

WESTERN AUSTRALIA

Osteoporosis costing Western Australia: A burden of disease analysis – 2012 to 2022



osteoporosis australia



Authors

Kerrie M Sanders, Jennifer J Watts, Julie Abimanyi-Ochom, Ghulam Murtaza



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Prepared for Osteoporosis Australia, C2.11, Level 2, 22-36 Mountain Street, Ultimo, NSW 2007

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ISBN 978-0-6481053-0-5

Suggested Citation: Sanders KM, Watts JJ, Abimanyi-Ochom J, Murtaza G. Osteoporosis costing Western Australia: A burden of disease analysis – 2012 to 2022. Osteoporosis Australia 2017 ISBN 978-0-6481053-0-5 <http://osteoporosis.org.au/burdenofdisease>

Acknowledgements

Data obtained from the following people and associated projects has been crucial to the analyses used in this current report. Both Osteoporosis Australia and the authors gratefully acknowledge the expertise from the Investigators of the NHMRC-funded AusICUROS project; the Geelong Osteoporosis Study and the Data Integrity manager at Barwon Health.

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The AusICUROS research is supported by a National Health & Medical Research Council (NHMRC) Project Grant (#628422) with supplemental funding from MSD (Australia).

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Forewords



Professor Peter R Ebeling AO
Medical Director, Osteoporosis Australia

In Australia a fracture occurs due to poor bone health every 3.3 minutes. Over 160,000 fractures occur annually. They are costly for our healthcare system and, in particular, for hospitals in all Australian states and territories.

This burden of disease report for osteoporosis shows the number of fractures and associated costs in Western Australia.

- Over a 10-year period an estimated 171,000 fractures costing \$2.2 billion in total direct costs will occur in Western Australia.
- Our hospital system is becoming a revolving door for first fractures and, most importantly, subsequent fractures, which can and should be prevented.
- It's now time to make bone health a priority and to ensure osteoporosis is diagnosed and appropriately managed to reduce fractures.



Professor Charles Inderjeeth
University of Western Australia
Consultant Physician, Geriatrician and Rheumatologist, Sir Charles Gardiner Hospital Group
Director of Clinical Training – Osborne Park Hospital Program

This important burden of disease analysis reviews the common types of fractures associated with poor bone health and shows they are a costly to the health system in Western Australia.

These fractures are common and generally require emergency assistance, surgery, hospital stays, rehabilitation and community services (such as home care). It also shows the most expensive type of fracture remains hip fracture and costs increase with age.

We need to reduce fracture numbers and offer significant savings to the health system in Western Australia. Health Professionals and government can collectively reduce the fracture burden by focussing on this health issue.



Greg Lyubomirsky
CEO, Osteoporosis Australia

Breaking a bone from poor bone health is serious and painful for any patient and affects their family. It significantly disrupts normal daily tasks such as working, driving, shopping and caring for children or grandchildren.

The estimated number of fractures over a 10-year period is staggering and yet many people leave hospital following a serious fracture without investigation or diagnosis of osteoporosis. We are ignoring the underlying cause! This is an unacceptable burden for the community and places patients at higher risk of further fractures.

List of Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
ALOS	Average Length of Stay
ARDRG	Australian Refined Diagnosis Related Group
AUD	Australian Dollars
AusICUROS	The Australian Study of Cost and Utilities Related to Osteoporotic Fractures
BMD	Bone Mineral Density
BMI	Body Mass Index
BOD	Burden of Disease
COI	Cost if Illness
DALYs	Disability Adjusted Life Years
DRG	Diagnosis Related Group
DXA	Dual-energy X-ray Absorptiometry
ED	Emergency Department
GOS	Geelong Osteoporosis Study
GPs	General Practitioners
HRT	Hormone Replacement Therapy
IHPA	Independent Hospital Pricing Authority
IOF	International Osteoporosis Foundation
MBS	Medicare Benefit Schedule
Med Spec	Medical Specialist
MOW	Meals on wheels
NSAIDs	Non-Steroidal Anti Inflammatory Drugs
OA	Osteoporosis Australia
OPD	Out Patient Department
OTC	Over the counter
PBS	Pharmaceutical Benefit Scheme
Physio	Physiotherapy
RPBS	Repatriation Pharmaceutical Benefits Scheme
SES	Social Economic Status
SERMs	Selective Estrogen Receptor Modulators
WHO	World Health Organisation

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Objectives

The primary aim of this study is to determine the annual burden of disease of osteoporosis from a societal perspective in each of the State and Northern Territory populations in 2012, and then model the assumptions from this analysis to predict the annual fracture burden from 2013 to 2022. The objectives of the analysis are to:

- 1 use the best available Australian data on incidence and prevalence and health service utilisation to estimate the burden of disease relating to osteoporosis and low trauma fractures (prevention and management) and the total disease burden attributable to osteoporosis in each state and territory in 2012;
- 2 model the burden forward 10 years to 2022 to estimate the annual number of fractures projected to occur in adults with osteoporosis and osteopenia and the total direct costs of treating these fractures.

Reports in this Series

Reports have been produced for each state and territory:

- Victoria
- NSW & ACT
- Queensland
- Northern Territory
- Western Australia
- South Australia
- Tasmania

Key findings in each report outline the burden of osteoporosis and fractures in 2012 and predicted annual number and total direct cost of fractures for each year 2013 to 2022.

As Australia does not have adequate data on the state by state prevalence of low bone mass and fracture incidence, the reports for each state and territory are based on the same prevalence, incidence and unit cost data as previously used in the national 2012 report 'Osteoporosis Costing All Australians: A new burden of disease analysis 2012 to 2022'¹. These raw data have been applied to the ABS population estimates for each state and territory for each gender and 5-year age band with results then compiled into two age groups for both women and men (50 to 69 year olds and 70+ year olds). Therefore the differences in the size of the population aged 50 years and over and also the distributions by gender and 5-year age groups between the states and Northern Territory drives the disparities in the estimated burden of osteoporosis and associated fractures. The States with the highest population in the oldest age groups have the largest in number of people with fracture and the highest total cost of osteoporosis management and associated fracture treatment. Table 1 shows the mean direct cost per individual with a fracture.

Table 1: Mean direct cost per fracture (2012\$)*

Fracture Type	Female		Male	
	50-69 years	70+ years	50-69 years	70+ years
Hip	21,859	35,856	23,313	32,427
Wrist	4,848	7,992	4,215	5,323
Vertebral	6,099	9,606	6,228	6,987
Other	8,645	12,391	6,600	13,059

* Mean cost per fracture has been derived from health and non-health service utilisation collected from AusICUROS data, as detailed in the methods. All calculations have been done using gender and 5-year age distributions prior to presenting results in the two broad age groups.

WESTERN AUSTRALIA

Burden of Osteoporosis, Osteopenia and Associated Fractures in Western Australia



Authors
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Summary – Key Findings

Burden of Osteoporosis, Osteopenia and Associated Fractures in Western Australia

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Poor Bone Health: 2012-2022

- By 2022, it is estimated there will be 677,800 older people in Western Australia with low bone mass, an increase of 45% from 2012.
- 567,000 adults in Western Australia aged 50 years and older (66%) have osteoporosis or osteopenia (poor bone health) in 2017.
- 467,000 adults in Western Australia aged 50 years and older (66%), had osteoporosis or osteopenia (poor bone health) in 2012.
- Among people in Western Australia aged 50 years and older, 14% had osteoporosis and 52% have osteopenia.
- Among people in Western Australia aged 70 years and older, 43% of women and 13% of men had osteoporosis (47,000 women and 11,000 men).

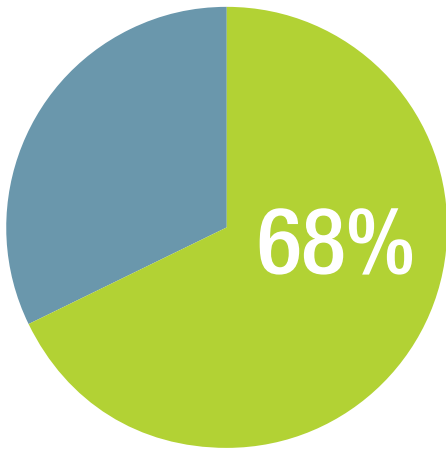
Fracture Impact: 2012-2022

- The total number of fractures over the ten year period 2013 to 2022 is projected to be 171,000.
- In 2022 it is expected there will be a 51% increase in the annual number of fractures (over 10 years) resulting in 20,470 fractures per annum.
- In 2022 there will be 56 fractures every day among older adults in Western Australia. Approximately one in six of these fractures will be a hip fracture.
- In 2017 there will be 46 fractures each day among older adults in Western Australia.

Cost Impact: 2012-2022

- The total direct costs of fractures over the ten years 2013 to 2022 will be \$2.2 billion (2012\$). These costs include ambulance services, hospitalisations and emergency and outpatient departments, rehabilitation, limited aged care and community services.
- In 2017 the total direct costs of osteoporosis and osteopenia in Western Australian adults aged 50 years and over will be \$307 million of which \$211 million (69%) relates to the treatment of fractures.
- In 2012 the total direct costs of osteoporosis and osteopenia in Western Australian adults aged 50 years and over, were almost \$250 million of which \$170 million (69%) relates to the treatment of fractures.

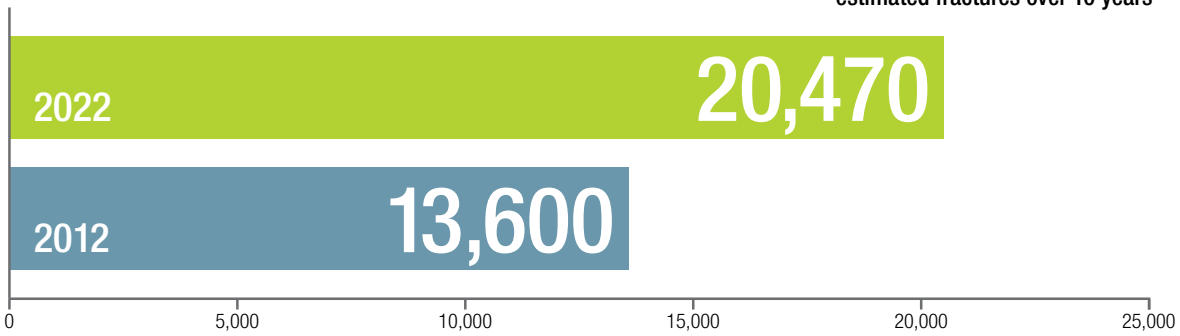
People in Western Australia over 50 estimated to have osteoporosis or osteopenia in 2022



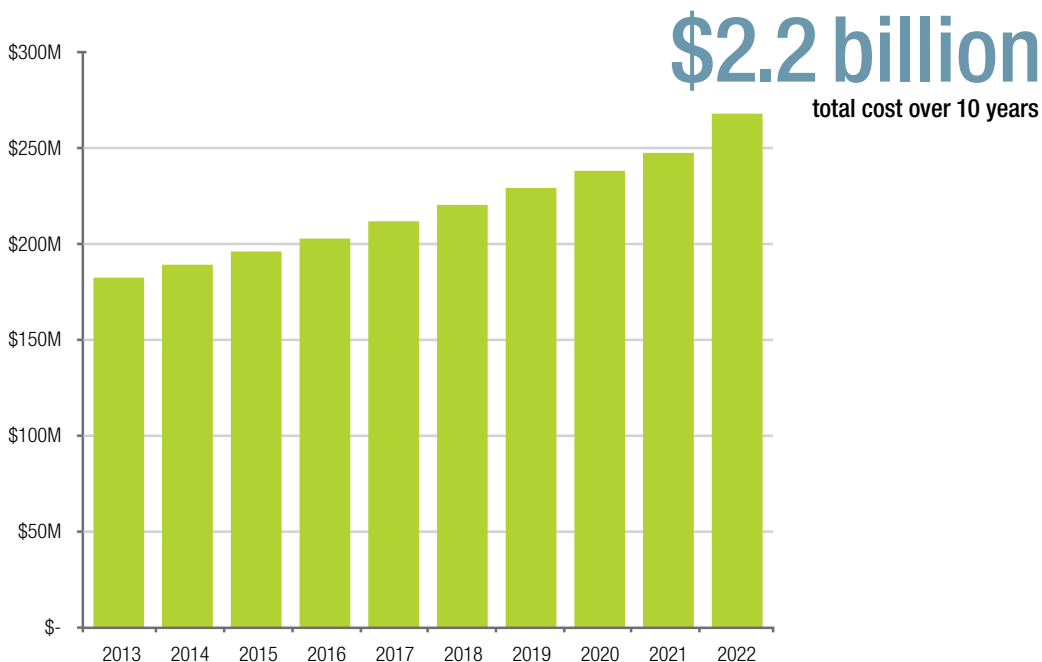
677,800
People in Western Australia over 50

Number of fractures due to osteoporosis and osteopenia

171,000
estimated fractures over 10 years



Total direct costs of fractures, 2013-2022 (2012\$) \$millions



Impact of Osteoporosis, Osteopenia and Fractures in Western Australia

A total of 66% of the Western Australia population aged 50 years and over in 2012 had osteoporosis or osteopenia, consistent with that reported for the Australian population (Table 2). Among older persons in Western Australia, 52% had osteopenia (n=367,025) and 14% (n=99,584) had osteoporosis. Osteopenia in those aged 50-69 years formed the group with the largest number of people, with 15,500 more men than women (Table 2). Although substantially fewer people had osteoporosis, there were four times as many women as men irrespective of the age group. Among adults aged 70 years and older it is estimated that 43% of women and 13% of men had osteoporosis in 2012 (approximately 47,000 women and 11,000 men).

Of the Western Australia population with osteoporosis and osteopenia aged 50 years and over, 3% (n=13,551) had fractures in 2012. Of these older adults 16% had a hip fracture (n=2,128) with the remainder sustaining non-hip fractures (14% wrist, 18% vertebral and 52% with 'other' fracture types). Due to the higher prevalence of osteopenia compared to osteoporosis, fracture numbers were highest among those with osteopenia in each age and gender subgroup except for women aged 70+ years, where 58% more fractures occurred in women with osteoporosis compared to osteopenia (Table 3).

Fractures in Men vs Women

Seventy-one percent of all fractures occurred in women – 38% in those aged 70 years and over and 32% in those aged 50 to 69 years. Approximately 16% and 13% of all fractures occur in men aged 50 to 69 years and 70 years and over, respectively (Table 3).

Across the two age groups and both bone density categories, absolute fracture numbers were consistently higher in women than men (percentages of fractures in men were: 'All' fractures 29%; Hip 29%; Wrist 11%; Vertebral 23%; 'Other' sites grouped: 37%). There were twice as many fractures in men with osteopenia than osteoporosis (osteopenia: n=2,688 vs osteoporosis n=1,303). In women the fracture numbers were more balanced due to the combination of a higher population in the older age group and the very high fracture rate among these older women with osteoporosis (aged 70+ years: 6.8%; n=3,189/46,800).

Table 2: 2012 Western Australia population by gender, age group and BMD category

Age Group	Osteoporosis		Osteopenia		Normal BMD		Total Population		
	Female	Male	Female	Male	Female	Male	Female	Male	Both
50-69 years	33,328	8,293	125,149	140,887	97,527	108,720	256,004	257,899	513,903
70+ years	46,800	11,164	49,910	51,079	11,509	24,245	108,220	86,488	194,708
Totals	80,128	19,456	175,059	191,966	109,037	132,965	364,224	344,387	708,611

Table 3: 2012 populations by gender, age group BMD category and fracture type

Population	Female				Total	Male				Total	All
	50-69 years		70+ years			50-69 years		70+ years			
	Osteoporosis	Osteopenia	Osteoporosis	Osteopenia	All Women	Osteoporosis	Osteopenia	Osteoporosis	Osteopenia	All Men	Total
Total Population	33,328	125,149	46,800	49,910	255,187	8,293	140,887	11,164	51,079	211,422	466,609
Population with fracture (Total)	1,839	2,516	3,189	2,015	9,559	711	1,516	592	1,172	3,992	13,551
Hip											
Starting population	68	94	821	519	1,502	42	89	166	328	626	2,128
Hospitalised	68	94	821	519	1,502	42	89	166	328	626	2,128
Wrist											
Starting population	361	494	528	334	1,718	37	79	33	65	215	1,933
Hospitalised	163	222	338	214	937	16	35	17	33	100	1,037
Vertebral											
Starting population	277	378	747	472	1,874	74	159	105	208	546	2,420
Hospitalised	130	178	471	297	1,076	37	79	70	139	326	1,402
Other											
Starting population	1,133	1,550	1,093	690	4,465	557	1,189	288	571	2,605	7,071
Hospitalised	691	945	743	469	2,849	256	547	213	422	1,439	4,288
Low BMD population without fracture	31,489	122,632	43,611	47,895	245,628	7,582	139,371	10,572	49,906	207,430	453,058

Total Cost of Osteoporosis and Osteopenia in Western Australia 2012

Table 4: Total costs (direct and indirect) of osteoporosis and osteopenia in 2012

Cost	Total Cost (\$)	% Total Cost (direct and indirect)
Total Direct Fracture Cost (excluding informal care)	\$156,794,345	59.6
- Hip fractures	\$67,463,951	
- Wrist fractures	\$11,360,901	
- Vertebral fractures	\$16,536,074	
- Other fractures	\$61,433,419	
Total Cost Informal Care	\$13,496,624	5.1
- Hip fractures	\$3,420,342	
- Wrist fractures	\$693,647	
- Vertebral fractures	\$2,805,145	
- Other fractures	\$6,577,490	
Total Direct Fracture Cost (including informal care)	\$170,290,970	64.7
- Hip fractures	\$70,884,293	
- Wrist fractures	\$12,054,548	
- Vertebral fractures	\$19,341,219	
- Other fractures	\$68,010,910	
Total Direct Non-Fracture Cost	\$76,458,109	29.1
- Routine medical and pathology (includes Vitamin D tests)	\$61,661,605	
- DXA	\$1,960,230	
- Pharmaceuticals – bone health	\$12,836,274	
TOTAL DIRECT COSTS (fracture treatment + management of osteoporosis)	\$246,749,078	93.8
TOTAL DIRECT COSTS (excluding informal care)*	\$233,252,454	
Total Indirect cost (Productivity Loss due to Fractures)	\$16,323,907	6.2
- Hip fractures	\$7,401,199	
- Wrist fractures	\$813,359	
- Vertebral fractures	\$1,856,781	
- Other fractures	\$6,252,568	
TOTAL DIRECT and INDIRECT COST	\$263,072,986	
TOTAL DIRECT and INDIRECT COST (DUE TO FRACTURES)	\$186,614,877	70.9

* Total direct cost (excluding informal care) was used as the denominator in percentage calculations in all tables (unless otherwise stated)

The treatment of fractures accounted for 69% of the total direct costs (including informal care) associated with osteoporosis (\$170/\$247 million: Table 4). Of this, hip fractures accounted for the highest proportion (42%) although the direct treatment cost of fractures at 'other' sites was 40% of the cost of all fractures. Treatment costs of vertebral fracture accounted for 11% of the cost of all fractures. Informal care includes the cost of non-health community services such as 'meals on wheels' and home help. This cost was 8% of the total direct cost of treating fractures and fractures at 'other' sites accounted for almost half of this expenditure.

The management of osteoporosis accounted for 31% of the total direct costs associated with osteoporosis. This includes the use of bone-active medications (see Appendices A and D2), supplements of calcium and vitamin D but does not include costs associated with exercise therapy or other lifestyle interventions.

Acute Care Fracture Costs

Acute Hospital Services (including Emergency Department and Non-Admitted Services)

In Western Australia the total cost of acute hospital care for fractures associated with osteoporosis or osteopenia in 2012 was \$115 million, of which the total for acute inpatient hospitalisation was \$109.4 million (95% of total hospital costs) (Table 5). The remainder of \$5.7 million was for non-admitted services (including emergency departments). Total costs of hospital care for fractures represented 68% of the direct costs of fractures. Hospital costs alone account for 43% of the direct total costs attributed to osteoporosis in 2012. Fractures accounted for approximately 8,855 acute admissions to hospital in 2012, representing 62,461 bed-days, with an average length of stay of 3.9 days in those aged 50 to 69 years old and 9.2 days in those aged 70 years and older.

Hip fractures represented 42% of total acute inpatient hospital costs and 36% of bed-days, vertebral fractures 9% of hospital costs and 11% of bed-days, wrist fractures 7% of hospital costs and 3% of bed-days and 'other' fractures 42% of total acute hospital costs and 50% of acute bed-days. People aged 70 years and over accounted for 68% of total acute hospital inpatient costs of fractures, and costs for women were 71% of the total. The highest single category was acute inpatient care for women aged over 70 years with a hip fracture, with a total cost of \$30 million representing 26% of total hospital costs for all age, sex and fracture categories. See Table 5 below for a summary of costs relating to the hospital management of fractures.

Table 5: Hospital (admitted and non-admitted) costs for fracture management by gender, age group and fracture type

	Female (Total Cost)				Male (Total Cost)				All		% Total Direct Costs
	50-69 years	% Total	70+ years	% Total	50-69 years	% total	70+ years	% Total	Total Cost	% Total	
Hospital Inpatient – Total Cost	\$24,309,701	22	\$53,196,868	49	\$11,581,993	11	\$20,285,788	19	\$109,374,350	100	44.3
- Hip	\$2,773,932	3	\$30,195,175	28	\$2,246,876	2	\$11,184,088	10	\$46,400,070	42	
- Wrist	\$2,814,932	3	\$3,798,904	3	\$374,360	0	\$339,439	0	\$7,327,635	7	
- Vertebral	\$2,057,379	2	\$5,132,556	5	\$777,200	1	\$1,397,951	1	\$9,365,086	9	
- Other	\$16,663,459	15	\$14,070,233	13	\$8,183,557	7	\$7,364,310	7	\$46,281,559	42	
Hospital (Non-admitted services) – Total Cost	\$2,252,388	39	\$1,714,270	30	\$1,251,746	22	\$509,384	9	\$5,727,788	100	2.3
- Hip	\$31,849	1	\$79,840	1	\$21,852	0	\$45,146	1	\$178,687	3	
- Wrist	\$506,841	9	\$427,123	7	\$73,808	1	\$52,411	1	\$1,060,184	19	
- Vertebral	\$276,538	5	\$394,870	7	\$120,979	2	\$97,742	2	\$890,128	16	
- Other	\$1,437,161	25	\$812,437	14	\$1,035,107	18	\$314,085	5	\$3,598,790	63	
All Hospital – Total Cost	\$26,562,089	23	\$54,911,138	48	\$12,833,738	11	\$20,795,172	18	\$115,102,138	100	46.6
- Hip	\$2,805,781	2	\$30,275,015	26	\$2,268,728	2	\$11,229,234	10	\$46,578,757	40	
- Wrist	\$3,321,773	3	\$4,226,027	4	\$448,168	0	\$391,850	0	\$8,387,818	7	
- Vertebral	\$2,333,916	2	\$5,527,427	5	\$898,178	1	\$1,495,693	1	\$10,255,214	9	
- Other	\$18,100,619	16	\$14,882,670	13	\$9,218,664	8	\$7,678,395	7	\$49,880,349	43	

Tables 6 to 10 provide more detail on the individual cost categories that are included in the total direct and indirect costs associated with fractures. The costs have been calculated based on utilisation of services in the 12 month period following the fracture event (Appendix B). All costs are restricted to services used as a direct consequence of the fracture.

Table 6: Total cost of all fractures by gender, age group and sector

	Female				Male				All	
	Ages 50-69 years		Age 70+ years		Ages 50-69 years		Age 70+ years		Total Cost	% Direct Total Cost
All Fractures	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost		
Hospital Total	\$26,562,089	10.8	\$54,911,138	22.3	\$12,833,738	5.2	\$20,795,172	8.4	\$115,102,138	46.6
Ambulance	\$1,137,961	0.5	\$2,308,383	0.9	\$654,447	0.3	\$937,408	0.4	\$5,038,200	2.0
Community Fracture Mgt (incl GP, Physio, Med Spec, X-ray)	\$590,365	0.2	\$686,435	0.3	\$296,476	0.1	\$335,610	0.1	\$1,908,887	0.8
Rehabilitation	\$2,270,659	0.9	\$16,364,663	6.6	\$769,706	0.3	\$4,249,881	1.7	\$23,654,910	9.6
Nursing Home	\$-	0.0	\$4,307,189	1.7	\$-	0.0	\$1,374,665	0.6	\$5,681,854	2.3
Community Services (home help and MOW)	\$779,388	0.3	\$2,887,935	1.2	\$18,002	0.0	\$714,765	0.3	\$4,400,090	1.8
Pharmaceuticals – Fracture Management	\$8,935	0.0	\$10,209	0.0	\$2,575	0.0	\$1,705	0.0	\$23,424	0.0
Supplements – Vitamin D and Calcium	\$323,274	0.1	\$371,897	0.2	\$164,919	0.1	\$124,752	0.1	\$984,843	0.4
Total Direct Health Care Cost (excludes informal care)	\$31,672,671	12.8	\$81,847,850	33.2	\$14,739,865	6.0	\$28,533,959	11.6	\$156,794,345	63.5
Informal care	\$3,200,763		\$6,903,522		\$1,787,940		\$1,604,400		\$13,496,624	
Total Direct Cost (includes informal care)	\$34,873,434		\$88,751,372		\$16,527,804		\$30,138,359		\$170,290,970	
Productivity Loss due to Fracture (Indirect)	\$2,226,149		\$9,769,387		\$997,201		\$3,331,170		\$16,323,907	
Total Cost (Direct and Indirect)	\$37,099,583		\$98,520,760		\$17,525,006		\$33,469,529		\$186,614,877	

Table 7: Total cost of hip fractures by gender, age group and sector

	Female				Male				All	
	Ages 50-69 years		Age 70+ years		Ages 50-69 years		Age 70+ years		Total Cost	% Direct Total Cost
Hip Fractures	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost		
Hospital Total	\$2,805,781	1.1	\$30,275,015	12.3	\$2,268,728	0.9	\$11,229,234	4.6	\$46,578,757	18.9
Ambulance	\$97,037	0.0	\$867,301	0.4	\$81,310	0.0	\$341,747	0.1	\$1,387,395	0.6
Community Fracture Mgt (incl GP, Physio, Med Spec, X-ray)	\$57,085	0.0	\$218,845	0.1	\$44,252	0.0	\$171,332	0.1	\$491,514	0.2
Rehabilitation	\$541,284	0.2	\$9,784,419	4.0	\$649,538	0.3	\$2,702,705	1.1	\$13,677,945	5.5
Nursing Home	\$-	0.0	\$2,797,152	1.1	\$-	0.0	\$1,332,059	0.5	\$4,129,211	1.7
Community Services (home help and MOW)	\$7,799	0.0	\$804,833	0.3	\$-	0.0	\$234,829	0.1	\$1,047,461	0.4
Pharmaceuticals – Fracture Management	\$472	0.0	\$3,623	0.0	\$110	0.0	\$411	0.0	\$4,616	0.0
Supplements – Vitamin D and Calcium	\$11,962	0.0	\$91,928	0.0	\$9,113	0.0	\$34,049	0.0	\$147,052	0.1
Total Direct Health Care Cost (excludes informal care)	\$3,521,419	1.4	\$44,843,115	18.2	\$3,053,051	1.2	\$16,046,366	6.5	\$67,463,951	27.3
Informal care	\$19,731		\$3,211,304		\$6,012		\$183,294		\$3,420,342	
Total Direct Cost (includes informal care)	\$3,541,150		\$48,054,419		\$3,059,063		\$16,229,661		\$70,884,293	
Productivity Loss due to Fracture (Indirect)	\$305,638		\$5,122,891		\$313,587		\$1,659,082		\$7,401,199	
Total Cost (Direct and Indirect)	\$3,846,787		\$53,177,310		\$3,372,651		\$17,888,743		\$78,285,492	

Table 8: Total cost of wrist fractures by gender, age group and sector

Wrist Fractures	Female				Male				All	
	Ages 50-69 years		Age 70+ years		Ages 50-69 years		Age 70+ years		Total Cost	% Direct Total Cost
	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost		
Hospital Total	\$3,321,773	1.3	\$4,226,027	1.7	\$448,168	0.2	\$391,850	0.2	\$8,387,818	3.4
Ambulance	\$100,159	0.0	\$166,202	0.1	\$15,226	0.0	\$27,155	0.0	\$308,742	0.1
Community Fracture Mgt (incl GP, Physio, Med Spec, X-ray)	\$91,973	0.0	\$105,443	0.0	\$9,396	0.0	\$8,280	0.0	\$215,092	0.1
Rehabilitation	\$285,922	0.1	\$1,433,900	0.6	\$6,337	0.0	\$85,414	0.0	\$1,811,573	0.7
Nursing Home	\$-	0.0	\$329,052	0.1	\$-	0.0	\$2,352	0.0	\$331,404	0.1
Community Services (home help and MOW)	\$10,965	0.0	\$146,936	0.1	\$-	0.0	\$2,528	0.0	\$160,429	0.1
Pharmaceuticals – Fracture Management	\$1,872	0.0	\$1,840	0.0	\$74	0.0	\$62	0.0	\$3,848	0.0
Supplements – Vitamin D and Calcium	\$63,626	0.0	\$62,514	0.0	\$8,655	0.0	\$7,199	0.0	\$141,994	0.1
Total Direct Health Care Cost (excludes informal care)	\$3,876,291	1.6	\$6,471,912	2.6	\$487,857	0.2	\$524,841	0.2	\$11,360,901	4.6
Informal care	\$272,551		\$418,396		\$2,700		\$0		\$693,647	
Total Direct Cost (includes informal care)	\$4,148,842		\$6,890,308		\$490,557		\$524,841		\$12,054,548	
Productivity Loss due to Fracture (Indirect)	\$169,646		\$588,744		\$13,958		\$41,011		\$813,359	
Total Cost (Direct and Indirect)	\$4,318,488		\$7,479,052		\$504,516		\$565,851		\$12,867,907	

Table 9: Total cost of vertebral fractures by gender, age group and sector

Vertebral Fractures	Female				Male				All	
	Ages 50-69 years		Age 70+ years		Ages 50-69 years		Age 70+ years		Total Cost	% Direct Total Cost
	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost		
Hospital Total	\$2,333,916	0.9	\$5,527,427	2.2	\$898,178	0.4	\$1,495,693	0.6	\$10,255,214	4.2
Ambulance	\$238,979	0.1	\$587,434	0.2	\$100,872	0.0	\$90,268	0.0	\$1,017,553	0.4
Community Fracture Mgt (incl GP, Physio, Med Spec, X-ray)	\$97,555	0.0	\$118,724	0.0	\$30,437	0.0	\$29,149	0.0	\$275,865	0.1
Rehabilitation	\$228,546	0.1	\$1,995,546	0.8	\$14,389	0.0	\$362,350	0.1	\$2,600,832	1.1
Nursing Home	\$-	0.0	\$457,939	0.2	\$-	0.0	\$9,978	0.0	\$467,917	0.2
Community Services (home help and MOW)	\$267,287	0.1	\$1,454,062	0.6	\$-	0.0	\$18,913	0.0	\$1,740,262	0.7
Pharmaceuticals – Fracture Management	\$404	0.0	\$734	0.0	\$132	0.0	\$173	0.0	\$1,444	0.0
Supplements – Vitamin D and Calcium	\$48,682	0.0	\$88,424	0.0	\$17,280	0.0	\$22,602	0.0	\$176,988	0.1
Total Direct Health Care Cost (excludes informal care)	\$3,215,369	1.3	\$10,230,289	4.1	\$1,061,289	0.4	\$2,029,127	0.8	\$16,536,074	6.7
Informal care	\$778,668		\$1,483,644		\$386,994		\$155,839		\$2,805,145	
Total Direct Cost (includes informal care)	\$3,994,037		\$11,713,933		\$1,448,284		\$2,184,966		\$19,341,219	
Productivity Loss due to Fracture (Indirect)	\$314,835		\$1,172,407		\$99,399		\$270,140		\$1,856,781	
Total Cost (Direct and Indirect)	\$4,308,872		\$12,886,341		\$1,547,683		\$2,455,105		\$21,198,000	

Table 10: Total cost of 'other' fractures by gender, age group and sector

Other Fractures	Female				Male				All	
	Ages 50-69 years		Age 70+ years		Ages 50-69 years		Age 70+ years		Total Cost	% Direct Total Cost
	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost	Total Cost	% Direct Total Cost		
Hospital Total	\$18,100,619	7.3	\$14,882,670	6.0	\$9,218,664	3.7	\$7,678,395	3.1	\$49,880,349	20.2
Ambulance	\$701,786	0.3	\$687,447	0.3	\$457,039	0.2	\$478,238	0.2	\$2,324,510	0.9
Community Fracture Mgt (incl GP, Physio, Med Spec, X-ray)	\$343,752	0.1	\$243,424	0.1	\$212,391	0.1	\$126,849	0.1	\$926,416	0.4
Rehabilitation	\$1,214,908	0.5	\$3,150,799	1.3	\$99,442	0.0	\$1,099,411	0.4	\$5,564,559	2.3
Nursing Home	\$-	0.0	\$723,047	0.3	\$-	0.0	\$30,275	0.0	\$753,322	0.3
Community Services (home help and MOW)	\$493,337	0.2	\$482,104	0.2	\$18,002	0.0	\$458,495	0.2	\$1,451,938	0.6
Pharmaceuticals – Fracture Management	\$6,187	0.0	\$4,012	0.0	\$2,259	0.0	\$1,059	0.0	\$13,516	0.0
Supplements – Vitamin D and Calcium	\$199,004	0.1	\$129,032	0.1	\$129,871	0.1	\$60,903	0.0	\$518,809	0.2
Total Direct Health Care Cost (excludes informal care)	\$21,059,592	8.5	\$20,302,534	8.2	\$10,137,667	4.1	\$9,933,625	4.0	\$61,433,419	24.9
Informal care	\$2,129,813		\$1,790,178		\$1,392,233		\$1,265,267		\$6,577,490	
Total Direct Cost (includes informal care)	\$23,189,406		\$22,092,712		\$11,529,900		\$11,198,892		\$68,010,910	
Productivity Loss due to Fracture (Indirect)	\$1,436,030		\$2,885,345		\$570,256		\$1,360,937		\$6,252,568	
Total Cost (Direct and Indirect)	\$24,625,435		\$24,978,057		\$12,100,156		\$12,559,829		\$74,263,478	

Table 11: Average cost per fracture: annual direct health and non-health care cost of low trauma fracture by gender and age group

Fracture Type		Female		Male	
		50-69 years (\$2012)	70+ years (\$2012)	50-69 years (\$2012)	70+ years (\$2012)
Hip	Average Direct Total Cost	21,859	35,856	23,313	32,427
Wrist	Average Direct Total Cost	4,848	7,992	4,215	5,323
Vertebral	Average Direct Total Cost	6,099	9,606	6,228	6,987
Other Fractures	Average Direct Total Cost	8,645	12,391	6,600	13,059

Table 11 (and Table 1) shows the average annual direct cost for each fracture site categorised by gender and age group. Average direct costs for fractures included acute hospital admitted and non-admitted care, subacute/rehabilitation, ambulance, community health care services following fracture, pharmaceuticals for fracture management and supplements for osteoporosis prevention. The average cost also includes average use of community services such as 'meals-on-wheels' and home help in addition to a proportional cost of nursing home stay (% of fracture cases who then moved into residential care) for the remainder of the 12-month period since the fracture event (Appendix B).

Sensitivity Analysis – Modelling a 25% Change in Hip Fracture Numbers

Table 12: Impact on total cost of a 25% change in the total number of hip fractures

	Change in Total Cost (\$)				
	2012 Results	Hip Fractures Increase by 25%		Hip Fractures Decrease by 25%	
	2012\$	2012\$	%	2012\$	%
Total Direct Fracture Cost (including informal care)	170,290,970	188,012,043	10.41	152,569,897	-10.41
TOTAL DIRECT COSTS	246,749,078	264,470,152	7.18	229,028,005	-7.18
TOTAL DIRECT and INDIRECT COST	263,072,986	282,644,359	7.44	243,501,613	-7.44

A sensitivity analysis was undertaken to estimate the effect on the total cost of all fractures if the number of hip fractures was changed by 25% (both increased and decreased) (Table 12). A 25% change equates to ± 532 hip fractures. The impact of this was a 10% change in the direct cost of all fractures. The total direct cost of all fractures was estimated to be approximately \$188 million if hip fracture numbers were 25% higher in 2012. If hip fracture numbers were 25% lower in 2012, the total direct cost of all fractures would be approximately \$152 million, a change of almost \$17 million.

Burden of Osteoporosis and Osteopenia in Western Australia from 2013 - 2022

Fracture Numbers and Costs in Western Australia 2013 - 2022

As described in the Method (Appendix A), the change in fracture numbers is based on the ABS projection for the Western Australia population using the assumption that the fracture rate remains stable. Although the data are presented as two broad age categories of 50-69 years and 70 years and over, the calculations have been done in 5-year age brackets to increase the precision of the estimates.

All Fractures

The annual total burden of all fractures related to osteoporosis and osteopenia for 2013 to 2022 are shown in Table 13. Over the ten years between 2013 and 2022, the population increases are highest in the older age group of 70+ years. Since this age group has a higher rate of fracture, the increase in fracture numbers is substantially higher in the 70+ year old compared to 50-69 year old groups (70+ vs 50-69 years: women: 157% vs 125%; men: 155% vs 125%).

Over the ten years from 2013 to 2022, 53% of the total direct costs of all fractures will be attributable to women aged 70 years and older. By comparison, 19% of the total costs will be attributable to men aged 70+ years and fractures in adults aged 50 to 69 years account for 19% and 9% of the costs in women and men, respectively.

Over the same ten year period the total direct cost of all fractures is expected to increase slightly more than the number of fractures (147% compared with a 141% overall increase in fracture numbers; Table 13). The increase in cost is proportionally more because the cost per hip fracture is substantially higher than fractures at other sites and hip fractures are much more common in the older age group where the highest increase in the population is expected.

Table 13: Annual number and total direct costs of all fractures by gender, age group and total, 2013-2022 (2012\$)

Year	All Fractures	Annual Total Number of Fractures and Total Direct Cost (2012\$)				Total All Fractures
		Female		Male		
		50-69 years	70+ years	50-69 years	70+ years	
2013	Annual total number of fractures	4,658	5,544	2,377	1,922	14,500
	Total Direct Costs \$	37,299,688	94,628,015	17,639,078	32,637,093	182,203,874
2014	Annual total number of fractures	4,798	5,750	2,448	2,014	15,011
	Total Direct Costs \$	38,422,976	98,151,312	18,170,739	34,208,568	188,953,595
2015	Annual total number of fractures	4,934	5,960	2,515	2,108	15,518
	Total Direct Costs \$	39,510,166	101,733,400	18,803,082	35,803,234	195,857,925
2016	Annual total number of fractures	5,065	6,176	2,580	2,207	16,027
	Total Direct Costs \$	40,554,990	105,416,842	19,146,828	37,473,152	202,591,812
2017	Annual total number of fractures	5,160	6,498	2,629	2,347	16,634
	Total Direct Costs \$	41,317,971	110,907,501	19,510,369	39,856,582	211,592,424
2018	Annual total number of fractures	5,271	6,797	2,686	2,478	17,232
	Total Direct Costs \$	42,208,728	115,934,505	19,934,736	42,077,122	220,155,091
2019	Annual total number of fractures	5,395	7,101	2,753	2,601	17,851
	Total Direct Costs \$	43,203,695	121,191,960	20,433,645	44,157,647	228,986,947
2020	Annual total number of fractures	5,522	7,409	2,824	2,725	18,481
	Total Direct Costs \$	44,218,551	126,444,740	20,961,395	46,263,539	237,888,225
2021	Annual total number of fractures	5,666	7,728	2,902	2,857	19,153
	Total Direct Costs \$	45,373,852	131,872,733	21,538,819	48,498,941	247,284,344
2022	Annual total number of fractures	5,805	8,698	2,979	2,987	20,470
	Total Direct Costs \$	46,485,697	148,406,562	22,113,551	50,708,750	267,714,560
2013-2022	Total number of fractures	52,274	67,661	26,693	24,246	170,874
	Total Direct Costs \$	\$418,596,314	\$1,154,687,570	\$198,252,242	\$411,684,628	\$2,183,220,754

Tables 14 to 17 provide the projected site-specific fracture numbers for each year from 2013 to 2022.

Table 14: Annual number and total direct costs of hip fractures by gender, age group and total, 2013-2022 (2012\$)

Year	Hip Fractures	Annual Total Number of Hip Fractures and Total Direct Cost (2012\$)				Total Hip Fractures
		Female		Male		
		50-69 years	70+ years	50-69 years	70+ years	
2013	Annual number of hip fractures	173	1,428	140	538	2,279
	Total Direct Costs \$	3,787,519	51,187,283	3,266,986	17,465,791	75,707,578
2014	Annual number of hip fractures	178	1,481	144	564	2,368
	Total Direct Costs \$	3,901,581	53,093,712	3,365,457	18,306,683	78,667,432
2015	Annual number of hip fractures	184	1,535	148	591	2,466
	Total Direct Costs \$	4,011,977	55,032,070	3,458,983	19,160,273	81,868,440
2016	Annual number of hip fractures	188	1,590	152	618	2,549
	Total Direct Costs \$	4,118,071	57,025,428	3,546,241	20,053,518	84,743,259
2017	Annual number of hip fractures	192	1,673	155	658	2,678
	Total Direct Costs \$	4,195,547	59,998,490	3,613,574	21,328,766	89,136,377
2018	Annual number of hip fractures	196	1,750	158	694	2,799
	Total Direct Costs \$	4,285,997	62,759,951	3,692,172	22,516,883	93,255,003
2019	Annual number of hip fractures	201	1,829	162	729	2,920
	Total Direct Costs \$	4,387,029	65,566,307	3,784,576	23,630,112	97,368,024
2020	Annual number of hip fractures	205	1,908	167	764	3,043
	Total Direct Costs \$	4,490,080	68,409,955	3,882,323	24,756,919	101,539,276
2021	Annual number of hip fractures	211	1,990	171	800	3,172
	Total Direct Costs \$	4,607,393	71,348,228	3,989,269	25,953,029	105,897,918
2022	Annual number of hip fractures	216	2,240	176	837	3,468
	Total Direct Costs \$	4,720,293	80,303,436	4,095,717	27,135,445	116,254,890
2013-2022	Total number of hip fractures	1,944	17,424	1,573	6,793	27,734
	Total Direct Costs \$	\$42,505,487	\$624,724,860	\$36,695,298	\$220,307,419	\$924,233,064

Hip fractures in adults younger than 70 years are not common. The number of 50 to 69 year old women with hip fracture is approximately 24% higher than the number of men. In Western Australia for people aged 70 years and older, the annual number of hip fractures increases dramatically. In women the number of hip fractures is eight times higher than those aged less than 70 years. In men the annual number of hip fractures in the older age group is four times higher than the younger age group. However, using the population projections for the 10 years from 2013 to 2022 the annual number of 70+ year old adults with hip fractures will increase by 56% in men and 57% increase in women. The projected increase in hip fractures in women and men aged 50 to 69 years is approximately 25% over the ten year period.

Compared with the younger age group, those aged over 70 years have a longer length of acute care hospital stay and utilise more non-acute services post-discharge. Accordingly the higher cost of treating hip fractures is greater than that explained by the higher number of patients. In 2022 it is estimated that almost 70% of the total direct cost of all hip fractures will be attributable to treating hip fracture in women aged 70 years and over (Table 14).

Table 15: Annual number and total direct costs of wrist fractures by gender, age group and total, 2013-2022 (2012\$)

Year	Wrist Fractures	Annual Total Number of Wrist Fractures and Total Direct Cost (2012\$)				Total Wrist Fractures
		Female		Male		
		50-69 years	70+ years	50-69 years	70+ years	
2013	Annual number of wrist fractures	915	918	124	107	2,065
	Total Direct Costs \$	4,437,490	7,341,842	523,245	571,342	12,873,918
2014	Annual number of wrist fractures	943	953	128	113	2,136
	Total Direct Costs \$	4,571,126	7,615,309	539,016	598,877	13,324,328
2015	Annual number of wrist fractures	970	987	131	118	2,214
	Total Direct Costs \$	4,700,467	7,893,362	554,600	626,733	13,807,413
2016	Annual number of wrist fractures	995	1,023	135	123	2,276
	Total Direct Costs \$	4,824,769	8,179,312	567,971	656,089	14,228,140
2017	Annual number of wrist fractures	1,014	1,077	137	131	2,359
	Total Direct Costs \$	4,915,539	8,605,880	578,755	697,886	14,798,060
2018	Annual number of wrist fractures	1,036	1,126	140	138	2,441
	Total Direct Costs \$	5,021,511	9,002,071	591,343	736,820	15,351,745
2019	Annual number of wrist fractures	1,060	1,176	144	145	2,526
	Total Direct Costs \$	5,139,881	9,404,693	606,143	773,291	15,924,007
2020	Annual number of wrist fractures	1,085	1,227	148	152	2,612
	Total Direct Costs \$	5,260,617	9,812,665	621,798	810,204	16,505,284
2021	Annual number of wrist fractures	1,113	1,280	152	160	2,705
	Total Direct Costs \$	5,398,062	10,234,202	638,926	849,387	17,120,577
2022	Annual number of wrist fractures	1,141	1,441	156	167	2,904
	Total Direct Costs \$	5,530,336	11,519,193	655,975	888,121	18,593,626
2013-2022	Total number of wrist fractures	10,272	11,208	1,395	1,354	24,229
	Total Direct Costs \$	\$49,799,798	\$89,608,529	\$5,877,772	\$7,208,750	\$152,494,849

Unlike other fracture sites where the ratio of women to men is about three to one, the annual projected number of wrist fractures in women is nine times the projected number in men. There is less difference in fracture numbers between the older and younger age groups in wrist fractures compared with fractures at other sites. The cost of treating wrist fractures in older adults in Western Australia will increase by 44% over the ten years from 2013 to 2022 from \$13 million to a projected \$19 million per year in 2022 (Table 15). This is based on the higher number of older people in the population and does not account for inflation.

In 2013, 57% of the total cost of treating wrist fractures is attributable to women aged 70 years and older (Table 15). From our source data (based on service use from 284 individuals with wrist fracture from eight study sites across Australia; Appendix table A1), the mean cost of treating a woman with a wrist fracture aged 70 years and over is 65% higher than treating a woman aged 50 to 69 years. Utilisation rates of services (Appendix B) shows hospitalisation is almost 20% higher in older woman than younger woman (65% vs 45%: 70+ years vs 50 to 69 years old, respectively). The comparable hospitalisation rates in men are 5% higher in older men (50% vs 44%, 70+ years vs 50 to 69 years old, respectively).

Table 16: Annual number and total direct costs of vertebral fractures by gender, age group and total, 2013-2022 (2012\$)

Year	Vertebral Fractures	Annual Total Number of Vertebral Fractures and Total Direct Cost (2012\$)				Total Vertebral Fractures
		Female		Male		
		50-69 years	70+ years	50-69 years	70+ years	
2013	Annual number of vertebral fractures	700	1,298	249	340	2,588
	Total Direct Costs \$	4,271,914	12,481,998	1,549,313	2,383,306	20,686,531
2014	Annual number of vertebral fractures	722	1,347	256	357	2,681
	Total Direct Costs \$	4,400,564	12,946,626	1,596,011	2,497,585	21,440,785
2015	Annual number of vertebral fractures	742	1,396	263	373	2,790
	Total Direct Costs \$	4,525,079	13,418,982	1,667,178	2,615,161	22,296,870
2016	Annual number of vertebral fractures	762	1,447	270	391	2,869
	Total Direct Costs \$	4,644,743	13,904,672	1,681,745	2,734,796	22,965,955
2017	Annual number of vertebral fractures	776	1,522	275	416	2,989
	Total Direct Costs \$	4,732,126	14,628,311	1,713,676	2,907,456	23,981,569
2018	Annual number of vertebral fractures	793	1,592	281	439	3,105
	Total Direct Costs \$	4,834,144	15,300,619	1,750,950	3,068,445	24,954,159
2019	Annual number of vertebral fractures	811	1,663	288	461	3,224
	Total Direct Costs \$	4,948,097	15,983,944	1,794,771	3,219,435	25,946,248
2020	Annual number of vertebral fractures	830	1,735	296	483	3,344
	Total Direct Costs \$	5,064,328	16,676,356	1,841,126	3,372,301	26,954,111
2021	Annual number of vertebral fractures	852	1,810	304	506	3,472
	Total Direct Costs \$	5,196,644	17,391,910	1,891,843	3,534,593	28,014,991
2022	Annual number of vertebral fractures	873	2,037	312	529	3,751
	Total Direct Costs \$	5,323,983	19,570,459	1,942,324	3,695,033	30,531,799
2013-2022	Total number of vertebral fractures	7,861	15,847	2,794	4,295	30,797
	Total Direct Costs \$	\$47,941,622	\$152,303,877	\$17,428,937	\$30,028,111	\$247,702,547

Our estimates of the number of individuals with vertebral fracture are based on individuals with a clinically diagnosed vertebral fracture(s). This is likely to represent an underestimate as individuals without confirmation of their vertebral fracture by medical imaging techniques are not included.

Approximately 20% of the total cost and 23% of the number of individuals with clinically diagnosed vertebral fracture are men. This highlights the significant burden of vertebral fractures in men, notwithstanding the majority of these fractures occur in women. In 2013 the total cost of treating individuals with clinically diagnosed vertebral fracture(s) was 61% higher than the total cost of treating individuals with wrist fracture. Our source data, although based on small numbers of hospitalised individuals suggests the length of stay in acute hospital is longer for individuals with clinical vertebral fractures (5.4 vs 2.4 days, vertebral vs wrist fracture patients, respectively;¹ see Table 8 of this reference).

Table 17: Annual number and total direct costs of 'other' fractures by gender, age group and total, 2013-2022 (2012\$)

Year	'Other' Fractures	Annual Total Number of 'Other' Fractures and Total Direct Cost (2012\$)				Total 'Other' Fractures
		Female		Male		
		50-69 years	70+ years	50-69 years	70+ years	
2013	Annual number of 'other' fractures	2,869	1,899	1,863	935	7,567
	Total Direct Costs \$	24,802,765	23,534,703	12,299,534	12,216,655	72,853,657
2014	Annual number of 'other' fractures	2,955	1,970	1,920	981	7,826
	Total Direct Costs \$	25,549,706	24,411,291	12,670,255	12,805,423	75,436,675
2015	Annual number of 'other' fractures	3,039	2,042	1,972	1,026	8,197
	Total Direct Costs \$	26,272,642	25,302,572	13,122,322	13,401,067	78,770,945
2016	Annual number of 'other' fractures	3,119	2,116	2,023	1,074	8,332
	Total Direct Costs \$	26,967,408	26,219,159	13,350,871	14,028,749	80,566,187
2017	Annual number of 'other' fractures	3,178	2,226	2,061	1,143	8,608
	Total Direct Costs \$	27,474,759	27,586,405	13,604,365	14,922,473	83,588,002
2018	Annual number of 'other' fractures	3,247	2,329	2,106	1,206	8,888
	Total Direct Costs \$	28,067,076	28,856,301	13,900,271	15,754,973	86,578,621
2019	Annual number of 'other' fractures	3,323	2,433	2,159	1,266	9,181
	Total Direct Costs \$	28,728,688	30,146,823	14,248,155	16,534,809	89,658,475
2020	Annual number of 'other' fractures	3,401	2,539	2,214	1,327	9,481
	Total Direct Costs \$	29,403,526	31,454,493	14,616,149	17,324,115	92,798,282
2021	Annual number of 'other' fractures	3,490	2,648	2,275	1,391	9,804
	Total Direct Costs \$	30,171,753	32,805,654	15,018,780	18,161,933	96,158,120
2022	Annual number of 'other' fractures	3,576	2,980	2,336	1,454	10,346
	Total Direct Costs \$	30,911,085	36,924,212	15,419,534	18,990,152	102,244,984
2013-2022	Total number of 'other' fractures	32,197	23,182	20,929	11,803	88,111
	Total Direct Costs \$	\$278,349,408	\$287,241,613	\$138,250,236	\$154,140,349	\$857,981,606

'Other' fractures refer to a heterogeneous group of fractures at sites other than hip, vertebral, or wrist. The mean cost of fracture treatment per individual for this collective group ranges from \$6,600 in men aged 50 to 69 years to \$13,059 for men aged 70 years and older (Table 1). Fractures of the humerus, ankle /foot, pelvis and other non-hip femoral and rib fractures together contribute 90% of the individuals with fractures grouped as 'other' sites (Appendix table A2). Rib fractures are likely to be significantly underestimated as many individuals with suspected rib fractures are not referred for fracture confirmation by medical imaging techniques and so would not be included in our estimates. Facial and skull fractures as well as those of the fingers and toes were excluded.

When grouped together as fractures at 'other' sites, the total number of individuals with 'other' fracture is three times higher than the number of individuals with hip fracture. However the total cost burden of fracture treatment for this group is almost the same (~90%) as that attributed to hip fractures (Tables 14 & 17).

Cost of Management of Osteoporosis and Osteopenia in the Community: 2013-2022

Table 18: Total annual costs of community services for osteoporosis and osteopenia (irrespective of fracture), 2013-2022 (2012\$)

Community Health Care Service	Annual Total Cost (2012\$)									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Bisphosphonates	13,362,978	15,526,337	16,214,499	16,646,634	17,155,483	17,650,063	18,138,514	18,643,066	19,166,434	19,685,263
DXA	2,896,325	2,982,313	3,073,091	3,168,141	3,294,871	3,410,805	3,523,394	3,640,955	3,759,877	3,877,373
Vitamin D Test	9,742,019	10,073,667	10,594,555	8,286,174	11,065,884	11,417,861	11,788,275	12,168,019	12,577,924	13,218,111
Routine Pathology Test	13,621,363	14,085,077	14,813,386	14,990,244	15,472,401	15,964,538	16,482,453	17,013,414	17,586,547	18,481,661
Community GP Visits	42,643,925	44,095,698	46,375,576	46,929,606	48,439,371	49,980,317	51,601,952	53,264,426	55,058,910	57,862,636
All Total Cost \$	82,266,609	86,763,093	91,071,106	90,020,799	95,428,009	98,423,585	101,534,587	104,729,881	108,149,690	113,125,043

The total cost of managing osteoporosis and osteopenia in Western Australia in 2017 is estimated to be \$95 million. This is 45% of the estimated cost of fracture management/treatment in 2017 (Table 19: \$211.6 million). The costs related to the management of osteoporosis /osteopenia are detailed in Appendix A and are based on 2.4 visits to a general practitioner each year and twice yearly routine biochemistry to assess renal function and serum calcium. Cost assumptions include serum 25-hydroxyvitamin D levels assessed once every two years and a bone mineral density (BMD) scan once every three years (plus a BMD scan for those people who had a fracture during the year). The number of older adults taking bone active medications is based on assumptions which approximately equal the annual volume of dispensed scripts filled for bone active medications taken from Medicare Australia for 2011/2012² with costs conservatively assigned at the lowest cost bisphosphonate (see Appendix A Methods). In 2017 the cost of management of low bone status is 31% of the total cost burden of osteoporosis in Australia.

Total Cost Burden of Osteoporosis, Osteopenia and Fractures: 2013-2022

Table 19: Total annual costs of osteoporosis and osteopenia management and direct cost of fractures, 2013-2022 (2012\$)

Year	Osteoporosis/Osteopenia and Fractures	Total Cost of Osteoporosis/Osteopenia and Fractures 2013 - 2022 (2012\$)				Total All Fractures
		Female		Male		
		50-69 years	70+ years	50-69 years	70+ years	
2013	Total management cost of osteoporosis/osteopenia* \$					82,266,609
	Total Direct Costs of Fractures \$	37,299,688	94,628,015	17,639,078	32,637,093	182,203,874
	Combined costs \$					264,470,483
2014	Total management cost of osteoporosis/osteopenia* \$					86,763,093
	Total Direct Costs of Fractures \$	38,422,976	98,151,312	18,170,739	34,208,568	188,953,595
	Combined costs \$					275,716,688
2015	Total management cost of osteoporosis/osteopenia* \$					91,071,106
	Total Direct Costs of Fractures \$	39,510,166	101,733,400	18,803,082	35,803,234	195,849,882
	Combined costs \$					286,920,988
2016	Total management cost of osteoporosis/osteopenia* \$					90,020,799
	Total Direct Costs of Fractures \$	40,554,990	105,416,842	19,146,828	37,473,152	202,591,812
	Combined costs \$					292,612,611
2017	Total management cost of osteoporosis/osteopenia* \$					95,428,009
	Total Direct Costs of Fractures \$	41,317,971	110,907,501	19,510,369	39,856,582	211,592,424
	Combined costs \$					307,020,433
2018	Total management cost of osteoporosis/osteopenia* \$					98,423,585
	Total Direct Costs of Fractures \$	42,208,728	115,934,505	19,934,736	42,077,122	220,155,091
	Combined costs \$					318,578,676
2019	Total management cost of osteoporosis/osteopenia* \$					101,534,587
	Total Direct Costs of Fractures \$	43,203,695	121,191,960	20,433,645	44,157,647	228,986,947
	Combined costs \$					330,521,534
2020	Total management cost of osteoporosis/osteopenia* \$					104,729,881
	Total Direct Costs of Fractures \$	44,218,551	126,444,740	20,961,395	46,263,539	237,888,225
	Combined costs \$					342,618,106
2021	Total management cost of osteoporosis/osteopenia* \$					108,149,690
	Total Direct Costs of Fractures \$	45,373,852	131,872,733	21,538,819	48,498,941	247,284,344
	Combined costs \$					355,434,034
2022	Total management cost of osteoporosis/osteopenia* \$					113,125,043
	Total Direct Costs of Fractures \$	46,485,697	148,406,562	22,113,551	50,708,750	267,714,560
	Combined costs \$					380,839,603
2013 - 2022	Total management cost of osteoporosis/osteopenia* \$					971,512,402
	Total Direct Costs of Fractures \$	418,596,314	1,154,687,570	198,252,242	411,684,628	2,183,220,754
	Combined costs \$					3,154,733,156

* Irrespective of fracture

Appendix

Appendix A: Method

Appendix A describes the method used for the determination of the annual burden of disease attributable to osteoporosis in each state and Northern Territory in 2012. There are two major components to the method to determine costs in 2012: the data sources that have been used as a basis for the population rates of osteoporosis, osteopenia and fractures; and the methods used to analyse the cost data. These data were used to determine the average direct health care and non-health care total costs and the indirect costs of a fracture in 2012, as well as the average community health service costs of managing someone with osteoporosis or osteopenia.

The prevalence of osteoporosis and osteopenia and the direct costs of treating fractures were then used as the basis to model the burden of fractures associated with low bone mass for 10 years to 2022.

Population Estimates for Osteoporosis by Age and Gender

The methods to estimate the burden of osteoporosis in each State and the Northern Territory are identical to those used and described in the national report (Costing All Australians: A new burden of disease analysis – 2012 to 2022; Watts JJ, Abimanyi-Ochom J and Sanders KM. www.osteoporosis.org.au)¹ Unlike the national survey, the projected number and cost of fractures in 2013 to 2022 were not categorised into fractures and re-fractures but are simply presented as fracture (categorised by site, gender and age).

State and Territory Population Data

Australian Bureau of Statistics (ABS) population data were used from the estimated resident population for each State and the Northern Territory at June 30th 2012 based on the 2011 census.³ Population data by gender and 5-year age bands from aged 50 years and over were used to generate population estimates for men and women in two age groups (50-69 years and 70+ years). This represents the method for the determination of the annual burden of disease attributable to osteoporosis in each State and the Northern Territory in 2012. There are two major components to the method to determine costs in 2012: the data sources that have been used as a basis for the population rates of osteoporosis, osteopenia and fractures; and the methods used to analyse the cost data. These data were used to determine the average direct health care and non-health care total costs and the indirect costs of a fracture in 2012, as well as the average community health service costs of managing someone with osteoporosis or osteopenia. The costs were then used as the basis to model the burden of fractures associated with low bone mass for 10 years to 2022.

Incidence/Prevalence Data for Osteoporosis and Osteopenia

To determine the proportion of the each State and Territory population in 2012 with osteoporosis and osteopenia, the 5-year age interval data from the Geelong Osteoporosis Study⁴ were used. The 5-year rates were then applied to the 5-year population cohorts from the ABS⁵ to determine the weighted average proportions (by population) for osteoporosis and osteopenia for men and women in two age groups (50-69 years and 70+ years) (refer to Tables A1 and A2).

Fracture Incidence

The Geelong Osteoporosis Study cohort⁶ was followed prospectively for approximately five years after baseline for fracture ascertainment.^{7,8} Fracture cases were categorised according to their BMD scores at baseline (categorised as normal, osteopenia and osteoporosis). The proportion of all fractures in each BMD category was used to estimate the population-standardised number of fractures in each BMD category over a 5-year period. The fractures arising from those with BMD in the normal category (BMD above a t-score of -1) were not attributed to osteoporosis and not included in the analysis of cost and burden of osteoporosis.

Proportion of Each Fracture Type

The next stage of the population analysis was to estimate, from the total fracture numbers, the proportion or distribution of each fracture type (hip, wrist, vertebral and 'other'). This was determined using data from the Sanders et al study.⁹ The number of people with fracture was calculated using gender-specific and 5-years age groups data were from population estimates in 1994 to 1996 and since then Crisp et al have found declining incidence of hip fracture rates by 20% and 13% in women and men respectively.¹⁰ The proportion of hip fractures observed by Sanders et al was reduced by 20% in each 5-year age cohort for females and by 13% in each 5-year age cohort for males to account for these changes. The proportion of non-hip fractures was then increased so that the overall number of fractures remained the same as observed in the prospective population group with osteoporosis and osteopenia.⁷ The fracture distribution was assumed to be the same in both osteoporosis and osteopenia populations but varied by gender and age (in 5-year age bands).

'Other' fractures observed in the Sanders et al study⁹ included humerus, ankle, lower limb, as well as other 'low trauma' fractures such as rib, pelvic, forearm (not classified as wrist), patella, foot and hand fractures. Skull and facial as well as finger and toe fractures were not included.

Cost and Resource Utilisation Estimates for the Management of Osteoporosis and Osteopenia in 2012

For the community management of osteoporosis or osteopenia (irrespective of fracture) the following assumptions were made concerning medication, investigations and medical care. To determine the total utilisation of osteoporosis (bone active) medications for osteoporosis treatment, the volume of dispensed scripts by the Pharmaceutical Benefits Scheme (PBS) and Repatriation Pharmaceutical Benefits Scheme (RPBS) using the Item Reports from Medicare Australia² were used for the 2011/2012 financial year. To determine the annual cost, the reported number of services (scripts) from the PBS and RPBS was multiplied by the scheduled fee for each unit of service to determine the total cost. All medications where osteoporosis was listed under the authority restriction were included.

Other services were included based on the assumed need for likely follow-up investigations for the management of osteoporosis/osteopenia. It was assumed that everyone with a new fracture would have one DXA in the year of the fracture, and that the rest of the population with osteoporosis or osteopenia would have one DXA every three years (an annual rate of 0.33).¹¹ The total cost of DXA in 2012 was determined from the MBS expenditure data and not attributed to individuals. Pathology tests for Vitamin D were assumed once every 2 years for the entire population with osteoporosis or osteopenia, and other relevant routine pathology tests for renal function and serum calcium were based on the assumption of two tests annually. General practitioner visits were assumed at a rate of 2.4 visits annually for the population with osteoporosis or osteopenia irrespective of fracture.

Data Sources for Cost and Service Utilisation Rates

Data from existing sources (published) and from new data collections on fractures (AusICUROS) and associated health service utilisation have been used and combined with cost/price data from the MBS, PBS and hospital costing to attribute costs to treatment of fractures (by fracture type), drug treatment for management of osteoporosis and screening for osteoporosis.

A bottom-up costing approach was used to determine the total burden attributable to fractures based on service utilisation data collected as part of the AusICUROS study. From this study, complete service utilisation data was available for 791 people from the time of the fracture to 12 months later. These adults sustained a low trauma fracture and were at least 50 years old. The distribution of fracture type sustained by these AusICUROS participants is detailed in Tables A1 and A2.

Direct Cost of Fractures, 2013-2022

The average annual direct cost of a fracture (by gender, age group and fracture type) determined from 2012 were attributed to the fractures that occurred each subsequent year to 2022 inclusive. This includes the cost of healthcare as well community services related to the fracture. The total direct cost for each year was determined by fracture site, age and gender.

Table A1: Fracture numbers from AusICUROS on which health care and service utilisation is based

Fracture Type	Age 50-69 years			Age 70+ years			Total
	Men	Women	Both	Men	Women	Both	
Hip	10	30	40	32	102	134	174
Wrist	32	155	187	10	87	97	284
Vertebral	16	19	35	12	27	39	74
Other	50	120	170	27	62	89	259
ALL	108	324	432	81	278	359	791

Table A2: Distribution of 'other' group of fracture in the AusICUROS cohort

Fracture Type	Number	% of all fractures
Foot and ankle	97	11.4
Humeral	57	7.2
Tibia/Fibula	29	3.7
Other femoral and pelvis	22	2.8
Rib	23	2.9
Clavicle	7	0.9
Forearm (not wrist)	15	1.9
Other (not specified)	9	1.1
Total	252	31.9

Appendix B: Utilisation Rates for Service use Following Fractures, by Fracture Type, Age and Gender

Post Fracture Utilisation Rates (AusICUROS)		50-69 years		70+ years		
		Men	Women	Men	Women	
Hospitalisation	Hip	1.00	1.00	1.00	1.00	
	Wrist	0.44	0.45	0.50	0.64	
	Vertebral	0.50	0.47	0.67	0.63	
	Other	0.46	0.61	0.74	0.68	
Ambulance Paramedic	Hip	0.90	0.87	1.00	0.94	
	Wrist	0.19	0.17	0.40	0.28	
	Vertebral	0.63	0.53	0.42	0.70	
	Other	0.38	0.38	0.81	0.56	
ED Presentation (not admitted)	Hip	0.00	0.00	0.00	0.00	
	Wrist	0.45	0.55	0.50	0.36	
	Vertebral	0.50	0.38	0.00	0.25	
	Other	0.53	0.36	0.16	0.27	
Hospital Outpatient Fracture Clinic	Hip	0.55	0.55	0.41	0.43	
	Wrist	1.00	0.82	0.80	0.86	
	Vertebral	0.60	0.50	0.70	0.45	
	Other	0.71	0.75	0.60	0.77	
Non-admitted Fracture Management (GP, X-ray)	Hip	0.00	0.00	0.00	0.00	
	Wrist	0.01	0.00	0.00	0.00	
	Vertebral	0.00	0.15	0.33	0.12	
	Other	0.01	0.03	0.10	0.05	
Orthopaedic Specialist	Hip	0.37	0.37	0.37	0.37	
	Wrist	0.30	0.30	0.30	0.30	
	Vertebral	0.28	0.28	0.28	0.28	
	Other	0.30	0.30	0.30	0.30	
Community Physiotherapy	Hip	0.70	0.83	0.75	0.75	
	Wrist	0.69	0.75	0.30	0.80	
	Vertebral	0.63	0.58	0.33	0.59	
	Other	0.64	0.74	0.70	0.71	
Rehabilitation/Subacute Care	Hip	0.40	0.27	0.44	0.59	
	Non-hip	0.01	0.06	0.14	0.21	
Residential Aged Care	Hip (AIHW)	0.00	0.00	0.09	0.07	
	Non-hip (AusICUROS)	0.00	0.003	0.04	0.02	
Community-based Services	Home help	Hip	0.00	0.17	0.19	0.43
		Wrist	0.09	0.05	0.00	0.16
		Vertebral	0.00	0.21	0.17	0.37
		Other	0.08	0.16	0.37	0.35
	Meals on wheels	Hip	0.00	0.00	0.03	0.09
		Wrist	0.00	0.00	0.00	0.02
		Vertebral	0.00	0.00	0.05	0.04
		Other	0.00	0.00	0.13	0.10
	Informal community care	Hip	0.04	0.17	0.25	0.34
		Wrist	0.06	0.08	0.00	0.18
		Vertebral	0.00	0.21	0.08	0.30
		Other	0.20	0.43	0.44	0.29
Mortality (post fracture)	Hip	0.01	0.01	0.08	0.08	
	Non-hip	0.01	0.01	0.05	0.05	

Appendix C: Unit Costs, Source and Assumptions for Each Component of the Model

Parameter	Unit Cost (2012 AUD)	Units	Assumptions re use	Data Source
Ambulance	\$688.50	per transport	Same average cost for both metropolitan and rural/remote regions	Ambulance Victoria Annual Report 2011-2012 ¹²
Emergency Department (Non-admitted) Wrist fractures	\$251.00	per visit	ED non admitted Triage 5 Injury	Source: ¹³
ED (Non-admitted) Non-wrist, non-hip fractures	\$361.00	per visit	ED non admitted Triage 4 Injury	Source: ¹³
Fracture or Orthopaedic Hospital Outpatient Clinic	\$190.88	per visit	3 visits post-fracture, all age groups, for admitted patients or non-admitted with ED visit, if attended hospital clinic then no community physiotherapy	Source: ¹³
General Practitioner	\$35.60	per visit	2.4 visits per year for osteoporosis/osteopenia management 3 visits post fracture if no hospital attendance	MBS Online 2012 Item 23; ¹⁴ Average number of visits for osteoporosis AusICUROS; Expert opinion for fracture management
Medical specialist	\$83.95	per visit	2.5 visits post fracture to medical specialist if seen in ED but no OPD, fracture population only	MBS Online 2012 Item 104; ¹⁴ Recommended Schedule fee Average number of visits from AusICUROS
Routine pathology test	\$13.65	per group of 3 tests	Based on 3 tests for renal function (urea and creatinine) and serum calcium; 2 groups of 3 tests/year per person	MBS Online 2012 Item 66506; ¹⁴ Expert opinion
Serum Vitamin D Test	\$39.05	per test	Based on full blood examination; assume 1 every two years for everyone (fracture and non-fracture population)	MBS Online 2012 Item 66608; ¹⁴ Expert opinion
Diagnostic Imaging for community managed fractures:				
Hip	\$47.15	per X-ray	Where no ED or admission, 1 X-ray	MBS Online 2012 Item 57712, Diagnostic imaging with referral
Hand, wrist, forearm, elbow, humerus	\$29.75	per X-ray	Where no ED or admission, 1 X-ray	MBS Online 2012 Item 57506, Diagnostic imaging no referral
Spine (4 regions)	\$110.00	per X-ray	Where no ED or admission, 1 X-ray	MBS Online 2012 Item 58108, Diagnostic imaging with referral
Foot, ankle, knee or femur	\$32.50	per X-ray	Where no ED or admission, 1 X-ray	MBS Online 2012 Item 57518, Diagnostic imaging no referral ¹⁴
Physiotherapist (community)	\$62.25	per session	9 sessions for hip fractures, wrist (5), vertebral (4) other (6) if no Outpatient Fracture Clinic	MBS Item No. 10960, number of sessions from AusICUROS
Rehabilitation costs	\$12,375	per episode	Mean episode cost all fractures; both age groups	Barwon cost data (N=30; SD=\$8557)
Residential aged care	\$162.94	per day	Annual cost of Nursing Home was \$42872 for low care in 2010, inflated to 2012 prices, assumed LOS 6 mths	Cost; ¹³ Admission rate and length of stay, AusICUROS
Home help	\$25	per hour	Casual hourly rate for home help Level 3	Source: ¹⁵
Home care (informal care)	\$25	per hour	Cost assumed as for PCA/Home help	Source: ¹⁵
Meals on wheels	\$16.50	per day	Casual	Geelong City Council communication for daily cost
Wage rate (adult population)	\$151.24	per day	Average fulltime adult wage rate (seasonally adjusted), May 2012 (7-day week)	Source: ¹⁶

Appendix D1: Unit Costs, Source and Assumptions for Pharmaceuticals/Supplements used for Osteoporosis/Osteopenia, 2012

Table D1.1: Pharmaceuticals fracture management

Pharmaceuticals – Fracture Management	Unit Cost 2012\$		Assumptions re Use	Data Source
	Cost (as needed)	Cost (routine)		
- Hip	8.77	80.79	Drugs taken as needed were costed for 14 days. Drugs taken on a routine basis were costed over 122 days (4 months)	Pharmaceutical online website (price)
- Wrist	14.37	38.27		
- Vertebral	13.78	43.41		
- Other	9.71	54.45		

Table D1.2: Supplements (calcium and vitamin D) for osteoporosis prevention

Osteoporosis Prevention Supplements	Population Rate of Use		Cost 12 months (2012\$)		Assumptions re Use	Data Source
	Women	Men	Women	Men		
All Fractures	0.39	0.39	191.73	191.73	Osteoporosis supplements (Calcium and Vitamin D) were costed over 12 months	Pharmaceutical online website (price)

Appendix D2: List of Osteoporosis (Bone-Active) Pharmaceuticals used for Osteoporosis/ Osteopenia, 2012

Medication Group	Name, form and strength	Frequency	PBS Item Code (2012)	Unit (Script) Price (\$2012)
Alendronate	Alendronate tablet 70mg	Weekly	8511Y	27.62
Alendronate with Cholecalciferol				
	Alendronate 70mg + Cholecalciferol 70 micrograms, tablet	Weekly	9012H	45.26
	Alendronate 70mg + Cholecalciferol 140 micrograms, tablet	Weekly	9183H	45.26
Alendronate with Cholecalciferol and Calcium Carbonate				
	Alendronate 70mg + Cholecalciferol 140 micrograms tablet and Calcium Carbonate (500mg Ca) tablet	Weekly (alendronate)	9351E	45.26
Denosumab	Denosumab, injection 60mg/ml	6 Monthly	5457F	304.97
Etidronate^a	Disodium Etidronate, tablet 200mg	Daily	2920Q	115.27
	Disodium Etidronate, tablet 200mg and Calcium Carbonate sachets 1.25g (500mg Ca)	Daily (etidronate)	8056B	70.79
Raloxifene	Raloxifene 60mg	Daily	8363E	57.97
Risedronate	Risedronate Sodium, tablet 5mg	Daily	4443W, 8481J	46.65
	Risedronate Sodium, tablet 35mg	Weekly	4444X, 8621R, 8972F	46.65
	Risedronate Sodium, tablet 150mg	Monthly	9391G	49.63
Risedronate Sodium and Calcium Carbonate				
	Risedronate Sodium, tablet 35mg and Calcium Carbonate, tablet 1.25g (500mg Ca)	Weekly (risedronate)	8899J, 8973G	46.65
Risedronate Sodium and Calcium Carbonate with Cholecalciferol				
	Risedronate Sodium, tablet 35mg and Calcium Carbonate with Cholecalciferol, sachets 2.5g (1g calcium) with Cholecalciferol 22 micrograms	Weekly (risedronate)	4380M, 8974H, 9147K	46.65
Strontium Ranelate^b	Strontium, sachets 2g granules	Weekly	3036T	53.44
Teriparatide	Teriparatide, injection 20 microgram	Daily	9411H	488.47
Zoledronic Acid	Zoledronic acid, injection 5mg/100ml	Once a year	9288W	589.27

a: Etidronate was available on the PBS in 2012 but has been removed from the PBS in 2013.
b: Strontium Ranelate was available on the PBS in 2012 but has been removed in 2016.

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This report was prepared for Osteoporosis Australia, C2.11, Level 2, 22-36 Mountain Street, Ultimo, NSW 2007

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