OSTEOPOROSIS NEW ZEALAND INC
Building a stronger future

The Burden of Osteoporosis in New Zealand: 2007 - 2020

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1 Executive Summary

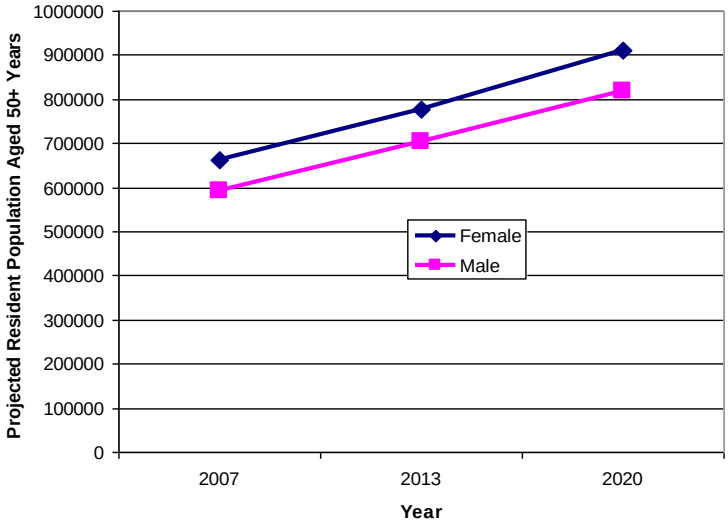
- Osteoporosis is internationally recognized as a serious health condition in developed countries. The impact of osteoporosis is far greater than many other high profile conditions, including breast and prostate cancers.
- Until now the burden has been unknown in New Zealand. Furthermore, because the diagnosis of the condition is not regularly funded by the Public Health system, has been difficult to estimate. However estimates of the burden are now showing similarity with other developed countries.
- Many osteoporotic fractures are preventable – essentially "the disease we *don't* have to have". Like the major epidemics of the past, targeted health interventions now could drastically curb the incidence of osteoporosis, fractures and morbidity, which in New Zealand currently stands at one hip fracture every two hours.
- This year about 80,000 New Zealanders will break bones because of osteoporosis, and about three quarters will be women.
    - That is a fracture every 6 minutes, and if nothing is done, this will increase to 120,000 people by 2020, with a fracture every 41/2 minutes.
- Moreover, osteoporosis is an expensive disease in relative terms. The cost of treating fractures is estimated to be over $300 million per annum. The total cost is estimated to be over **$1.15 billion** per annum in health costs, with a heavy burden on hospitals and nursing homes.
- Osteoporosis costs New Zealanders 12,000 years of life in 2006-07, 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 life are lost in New Zealand due to osteoporosis than to Parkinson's disease, HIV/AIDS, rheumatoid arthritis or cervical cancer.
- Fracture rates due to osteoporosis are comparable with those identified elsewhere, including Australia, the US and Europe. The international osteoporosis epidemic has become widely acknowledged, with the International Bone and Joint Decade (2001-10) launched to counter the burgeoning problems of the disease.
- Most fractures are seen later in life, but the foundations of bone health are laid down in childhood, adolescence and young adulthood, and so osteoporosis is sometimes referred to as a pediatric disease.
- If preventative action is taken now, the health burden and financial burden of osteoporosis for New Zealanders can be significantly reduced in the future.
- In view of the enormous costs and health burden of osteoporosis, it is recommended that:
    - The diagnosis of osteoporosis by DXA scan be funded for women over 50 years who have experienced a low trauma fracture
    - Active steps to increase awareness the population and health professionals of the significant health burden of osteoporosis should be taken without delay, and
    - Osteoporosis be adopted by Government as a national public health priority with commensurate funding.

2 Understanding the burden of osteoporosis

Osteoporosis is a skeletal disease associated with low bone density and disruption of bone architecture. Although bones naturally lose density and weaken with age, osteoporosis, especially if severe or accelerated, is seen as a significant issue for the public health system for two reasons. First, osteoporosis is associated with an increased risk of fractures (particularly fractures of the hip and vertebra), and these fractures result in significant decrease in quality of life and premature mortality. The impact of fractures can last for years, and some fractures can lead to premature mortality. Thus, the potential impacts on the health of those who suffer from osteoporosis make the condition a cause of concern.

Yet in addition to the impact on those who suffer from the condition, osteoporosis is seen as a significant issue for the public health sector as well. The reason is that as the number of older (50+ years) New Zealanders increases (Figure 1), so too will the burden of the disease on the public health system. This makes the condition a cause of concern for all New Zealanders, regardless of whether they suffer from the condition or not.

Figure 1: Projected resident population aged 50+ years in 2007, 2013 and 2020



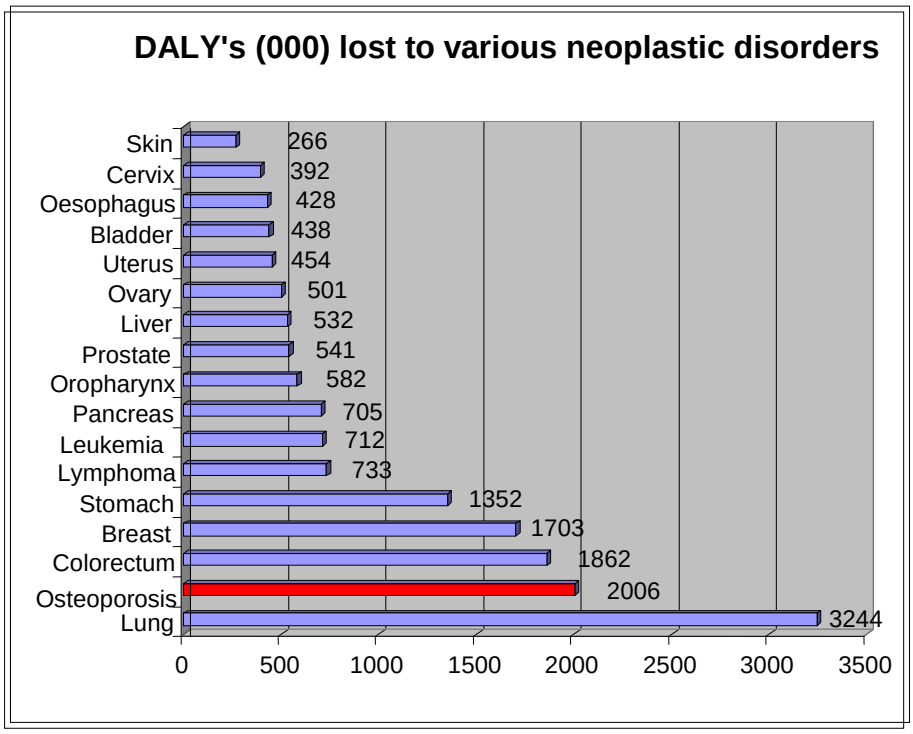
International studies have identified osteoporosis as a significant public health issue in most developed countries. Figure 2, for instance, shows the Disability Adjusted Life Years (DALYs) lost to various disorders in Europe (Johnell and Kanis, 2006). Osteoporosis ranks between lung cancer and colorectal cancer in terms of the number of DALYs lost.

The burden of osteoporosis in New Zealand has not previously been quantified. While evidence from other countries suggests that it is likely to be significant, identifying the burden requires considering factors such as the age of population and the health services and treatments that are available to the general public. This report describes the current and future burden of osteoporosis, focusing first on the mortality and morbidity associated with the condition and then the economic burden on the public health system in New Zealand.

The burden of osteoporosis is reported for 2007 and then projected for 2013 and 2020. As described below, it is estimated that there will be over 84,000 osteoporotic related fractures in New Zealand in 2007, including over 3800 hip fractures (the most serious type of osteoporotic fracture). The cost of treating

these fractures is expected to exceed $300 million, with another $33 million spent on treatment and management of the condition and over $800 million to treat and manage secondary illnesses related to osteoporosis. If nothing is done, these numbers are expected to increase significantly by 2013 and 2020.

Figure 2. **Disability-adjusted life years lost to osteoporosis and various neoplastic disorders in Europe (taken from Johnell and Kanis, 2006)**



The conclusion that the loss in quality of life and health expense due to osteoporosis will increase in the future is based on the assumption that New Zealand does nothing to stem the tide. However, the future impacts are only projections and the good news is that a number of treatments and interventions have been shown to be effective and cost-effective in treating and preventing fractures due to osteoporosis. Thus, the burden can be reduced if New Zealanders choose to take steps to combat and stem the condition.

The purpose of this report is therefore to help New Zealanders understand the health and economic burden of osteoporosis in New Zealand so as to guide decisions about actions that can be taken to diagnose, prevent and treat the condition. The information in this report describes not only the size of the problem, but also the potential gains that might be made from taking actions to prevent or reduce the adverse health effects resulting from osteoporosis.

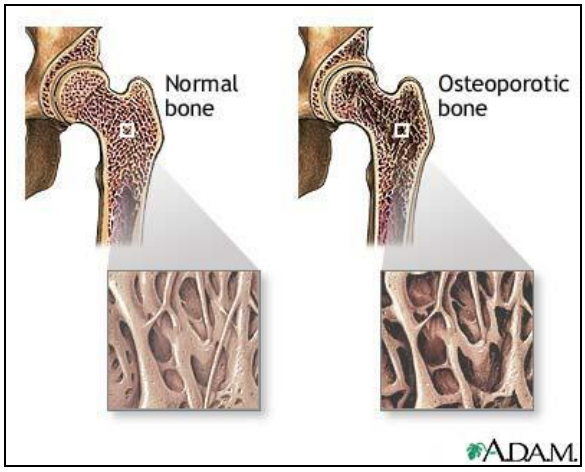
3 Background

3.1 What is osteoporosis?

Bone is living, growing tissue made mostly of an organic matrix (protein *collagen)*, bone cells and bone minerals. Bone cells consist of osteoblasts (bone forming cells) and osteoclasts (bone resorption cells) (WHO, 2003). The bones that form the skeleton of the human body undergo a continuous process of modelling during childhood and adolescence (Office of the Surgeon General, 2004). The mechanical competence of the skeleton is maintained by the process of remodelling where osteoclasts remove old bone which is replaced by new bone formation by osteoblasts (Compston, 2004). Formation of new bones on one site, and removal of old bone at another site on the same bone, allows for bone growth and repair (Office of the Surgeon General, 2004). During the first three decades of life there is bone growth, with relative balance occurring (under normal circumstances) between 20-40 years of age (Compston, 2004).

Peak bone mass, the point at which bones have their maximum strength, is attained at the third decade of life (Compston, 2004). With higher peak bone mass, the impact of subsequent bone loss is lessened, and therefore the risk of fracture is reduced (Compston, 2004; Poole & Compston, 2006; WHO, 2003). Bone mineral density (BMD) is often used as a surrogate measure of bone strength. Bone loss starts to occur when there is increased bone resorption that is not followed by equivalent bone formation. This bone loss gives rise to porous bones, or osteoporosis, as shown in Figure 3 (Compston, 2004). Bone loss is often gradual and without warning signs until the disease is advanced (WHO, 2003). For this reason, osteoporosis has become known as “the silent thief” (Munch & Shapiro, 2006).

Figure 3: Normal bone compared to osteoporotic bone (Image from A.D.A.M. Inc.)



3.2 Types and causes of osteoporosis

There are three types of osteoporosis, relating to different causal factors:

- **Post-menopausal/Age Associated:** Women often develop an accelerated bone loss around menopause due to reduced oestrogen levels (WHO, 2003). Age associated osteoporosis appears with advancing age (Manuele et al., 2007). Most age-associated osteoporosis in women is post-menopausal, so these types are often not treated as separate.
- **Idiopathic:** Refers to cases where there is no known aetiological reason identified for osteoporosis (Manuele et al., 2007).
- **Secondary:** There are a number of diseases and conditions associated with increased risk of secondary osteoporosis, including endocrine disorders (e.g., thyrotoxicosis and insulin-dependent diabetes mellitus), gastrointestinal disorders (e.g., Coeliac disease and Crohn's disease), metabolic and nutritional disorders (e.g., Haemophilia and chronic renal disease, anorexia and bulimia), neoplastic and various other conditions. In addition, a number of common drugs are associated with increased risk of secondary osteoporosis, including glucocorticosteroids, anticonvulscents, gonadotrophin-releasing hormone agonists and oestrogen antagonists (e.g., Tamoxifen).

This said, osteoporosis is generally viewed as resulting from a combination of age-related, hormonal, dietary, lifestyle and genetic factors, all of which can lead to reduced bone mass (Compston, 2004).

3.2.1 Genetics

Some of the variability in bone mineral density may also be genetically determined. Evidence of this comes from the fact that a family history of fragility fracture is strongly associated with fracture risk (WHO, 2003). Populations with higher body weights also have higher bone mineral density. This is particularly relevant in New Zealand, where Maori and Pacific peoples tend to have greater bone density than people of European origin. The prevalence of osteoporotic fractures in immigrant populations (including Asian populations in New Zealand) tends toward that of the host nation, suggestion a strong influence of lifestyle.

3.2.2 Age

Peak bone mass is one of the main determinants of fracture risk due to osteoporosis later in life (WHO, 2003). Bones become larger, heavier and denser, until peak bone mass is reached in our third decade (20 to 30 years of age) of life (Compston, 2004). After that, resorption begins to exceed formation, and bones gradually lose their strength. With lower peak bone mass there will be an increased risk of osteoporotic fractures from this natural age-related loss of bone mass (WHO, 2003). This also means that the longer we live, the more likely we are to have an osteoporotic fracture, regardless of peak bone mass.

3.2.3 Lifestyle

Lack of physical activity, and particularly weight-bearing resistance-training, is another important determinant of bone loss (WHO, 2003). For example, patients confined to bed and astronauts under weightless conditions lose as much as one percent of their trabecular bone per week (Cummings, Kelsey, Nevitt, & O'Dowd, 1985). Studies comparing athletes with normal controls have also shown that athletes have a higher bone mineral density than non-athletes (Cummings, Kelsey, Nevitt, & O'Dowd, 1985; WHO, 2003).

3.2.4 Hormones

Osteoporosis is three times more common in women than in men (WHO, 2003), partly due to oestrogen deficiency that accelerates bone turnover during menopause. Women lose bone density two to four times faster after menopause than before, so that some women have lost half their skeletal mass by age 65. Early or surgically induced menopause or amenorrhea increases the risks of osteoporotic fractures, as do decreases in oestrogen resulting from anorexia nervosa or exercise induced amenorrhea (WHO, 2003).

Male hypogonadism, manifested by a decrease in testosterone levels, contributes to the development of osteoporosis in males in their later years. Declines in testosterone with age occur more slowly in men than the sharper decrease in oestrogen at menopause. This combined with a higher peak bone mass and shorter life expectancy are contributing factors to a lower rate of osteoporosis presentation in men (Levy et al., 2002; WHO, 2003).

Other hormonal events or conditions that increase the risk of osteoporosis are thyroid conditions and conditions that increase glucocorticoid levels. Primary hyperparathyroidism and hyperthyroidism increase the rate of bone turnover, whereas glucocorticoids reduce bone formation (WHO, 2003).

3.2.5 Diet

Bone is constructed mainly of calcium and phosphate deposited in a matrix of protein (Cummings, Kelsey, Nevitt, & O'Dowd, 1985). Almost all of the body's calcium is present in the bones and teeth (WHO, 2003). Adequate calcium balance depends on dietary intake, absorption and excretion. Inadequate calcium intake or calcium absorption is a major risk factor for osteoporosis (Cummings, Kelsey, Nevitt, & O'Dowd, 1985). With age, calcium intake falls (on average to about half that of RDI for those older than 60) and the ability to adapt to a low calcium diet and calcium absorption are decreased.

Vitamin D deficiency also results in bone loss (WHO, 2003). Vitamin D is produced in the skin on exposure to ultraviolet rays. The efficiency of this process is reduced with age, skin pigmentation and extensive use of sunscreens applied to the skin and reduced exposure to sunlight (WHO, 2003). There are reports of increasing vitamin D deficiency in many population groups. Some of these groups are represented in New Zealand, including those suffering reduced Vitamin D due to reduced ultraviolet exposure in Southern latitudes and in certain ethnic groups.

3.2.6 Cigarette smoking

Smoking reduces bone mineral density (WHO, 2003), with bone density diminishing by 2% for each 10 year increase in age in smoking women. For instance, by 80 years of age, women who smoke will have 6% less bone density than women who do not smoke (Law & Hackshaw, 1997).

3.3 Diagnosis

Osteoporosis results in lower bone density and disruption of bone architecture. It is usually diagnosed through the measurement of bone mineral density. Although there are several ways to measure bone density, the recommended approach is through a single or dual energy X-ray absorptiometry (SXA and DXA scans). These scans examine the bone mineral content by the area or volume measured. SXA is used in measuring bone mineral density at appendicular sites such as heel and wrist. DXA measures bone mineral density at other sites such as the spine and hip.

Bone mineral density decreases with age. All individuals can expect a loss of BMD as they get older. Thus, a reduction in bone mineral density alone is not sufficient to diagnose an individual as having osteoporosis.

Traditionally, this determination is made using the World Health Organisation's definition of osteoporosis - bone mineral density at the time of diagnosis that is 2.5 or more standard deviations below the normal 'age-matched' peak bone mass (WHO, 2003). The determination of the normal peak bone mass is derived from the measurement of a representative sample of men or women aged 20-29 years, meaning that the diagnosis is made by comparing loss of bone mineral density to this criterion.

The New Zealand Health Survey (2002/03) asked people whether they had been told by a doctor that they had osteoporosis. As shown in Table 1, it is estimated that approximately 70,000 people 50+ years are diagnosed with osteoporosis in 2007, almost 90% of them being female. Approximately 20,000 diagnoses are associated with a fracture, but another 50,000 had their diagnoses initiated through other means. Some (though probably not all) would have had the diagnosis confirmed by DXA scan, though the precise number is difficult to estimate. (See Appendix B for a description of the methodology).

In New Zealand, diagnosis of osteoporosis is usually made using DXA scans. Many individuals who may have osteoporosis are not investigated for and therefore cannot be diagnosed as having osteoporosis. . For every person who is diagnosed there are an unknown number of people at risk for osteoporotic fractures who remain undiagnosed.

Table 1: Estimated number of men and women diagnosed with osteoporosis in New Zealand in 2007 (from New Zealand Health Survey 2002-2003)

Men	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85 +	TOTAL
Diagnosed by fracture	903	1046	9	1082	407	11	0	474	**3932**
Diagnosed other	467	1363	982	12	0	1255	1100	273	**5452**
Diagnosed	1370	2409	991	1094	407	1266	1100	747	**9384**
Women	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
Diagnosed by fracture	1175	1100	3285	1458	2749	1907	1284	2498	**15456**
Diagnosed other	3662	5043	5269	5110	7472	6532	8159	4544	**45791**
Diagnosed	4837	6143	8554	6568	10221	8439	9443	7042	**61247**
TOTAL	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
Diagnosed by fracture	2078	2146	3294	2540	3156	1918	1284	2972	**19388**
Diagnosed other	4129	6406	6251	5122	7472	7787	9259	4817	**51243**
Diagnosed	**6207**	**8552**	**9545**	**7662**	**10628**	**9705**	**10543**	**7789**	**70,631**

3.4 Predictors of osteoporotic fractures

The primary cause of mortality and morbidity associated with loss of bone density results from the increased likelihood of fractures, and there are numerous other risk factors associated with fractures, including (Melton, 2000):

- Age
- Previous fractures
- Self-rated health

- Smoker
- Weight gain since age 25 (protective)
- Height
- Socioeconomic status

However, BMD is the most significant single risk factor in predicting the likelihood of osteoporotic fractures (although many fractures occur in those who have normal BMD especially at menopause). The risk of fractures increases with any BMD loss. For instance, the risk of a hip fracture increases 2.6 fold with each standard deviation decrease in bone mineral density, and the risk of other types of fractures increases by 1.6 fold for each standard deviation decrease (Johnell et al., 2005; Marshall, Johnell, & Wedel, 1996).

As the risk of fractures increases with any BMD loss and continues to increase past the point of 2.5 standard deviations below peek BMD (the WHO definition of osteoporosis), there is some debate over the usefulness of the defining 'osteoporosis' as a condition. According to this view, bone loss and bone density are important factors, but the focus should be on the increased risk associated with ***any*** bone loss, not just the bone loss that is 2.5 standard deviations below an average (Johnell et al., 2005; Marshall, Johnell, & Wedel, 1996; Richards et al., 2007; Schuit et al., 2004). Interventions to reduce fractures should include all the factors that predict fractures, not just those related to osteoporosis.

Despite this, the WHO's definition of osteoporosis is still useful. The point of 2.5 standard deviations does represent a point at which there is a significantly increased risk of fracture. Thus, an individual meeting the criterion of osteoporosis runs a significant risk of suffering a fracture. It is important for individuals to understand their condition and health status so that they can take actions to reduce their chance of suffering a fracture. The diagnosis conveys information about the extent of their risk. The definition is also useful for health funders and decision makers who require a measure of the extent of the problem when prioritising health spending.

4 Burden of osteoporosis: Morbidity and morbidity

4.1 Morbidity: Bone fractures

As stated above, the main burden of osteoporosis results from fractures due to reduced bone mineral density and other risk factors (WHO, 2003). For instance, a longitudinal study of an elderly population (60 years old and above) showed that 1 in 2 women and 1 in 3 men will sustain an osteoporotic fracture at some point in their lives (Jones et al., 1994). After one vertebral fracture, the risk of another fracture within 12 months increases over four fold (Osteoporosis Australia, 2001). There is also a large increase in fracture risk after the first hip fracture.

From middle-age onwards, osteoporotic fractures cause increasingly significant morbidity since musculoskeletal damage is more likely to result in long term disability. The most commonly occurring osteoporotic fractures occur in the hip, spine and forearm (Kanis et al., 2001). Although all types of fractures are associated with significant pain and loss of quality of life (Rabenda et al., 2007), hip fractures result in the most serious disabilities (Pasco et al., 2005; Taylor et al., 2004). An estimated 50% of individuals require long-term care after a hip fracture (Osteoporosis Australia, 2001) and hip fractures often lead to an earlier death (approximately 25% of people suffering from a hip fracture dying within 12 months of sustaining a fracture; Kanis et al., 2003). For those who live, fractures can result in a loss of function, consistent pain and deformity. It also leads to reduced activity levels due to fear of suffering another fracture. This can lead to significant psychological issues among people with osteoporosis (Gold & Solimeo, 2006). There is also evidence that all fractures are associated with increased mortality (Pongchaiyakul et al., 2005).

4.1.1 The Incidence of osteoporotic fractures in New Zealand

There are two challenges faced when estimating the number of fractures due to osteoporosis in New Zealand.

1. The under-diagnosis of osteoporotic fractures. The diagnosis of osteoporosis can be an expensive and time consuming process. As a result, a formal diagnosis of osteoporosis is often not conducted, meaning it is difficult to ascertain from hospital or primary care records alone whether osteoporosis was a contributing factor to the fracture. Another commonly omitted contributory factor for fracture is the severity and/or nature of the force that lead to the fractures (e.g., fracture resulting from a trip from less than standing height might indicate a fragility fracture). This can make it difficult to discern whether osteoporosis was a contributing factor.
2. The under-reporting of fractures. The major source of information on fractures in New Zealand comes from the National Minimum Data Set (discharge records from all events in public hospitals). While some types of fractures, such as hip fractures, nearly always result in hospitalisations, many other fractures may be left un-treated or be treated in a primary care or A&E clinic. Basing incidence estimates on recorded hospitalised fractures can significantly under estimate the prevalence of osteoporotic fractures.

This report overcomes these obstacles using a methodology employed elsewhere to extrapolate the number of all common osteoporotic fractures (e.g., (Johnell & Kanis, 2006).

Hip fractures nearly always result in a hospitalisation and therefore represent a relatively accurate estimate of the number of this type of fracture, the incidence of hip fractures between 2003 and 2005 was taken from the National Minimum Data Set (NMDS). This was then used to estimate the number of hip

fractures per 10,000 of the population (by age and ethnicity) in New Zealand. This information was then combined with NZ Census information (including projections by age, gender and ethnicity) to get the expected number of hip fractures in 2007, 2013 and 2020. The number of other types of fractures was then estimated using information from previous studies (Kanis, Oden et al, 2001) on the ratio of hip fractures to other types of osteoporosis fractures. This provided an estimate of the number of all common types of osteoporotic fractures in each age group.

This methodology assumes that the relationship between hip fractures and other fractures is the same in New Zealand as in other countries, without any adjustments for a different lifestyle (although it does account for ethnicity, age and gender). Details of the methodology are provided in Appendix B.

4.1.2 Incidence of hip fractures from all causes: 2003 to 2005

Table 2 and Table 3 show the annual hip fracture incidence (per 10,000 people) for females and males respectively, between the years 2003 and 2005. The results show that hip fracture rates increase with age and are much more common in people of European origin. On average the fracture rates for Europeans were approximately 30% higher than for Maori, Pacific and Asian peoples. The results also show that the fracture rates for females were approximately 70% higher than for males. It should be noted that cohort group effect and small numbers of hip fractures in some age bands may be a potent confounder for ethnic minorities and the very old.

Table 2: Annual Female hip fracture incidence between 2003-05 by age band and ethnicity (per 10,000)

Age Group	European	Maori	Pacific	Asian
50-54	1.19	1.58	0.64	1.06
55-59	3.28	2.15	3.31	2.19
60-64	5.81	7.18	4.55	3.85
65-69	12.11	8.18	2.90	9.62
70-74	27.76	14.02	20.83	20.29
75-79	65.43	39.06	34.38	44.74
80-84	132.80	84.85	70.59	109.52
85-89	242.44	153.33	150.00	150.00
90+	359.16	200.00	100.00	250.00

Table 3: Annual Male hip fracture incidence between 2003-05 by age band and ethnicity (per 10,000)

Age Group	European	Maori	Pacific	Asian
50-54	1.99	1.39	1.28	1.53
55-59	3.95	3.05	1.72	0.00
60-64	4.39	7.14	3.61	0.84
65-69	8.11	8.39	10.34	5.94
70-74	15.52	12.09	21.05	9.38
75-79	35.73	22.92	13.64	25.00
80-84	82.30	60.00	33.33	50.00
85-89	158.21	66.67	66.67	100.00
90+	264.12	100.00	*	33.33

*No fractures reported in this age group

4.1.3 Incidence of fractures in New Zealand: 2007

Combining the information provided in Tables 2 and 3 with information on the projected population in New Zealand (by age and ethnicity) in 2007 provides an estimate of the number of hip fractures that can be expected in New Zealand in 2007. As in previous studies (e.g., Jones, et al, 1994; Kanis et al, 2000; Kanis, Oden et al, 2001), it is assumed that all hip fractures in this age group are attributable to osteoporosis. While this approach has been recognised as creating a slight upward bias in the number of hip fractures for younger ages, it is thought to balance out by missing some hip fractures in older individuals (especially those in residential care) that are not diagnosed or are not referred to hospital (e.g., remain in a residential care facility). Using this approach, there are estimated to be 3803 osteoporotic hip fractures in New Zealand in 2007 (Table 4).

Identifying the number of other types of fractures due to osteoporosis is more problematic because of underreporting and misdiagnosing. As described in Appendix B, the approach used here follows that used in previous studies (e.g., Kanis, Oden et al, 2001), namely using the ratio of osteoporotic hip fractures to other osteoporotic fractures receiving treatment to estimate the number of osteoporotic fractures receiving treatment in hospitals in New Zealand, and using the estimates from previous studies of the number of vertebral and other types of osteoporotic fractures (e.g., ribs, wrist and forearm) receiving treatment to estimate the total number of osteoporotic fractures in New Zealand in 2007. For instance, Kanis, Oden et al (2001) estimate the ratio of osteoporotic rib fractures receiving treatment to osteoporotic hip fractures to be 1.72 , suggesting that there are approximately 3780 osteoporotic rib fractures receiving treatment each year. However, it is estimated that only 18% of all osteoporotic rib fractures present to hospital, meaning that there is an estimated 21000 rib fractures in New Zealand in 2007 (see Appendix C).

The estimated total number of osteoporotic fractures is show in Table 4. In all, there will be approximately 84,354 osteoporotic fractures in New Zealand in 2007. As shown in Appendix B, only 5% of the total fractures are hip fractures, with vertebral (33%), rib (25%) and forearm (14%) being the most common type of fractures. 60% of the fractures will happen to women.

Table 4: Total projected osteoporotic fracture incidence in 2007

Men	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85 +	TOTAL
Hip	29	46	45	68	95	173	266	384	**1106**
Vertebra	1687	1001	953	751	1191	1429	1616	1775	**10405**
Other	2513	4192	1411	2048	1604	1654	3506	3476	**20406**
TOTAL	**4229**	**5239**	**2410**	**2867**	**2890**	**3257**	**5389**	**5636**	**31917**
Women	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
Hip	17	41	62	103	179	382	624	1289	**2697**
Vertebra	865	888	1304	1458	2128	3140	2693	5114	**17590**
Other	2059	2486	2101	2727	2780	4557	4759	10681	**32151**
TOTAL	**2941**	**3415**	**3467**	**4288**	**5086**	**8079**	**8077**	**17084**	**52437**
TOTAL	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
Hip	46	87	107	171	274	555	890	1673	**3803**
Vertebra	2552	1890	2258	2209	3319	4569	4309	6889	**27994**
Other	4572	6678	3512	4775	4384	6212	8266	14157	**52556**
TOTAL	**7170**	**8654**	**5877**	**7155**	**7977**	**11336**	**13465**	**22720**	**84354**

The projected number of osteoporotic fractures by ethnicity in New Zealand is shown in Appendix B. NZ European's constitute nearly 92% of all fractures, due both to the high life expectancy (particularly among

women) and the higher presumed incidence of osteoporosis. Fractures in Maori people constitute 4% of the total, with fractures in Pacific and Asian people constituting the remaining 4% of the total number of fractures.

4.2 Burden of osteoporosis and osteoporotic fractures on quality of life

Osteoporotic fractures lead to a significant reduction in quality of life. While there are many measures of quality of life, a measure that is commonly used in health funding decisions is Quality Adjusted Life Years (QALYS). QALYs consist of two parts:

1. a measure of the individual's quality of life (utility state) given their health status (e.g., fracture)
2. The number of years they are in that utility state.

Utility states range from 0 (representing death) to 1 (representing full health). Reductions in QALY can therefore be interpreted as the number of life years lost due to osteoporosis adjusted for the reduced health state of the individuals after the fracture.

The utility states following an osteoporotic fracture are shown in Table 5 (adapted from Zethraeus et al, 2007). Two caveats to note. First, the results report only the utility losses due to hip fractures and vertebral fractures that require hospitalisation. This is not to imply that the other types of fractures do not result in reductions in utility, but rather that the reductions tend to be of a short duration relative to the more serious fractures. Second, the utility losses are only for fractures and not for those living with osteoporosis with or without complications. There is little information available on the utility losses for those suffering from osteoporosis. The result of both these caveats is to underestimate the true utility loss due to osteoporosis. As such, the numbers reported below should be seen as indicative only.

The first line of Table 5 shows the average utility for individuals by age. The difference between the utility state after a hip or vertebral fracture and the well utility state is therefore the reduction in utility due to the fracture. Not surprisingly, hip fractures are associated with the largest drop in utility; an average of 20 points relative to the well state utility. The utility loss after a vertebral fracture varies slightly with age, from a 10 point drop for younger ages to a six point drop in later age groups.

Table 5: Utility estimates after fractures *

	50–54	55–59	60–64	65–69	70–74	75–79	80-84	85 +
Well	0.94	0.90	0.86	0.83	0.79	0.71	0.63	0.55
Hip fracture	0.74	0.70	0.66	0.63	0.59	0.51	0.43	0.35
Vertebral fracture	0.84	0.81	0.77	0.74	0.71	0.64	0.57	0.50

(* Adapted from Zethraeus et al, 2007)

The number of QALYs lost can be calculated by combining the lost utility with the number of life years lost due to osteoporotic fractures. Center et al (1999) reported the lost life years due to different type of fractures by comparing life expectancy of a sample of the general population with people who had suffered a hip fracture or other major fracture (including a major vertebral fracture). The life years and difference in life expectancy are shown in Table 6 (adapted from Center, Nguyen, Schneider, Sambrook, & Eisman, 1999).

Table 6: Life years lost due to osteoporotic fractures

MEN	50–54	55–59	60–64	65–69	70–74	75–79	80-84	85 +	TOTAL
Hip	-510	-666	-519	-574	-512	-798	-399	-379	**-4357**
Vertebra	-1512	-693	-465	-213	-95	-126	-181	-241	**-3527**
TOTAL	**-2022**	**-1359**	**-984**	**-788**	**-607**	**-924**	**-580**	**-620**	**-7884**
WOMEN	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
Hip	-367	-670	-694	-619	-786	-458	-250	-328	**-4172**
Vertebra	-159	-149	-198	-198	-204	-126	-86	-123	**-1244**
TOTAL	**-526**	**-819**	**-892**	**-817**	**-991**	**-584**	**-336**	**-451**	**-5416**
TOTAL	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
Hip	-878	-1336	-1212	-1193	-1298	-1256	-648	-707	**-8529**
Vertebra	-1671	-842	-663	-411	-300	-251	-267	-364	**-4770**
TOTAL	**-2548**	**-2178**	**-1876**	**-1605**	**-1598**	**-1508**	**-916**	**-1071**	**-13299**

Combining the information from Tables 5 and 6 with the number of osteoporotic fractures in New Zealand Table 4 provides an estimate of the number of QALYs lost in a given year due to osteoporotic fractures in New Zealand.

The results suggest that in 2007, the number of QALYs lost due to osteoporotic fractures in New Zealand is expected to be nearly 2,100 per year (Table 7). There are more life years lost for males (1,175) than females (935) due to the differing pattern and timing of fractures and the difference in life expectancy. As discussed below, QALYs can be used when evaluating and prioritising interventions to reduce the burden of osteoporosis.

Table 7: Lost QALYs from osteoporotic fractures

MEN	50–54	55–59	60–64	65–69	70–74	75–79	80-84	85 +	TOTAL
Hip	-102	-133	-104	-115	-102	-160	-80	-76	**-871**
Vertebra	-141	-62	-42	-19	-8	-9	-11	-12	**-304**
TOTAL	**-243**	**-196**	**-146**	**-134**	**-110**	**-168**	**-91**	**-88**	**-1175**
WOMEN	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
Hip	-73	-134	-139	-124	-157	-92	-50	-66	**-834**
Vertebra	-15	-13	-18	-18	-16	-9	-5	-6	**-100**
TOTAL	**-88**	**-147**	**-157**	**-142**	**-174**	**-100**	**-55**	**-72**	**-935**
TOTAL	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
Hip	-176	-267	-242	-239	-260	-251	-130	-141	**-1706**
Vertebra	-156	-76	-60	-37	-24	-18	-16	-18	**-404**
TOTAL	**-331**	**-343**	**-302**	**-276**	**-284**	**-269**	**-146**	**-160**	**-2110**

5 Burden of osteoporosis – Health services usage and cost of care

There are a number of different types of resources to consider when assessing the cost of osteoporosis, including:

- Direct cost of treating fractures that result in a hospitalisation (including acute treatment, rehabilitation and outpatient visits);
- Direct cost of treating fractures that do not result in a hospitalisation (such as GPs and A&E clinics);
- Medical and non-medical costs after a fracture;
- Cost of management for people diagnosed with osteoporosis; and
- Costs of treating other conditions for which osteoporosis is a contributing factor.

These are not the full range of resources associated with treating, detecting and caring for people with osteoporosis. Not included are the time and energy expended in caring for people with fractures, loss of productivity and other indirect costs. These are likely to be significant since osteoporotic fractures can place a significant burden to informal caregivers. However, there is little information available to help quantify the burden on caregivers, nor is there information on the lost opportunities that people with osteoporosis suffer as a result of their condition or fracture.

The costs shown below do reflect the majority of resources expended by the public health system to detect and treat conditions relating to osteoporosis. Understanding the magnitude of the costs is particularly relevant for health planning since it provides an indication of the resources expended (and therefore the potential savings) from interventions aimed at reducing the burden of osteoporosis.

The relationship between osteoporosis and a number of other conditions is only now being recognised. This includes some conditions that are attributable to other conditions (e.g., back pain) but are really the result from osteoporotic fractures (e.g., vertebral fractures). This misdiagnosis can lead to significant expenditure of health care resources. But osteoporosis is also a risk factor for many common conditions, with the increased severity of those conditions being related to the increased severity of osteoporosis. Although the resources associated with these conditions are difficult to identify, previous studies (Access, 2005) have estimated the relationship between the expenditures on osteoporotic fractures and these other conditions. The estimated costs are described below.

The goal is to identify the financial burden associated with osteoporosis. The financial burden refers to the ***additional*** or ***marginal*** cost associated with the condition, not the total cost associated with treating and caring for people with osteoporosis. A prevalence approach is taken in that the costs represent the total cost to New Zealand in a given year (valued in 2007 New Zealand dollars). A list of the unit prices and other information relating to the estimated use of health services are described in Appendix E.

5.1 Cost of Treating Osteoporotic Fractures

5.1.1 Cost of treating hip and vertebral fractures in hospital

Hip fractures are the most resource intensive type of osteoporotic fracture, with hospital stays in New Zealand averaging nearly 14 days in acute wards. Approximately 70% of those suffering hip fractures will be admitted to a rehabilitation ward, with the average stay being an additional 22 days.

Finally, it is estimated that 50% of those with hip fractures will receive outpatient visits after care is concluded. In all, the average cost of treating a hip fracture is estimated to be nearly $24,000 per person (Table 8).

Table 8: Average cost of hospitalisation - hip and vertebral fractures

	Hospitalisation		Rehabilitation			Outpatient			
	Length of stay (days)	Cost	Length of stay (days)	Cost	Prob. of Rehab	Average number of visits	Cost	Prob. of outpatient visit	Total Cost of hosp.
Hip	13.9	$14,937	22	$12,062	70%	2.4	$955	50%	$23,859
Vertebra	11.3	$12,131				1.6	$637	50%	$12,450

For those who are hospitalised due to a vertebral fracture, the average length of stay in hospital is approximately 11 days. They typically do not receive rehabilitation as a separate inpatient event, but may receive outpatient visits. The estimated cost of the hospitalisation event for a vertebral fracture is $12,450.

As mentioned above, because of their severity, it is assumed that all hip fractures result in a hospitalisation. The evidence suggests that the number of vertebral fractures that go undetected is significantly higher, with some studies reporting that only 8% of these fractures result in hospitalisations and many go completely undiagnosed (or misdiagnosed) (Finnern & Sykes, 2003).The best estimate for the number of vertebral fractures resulting from osteoporosis that require hospitalisation in New Zealand is 8%.

Combining the cost of treatment with the probability of receiving treatment and the number of fractures implies that the cost of treating hip and vertebral fractures in New Zealand hospitals is $118 million per year (see Table 9).

Table 9: Hospitalisation cost of hip and vertebral fractures in New Zealand ($NZ2007)

	Expected cost per case	Number of cases	Probability of cases requiring hospital stay	Total Cost to NZ
Hip	$23,859	3803	100%	$90,748,983
Vertebra	$12,450	27994	8%	$27,881,511
	TOTAL COST			**$118,630,494**

5.1.2 Cost of treating vertebral and other types of fractures outside of hospital

Some fractures to the wrist, forearm or other sites will be treated in hospital. For instance, patients hospitalised with a fractured tibia have an average length of stay of 3.3 days in hospital and experience several weeks of moderate disability. However, most fractures to the wrist, forearm or other sites will not result in hospitalisation stay but rather be seen in primary care or by the other health professionals. Yet treatment for these patients is still costly, requiring multiple visits to health providers, imaging and diagnostic procedures and medications to control pain and discomfort.

There is little information on the cost of treating other fractures or vertebral fractures that do not require hospitalisation. However, previous studies (e.g., Dolan, P., & Torgerson; 1998), applied an average cost of

treatment across all common other fractures (including those requiring hospitalisation and those that do not). For the purposes of this study, it was assumed that the average cost of fractures other than vertebral or hip treated in hospital was $2,191 per fracture. However, based on previous studies, it is estimated that only 70% of the other fractures will be treated (with the others being left untreated), and only 22% of the remaining vertebral fractures being correctly identified and treated as a fracture (see Appendix E for more detail).

Using this estimate, the expected cost of treating wrist, forearm and other similar types of fractures in New Zealand is over $94 million per year (Table 10).

Table 10: Cost of treating wrist, forearm and other fractures in New Zealand ($NZ2007)

	Expected cost per treated case	Number of cases	Probability of being treated	Total Cost to NZ
Other fractures	$2,191	52556	70%	$80,605,724
Vertebral fractures	$2,191	27994	22%	$13,493,815
	TOTAL COST			**$94,099,539**

5.2 Medical and Associated Costs after a fracture

People with osteoporosis can suffer fractures while living in the community, in a residential facility or private hospital or in a public hospital. In order to identify the costs associated with osteoporotic fractures after leaving a hospital or receiving care, it is important to identify where people were living before their fractures and what happened to them after the fracture. Most fractures resulting from osteoporosis do not result in a change in residence.

For instance, as shown in Table 4, 53% of those suffering a hip fracture will be in residential care or a private hospital at the time of the incident and 47% out in the community. After the fracture, 61% will be discharged to a residential facility, suggesting that for 8% of people the hip fracture will be the reason for their admission to a residential facility.

For those suffering a vertebral fracture who are hospitalised, 62% will be in the community prior to the incident, and 58% will return to the community after hospitalisation. The remaining 42% will go to a residential facility, implying that 4% of those hospitalised will be admitted to a residential facility for the first time as a result of their fracture.

Finally, those suffering vertebral fractures not requiring hospitalisation or fractures of other types are not expected to change their place of residence as a result of the fracture. Those who were in a residential facility are likely to remain in the facility and those living in the community are likely to remain there.

People returning home after a fracture are likely to receive a variety of community services such as meals on wheels, home help and visits by a District Nurse during their recovery. Previous studies suggest that the percentage of people receiving the care depends upon the type of fractures (more services are made available to those with hip fractures than with other types), with the number of visits or services depending on a variety of factors.

Extrapolating these findings to New Zealand would suggest that:

- After a hip fracture, 22% of people will receive nursing services, 49% physiotherapy and 16% meals on wheels. Most will attend an orthopaedic clinic.
- For those who suffer a vertebral fracture, 16% can be expected to receive physiotherapy, 23% will receive home help and 9% will receive meals on wheels (Table 11).

Overall, the expected cost of care for someone with a hip fracture who returned to the community is $1,381 in the year following the fracture.

Fewer services are generally provided to those suffering from a vertebral fracture or fracture to another site. For instance, only 10% of those with a vertebral fracture will receive nursing services in the community, while only 5% of those with fractures to other sites.

In total across all service categories, the average expenditures on a patient with a vertebral fracture or fracture to another site who returns to the community are $646 and $293 (respectively).

Figure 4: **Outcome pathways following vertebral and hip fractures with associated probabilities**

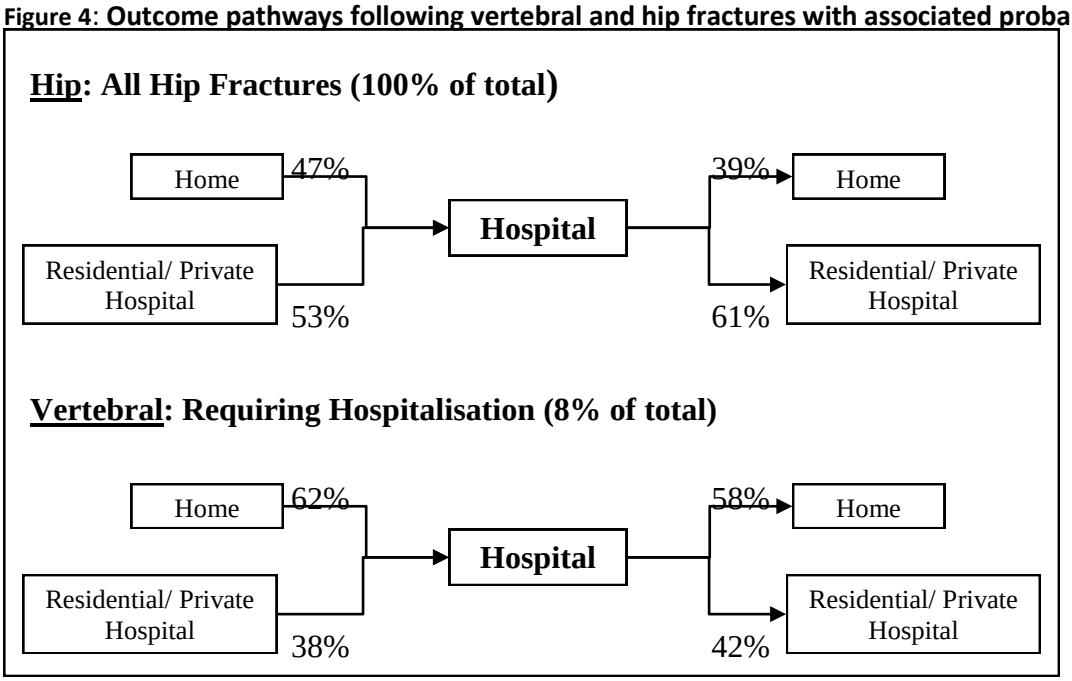


Table 11: Average amount and cost of community support *

	Community support							
	Nursing services	Occup. therapy	Physio therapy	Ortho. clinic	Home help	Meals on wheels	Equip.	Total Average Cost of
Hip	22%	25%	49%	74%	45%	16%	100%	**$1,381**
Vertebra	10%	0%	16%	14%	23%	9%	47%	**$646**
Other sites	5%	0%	38%	45%	16%	4%	0%	**$293**

* Based on results from Pascoe et al (2005) using prices from New Zealand ($2007)

The average cost of care for individuals after a fracture is shown in Table 12. Those readmitted to a residential facility after fractures are expected to require additional support (e.g., a higher level of care in the facility or a higher need facility). The additional cost of the fracture is therefore the difference between the average cost in the facility for the stay. With an average stay after a fracture of 211 days, the additional cost is estimated at $3,165 per year.

For those who are admitted to a residential facility or private hospital after their fracture, the additional cost to the public system is the cost of the residential unit. This is estimated to be over $20,045 for the average stay of 211 days. The majority of the expense is associated with caring for vertebral fractures (nearly $55 million).

Table 12: Cost of care after fracture: Community support and residential care

		No. of days	Expected cost	Percentage	Expected cost of care	Total expected cost of care
Hip	Home		$1,381	39%	$539	**$3,820**
	Residential – Readmission	211	$3,165	53%	$1,677	
	Residential - First time admission	211	$20,045	8%	$1,604	
Vertebral	Home		$646	52%	$336	**$1,960**
	Residential – Readmission	171	$2,565	38%	$975	
	Residential - First time admission	171	$16,245	4%	$650	
Other site	Home/Residential		$293			**$293**

Table 13: Total cost of care after a fracture due to osteoporosis

	Expected cost per case	Number of cases	Total Cost to NZ
Hip	$3,820	3,803	$14,527,628
Vertebra	$1,960	27,994	$54,879,005
Other site	$293	52,556	$15,404,147
	TOTAL COST		**$84,810,780**

5.3 Treatment and Management of Osteoporosis

The treatment and management of osteoporosis is aimed at all individuals who have had a fracture and/or have been assessed as being at risk for an osteoporotic fracture. As mentioned above, there are a number of treatments for osteoporosis, ranging from increase physical exercise and better nutrition to specific medications aimed at increasing bone mineral density. In addition, there are numerous Over-the-Counter medications available as well as recommended visits to a General Practitioner.

The total expenditure on pharmaceuticals is shown in Table 14. In 2006, over $20 million was spent on prescribed treatments for osteoporosis and osteoporotic falls. With an estimated 70,631 people diagnosed with osteoporosis, this equates to an average cost of $290 per person per year. Note that it is difficult to say whether those reporting being diagnosed with osteoporosis have the condition or not, and the extent to which there is under-diagnosis. The figures shown below report the total amount spent on medications and primary care in New Zealand. The average cost per case diagnosed is also shown as this information is used when estimating the costs in 2013 and 2020.Table 14: Expenditures on pharmaceuticals specific or mainly used in the treatment of osteoporosis

Chemical name	No of items	Cost of items	Patient contribution	Total cost
Alendronate sodium	321860	$11,937,297	$279,343	**$12,216,640**
Calcitriol	62420	$2,075,408	$87,500	**$2,162,908**
Calcium carbonate	504292.5	$1,473,642	$562,981	**$2,036,623**
Calcium lactate-gluconate	44208	$743,059	$94,336	**$837,395**
Etidronate disodium	73884	$754,836	$209,280	**$964,116**
Vitamins D				**$2,300,000**
Totals				**$20,517,682**
Per diagnosed case				**$290**

Table 15: Total cost of treatment and pharmaceuticals to New Zealand

	Expected cost per case	No. of diagnosed cases	Total Cost to NZ
Pharmaceuticals	$290	70,631	$20,517,682
General Practitioner visits	$75		$5,297,325
Over the Counter	$109		$7,694,131
Total cost	**$474**		**$33,509,137**

In addition to prescription medications, there are also expenditures on General Practitioner (GP) visits and over-the-counter medications. The average number of visits to a GP for those diagnosed with osteoporosis was two visits a year, equating to an expected cost of $75 per case per year. For over-the-counter drugs, it has been estimated that the total expenditure on these medications and supplements is approximately 25% of the total expenditure on prescription drugs, meaning an average of $109 per person per year. Taken together, this equates to an average cost of $474 per year for those diagnosed with osteoporosis.

The total cost of treatment and pharmaceuticals to New Zealand is shown in Table 15. Overall, New Zealand can expect to spend over $33 million per year on the treatment and management of osteoporosis.

5.4 Cost of other conditions

The costs described above are associated with the treatment of fractures and the treatment and management of osteoporosis. But osteoporosis is a contributing factor to a number of other conditions, ranging from other musculoskeletal problems to back problems and curvature of the spine. Estimates of the percentage of various conditions attributable to osteoporosis are shown in Table16.

Table 16: Percentage of conditions attributable to osteoporosis (taken from Access Economics, 2001)

	% Attributable to Osteoporosis
Back problems	11.6%
Curvature of the spine	15.9%
Other fractures for which osteoporosis has been identified as a risk factor	63.1%

Information on the relative cost of these conditions is not available in New Zealand. However, a previous study of the cost of osteoporosis in Australia (Access Economics, 2001) estimated that the cost of treating these other conditions attributable to osteoporosis amounted to over 250% of the costs associated with fractures, treatment and management of osteoporosis. This is consistent with other studies, including Orsini et al (2005) where the health care costs for people with osteoporosis were significantly higher than the health care costs of those without osteoporosis even after controlling for the costs of fractures. Extrapolating these figures to New Zealand results in an estimated additional cost of $827 million in 2007 (Table 17).

5.5 Total cost of Osteoporosis

As shown in Table 17, the total cost of osteoporosis is estimated to be over $1.15 billion per year. The majority of this amount (71%) is for treatment of other conditions, with treatment of fractures comprising 18% of the total cost, after fracture care 7% and treatment and management of the condition at 3%.

Table 17: Total cost of osteoporosis in New Zealand

		Cost	Total Cost	
Fractures	**Hip**	$90,748,983		
	Vertebra	$41,375,326		
	Other site	$80,605,724	**$212,730,033**	
After Fracture	**Hip**	$14,527,628		
	Vertebra	$54,879,005		
	Other Sites	$15,404,147	**$84,810,780**	
Treatment and management	**Pharmaceuticals**	$20,517,682		
	GP	$5,297,325		
	Over the Counter	$7,694,131	**$33,509,137**	
SUBTOTAL				**$331,049,950**
Other Osteoporotic conditions				**$827,624,875**
TOTAL COST				**$1,158,674,825**

6 Burden of Osteoporotic Fractures: 2007, 2013 and 2020

6.1 Incidence of osteoporotic fractures: 2007, 2013 and 2020

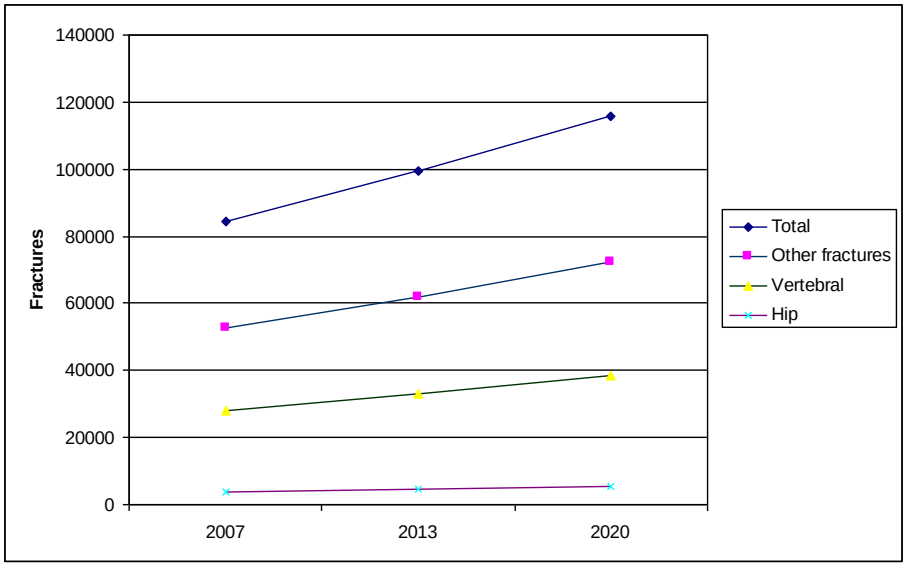
The increasing elderly population (Figure 1) is expected to result in more fractures in the future. Projections for 2013 and 2020 show that the estimated number of osteoporotic fractures will increase by 15% between 2007 and 2003, and 30% between 2007 and 2020 (Table 18 and Appendix C). By 2020, New Zealand can expect nearly 116,000 fractures directly attributable to osteoporosis each year.

Table 18: Total Projected Osteoporotic Fracture Incidence in 2007, 2013, 2020*

		50–54	55–59	60–64	65–69	70–74	75–79	80–84	85 +	TOTAL
2007	**Hip**	46	87	107	171	274	555	890	1673	**3803**
	Vertebra	2552	1890	2258	2209	3319	4569	4309	6889	**27994**
	Other	4572	6678	3512	4775	4384	6212	8266	14157	**52556**
	TOTAL	**7170**	**8654**	**5877**	**7155**	**7977**	**11336**	**13465**	**22720**	**84354**
		50–54	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
2013	**Hip**	54	94	128	212	338	574	965	2170	**4535**
	Vertebra	2970	2052	2708	2735	4101	4720	4702	8976	**32965**
	Other	5345	7222	4214	5922	5419	6412	9056	18410	**61999**
	TOTAL	**8369**	**9368**	**7051**	**8869**	**9858**	**11706**	**14722**	**29556**	**99500**
		50–54	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
2020	**Hip**	57	105	147	235	429	715	1070	2591	**5350**
	Vertebra	2676	2253	2985	3034	5177	5885	5317	10917	**38244**
	Other	5030	7965	4818	6598	7031	8169	10329	22381	**72321**
	TOTAL	**7763**	**10324**	**7950**	**9866**	**12637**	**14769**	**16715**	**35889**	**115914**

*Assuming that fracture rates within age groups do not change over time.

Figure 5: Estimated number of osteoporotic fractures in 2007, 2013 & 2020



6.2 Mortality and morbidity from osteoporotic fractures: 2007, 2013 and 2020

The projected QALYs lost due to osteoporotic fractures are shown in Table 19. Assuming no change in overall life expectancy, the ageing of the population and the increased number of fractures will increase the number of QALYs lost due to osteoporotic fractures by 15% between 2007 and 2013 and by another 11% between 2013 and 2020. By 2020, the number of QALYs lost due to osteoporosis each year will be over 2800, an increase of 31% on 2007.

Table 19: Life years lost due to osteoporotic fractures

		50–54	55–59	60–64	65–69	70–74	75–79	80–84	85 +	TOTAL
	Hip	-878	-1336	-1212	-1193	-1298	-1256	-648	-707	**-8529**
	Vertebra	-1671	-842	-663	-411	-300	-251	-267	-364	**-4770**
2007	**TOTAL**	**-2548**	**-2178**	**-1876**	**-1605**	**-1598**	**-1508**	**-916**	**-1071**	**-13299**
		50–54	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
	Hip	-1030	-1451	-1454	-1479	-1604	-1298	-703	-917	**-9936**
	Vertebra	-1961	-915	-796	-510	-370	-260	-290	-472	**-5574**
2013	**TOTAL**	**-2991**	**-2365**	**-2250**	**-1989**	**-1974**	**-1557**	**-992**	**-1389**	**-15510**
		50–54	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
	Hip	-1087	-1623	-1670	-1637	-2038	-1618	-779	-1095	**-11547**
	Vertebra	-2070	-1023	-914	-565	-470	-324	-321	-564	**-6251**
2020	**TOTAL**	**-3158**	**-2647**	**-2583**	**-2202**	**-2508**	**-1942**	**-1101**	**-1658**	**-17798**

Table 20: Estimated QALYs lost due to osteoporotic fractures

		50–54	55–59	60–64	65–69	70–74	75–79	80–84	85 +	TOTAL
2007	**Hip**	-176	-267	-242	-239	-260	-251	-130	-141	-1,706
	Vertebra	-156	-76	-60	-37	-24	-18	-16	-18	-404
	TOTAL	-331	-343	-302	-276	-284	-269	-146	-160	-2,110
		50–54	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
2013	**Hip**	-206	-290	-291	-296	-321	-260	-141	-183	-1,987
	Vertebra	-181	-82	-72	-46	-30	-18	-17	-24	-470
	TOTAL	-388	-372	-363	-342	-350	-278	-158	-207	-2,458
		50–54	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85 +**	**TOTAL**
2020	**Hip**	-217	-325	-334	-327	-408	-324	-156	-219	-2,309
	Vertebra	-164	-90	-79	-51	-37	-23	-20	-29	-492
	TOTAL	-381	-415	-413	-378	-445	-346	-176	-248	-2,802

6.3 Economic burden of osteoporosis: 2007, 2013 and 2020

Finally, the increase in osteoporotic fractures caused by an aging population is expected to create additional financial stress on the health care system. As shown in Table 21, the health care expenditure for care associated with osteoporosis is expected to increase by over 15% between 2007 and 2013 to over $1.3 billion. By 2020, the cost of care associated with osteoporosis is expected to increase by over 30% to nearly $1.6 billion. These increases will put further strain on the health care system.

Table 21: Total cost of osteoporosis 2007, 2013 and 2020

2007	Expected cost per case ($2007)	No cases	Total Cost
* Hip	$27,679	3803	$105,276,611
* Vertebra	$3,438	27994	$96,254,331
* Other sites	$1,827	52556	$96,009,871
Total Fractures		84354	**$297,540,813**
Management (Diagnosed cases)	$474	70631	**$33,509,137**
Other osteoporotic conditions			**$827,624,875**
Total Cost			**$1,158,674,825**
2013	**Expected cost per case ($2007)**	**No cases**	**Total Cost**
* Hip	$27,679	4535	$125,524,048
* Vertebra	$3,438	32965	$113,345,340
* Other sites	$1,827	61999	$113,259,622
Total Fractures		99500	**$352,129,011**
Management (Diagnosed cases)	$474	82612	**$39,193,228**
Other osteoporotic conditions			**$978,305,595**
Total Cost			**$1,369,627,834**
2020	**Expected cost per case ($2007)**	**No cases**	**Total Cost**
* Hip	$27,679	5350	$148,082,394
* Vertebra	$3,438	38244	$131,496,411
* Other sites	$1,827	72321	$132,115,826
Total Fractures		115914	**$411,694,632**
Management (Diagnosed cases)	$474	99325	**$47,122,299**
Other osteoporotic conditions			**$1,147,042,326**
Total Cost			**$1,606,074,970**

7 Prevention, Treatment and Management

Prevention can be classified into primary, secondary and tertiary prevention; depending on the extent to which the individual being treated already manifests the disease (WHO, 2003). Primary prevention relates to the prevention of disease onset, whereas secondary and tertiary prevention relate to the prevention of disease-related morbidity in asymptomatic individuals and prevention of complications in symptomatic cases respectively. Tertiary prevention is generally unhelpful in osteoporosis.

Treatment predominantly focuses on secondary prevention to reduce the burden of osteoporotic fractures in the at-risk population. Interventions for osteoporosis include nutritional changes or supplements, physical activity, life-style changes and pharmaceutical interventions. All of these have the same goal of increasing, maintaining, or slowing the decline in, bone mineral density. It has been suggested that increasing the average bone mineral density of the whole population 10% might conservatively be expected to decrease fracture rates by 20% (WHO, 2003).

7.1 Nutrition

The World Health Organisation recommends a population-based approach to the primary prevention of osteoporosis, especially in developing countries where diagnosis and treatment are not always available (WHO, 2003). These approached mainly focus on increasing calcium intake, which has been found to reduce rates of bone loss and prevent fractures (WHO, 2003). Increasing the intake of calcium in the population will increase the peak bone mass of those in their first three decades of life, as well as reducing the decline in bone mass for those who have passed their peak bone mass (Compston, 2004; Horwath, Parnell, Wilson, & Russell, 2001).

In younger populations, the recommended daily intake of calcium can be obtained through a healthy diet. Calcium is found naturally in dairy products (especially milk, yoghurt and cheese), green leafy vegetables (especially broccoli and spinach), some fish (especially salmon and sardines), fruits (especially citrus), beans, and other miscellaneous foods such as sesame seeds, almonds and brown sugar (WHO, 2003).

In older populations, calcium supplements together with vitamin D can further help to maintain bone mineral density for longer (Cummings, Kelsey, Nevitt, & O'Dowd, 1985; WHO, 2003). Some calcium supplements are not well absorbed by the body and calcium absorption can be enhanced by the addition of vitamin D (WHO, 2003). Vitamin D is mainly synthesized through the skin from sunlight and is often lacking in elderly or institutionalised people. Direct exposure to sunlight for 15-30 minutes daily is enough to avoid vitamin D deficiency (WHO, 2003). Vitamin D deficiencies can also be treated by changing dietary intake and taking supplements (Brown, Josse, & Scientific Advisory Council of the Osteoporosis Society of, 2002).

The need for an adequate intake of calcium and Vitamin D throughout life is essential to maintain bone mass and reduce the risk of fracture (Horwath, Parnell, Wilson, & Russell, 2001; WHO, 2003).

The National Nutrition Survey conducted in New Zealand in 1997 found that milk and milk products were the main source of calcium intake in this country. This survey also found that 20% of the New Zealand population and one in four women did not have an adequate intake of calcium compared to the UK recommendations (Horwath, Parnell, Wilson, & Russell, 2001).

Overall, women showed higher prevalence of inadequate intake compared to men; especially for those 15-18 years of age, Maori and people living in low socioeconomic areas (Horwath, Parnell, Wilson, & Russell,

2001). This means that these women will reach a lower peak bone mass and enter the high-risk menopausal period with already weaker bones.

7.2 Lifestyle

Physical activity in the form of weight bearing exercise has been shown to maximise peak bone mass in children and younger people, reduce the risk of osteoporosis when maintained throughout adulthood and decrease the risk of fracture in those with osteoporosis (WHO, 2003). Some studies have shown a beneficial effect of 30-60 minutes of regular exercise three to five times a week on cortical bone and calcium stores (Cummings, Kelsey, Nevitt, & O'Dowd, 1985).

The effect of physical activity on the skeletal muscles can also reduce risk of falling, especially in adults (Cummings, Kelsey, Nevitt, & O'Dowd, 1985; WHO, 2003).

Smoking cessation, as well as alcohol and caffeine intake reduction, also help to decrease the risk of osteoporosis (Brown, Josse, & Scientific Advisory Council of the Osteoporosis Society of, 2002; Gullberg, Johnell, & Kanis, 1997; WHO, 2003).

Interventions to prevent falls in the elderly such as rubber-soled shoes, hip protectors, carpet runners, canes, night lighting, grab rails can be effective in reducing risk of fracture for the elderly population (NZGG, 2003). The use of hip protectors for the frail elderly in residential care has been shown to reduce fracture rates.

7.3 Pharmaceutical Interventions

Other preventive measures involve pharmaceutical interventions for people at risk, such as post menopausal women, elderly men and women, and people with underlying medical conditions and usage of medications that affect bone density (WHO, 2003). The pharmaceutical interventions for osteoporosis can be divided into hormonal and non-hormonal medications.

Hormonal

The hormonal medications include hormone replacement therapy (HRT), selective oestrogen receptor modulators (SERMs) and active vitamin D metabolites. There is evidence that HRT can reduce fracture risk in post-menopausal women (Vestergaard, Rejnmark, & Mosekilde, 2006), however HRT is no longer recommended as a first line treatment for osteoporosis prevention, due to increased risks of stroke and some cancers.

SERMs such as Raloxofene have been shown to reduce the risk of vertebral fracture by up to half (Geusens & Reid, 2005), but are not subsidised in New Zealand.

Calcitonin inhibits osteoclast function and therefore reduces bone loss (Whitfield, Morley, & Willick, 2002).

Active vitamin D metabolites such as Calcitrol increase calcium absorption and therefore maintain bone mass but are often not currently recommended (Whitfield, Morley, & Willick, 2002).

Non Hormonal

Non-hormonal medications for osteoporosis include bisphosphonates and calcium supplements. There is extensive evidence for the effectiveness of bisphosphonates, such as alendronate sodium and etidronate

disodium, for the prevention of bone resorption (Poole & Compston, 2006). Both of these medications are subsidised in New Zealand.

Calcium supplements have more mixed evidence for their effectiveness as they cannot prevent bone loss on their own, but are recommended particularly for older populations who may be more likely to have a poor diet (Poole & Compston, 2006).

7.4 Education and Counselling

Any strategy that improves people's understanding of osteoporosis, particularly around risks and preventive measures, has the potential to dramatically reduce the burden of osteoporotic fractures in the population.

If people are more aware of their risk and the steps that they can take to reduce them, then they will be more likely to change their behaviour to reduce their risk of suffering from an osteoporotic fracture (Bartlett, 1989; Gutin et al., 1992). The literature suggests that awareness among populations in developed countries is very low in relation to the high prevalence of the condition (Edwards & Fraser, 1997).

It is important that health professionals are aware of and use all facilities available to prevent osteoporotic fractures; from nutritional advice and encouraging physical activity in younger adults , through the use of vitamin D supplements in the elderly and the use of hip protectors where appropriate. Prescription medicines are only a part of the range of tools available to prevent fractures.

8 Conclusions and Recommendations

8.1 The Burden of Osteoporosis

Osteoporosis is a condition that affects a large proportion of the population through increasing the risk of bone fractures. This study has estimated the overall burden of osteoporotic fractures in New Zealand both now and through to 2020. In sum, the impact of osteoporosis on the health and well-being (excess mortality and quality of life) and the cost to the public health system is currently very significant but will be even larger in the future.

The analysis suggests that **there will be 84,000 osteoporosis-related fractures in 2007**, with almost two-thirds of the fractures happening to women. This represents a rate of approximately 850 fractures for every 10,000 people 50 years of age or older. Hip fractures are estimated to account for 5% of all fractures and are associated with the greatest reduction in quality of life.

Between 2007 and 2020, the number of osteoporotic fractures is estimated to increase by 30%, to 118,000 due to the ageing population. The estimated burden of fractures was lower for Maori and Pacific peoples compared to people of European origin. This is partly due to relative numbers in the populations, but also reflects differences in life expectancy, genetic and cultural factors relating to diet and body mass. These incidence results all give a clear indication that osteoporotic fractures are very common among the older population of New Zealand.

An analysis of the loss of quality of life from osteoporotic fractures, measured through reductions in quality of life adjusted life years (QALYs), showed that there would be **an estimated loss of over 2,100 QALYs lost in 2007 and that this would increase to 2,800 QALYs lost by 2020**. Interestingly, the results showed that there were very similar numbers of QALYs lost for men and women. This can be explained by the relatively similar numbers of hip fractures for men and women in the younger age bands (50-69), where the largest impact on QALYs lost would be seen. Overall, the estimates of quality of life lost due to osteoporosis reinforce the impact that this condition has on the New Zealand population.

In terms of health services costs the analysis suggested that **the total cost of osteoporosis in New Zealand in 2007 will be over $1.5 billion**, with immediate fracture treatment (including hospitalisations and non-hospital treatment) costing approximately $210 million, after fracture care (including community support and rest home care) costing approximately $84 million, treatment and management (including pharmaceuticals, GP care and over-the-counter medications) costing approximately $33 million, and 'other osteoporotic conditions' (including back pain, curvature of the spine and other musculoskeletal problems) costing approximately $800 million. In terms of hospital bed days for the treatment of hip and spinal fractures, this equates to over 114,000 days for hip and vertebral fractures in 2007

These results clearly demonstrate the considerable economic burden of osteoporosis in New Zealand. In other words, this translated to:

- 231 osteoporotic fractures per day;
- 312 people in hospitals beds recovering from osteoporotic fractures each day;
- Expenditure for treating fractures of over $325,000 each day; and
- Overall expenditures of over $3 million per day associated with osteoporosis and osteoporotic fractures

8.2 Implications and Recommendations

These projections of the future burden of osteoporosis were made under the assumption that until government recognises the considerable burden on osteoporosis in New Zealand, nothing will change.

However, there are a number of cost effective options available that can lessen the burden in the future and improve the health of New Zealanders.

The implications of this research are that osteoporosis is currently a large burden on the New Zealand population in terms of loss of quality of life; it creates a huge burden on the health system; and that these burdens are likely to increase over the next decades with the ageing of the population. It is also important that the population, and health professionals, are aware of the extent and impact of osteoporosis on the New Zealand population.

Recommendations

1. Publicly funded DXA scans for women over 50 with a low trauma fracture

The findings of this study stress the importance of early detection for those who might be at increased risk of having bone fractures. In addition to the consideration of other risk factors, the most effective diagnostic tool for assessing the risk of fracture is a bone density scan, such as a DXA scan.

Funding of bone density scans for women over 50 with a low trauma fracture could potentially identify more women at risk, prior to a life changing/serious fracture and with appropriate treatment and advice there could be a significant reduction in the incidence and cost of osteoporotic fractures. Currently most DXA scans performed are funded by individuals, thus forming a significant financial burden on people and a barrier to diagnosis.

2. Implement awareness campaigns to inform the public and their health professionals of the risks of osteoporosis and osteoporotic fractures;

Previous research has shown that awareness of osteoporosis and treatments for preventing osteoporosis is low in the general population. Increased awareness, through public campaigns and patient and health professional education through avenues such as primary care, could lead to a much smaller proportion of the population being at risk of osteoporotic fractures.

3. Osteoporosis be adopted as one of government's top public health priorities

Until government recognises the significant burden of osteoporosis on New Zealand the burden will not reduce. Government funded health initiatives must include programmes which target bone health, for people of all ages and health professionals.

It has a clinical and functional interaction with many other chronic disorders, and should be included in the government's implementation of strategies to manage chronic conditions.

Bone health should be incorporated as an outcome of current public health initiatives such as Health Eating Healthy Action (HEHA).

9 Osteoporosis New Zealand – Building a Stronger Future

Osteoporosis New Zealand (ONZ) was launched on October 20 1999. It was formed to raise awareness and knowledge of osteoporosis and to provide a national "voice" for those with osteoporosis and those at risk of developing this bone disease.

Our Vision

To raise awareness of osteoporosis as a critical health issue in New Zealand.

Objectives to 2010

1. To achieve awareness of the health implications of osteoporosis by 2010 among:
   - 55% of New Zealanders; and
   - 100% of New Zealand health practitioners.
2. To have osteoporosis feature on Government's list of top 13 public health priorities by 2010.
3. To achieve uniform Government funding and readily available regional access for the diagnosis and treatment for people with osteoporosis by 2010.
4. To be perceived as the pre-eminent body representing osteoporosis in New Zealand, and the recognised source of evidence-based information.
5. To obtain funding to ensure the ONZ objectives to 2010 and beyond.

Values

For those with osteoporosis and those at risk, Osteoporosis NZ Inc.

1. Is committed to advocating on their behalf
2. Will maintain its integrity
   a. In providing best-evidence and best-practice information
   b. Will remain free of undue influence
3. Values the contribution of health professionals and others who advise, support and care for those with osteoporosis.
4. Will focus on creating a sound administrative and financial base for its activities
5. Will be sensitive to cultural differences and will respect the principle of partnership inherent in the Treaty of Waitangi.

Osteoporosis New Zealand does this by providing:

- **Information** - providing information on osteoporosis, its risks, prevention and treatment to health professionals and the wider public.
- **Education** - targeting education programmes at those most at risk, and producing guidelines for health professionals on the diagnosis and management of osteoporosis.
- **Support** - providing best practice and evidence-based information for those with osteoporosis.
- **Advocacy**
  - Establishing and maintaining contact with decision makers on health issues to represent the interests of New Zealanders with osteoporosis.
  - Providing a national voice for advocacy for patient services so that those who have osteoporosis are well managed and that medicines for treating osteoporosis are available at a reasonable cost.

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11 Appendices

Appendix A: Population Projections for 2007, 2013 and 2020

2007

	NZ European		Maori		Pacific Islander		Asian		Total	
Age	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
50-54	107300	105200	14400	13200	5800	5900	12000	10900	139500	135200
55-59	100800	99700	10900	10300	4600	4500	8100	7700	124400	122200
60-64	84200	82800	7600	7000	3400	3200	5200	4900	100400	97900
65-69	71400	67900	5900	5400	2600	2300	4000	3700	83900	79300
70-74	56200	51100	4100	3600	1900	1400	3000	2800	65200	58900
75-79	52300	44300	2600	1900	1200	900	1700	1500	57800	48600
80-84	42700	29700	1400	900	700	400	900	600	45700	31600
85-89	27300	13900	600	300	300	100	400	200	28600	14500
90+	14900	5400	200	100	100	0	200	100	15400	5600
Total	557100	500000	47700	42700	20600	18700	35500	32400	660900	593800

2013

	NZ European		Maori		Pacific Islander		Asian		Total	
Age	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
50-54	122100	116500	19300	17200	7800	7200	17900	16900	167100	157800
55-59	107100	104300	14200	12800	6000	5900	13300	12200	140600	135200
60-64	97700	95800	10500	9700	4600	4500	9100	8600	121900	118600
65-69	87300	84200	7300	6600	3400	3100	5700	5600	103700	99500
70-74	68600	63100	5300	4600	2400	2000	4200	3800	80500	73500
75-79	52200	44800	3600	2800	1700	1200	3000	2800	60500	51600
80-84	44000	33400	2100	1500	1000	600	1700	1300	48800	36800
85-89	31400	19500	1000	600	500	200	700	500	33600	20800
90+	20800	8500	400	100	200	100	300	200	21700	8900
Total	631200	570100	63700	55900	27600	24800	55900	51900	778400	702700

2020

	NZ European		Maori		Pacific Islander		Asian		Total	
Age	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
50-54	114300	106200	19500	17300	9800	8700	23700	22600	167300	154800
55-59	119200	112300	18900	16600	8300	7600	20100	19700	166500	156200
60-64	109500	105600	14900	13100	6400	6000	15200	14100	146000	138800
65-69	96300	92400	10600	9400	4700	4600	10600	9800	122200	116200
70-74	89800	83800	7400	6300	3500	3100	6900	6700	107600	99900
75-79	66700	58700	4800	3900	2300	1800	4300	3800	78100	68200
80-84	48800	38100	3300	2400	1500	1000	2900	2500	56500	44000
85-89	32700	22400	1700	1100	800	400	1600	1100	36800	25000
90+	27500	13900	800	400	400	200	800	400	29500	14900
Total	704800	633400	81900	70500	37700	33400	86100	80700	910500	818000

Appendix B: Methodology for Estimating the Prevalence of Osteoporotic Fractures in New Zealand

Many fractures are not recorded in national hospital discharge records. For example, forearm fractures are often treated outside the hospital, in emergency clinics and do not show up in the hospital data. Some vertebral fractures are clinically silent and so are not reported (WHO, 2003). Hip fractures, however, constitute the most serious osteoporotic fractures in terms of loss of function and nearly always necessitate hospitalisation (WHO, 2003). It is, therefore, expected that the number of hip fractures recorded in the New Zealand national hospital discharge data (National Minimum Data Set, NMDS) will be a relatively accurate record of the total number of hip fractures in the population. Table B1 shows the ICD-10 codes used to identify hip fractures in the hospital records. Records from 2003-05 were used to establish the incidence of hip fractures stratified by gender, ethnicity and age group. Three years of data were used due to the low annual number of fractures in some demographic groups. Table B2 and Table B3 show the total number of hip fractures found in the national hospital data for females and males between 2003-05 using this method.

Table B 1: ICD-10 codes for hip fractures

ICD-10 Code	Definition
S32.4	Fracture of acetabulum
S72.0	Fracture of Neck of Femur Fracture of hip NOS
S72.1	Pertrochanteric Fracture - Intertrochanteric fracture - Trochanteric fracture
M80 (Site Code 5)	Osteoporosis with Pathological Fracture of the Pelvic Region and Thigh

Table B 2: FEMALES – Total number of hip fractures, 2003-05

Age Band	European	Maori	Pacific	Asian	Other	Total
50-54	37	6	1	3	2	49
55-59	95	6	4	4	6	115
60-64	134	15	4	5	11	169
65-69	227	13	2	10	19	271
70-74	473	15	10	14	21	533
75-79	1020	25	11	17	53	1126
80-84	1652	28	12	23	89	1804
85-89	1731	23	12	15	93	1874
90+	1372	12	3	10	75	1472
Total	*6741*	*143*	*59*	*101*	*369*	*7413*

Table B 3: MALES – Total number of hip fractures, 2003-05

Age Band	European	Maori	Pacific	Asian	Other	Total
50-54	61	5	2	4	11	83
55-59	113	8	2	0	7	130
60-64	99	14	3	1	6	123
65-69	144	12	6	6	10	178
70-74	241	11	8	6	17	283
75-79	458	11	3	8	17	497
80-84	651	12	3	7	31	704
85-89	549	4	2	6	27	588
90+	346	3	0	1	15	365
Total	*2662*	*80*	*29*	*39*	*141*	*2951*

The incidence of hip fractures was then used to estimate the incidence of other types of osteoporotic fractures. Published literature provides the different proportions of different fracture sites such as vertebral, forearm, and humerus (Kanis et al., 2001). Table B4 shows the relative proportion of the total number of osteoporotic fractures that occur at each site. Once the number of hip fractures is established, all other fractures can be estimated from the proportions in Table B4. For example, hip fractures represent an estimated 19.8% of all osteoporotic fractures in females 70-74 years of age, whereas 34.1% of osteoporotic fractures in this group are rib fractures.

Table B 4: Percentage of osteoporotic fractures by gender, age group and fracture site*

Fracture Site	Age range (years)							
	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89
Males								
Vertebra	21.90	9.1	20.3	12.1	19.9	20.7	12.6	12.3
Ribs	36.30	57.6	35.8	39.5	34.1	26.9	41.3	31
Pelvis	1.30	1.2	1.9	1.6	2	2.7	2.4	3
Humeral shaft	2.50	0.8	1.8	1.6	2.8	2	1	1.7
Proximal humerus	7.30	2.4	5.4	4.6	8.2	6	3.2	5.1
Clavicle, scapula, sternum	13.00	10.7	8	10.8	7.9	8.7	8.9	8.8
Hip	*4.70*	*5.2*	*12*	*13.7*	*19.8*	*31.4*	*25.9*	*33.3*
Other femoral	1.70	1.4	2.1	2.1	1.7	1.7	1.2	1.3
Tibia and fibula	5.60	6.3	5.6	3.7	2.7	2.3	1.6	1.4
Distal forearm	11.30	11.6	12.6	14.1	3.6	5.9	3.5	3.3
Females								
Vertebra	15.10	12.7	19.2	16.4	20	17.3	12.7	11.3
Ribs	11.80	13	10.6	12.7	11.1	14	15.3	21.9
Pelvis	0.80	1.3	1.8	1.8	3.2	3.2	4.8	4.8
Humeral shaft	3.80	3.4	2.7	4.4	3.3	3.3	2.1	2.6
Proximal humerus	11.60	10.2	8	13.2	9.9	9.8	6.4	7.7
Clavicle, scapula, sternum	7.20	7.8	2.7	5.4	3.1	5.6	4.5	2.4
Hip	*3.80*	*7.3*	*11.4*	*14.5*	*21*	*26.3*	*36.8*	*35.6*
Other femoral	1.00	1.4	2.3	1.9	2.3	2.3	2.6	2.8
Tibia and fibula	5.60	6.3	5.6	3.7	2.7	2.3	1.6	1.4
Distal forearm	39.10	36.6	35.9	25.9	23.2	16	13.2	9.5

*(Kanis et al., 2001)

Using this methodology, if there were 100 hip fractures in this group then the estimated number of rib fractures would be 1.72 (the ratio of rib fractures to hip fractures) times 1000, or 1722 rib fractures.

The numbers stated above refer to the number of fractures that are ***treated*** or ***diagnosed*** in hospital. It is known that osteoporosis is often misdiagnosed, and many osteoporotic fractures do not present in hospital. The exact number are difficult to estimate, but previous studies (e.g., Dolan & Torgerson, 1998) report that only 8% of all vertebral fractures result in registered hospital admissions. The number of other fractures that present to hospital is unknown, although Cummings, Kelsey, Nevitt and O'Dowd (1985) report 18% as an average presentation rate.

For the analysis here, the estimates of 8% and 18% presentations rates for vertebral and other fractures (respectively) has been used. Although this is only a rough estimate, it is noteworthy that the ratio of hip to vertebral to other fractures that results is similar to other studies. However, it does highlight the need for a comprehensive study examining the pathway of care for those suffering fractures.

After an estimate of the number of each fracture type was established, the annual incidence per 10,000 was calculated using the Statistics NZ population projections (series 6) for 2003-05. These figures were then applied to the population projections for 2007, 2013 and 2020.

Assumptions of the Analysis:

- Almost all hip fractures will be treated within the public health system and be recorded accurately in the National Minimum Data Set.
- Most hip fractures over the age of 49 are osteoporotic.
- The relative proportions of fractures published by Kanis et al. (2001) is:
    - valid for the New Zealand population.
    - consistent between ethnic groups.
    - stable over time.
- Fracture rates within age groups will remain stable over time.
- The population projections available from Stats NZ are accurate.

Appendix C: Projected Number of Osteoporotic Fractures for 2007

Table C 1*: Total number of Osteoporotic fractures in 2007*

Men	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85–89**	**TOTAL**
Vertebra	1687	1001	953	751	1191	1429	1616	1775	**10405**
Ribs	1243	2817	747	1089	907	826	2355	1988	**11972**
Pelvis	45	59	40	44	53	83	137	192	**652**
Humeral shaft	86	39	38	44	74	61	57	109	**508**
Proximal humerus	250	117	113	127	218	184	182	327	**1519**
Clavicle, scapula, sternum	445	523	167	298	210	267	507	564	**2982**
Hip	29	46	45	68	95	173	266	384	**1106**
Other femoral	58	68	44	58	45	52	68	83	**478**
Tibia and fibulaa	0	0	0	0	0	0	0	0	**0**
Distal forearm	387	567	263	389	96	181	200	212	**2294**
Total	**4229**	**5239**	**2410**	**2867**	**2890**	**3257**	**5389**	**5636**	**31917**
Women									**TOTAL**
Vertebra	865	888	1304	1458	2128	3140	2693	5114	**17590**
Ribs	300	404	320	502	525	1129	1442	4405	**9027**
Pelvis	20	40	54	71	151	258	452	966	**2014**
Humeral shaft	97	106	82	174	156	266	198	523	**1601**
Proximal humerus	295	317	241	522	468	790	603	1549	**4786**
Clavicle, scapula, sternum	183	242	82	213	147	452	424	483	**2226**
Hip	17	41	62	103	179	382	624	1289	**2697**
Other femoral	25	44	69	75	109	186	245	563	**1316**
Tibia and fibula	143	196	169	146	128	186	151	282	**1399**
Distal forearm	995	1138	1084	1024	1097	1291	1244	1911	**9782**
Total	**2941**	**3415**	**3467**	**4288**	**5086**	**8079**	**8077**	**17084**	**52437**

Table C 2*: Total number of Osteoporotic fractures in 2007: European population*

Men	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85–89**	**TOTAL**
Vertebra	1439	916	815	650	1067	1353	1557	1747	**9543**
Ribs	1060	2576	638	943	812	781	2269	1957	**11037**
Pelvis	38	54	34	38	48	78	132	189	**611**
Humeral shaft	73	36	32	38	67	58	55	107	**466**
Proximal humerus	213	107	96	110	195	174	176	322	**1394**
Clavicle, scapula, sternum	380	479	143	258	188	253	489	555	**2744**
Hip	25	42	39	59	85	164	256	378	**1047**
Other femoral	50	63	37	50	40	49	66	82	**438**
Tibia and fibulaa	0	0	0	0	0	0	0	0	**0**
Distal forearm	330	519	225	337	86	171	192	208	**2068**
Total	3608	4790	2059	2483	2588	3082	5191	5546	**29347**

Women									**TOTAL**
Vertebra	669	766	1115	1325	1940	2960	2578	4997	**16349**
Ribs	233	348	273	456	478	1065	1380	4304	**8538**
Pelvis	16	35	46	65	138	243	433	943	**1919**
Humeral shaft	75	91	70	158	142	251	189	511	**1487**
Proximal humerus	229	273	206	474	427	745	577	1513	**4445**
Clavicle, scapula, sternum	142	209	70	194	134	426	406	472	**2052**
Hip	13	35	53	94	163	360	598	1259	**2575**
Other femoral	20	38	59	68	99	175	235	550	**1244**
Tibia and fibula	110	169	144	133	116	175	144	275	**1267**
Distal forearm	770	981	926	930	1000	1217	1191	1867	**8882**
Total	**2277**	**2944**	**2963**	**3897**	**4637**	**7616**	**7731**	**16693**	**48758**

Table C 3*: Total number of Osteoporotic fractures in 2007: Maori population*

Men	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85–89**	**TOTAL**
Vertebra	107	69	106	50	55	36	33	14	**469**
Ribs	79	194	83	73	42	21	48	16	**554**
Pelvis	3	4	4	3	2	2	3	2	**23**
Humeral shaft	5	3	4	3	3	2	1	1	**22**
Proximal humerus	16	8	13	8	10	5	4	3	**66**
Clavicle, scapula, sternum	28	36	19	20	10	7	10	5	**134**
Hip	2	3	5	5	4	4	5	3	**32**
Other femoral	4	5	5	4	2	1	1	1	**23**
Tibia and fibulaa	0	0	0	0	0	0	0	0	**0**
Distal forearm	24	39	29	26	4	5	4	2	**133**
Total	**268**	**360**	**267**	**191**	**133**	**82**	**109**	**46**	**1455**
Women									**TOTAL**
Vertebra	113	51	115	68	68	84	51	53	**603**
Ribs	39	23	28	23	17	30	27	46	**234**
Pelvis	3	2	5	3	5	7	9	10	**43**
Humeral shaft	13	6	7	8	5	7	4	5	**55**
Proximal humerus	39	18	21	24	15	21	11	16	**166**
Clavicle, scapula, sternum	24	14	7	10	5	12	8	5	**85**
Hip	2	2	5	5	6	10	12	13	**56**
Other femoral	3	2	6	4	3	5	5	6	**34**
Tibia and fibula	19	11	15	7	4	5	3	3	**66**
Distal forearm	130	65	95	48	35	34	24	20	**452**
Total	**385**	**196**	**305**	**201**	**164**	**215**	**154**	**177**	**1796**

Table C 4*: Total number of Osteoporotic fractures in 2007: Pacific population*

Men	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85–89**	**TOTAL**
Vertebra	44	17	24	26	37	10	8	3	**170**
Ribs	32	48	19	38	28	6	12	3	**187**
Pelvis	1	1	1	2	2	1	1	0	**8**
Humeral shaft	2	1	1	2	2	0	0	0	**9**
Proximal humerus	7	2	3	4	7	1	1	1	**25**
Clavicle, scapula, sternum	12	9	4	10	7	2	3	1	**47**
Hip	1	1	1	2	3	1	1	1	**11**
Other femoral	2	1	1	2	1	0	0	0	**8**
Tibia and fibulaa	0	0	0	0	0	0	0	0	**0**
Distal forearm	10	10	7	14	3	1	1	0	**46**
Total	**110**	**89**	**62**	**100**	**90**	**23**	**27**	**10**	**511**
Women									**TOTAL**
Vertebra	18	33	33	11	47	34	21	22	**219**
Ribs	6	15	8	4	12	12	11	19	**87**
Pelvis	0	2	1	1	3	3	4	4	**18**
Humeral shaft	2	4	2	1	3	3	2	2	**19**
Proximal humerus	6	12	6	4	10	9	5	7	**58**
Clavicle, scapula, sternum	4	9	2	2	3	5	3	2	**30**
Hip	0	2	2	1	4	4	5	5	**23**
Other femoral	1	2	2	1	2	2	2	2	**13**
Tibia and fibula	3	7	4	1	3	2	1	1	**23**
Distal forearm	21	42	27	7	24	14	10	8	**154**
Total	**63**	**127**	**87**	**31**	**113**	**87**	**64**	**72**	**644**

Table C 5*: Total number of Osteoporotic fractures in 2007: Asian population*

Men	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85–89**	**TOTAL**
Vertebra	97	0	9	24	33	31	18	11	**223**
Ribs	71	0	7	35	25	18	27	12	**195**
Pelvis	3	0	0	1	1	2	2	1	**10**
Humeral shaft	5	0	0	1	2	1	1	1	**11**
Proximal humerus	14	0	1	4	6	4	2	2	**34**
Clavicle, scapula, sternum	26	0	2	10	6	6	6	3	**57**
Hip	2	0	0	2	3	4	3	2	**16**
Other femoral	3	0	0	2	1	1	1	1	**9**
Tibia and fibulaa	0	0	0	0	0	0	0	0	**0**
Distal forearm	22	0	2	13	3	4	2	1	**47**
Total	**243**	**0**	**22**	**93**	**80**	**70**	**61**	**34**	603
Women									**TOTAL**
Vertebra	63	39	42	54	72	63	43	43	**418**
Ribs	22	18	10	19	18	22	23	37	**168**
Pelvis	1	2	2	3	5	5	7	8	**33**
Humeral shaft	7	5	3	6	5	5	3	4	**39**
Proximal humerus	22	14	8	19	16	16	10	13	**117**
Clavicle, scapula, sternum	13	11	3	8	5	9	7	4	**59**
Hip	1	2	2	4	6	8	10	11	**43**
Other femoral	2	2	2	3	4	4	4	5	**25**
Tibia and fibula	10	8	5	5	4	4	2	2	**43**
Distal forearm	73	49	35	38	37	26	20	16	**294**
Total	**216**	**148**	**112**	**160**	**173**	**161**	**128**	**142**	1239

Appendix D: Methodology for Estimating the Prevalence of Diagnosed Osteoporosis

It is relatively easy to establish an estimate of the number of people in New Zealand with diagnosed osteoporosis through analysing the National Health Survey from 2002/03, albeit with some caveats. This nationwide survey asked if the respondents had ever been told that they have osteoporosis. Table 1 shows the percentage of respondents in each age group who reported a diagnosis of osteoporosis. These numbers were used to estimate the prevalence of osteoporosis in 2007, 2013 and 2020 using Statistics NZ population projections (series 6).

The two major caveats that apply to this method of estimating diagnosed osteoporosis are that it relies on having an adequate sample size and is also subject to over- and under-reporting. The sample size must be large enough to establish good estimates within different age and ethnic groups, for both males and females. The degree of over- and under-reporting due to erroneous responses, both intentional and unintentional, may be particularly relevant to a survey item like this, where the respondent may not be particularly clear as to what osteoporosis is. Knowing the number of people with diagnosed osteoporosis will, unfortunately, underestimate the exact burden of the disease as many cases do not come to clinical attention or are not diagnosed until a fracture occurs (WHO, 2003).

Table D 1: Percentage of people diagnosed with osteoporosis from the New Zealand health survey 2002/3 by age and gender

Age	Female	Male
50-54	3.5%	1.0%
55-59	4.9%	2.0%
60-64	8.5%	1.0%
65-69	7.8%	1.4%
70-74	15.7%	0.7%
75-79	14.6%	2.6%
80-84	20.7%	3.5%
85-89	17.3%	5.2%
90+	13.6%	*

*N=0

Appendix E: Unit prices and method for determining health services usage and cost associated with osteoporosis

ITEM	UNITS	UNIT PRICE	NOTES/SOURCE
DexaScan	Two scans	$258	Pacific radiology www.pacificradiology.co.nz [1]
Hospitalisation			
Hip Fracture – Probability of receiving hospitalisation		100%	[2]
Hospitalisation – Hip Fracture – Acute phase	Total stay	$14,557	Auckland District Health Board Decision Support Unit, based on the average daily cost of treating a hip fracture [3]
Hospitalisation – Hip Fracture – Rehabilitation	Total stay	$12,062	Auckland District Health Board Decision Support Unit [4]
Hospitalisation - Hip Fracture - Percentage of receiving rehabilitation		70%	Auckland District Health Board Decision Support Unit and expert review [4]
Hospitalisation – Hip Fracture – Outpatient visits	Per person	$955	Auckland District Health Board Decision Support Unit [5]
Hospitalisation – Hip Fracture – Percentage receiving outpatient visits		50%	Auckland District Health Board Decision Support Unit [6]
Vertebral Fracture – Probability of receiving hospitalisation		8%	(Finnern & Sykes, 2003)[7]
Hospitalisation – Vertebral fracture	Per stay	$11,571	[8]
Hospitalisation – Vertebral Fracture – Outpatient visits	Per person	$637	[9]
Average cost of treatment – Other fractures	Per person	$2,191	Average across NZ DRG cost weights [10]
Percentage of vertebral fractures receiving treatment outside of hospital		22%	(Dolan & Torgerson, 1998)[11]
Average cost of treatment – vertebral fractures treated outside hospital	Per person	$2,191	[12]
Percentage of other fractures receiving treatment outside hospital		70%	[11]
Place of living before and after fracture			
Percentage in residential care or private hospital after suffering a hip fracture		61%	(Burge, King, Balda, & Worley, 2003) [13]
Percentage in community care after suffering a hip fracture		39%	Residual number not in residential facility or dead (1 - 0.61)
Percentage living in residential facility or private hospital prior to hip fracture		53%	(Schwenkglenks, Lippuner, Hauselmann, & Szucs, 2005) [14]
Percentage living in community prior to hip fracture		47%	Residual number not in residential facility (1 - .53)
Percentage in residential care after being hospitalised with a vertebral fracture		42%	Burge, King, Balda, and Worley (2003)
Percentage living in community after being hospitalised with a vertebral fracture		58%	Residual number not in residential facility (1 - .42)
Percentage living in residential facility or private hospital prior to being hospitalised with a vertebral fracture		38%	

Place of living before and after fracture (continued)			
Percentage living in community prior to being hospitalised with a vertebral fracture		62%	Residual number not in residential facility (1 - .38)
Mortality from Osteoporotic fractures			
Excess mortality within one year of suffering a hip fracture		12%	(Norton et al., 1995)
Excess morality within one year of suffering with a vertebral fracture		2.25%	[15]
Health Services for those living in the community			
Hip Fracture – Cost of care	Per person in community	$1381	(Pasco et al., 2005) and NZ prices [17]
Vertebral Fracture – Cost of care	Per person in community	$646	(Pasco et al., 2005) and NZ prices
Other Fracture – Cost of care	Per person in community	$293	(Pasco et al., 2005) and NZ prices
Residential stay			
Average stay for those discharged to residential facility	Days	211	(Lane, 1996) citing the (Norton et al., 1995)
Residential facility: • Level 1 • Level 2 • Level 3 • Level 4	Cost per day	$80 $85 $90 $95	HealthPAC data and contractual price paid by the DHBs
Additional cost for residential stay – New admissions		$95	People with hip or vertebral fractures requiring residential care are assumed to be high needs patient
Additional cost for residential stay – Already in residential care	Additional cost per day	$15	Difference between high and low units ($95 - $80)
Treatment and management			
Pharmaceuticals • Alendronate sodium • Etidronate disodium • Vitamin A with vitamins D and C			Data supplied by NZHIS for 2006. These medications were seen as being used primarily or solely for the treatment and management of osteoporosis.
Over the counter medications		37.5% of prescription medications	Based on ratio of prescription to non-prescription medications as listed in Access Economics (2001).
General practitioner visits	Per year	2 visits	Assumes 2 visits per year for the purpose of managing and treating osteoporosis
QALY estimation			
Utility losses from various types of fractures			[18] Summarized in (Eddy et al., 1998).
Life years lost			[19]
Lost QALYs due to fractures			Calculated by multiplying the number of fractures x the number of life years lost per fracture. Note that because the lost years refer only to major of series fractures, the estimation for the vertebral fractures was based only the 8% who were hospitalized.

[1] Personal communication with Professor Ian Reid suggests that two scans are needed to confirm a diagnosis of Osteoporosis. The price per scan is estimated at $129 (NZ$2006).

[2] Because of the severity of hip fractures, it is assumed that all events in New Zealand result in a hospitalisation visit. This is consistent with the assumption made in all previous studies.

[3] Communication with the Auckland District Health Board Decision Support Unit indicated that the average length of stay after a hip fracture was 11 days and the total cost was $14,557. This translated to an average daily cost of $1323.

Included in the cost of services was:

- Emergency Department treatment,
- Surgery
- Prosthesis cost
- Ward stay
- Laboratory services
- Radiology
- Medications and
- Overheads

The price did not include the cost of a Dexa Scan, rehabilitation or outpatient visits.

Data from the National Minimum dataset (2005) suggested that the average length of stay across all of NZ was 13.9 days in hospital. Multiplying the average daily cost of $1323 by 13.9 days gives the total expected cost of hip fracture of $18,395. To this was added the cost of diagnosing osteoporosis via a DexaScan, for a total of $18,643.

[4] ADHB estimates the 58% of the patients with hip fractures receive rehabilitation. However, it was recognised that there is significant regional variation in the availability and funding of rehabilitation services across the country. While it is not possible to accurately estimate the number of days spent in rehabilitation or the probability of receiving rehabilitation for New Zealand as a whole, expert opinion suggests that a national figure of 70% was more likely. This has been used as the estimate in the analysis.

[5] Data from ADHB suggests that for those people with a hip fractures who receive at least one outpatient visit, the average number of visits per person is 2.4. The cost per visit is reported to be $398, making the expected cost per person who receives at least one outpatient visit of $955.

[6] Data from ADHB suggests that 30% of those with hip fractures receive at least one outpatient visit. However, it was again recognised that there is significant regional variation in the availability and funding of outpatient services, and regional variation in the percentage of people showing up for appointments. Expert opinion suggested that 50% more accurately reflected the likely national average.

[7] Previous studies (e.g., (Finnern & Sykes, 2003) and (Dolan & Torgerson, 1998) suggest that the rate of hospitalisation for people with a vertebral fracture is 8%.

[8] Data from the National Minimum Dataset (2005) suggests an average length of stay of 11.3 days following a fracture of the vertebra. Previous studies suggest that vertebra fractures that result in hospitalisations are 63% of the cost of hip fractures (acute event as there is no rehabilitation associated with vertebral fractures). This translates to an expected cost of hospitalisation of $11,751 (or $1040 per day). Note that this is consistent with previous studies (e.g., (Finnern & Sykes, 2003) and (Dolan & Torgerson, 1998) where the costs have been reported for vertebral fractures that are and are not accompanied by neurological damage. That Dolan and Torgerson (1998) their estimate on a study in the UK in which it is reported that 30% of those with vertebral fractures receive medical attention but only 8% are hospitalised, with the cost per vertebral fracture (averaged across both hospitalised and non-hospitalised) being £630 (£1995). This is comparable to the estimated cost per vertebral fracture assumed here and the cost estimate per hospitalisation in NZ ($11,571) times 25% (average cost of $2982).

[9] No information was available on the number of outpatient visits or the probability of attending outpatient for patients with a vertebral fracture. It is assumed that the cost is 63% of the cost of hip fractures (as per (Finnern & Sykes, 2003) and that the probability of receiving outpatient support is 50% (as per hip fractures).

[10] Given the number of other types of fractures that can result from osteoporosis, previous studies have tended to simply report an estimated cost of treating all other fractures, including:

- Lower limb: AU$6221 if it requires hospitalisation, AU$342 if no hospitalisation (Randell et al., 1995).
- Upper limb: AU$3057 if it requires hospitalisation, AU$576 if it does no hospitalisation (Randell et al., 1995).
- $3150 for a tibia/fibula fracture requiring hospitalisation (Lane, 1996).
- $2667 for a humerus fracture requiring hospitalisation (Lane, 1996).
- £1200 for all fractures other than vertebral and hip (Dolan & Torgerson, 1998)
- $1,795 from NZ DRGs

Data from the Auckland District Health Board suggests an average hospital stay of 3.3 days following a fracture of the tibia or fibula, suggesting an average cost of $3,432 per event.

Estimating the cost of treating other types of fractures means considering the wide range of fractures as well as the fractures that are not treated in hospital. Given these complications, the current report uses an average of the NZ DRG cost weight reimbursements for various types of fractures are shown below. This results in an average cost of $2,191 per fracture.

	ICD-10 code	DRG41 code	DRG cost weight	Cost
Fracture of shaft of ulna	S52.2	I74C	0.414349	$1,305.61
Fracture of shaft of radius	S52.3	I19Z	1.069874	$3,371.17
Fracture of shafts of both ulna and radius	S52.4	I74C	0.414349	$1,305.61
Fracture of lower end of radius	S52.5	I74C	0.414349	$1,305.61
Multiple fractures of forearm	S52.7	I19Z	1.069874	$3,371.17
Fracture of other parts of forearm	S52.8	I19Z	1.069874	$3,371.17
Fracture of forearm, part unspecified	S52.9	I74C	0.414349	$1,305.61
Average Cost				$2,190.85

[11] There are a number of vertebral fractures that are likely treated in the community as well. Dolan and Torgerson (1998) suggest that 30% of those with vertebral fractures will receive treatment, with 8% of those requiring hospitalization but the remaining 22% being treated outside of the hospitals. There is little information on the percentage of people with osteoporotic fractures other than vertebral and hip who receive treatment. Some fractures (such has those of the forearm) are likely to be treated, while others (such as fractures of the rib) are more likely to be misdiagnosed or not-treated. Expert opinion acknowledges the uncertainty but estimates that 70% would receive some medical care.

[12] No information is available on the specific cost of treating vertebral fractures outside of a hospital setting. Because vertebral fractures are likely to be misdiagnosed, it is likely that people with fractures might receive a number of treatments that are inappropriate before the condition either deteriorates to the point where it is diagnosed (or they are placed in a residential home) or improves. Given the lack of certain, the report assumes the cost of treating outside of the hospital is assumed to be comparable to the cost of treating other types of fractures.

[13] This estimate is also consistent with data from a 1995 study (Norton et al., 1995) looking at hip fractures incidence in Auckland. Their results suggest that 64% went to a private hospital or long term facility after being released.

Discharge location	
Home	21.10%
Rest home	39.70%
Private hospital	24.10%
Death or unknown	12.10%

The results also suggest that 12.1% died within a two years post hip fracture.

[14] The results from Schwenkglenks et al (Schwenkglenks, Lippuner, Hauselmann, & Szucs, 2005) report that 8% of hip fractures result in first time admissions to a long term residential facility. This result is consistent with findings of (Kanis, Brazier, Stevenson, Calvert, & Lloyd Jones, 2002) which report the percentage of first time admissions as:

% hip fractures that result in first time admission to rest home	
Age	Percentage
60-69	4.00%
70-79	4.00%
80-89	12.00%
90+	17.00%

[15] (Kanis, Oden, Johnell, De Laet, & Jonsson, 2004) report the rate of mortality after vertebral fractures for the Swedish population.

[16] Little information is available on the number of first time admissions for residential care resulting from a vertebral fracture. For the purposes of this report, the rate is assumed to be 4% or ½ the rate of hip fractures.

[17] The cost of care for those receiving services in the community was estimated using the health services usage after fractures from (Pasco et al., 2005) and the following unit prices from NZ:

Cost	Units	Unit Cost	Source
General practitioner	Per consultation	$37.40	RNZCGP report 2006
Medical specialist	Per consultation	$54.93	NZDHB Sr Med & Dent Officers MECA (step 7) & AMS Salary Survey
District Nurse	Per visit	$25.89	NZNO MECA (step 5 RN)
Occupational Therapist	Per visit	$27.23	Mr Warwick Jones, PSA, Allied Health MECA 2006, terms of settlement
Physiotherapist	Per visit	$27.23	Mr Warwick Jones, PSA, Allied Health MECA 2006, terms of settlement
Home help	Per hour	$18.87	HealthPAC average cost for April 2006
Meals on Wheels	Per meal	$12	Sheryl's Mealmaker, NZ.

Applying unit prices from New Zealand results in the following cost of community service for each of the types of fractures:

Community care	per hour/visit	Hip units (days)	Hip probability	Hip expected cost
Home help	$18.87	52	44.90%	$440.58
Meals on wheels	$12.00	4.3	16.30%	$8.41
District nursing	$51.78	19.5	22.40%	$226.18
Family doctor	$37.40	4	46.00%	$68.82
Orthopaedic specialist	$109.86	3	74.00%	$243.89
Physiotherapist	$54.46	12	49.00%	$320.22
Occupational therapist	$54.46	2	66.73%	$72.68
Total cost				**$1,380.77**

Community care	per hour/visit	Vertebral units (days)	Vertebral probability	Vertebral expected cost
Home help	$18.87	52	23.30%	$228.63
Meals on wheels	$12.00	8.7	8.90%	$9.29
District nursing	$51.78	52	10.00%	$269.26
Family doctor	$37.40	3	50.00%	$56.10
Orthopaedic specialist	$109.86	2	14.40%	$31.64
Physiotherapist	$54.46	6	15.60%	$50.97
Occupational therapist	$54.46	*	*	*
Total cost				**$645.89**

Community care	per hour/visit	Other units (days)	Other probability	Other expected cost
Home help	$18.87	6	15.80%	$17.89
Meals on wheels	$12.00	5	4.20%	$2.52
District nursing	$51.78	6	5.30%	$16.47
Family doctor	$37.40	2	72.60%	$54.30
Orthopaedic specialist	$109.86	2	45.30%	$99.53
Physiotherapist	$54.46	5	37.60%	$102.38
Occupational therapist	$54.46	*	*	*
Total cost				**$293.10**

[18]

The figures given in Table 9 are taken from Zethraeus et al (2007). These are consistent with the numbers shown below from Eddy et al (1998).

Utility loss following fracture	Hip	Vertebra	Other
Acute event	0.083	0.032	0.040
Discharge to residential facility	0.600	0.300	
Home care services	0.022		0.300
Some disability/deformity (Per year)	0.100	0.100	
Moderate disability/deformity (Per year)	0.300	0.250	
Serious disability/deformity (Per year)	0.600	0.400	
Death	1.000	1.000	

*source: (Eddy et al., 1998)

[19] The number of life years lost is multiplying by identifying the net years lost by the population. The net years lost is taken from Centre et al (1999):

Men	50–54	55–59	60–64	65–69	70–74	75–79	80- 84	>85
General population	26.5	23.0	19.4	15.9	12.3	9.4	7.0	4.6
Hip	8.9	8.4	7.9	7.4	6.9	4.8	5.5	3.6
Hip – Gen Pop	-17.6	-14.6	-11.5	-8.5	-5.4	-4.6	-1.5	-1.0
Vertebra	15.3	14.3	13.3	12.3	11.3	8.3	5.6	2.9
Vertebra – Gen Pop	-11.2	-8.7	-6.1	-3.6	-1.0	-1.1	-1.4	-1.7
Women	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**75–79**	**80- 84**	**>85**
General population	32.6	28.3	24.0	19.7	15.7	12.0	8.8	5.6
Hip	11.0	11.9	12.8	13.7	11.3	10.8	8.4	5.3
Hip – Gen Pop	-21.6	-16.4	-11.2	-6.0	-4.4	-1.2	-0.4	-0.3
Vertebra	30.3	26.2	22.1	18.0	14.5	11.5	8.4	5.3
Vertebra – Gen Pop	-2.3	-2.1	-1.9	-1.7	-1.2	-0.5	-0.4	-0.3

* Adapted from Center et al (1999)