quality of life and prevent early death. Target particularly women with a first vertebral fracture;
- Work with government to change public health policy regarding prevention & treatment of fractures;
- Identify osteoporosis in men as a major target area and drive and support public health initiatives for men;
- Review item numbers for rebate for bone density scans;
- Review drugs available on PBS for treatment & prevention;
- Work with government and others to promote osteoporosis specific exercise programs for all ages;
- Promote NHMRC—special research initiatives in Osteoporosis and support for clinical research;
- Identify General Practitioner initiatives that will result in case-finding, early detection and more appropriate treatments being offered;
- Government and local health authorities to provide increased support for OA to support joint campaigns to increase awareness of the long term health risks of osteoporosis among target audiences and to encourage them to visit a GP;
- Develop a Community Awareness Campaign around osteoporosis risk factors; and
- Promote Osteoporosis as the 7th National Health Priority Area.

**many of the initiatives outlined above have already been proposed to Government & other key bodies*

5 Conclusions and Recommendations

Osteoporosis is a condition of low bone mass affecting nearly two million Australians, including 1.5 million people over 55 years and 1.5 million women. It causes bone fragility and an estimated 65,000 fractures in 2000-01. Vertebral fractures are the most numerous, while hip fractures are the most serious, leading to hospitalisation, long term nursing care, disability and, frequently, death. Other morbidity includes pain, anxiety and depression.

Demographic projections of population ageing indicate that, in the absence of immediate health interventions, the prevalence of osteoporotic conditions will continue to increase over the next two decades—from 10% of the population currently to 13.2% in 2021. Fracture rates will also continue to increase, from one every 8.1 minutes today, to one every 3.7 minutes in 2021.

The financial costs and disease burden of osteoporosis are summarised in Table 15 below. Total financial costs are \$7.4 billion per annum, of which \$1.9 billion are direct health system costs, including over \$1.3 billion in hospital and nursing home costs. A further \$3.9 billion is lost earnings due to early retirement and absenteeism, causing lost potential tax revenue of \$1.1 billion. Volunteer carers for people with osteoporosis are estimated to cost nearly \$1.6 billion per annum.

The disease burden is measured in terms of the years of life lost due to premature mortality (13,680) and the years lost due to disability (12,116). Together this represented over 25,000 healthy years of life lost to Australians in 2000-01.

Table 12: Summary of the costs & burdens of osteoporosis, 2000-01

	\$A million	% GDP	\$ per capita
Direct costs			
Hospitals	958		
Nursing homes	350		
Medical services	219		
Allied health	108		
Pharmaceuticals	123		
Research and other	101		
Total Direct costs	1,858	0.29%	\$97
Indirect Costs			
Early Retirement loss of earnings	3,898		
<i>On which</i> Loss of potential tax revenue	1,124		
Absenteeism loss of earnings	21		
Volunteer Carers	1,573		
Equipment and Devices	82		
Total Indirect Dollar Costs	5,574	0.88%	\$292
Total Dollar Direct and Indirect Costs	7,432	1.17%	\$389
Health Burden of Disease			
Year of Life Lost (YLL)	13,680		
Years Lost due to Disability (YLDs)	12,116		
Disability adjusted life years (DALYs)	25,796		

Causes of osteoporosis include age-related, hormonal, dietary, lifestyle and genetic factors. While some of these are not amenable to intervention, many are, with the implication that much osteoporosis could be prevented. Adequate intakes of calcium and Vitamin D are essential for healthy bones, as is exercise. Underlying medical conditions and use of medications that cause secondary osteoporosis need

to be recognised and treated. Education and awareness programs are essential in averting an osteoporosis epidemic. Because the risk of fracture increases significantly after the first fracture, a key strategy is in first fracture prevention.

Furthermore, osteoporosis often goes undiagnosed and untreated, although many excellent treatments are available. Despite the evidence, most women do not realise they are at risk of osteoporosis. Those diagnosed wish they had taken action earlier. The most effective measures in preventing and treating osteoporosis, based on current medical evidence, are potent bisphosphonates such as alendronate and risedronate, followed by Selective Estrogen Receptor Modulators (SERMs) such as raloxifene, then hormone replacement therapy (HRT) and etidronate. There are varying degrees of evidence for the effectiveness of these in preventing osteoporotic fractures and increasing bone density. Other less proven treatments include nutrition (calcium and Vitamin D supplements), lifestyle changes (including specific exercise regimes, quitting smoking), calcitonin, active Vitamin D metabolites and other drugs. Fall prevention strategies and hip protectors are emerging as effective treatments in preventing fractures.

Relative to other diseases, osteoporosis is an expensive disease, more costly than either diabetes or asthma, both of which are National Health Priorities. In terms of disease burden, more years of healthy life are lost in Australia due to osteoporosis than to Parkinson's disease, HIV/AIDs, rheumatoid arthritis or cervical cancer. Osteoporosis is more prevalent in Australia than high cholesterol, allergies or the common cold.

Statistics from Europe and the US are comparable with the prevalence and cost estimates presented in this paper for Australia, showing diagnosed osteoporotic (i.e., low bone mass) conditions at around 10% of their respective populations, with just under half of these diagnosed osteoporosis. Fractures occur to about 0.5% of the population per annum, with about two thirds of these hospitalised, and about 20% hip fractures. The rate of fractures is much higher due to higher absolute population numbers, with around one fracture every 30 seconds in the EU.

About 0.2% to 0.3% of GDP is spent on the direct costs of osteoporosis in both the US and the European Union, with at least half of these in hospitals and nursing homes. Male-female ratios, mortality and morbidity are also comparable. However, in response to these burgeoning problems, there has been a concerted public health response in Europe (particularly the UK) and America. There has been nothing comparable in Australia, although public sector focus is sorely needed.

The International Bone and Joint Decade, launched in Australia in April 2001, provides a timely platform to launch a more effective campaign against osteoporosis. Osteoporosis Australia, the peak body representing consumers and professionals who have an interest in osteoporosis and fractures, has set a target for the Decade to reduce the incidence of osteoporotic fractures in Australia by 20% by the year 2010. To achieve this objective, OA has developed a strategic plan that requires public support and joint cooperative efforts.

In light of the enormous and growing prevalence, costs and disease burden of osteoporosis and fractures in Australia, it is recommended that:

- 1) Osteoporosis is adopted by the Federal Government as a national health priority area by 2002, with commensurate funding;
- 2) A National Strategic Plan is agreed by the Federal Government and OA, to be launched on World Osteoporosis Day on 20 October 2001 for immediate implementation over the International Bone and Joint Decade;

3) This Strategic Plan should involve:

- awareness programs implemented through state osteoporosis organisations with national coordination through OA, including programs targeted at general practitioners;
- prevention and management strategies such as schools programs, first fracture clinics in teaching hospitals, specific exercise programs and falls and fractures programs for older populations in residential care;
- research initiatives in key fields in cooperation with NH&MRC;
- initiatives targeted at preventing and treating osteoporosis in men;
- review of PBS drugs and bone densitometry item MBS rebates;
- targeted campaigns for early detection of high risk people; and
- monitoring and evaluation of fracture rates, the cost effectiveness of treatments and the prevalence and burden of osteoporosis in Australia in 2005 and 2010.

If the cost and burden of osteoporosis is to be reduced, the commitment must be increased.

Appendix—Costing Methodology

Prevalence and Direct Costs

Most cost of illness studies employ the prevalence-based approach to estimating direct costs. The prevalence-based approach estimates the costs incurred for health services to prevent, diagnose and treat illness that is prevalent during the period.

The Australian Institute of Health and Welfare (AIHW), in collaboration with the National Centre for Health Program Evaluation (NCHPE), have used the prevalence-based approach since 1992 in the development of the Disease Costs and Impact Study (DCIS). This major study measures health services utilisation and expenditure for specific diseases and disease groups in Australia, in accordance with the Ninth Revision of the International Classification of Disease (ICD9) published by the World Health Organisation (WHO) in 1977.

The DCIS methodology has been gradually refined to estimate direct costs of hospitals, GP and specialist medical services, allied professionals, pharmaceuticals, nursing homes, research and other costs (such as administration), primarily from hospital morbidity data, case-mix data and the National Health Survey (NHS), as well as other sources. The DCIS methodology is detailed in Mathers et al (1998).

Classification of osteoporosis is difficult because osteoporotic conditions span a number of different ICD-9 categories. The National Health Survey classification only includes the barest minimum (category 733.0) in "osteoporosis" and even then, the nature of the survey questioning is not detailed—a "do you have any of the following diseases?" multiple tick question. A substantial amount of under-reporting could be expected, particularly in view of the large numbers of cases of failure to diagnose and failure to treat.

The AIHW hospital morbidity database was thus used to identify, in conjunction with epidemiological studies (in particular the Geelong Osteoporosis Study) and expert opinions, the proportion of other ICD-9 categories that could be expected to include osteoporotic conditions. These are listed in Table 13. However, even this falls short of total prevalence, as the data is based on hospital separations only and fails to account for conditions that are not hospitalised.

Moreover, because osteoporosis is frequently a secondary condition, it was also necessary to identify and allocate, again through epidemiology and expert opinion, the proportion of diseases whose primary classification is elsewhere, such as rheumatoid arthritis, stroke, cystic fibrosis, chronic obstructive pulmonary disease, ankylosing spondylitis, hyperthyroidism and so on, which result in low BMD. Prevalence and direct cost estimates were then adjusted by a factor to take account of these two effects.

Projections to 2001 are based on two inflators:

1. Population inflator—the Australian population grew 7% between late 1995 (the NHS period) and mid-2001, based on ABS estimates; and
2. Cost inflator—the Health and Community Services GDP deflator was used, which grew 30% between 1993-94 (the DCIS period) and 2000-2001.

The effect on prevalence of the demographic ageing of the population is taken into account in the demographic projections.

Table 13: ICD-9 categories included (in part) in cost estimates

Musculoskeletal	
724.1	Pain in thoracic spine
724.2	Low back pain
724.5	Backache, unspecified
724.6	Disorders of sacrum
724.9	Disorders of coccyx
733.0	Osteoporosis
733.1	Pathologic fracture
737.1	Kyphosis (acquired)
737.3	Kyphoscoliosis and scoliosis
737.4	Curvature of the spine associated with other conditions
737.8	Other curvatures of the spine
737.9	Unspecified curvature of the spine
Fractures	
805.2	Dorsal (thoracic), closed
805.4	Lumbar, closed
805.6	Sacrum and coccyx, closed
805.8	Unspecified vertebral column, closed
807.0	Rib(s), closed
808.2	Pubis, closed
808.8	Unspecified pelvic, closed
812.0	Humerus upper end, closed
812.2	Shaft or unspecified part, closed
813.0	Upper end radius and ulna, closed
813.4	Lower end radius and ulna, closed
813.8	Unspecified part of radius and ulna, closed
818.0	Ill-defined fractures of the upper limb, closed
820.0	Transcervical fracture, closed
820.2	Pertrochanteric fracture, closed
820.8	Unspecified part of the neck of femur, closed
821.0	Shaft or unspecified part of femur, closed
821.2	Lower end of femur, closed
823.0	Upper end tibia and fibula, closed
823.8	Unspecified part tibia and fibula, closed
824.0	Medial malleolus, closed
824.2	Lateral malleolus, closed
824.4	Bimalleolar, closed
824.6	Trimalleolar, closed
824.8	Ankle unspecified, closed
825.0	Fracture of calcaneus, closed
825.2	Fracture of other tarsal and metatarsal bones, closed
826.0	Closed fracture of one or more phalanges of the foot
827.0	Other, multiple and ill-defined fractures of the lower limb, closed

Indirect Costs

Measurement of indirect costs remains a matter of some debate and controversy. In Access Economics (1994), the Felts and Yelin "lifetime costs" approach was adopted which, based on US studies, indicated that indirect costs were 75-87% of total costs. Thus indirect costs of osteoporosis were estimated conservatively as three times the direct costs. Components of indirect costs include the following:

Lost earnings and production ('human capital'): This focuses on the loss of production or earnings associated with illness and premature death. The higher end of such estimates includes absenteeism costs plus the discounted stream of lifetime earnings lost. The lower end might include only the 'friction' period until the worker can be replaced, which would take account of labour market conditions and un(der)employment levels. The lower is unemployment, the more accurate is the former approach, which is adopted in this paper.

Social welfare payments: The sickness benefits and disability pension paid to those suffering from disease, as well as carer payments through Centrelink, is a cost to the tax-paying community, which could be put to alternative use. This is not estimated in this paper.

Carer costs, modifications and devices: For many illnesses such as osteoporosis, the patient is supported and cared for by a spouse, family member or significant other. Furthermore, people with osteoporosis may make modifications to their homes or purchase devices as a result of their illness. In so far as these costs do not enter the health care system, the under-estimation should be recorded in indirect costing.

Potential tax revenue foregone: People with osteoporosis who work less or retire early will not only forego income, but will also pay less personal income tax. The income tax foregone is a product of the average personal income tax rate and the foregone income. With osteoporosis and lower income, there will be less consumption of goods and services, estimated up to the level of the disability pension. Without osteoporosis, it is conservatively assumed that consumption would comprise 90% of income (the savings rate may well be lower than this). The indirect tax foregone is a product of the foregone consumption and the average indirect tax rate, as per the AE macroeconomic model incorporating changes to the tax system from 1 July 2000.

Burden of disease

In recent years, the World Health Organisation (WHO), the World Bank and Harvard University have developed a methodology that provides a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020.⁴⁴ This approach has been adopted and applied in Australia by the AIHW⁴⁵ with a separate comprehensive study in Victoria.⁴⁶

"Quality-adjusted life years (QALY) has evolved as the primary outcome variable, integrating effects of fracture reduction on both survival and quality of life."

Jonsson (2000)

Mathers, Vos and Stevenson (1999) estimate the burden of disease in 1996. Once again, the direct osteoporosis component is only for category 733.0 and so is understated. The same method as per prevalence and direct costs is used to locate other osteoporotic conditions within the classifications. There is a difference in the allocation of injuries, where fractures is not itemised by the AIHW. Analysis of the burden of disease from falls, however, shows a sharp rise in falls over age 55. For women, mortality from falls over 55 represent 97% of the total, while for men the figure is 77%.⁴⁷ Mortality and morbidity in these age groups is thus attributed as osteoporotic in the calculation of Years of Life Lost (YLL), Years Lost due to Disability (YLD) and Disability Adjusted Life Years (DALYs). The disability weight estimated by the AIHW for osteoporosis seems quite small (0.009) compared to, say that for symptomatic osteoarthritis (0.420), which is based on a Dutch weight.⁴⁸ Nonetheless it is used here due to lack of an authoritative alternative. The population growth factor used in projecting the estimates from 1996 to 2001 is 5.8%.

⁴⁴ Murray, C.J. and Lopez, A.D. (1996)

⁴⁵ Mathers, C., Vos, T. and Stevenson, C. (1999)

⁴⁶ The Victorian study is available on www.ibdn.net/morbidity

⁴⁷ Mathers, C., Vos, T. and Stevenson, C. (1999), p217.

⁴⁸ *Ibid*, p199.

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