



Osteoporosis Model of Care

**Musculoskeletal, Diabetes & Endocrine, Falls
Prevention and Aged Care Health Networks (WA)**

August 2011

© Department of Health, State of Western Australia (2011).

Copyright to this material produced by the Western Australian Department of Health belongs to the State of Western Australia, under the provisions of the Copyright Act 1968 (C'wth Australia). Apart from any fair dealing for personal, academic, research or non-commercial use, no part may be reproduced without written permission of the Health Networks Branch, Western Australian Department of Health. The Department of Health is under no obligation to grant this permission. Please acknowledge the WA Department of Health when reproducing or quoting material from this source.

Suggested Citation

Department of Health, Western Australia. Osteoporosis Model of Care. Perth: Health Networks Branch, Department of Health, Western Australia; 2011.

Important Disclaimer:

All information and content in this Material is provided in good faith by the WA Department of Health, and is based on sources believed to be reliable and accurate at the time of development. The State of Western Australia, the WA Department of Health and their respective officers, employees and agents, do not accept legal liability or responsibility for the Material, or any consequences arising from its use.

Table of Contents

Executive Summary	5
Acknowledgements.....	8
1. Justification for a Model of Care for Osteoporosis in WA.....	10
2. Method	10
3. Model of Care	11
3.1 Health promotion.....	11
3.2 Lifetime fracture risk assessment.....	21
3.3 Treatment	26
3.4 Workforce development.....	31
3.5 Research, evaluation and horizon scanning.....	36
4. Implementation and recommendations matrix.....	37
5. Osteoporosis: Background, epidemiology and diagnosis	42
5.1 Osteoporosis: background and epidemiology	42
5.2 Development of osteoporosis and fragility fracture.....	43
5.3 Epidemiology of Osteoporosis in Western Australia	44
5.4 National and State epidemiology of low trauma fractures.....	46
5.5 Outcomes of fractures	48
5.6 Diagnosis of osteoporosis.....	49
6. References.....	50
Appendices	60

List of figures

Figure 1	Incidence of hip, spine and wrist low trauma fractures requiring hospitalisation for individuals by age and gender (2000-2009) using data from the WA Hospital Morbidity Data system.	47
-----------------	--	-----------

List of tables

Table 1.	Prevalence of people meeting recommended physical activity level, HWSS 2009.....	13
Table 2.	Target groups and how to reach them.....	18
Table 3.	Established risk factors for osteoporosis, falls and fracture.....	44
Table 4	Prevalence of osteoporosis in WA, 16 years & over, Health and Wellbeing Surveillance System, Jan to Dec 2009	45
Table 5	Trend for the prevalence (%) of osteoporosis in WA, 25 years & over, Health and Wellbeing Surveillance System, 2003-2009.....	46

Executive Summary

Osteoporosis is a systemic skeletal condition characterised by low mass and micro-architectural deterioration of bone tissue, with a consequent increase in bone fragility¹. Considering the global burden of disease imposed by osteoporosis, in particular fragility fractures, the projected population demographics for Western Australia and the current evidence-practice gap for osteoporosis management², a coordinated and integrated health service delivery model is required in order to deliver safe and high quality health care.

The *Osteoporosis Model of Care* has been developed by an interdisciplinary Working Group to address this need. To assist with identifying best practice care across the health continuum, relevant literature and existing service models were reviewed using forwards and backwards search methods³. The Osteoporosis Model of Care integrates with the [Falls Prevention](#), [Orthogeriatric](#) and [Elective Joint Replacement Models of Care](#), the [Clinical Services Framework](#) (CSF), [Activity-based funding](#) (ABF) policy, the [WA Primary Care Strategy \(consultation document\)](#) and the WA Chronic Conditions Framework (draft) to outline optimal health service delivery for osteoporosis and bone health across the lifespan in Western Australia.

The Osteoporosis Model of Care has been developed in alignment with key national and international strategies, including the [National Service Improvement Framework for osteoarthritis, rheumatoid arthritis and osteoporosis](#)⁴ and the [Ontario Osteoporosis Strategy](#),⁵ and tailored to the needs of Western Australia. The Model of Care is aligned closely with the [RACGP Clinical Guideline for the Prevention and Treatment of Osteoporosis in Postmenopausal Women and Older Men](#)⁶ and recommendations for treatment of osteoporosis in Australian residential aged care facilities⁷. Further, the Model of Care recognises that falling is the strongest single risk factor for fracture, therefore a consideration for falls prevention interventions in addition to osteoporosis management is warranted in all patients⁸. The Model is presented in five focus areas: Health promotion, Lifetime fracture risk assessment, Treatment, Workforce development, and Research and evaluation. Key recommendations in each of the Model of Care focus areas include:

■ Health promotion

- Ensure health promotion messages and methods of delivery are evidence based, culturally appropriate and suited to target groups. In particular, healthy lifestyle habits that are known to positively influence bone health and falls risk should be disseminated.
- It is important that health promotion includes messages about the importance of early identification of people who have sustained fractures and initiation of appropriate treatments.
- Deliver bone health messages across the lifespan towards particular 'at risk' groups, emphasising the role of prevention in osteoporosis and prevention of falls.
- Appoint coordinators and form strategic partnerships to improve development and dissemination of bone health promotion and falls prevention resources and activities.
- Identify champions to improve the reach of health promotion efforts in the context of bone health and falls prevention.
- Optimise nutritional content of meals provided in health and aged care facilities and home deliveries, especially calcium content.

■ Lifetime fracture risk assessment

- Improve compliance with evidence based guidelines on screening including the RACGP Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men⁶ and the 2007 Position Statement of the International Society for Clinical Densitometry (ISCD)⁹.
- Utilise information communication and technology (ICT) systems to provide prompts for follow-up and improve referrals from EDs to primary care facilities.
- Promote screening for osteoporosis, fracture risk and falls risk in primary care settings among all health practitioners, especially community pharmacy, practice nurses and nurse practitioners. Utilise pre-screening tools (such as OST and PROSPECT) to reduce unnecessary radiology tests¹⁰⁻¹².
- Refer all patients presenting to emergency departments with minimal trauma fractures to a fracture clinic and their GP to initiate appropriate assessment and treatment.
- Refer patients who have a history of falls or identified risk factors for falling to a falls clinic.

■ Treatment

- Ensure health professionals consider the clinical risk factors of patients and use evidence based guidelines such as the RACGP Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men⁶ and consensus recommendations for the treatment of osteoporosis in Australian residential aged care facilities⁷ to guide the prescription of treatments.
- Consumers should be educated about the efficacy of pharmacologic treatments for osteoporosis, in particular the significant benefits of treatment relative to the risks of not receiving treatment.
- Promote the importance of self-management in the prevention and treatment of osteoporosis and post-fracture care.
- Establish fracture liaison positions to coordinate care between hospital and community settings. Hospital GP Liaison Officers can contribute to this role.
- Introduce comprehensive electronic discharge summaries from hospitals to GPs that outline an appropriate management plan.
- Broader dissemination of detailed clinical guidelines and treatment algorithms to assist GPs to undertake appropriate and evidence-based management.
- Initiate evidence-based, multimodal interventions for individuals who have identified risk factors for falling^{13, 14}.

■ Workforce development

- Identify training needs by consulting with 'frontline' providers, eg carers, pharmacists, practice nurses, allied health professionals, GPs.
- Develop educational strategies to broaden health professionals' knowledge of:
 - The significance of bone fragility and that osteoporosis is not just a condition affecting postmenopausal women.
 - Appropriate points of referral and follow up across the health system.
 - Prevention and management of osteoporosis and falls risk across the lifecourse, especially within the primary care setting, involving GPs, pharmacy, practice nurses, nurse practitioners, and allied health professionals
 - Working within a multidisciplinary context to optimise patient care.

- Link any education initiatives with community-based services (either planned or currently available).
 - Deliver professional development opportunities in an inter-disciplinary context and offer a variety of learning platforms – lectures, workshops, e-learning, written materials, case studies, simple evidence-based practice algorithms.
 - Evaluate the effectiveness of any workforce development initiatives.
 - Support the dissemination of resources aimed at health professionals that outline best practice management of osteoporosis and falls prevention strategies.
 - Ensure all health professionals are aware of the role they play in osteoporosis and falls prevention risk factor identification, assessment and treatment. The use of case-based learning in this context may be particularly helpful, particularly during University training.
- **Research and evaluation**
- Evaluate the efficacy of resources aimed at increasing consumer awareness of osteoporosis, and encourage the roll out of those resources that are shown to be effective.
 - Collect prospective clinical and economic data to substantiate the need for fracture liaison positions in WA.
 - Investigate more thoroughly the barriers and enablers to undertaking evidence-based and/or guideline-consistent care for osteoporosis and falls prevention by engaging with 'front line' professionals, eg GPs, pharmacists practice nurses and carers.

Staged implementation of these recommendations will be considered by a dedicated working group after the endorsement of the Model of Care.

Acknowledgements

The development of the *Osteoporosis Model of Care* reflects the collective contribution of a dedicated working group. The time, expertise and willingness to attend meetings around busy schedules and a collaborative approach were invaluable in providing direction and guidance for the development of the Model.

Membership of the Osteoporosis Model of Care Working Group

Associate Professor Kathy Briffa	School of Physiotherapy, Curtin University (Chair)
Dr Andrew Briggs	Senior Development Officer, Musculoskeletal Health Network, Department of Health (WA)
Ms Rebecca Coghlan	Consumer representative
Ms Deirdre Criddle	Accredited consultant pharmacist. Consultant. pharmacist for Fremantle GP Network & Midwest GP Network
Associate Professor Amanda Devine	School of Exercise, Biomedical and Health Science, Nutrition and Dietetics, Edith Cowan University
Dr Therese Fisher	General Practitioner
Associate Professor Daniel A. Galvão	Director, Edith Cowan University (ECU) Health and Wellness Institute School of Exercise, Biomedical & Health Sciences, ECU
Ms Nicole Georgiou	Development Officer, Health Networks Branch, Department of Health (WA)
Dr Emma Hamilton	Consultant Endocrinologist, Fremantle Hospital
Dr David Hurley	Clinical Lead, Diabetes and Endocrine Health Network; Endocrinologist, Royal Perth Hospital
Clinical Professor Charles A Inderjeeth	Director of Clinical Training, Geriatrician and Rheumatologist, North Metropolitan Area Health Service
Associate Professor Deb Kerr	School of Public Health, Curtin University
Ms Jean McQuade	Manager Health Education & Research Programs, Arthritis WA
Dr Ee Mun Lim	Head, Department of Clinical Biochemistry, PathWest QEII Consultant Endocrinologist, Department of Endocrinology & Diabetes, Sir Charles Gairdner Hospital
Dr Roger Price	Head of Department, Medical Technology & Physics, Sir Charles Gairdner Hospital Adj. Prof., Surgery, University of WA Adj. A/Prof., School of Physics, University of WA
Dr Jenny Rogers	General Practitioner
Associate Professor Rob Will	Rheumatologist, Royal Perth Hospital
Ms Rosemarie Winsor	Registered Nurse, Education Liaison Officer, WA Practice Nurses Association

The Osteoporosis Model of Care represents a collective contribution from the Musculoskeletal, Diabetes and Endocrine, Falls Prevention and Aged Care Health Networks. Expertise from an external reference group has also been gratefully utilised to develop this Model of Care.

Membership of the Osteoporosis Model of Care External Reference Group

Assoc. Professor Caroline Brand	Associate Director, Centre of Research Excellence in Patient Safety, Department of Epidemiology and Preventive Medicine
Dr Jacquie Garton-Smith	Clinical lead, Cardiovascular Health Network, Hospital Liaison General Practitioner, Royal Perth Hospital
Ms Loren Geary	Senior Dietician, Fremantle Hospital Nutrition and Dietetic Department, South Metro Area Health Service
Professor Lyn March	Professor of Medicine, University of Sydney. Senior Staff Specialist (Rheumatology and Clinical Epidemiology), Royal North Shore Hospital, NSW.
Professor Richard Prince	Professor, School of Medicine and Pharmacology, University of Western Australia. Physician, Department of Endocrinology and Diabetes, Sir Charles Gairdner Hospital
Dr Hannah Seymour	Consultant Geriatrician, Rehabilitation in the Home, Royal Perth Hospital Acting Clinical Lead Four Hour Rule, Royal Perth Hospital Cluster Lead for Aged Care, South Metro Area Health Service Clinical Advisor, Aged Care Policy Directorate, Department of Health
Ms Shirley Teshome	Senior Program Coordinator, Western Australian General Practice Network
Dr Nicholas Waldron	Consultant Geriatrician, Armadale Health Clinical Lead, Falls Prevention Health Network NHMRC NICS-WA Health Fellow, Sir Charles Gardiner Hospital

Staff from the Health Networks Branch are acknowledged for their contributions to developing this Model of Care, including Lindsay France and Belinda Whitworth.

1. Justification for a Model of Care for Osteoporosis in WA

Models of Care describe evidence-based policy and practice frameworks for the way health services could be delivered in Western Australia to ensure the *right care* is delivered at the *right time*, in *the right place* and by the *right team*¹⁵. Considering the global burden of disease imposed by osteoporosis, in particular fragility fractures, the projected population demographics for Western Australia and the current evidence-practice gap for osteoporosis management², a coordinated and integrated health service delivery model is required in order to deliver safe, high quality health care.

The development of the Osteoporosis Model of Care for WA is a key recommendation of the [Model of Care for Falls Prevention for the Older Person in Western Australia](#). It will also complement the key aims and priorities of the previously developed [Orthogeriatric Model of Care](#) that describes best practice approaches in the care of older people who experience fragility or minimal trauma fractures.

Models of Care are critical to informing health service delivery in WA. For example, Models of Care are used in conjunction with other policies to develop funding models through [Activity Based Funding \(ABF\)](#) and identify appropriate service delivery strategies through the [Clinical Services Framework \(CSF\)](#) for WA. WA Health is moving to an ABF model for all health services. This is aligned with the national health reform to introduce a national activity based funding model. ABF means that health service providers will be funded on the basis of expected activity. Previously, health services in WA have been funded largely on an historical basis. Activity Based Management (ABM) is the approach used by WA Health to plan, budget, allocate and manage activity and financial resources to ensure delivery of safe high quality health services to the WA community. ABF, the CSF and Models of Care provide the components to define a cycle of care for health consumers for a given condition. The Osteoporosis Model of Care integrates with the [Falls Prevention](#), [Orthogeriatric](#) and [Elective Joint Replacement Models of Care](#), the CSF, ABF and the WA Chronic Conditions Framework (draft) to outline optimal health service delivery for osteoporosis and bone health across the lifespan in Western Australia

2. Method

In December 2009, the Musculoskeletal, Diabetes and Endocrine, Falls Prevention, and Aged Care Health Networks collaborated to host an Osteoporosis Model of Care Stakeholder Workshop. The workshop brought together relevant stakeholders from across the State to discuss the key issues relating to the prevention, treatment and management of osteoporosis in WA.

The Osteoporosis MOC Working Group was then established in April 2010, with broad representation from relevant professions and backgrounds. Building on the discussions and outcomes from the Stakeholder Workshop, the Working Group developed the Osteoporosis MOC for WA. The Model of Care is based around a lifespan approach to bone health, and therefore extends the [Orthogeriatric](#) and [Falls Prevention Models of Care](#).

The Osteoporosis Model of Care has been developed in alignment with key national and international strategies, including the [National Service Improvement Framework for osteoarthritis, rheumatoid arthritis and osteoporosis](#)⁴ and the [Ontario Osteoporosis Strategy](#)⁵. Recommendations and strategies outlined in the Model of Care align with the Health Service delivery objectives of WA Health¹⁵.

To assist with identifying best practice care across the health continuum, relevant literature and existing service models were reviewed using forwards and backwards search methods³. The Osteoporosis Model of Care aligns with and is informed by the following key documents:

- [National Service Improvement Framework for Osteoarthritis, Rheumatoid Arthritis and Osteoporosis](#)⁴
- Australian Fracture Prevention Summit¹⁶
- The [NHMRC clinical guidelines for management of osteoporosis / RACGP Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men](#)⁶
- [Preventing falls and harm from falls in older people](#)
- [Assessing Cost-Effectiveness in Prevention \(ACE prevention study\)](#)¹⁷
- The WA Primary Care Strategy: Consultation Document (draft)
- The WA Chronic Conditions Framework (draft)
- [The WA Health Promotion Strategic Framework 2007-2011](#)
- [US National Action Plan for Bone Health: Recommendations from the Summit for a National Action Plan for Bone Health](#)
- [National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes 2009](#)
- The strategic intent of the WA Department of Health (2010-2015):
 - Caring for individuals and the community
 - Caring for those who need it most
 - Making best use of funds and resources
 - Supporting our team.

Before finalising the MOC, the draft document was released for broad consultation to allow for further comments and feedback. The Executive Advisory Groups of the Musculoskeletal, Diabetes and Endocrine, Falls Prevention and Aged Care Health Networks endorsed the final draft of the Model of Care.

3. Model of Care

The Model of Care is based around the following objectives:

- Align with the WA Primary Care Strategy (draft), WA Chronic Conditions Framework (draft), [Orthogeriatric](#) and [Falls Prevention Models of Care](#)
- Align with the [National Service Improvement Framework for Musculoskeletal Conditions](#)⁴
- Improve bone health across the lifecourse
- Prevent minimal trauma fractures
- Promote and facilitate early recognition of high osteoporotic fracture risk
- Improve utilisation and quality of treatment
- Develop an adequately skilled workforce and community-based services

3.1 Health promotion

Introduction

Health promotion initiatives, including education, skills development and the creation of supportive environments, are relevant for the prevention, early detection and optimal management of osteoporosis.

These initiatives are appropriate for delivery across the lifecourse to reduce the risk of developing osteoporosis, the occurrence of minimal trauma fractures and to increase early detection and foster optimal management of this disease.

The adoption of positive lifestyle-related behaviours that optimise peak bone mass, reduce age-related bone loss, and reduce the risk and consequences of falls have an important role in the prevention of osteoporosis, falls and related fractures¹⁸. Appropriate lifestyle behaviours may include a diet rich in calcium, adequate (and safe) sunlight exposure for vitamin D synthesis, physical activity of sufficient frequency and intensity, avoidance of excessive alcohol consumption, smoking cessation interventions and maintenance of a healthy body mass index (BMI). All health professionals have a role in delivering these positive lifestyle messages, particularly those working in primary care. For example, community pharmacists who interface regularly with consumers are in an ideal position to provide and reinforce such health promotion messages.

The development of supportive environments through environmental design to reduce the risk of falls also has an important role in the prevention of osteoporosis, falls and related fractures. In addition, the development of policy to support positive lifestyle behaviours are also important, for example the provision of foods rich in calcium and vitamin D in institutions such as schools and aged care settings.

Current situation in WA

Nutrition

Maintaining a well balanced diet and healthy weight from in utero to old age is important in promoting bone mass accrual and limiting bone loss¹⁹. The evidence to support the benefits of good nutrition for overall health has recently been analysed by the NHMRC and [guidelines](#) developed for all Australians. The NHMRC has also developed [nutrient reference guidelines](#) for Australia that outline recommended nutrient intake for optimal health. In particular, calcium is vital for the growth and maintenance of the skeleton by providing structure and strength to bones. Calcium intake is of particular importance during periods of bone growth during childhood and adolescence and bone loss in later life. The 2007 Australian National Children's Nutrition and Physical Activity Survey reported that 82 to 89% of females aged 14 to 16 years were at risk of not meeting their dietary requirements for calcium. Similarly, 44% of males in the same age group were not meeting their calcium dietary requirements²⁰. This is of particular concern given that the majority of the body's mineral reserves are accumulated by the age of 20 years²¹, which have a direct relation to peak bone mass.

Vitamin D

Vitamin D is essential in promoting bone health as it enhances the ability of the small intestine to absorb calcium and phosphorus from the diet and promotes resorption of calcium from the kidneys²². Vitamin D can be either produced by sun exposure on the skin, specifically ultraviolet-B (UV-B) light radiation, or absorbed through a small range of foods²². Current evidence suggests most people do not consume sufficient levels of vitamin D from dietary sources²³. The Working Group of the Australian and New Zealand Bone Mineral Society (ANZBMS) prepared a [position statement on Vitamin D and adult bone health in Australia and New Zealand in 2005](#)²⁴ ([2010 draft revised version available](#)). The Statement suggests a significant number of Australians are deficient in vitamin D and recommends exposure of the hands, face and arms to one third of a minimal erythemal dose of sunlight on most days. Different durations of exposure are recommended depending on the region of Australia and season. Adequate vitamin D deficiency is particularly problematic for people in residential care facilities, those who avoid sun exposure due to skin conditions, veiled persons and

those with malabsorption problems^{24, 25}. In these circumstances, vitamin D supplementation may be indicated (refer to section 3.3).

Physical Activity

Physical activity is considered an important factor in overall musculoskeletal health, and particularly for falls prevention^{13, 14}. In the context of osteoporosis, physical activity is important for achieving maximal peak bone mass and bone strength during growth²⁶, maintaining bone mass and minimising the risk of falls¹⁶. Data from the [WA Health and Wellbeing Surveillance System \(HWSS\)](#) (January to December 2009) suggest that individuals in WA who self-report osteoporosis do not engage in adequate physical activity. Sufficient levels of physical activity for adults is defined as accruing at least 150 minutes of physical activity over 5 or more sessions in a week ([National Physical Activity Guidelines for adults in Australia](#)). Children and young people should participate in at least 60 minutes (and up to several hours) of moderate- to vigorous-intensity physical activity every day. Children and young people should not spend more than 2 hours a day using electronic media for entertainment (eg computer games, Internet, TV), particularly during daylight hours ([National Physical Activity Guidelines for Children and Young People](#)).

Table 1 outlines the proportion of adults meeting the recommended amount of physical activity, by osteoporosis diagnosis, in Western Australia.

Table 1. Prevalence of people meeting recommended physical activity level, HWSS 2009.

	%	95% CI
Adults aged 16 years and over		
Diagnosed with osteoporosis	32.4 (27.6 - 37.2)
Never diagnosed with osteoporosis	52.7 (51.1 - 54.3)
Adults aged 65 years and over		
Diagnosed with osteoporosis	30.5 (25.0 - 36.0)
Never diagnosed with osteoporosis	38.9 (36.0 - 41.8)

A significantly lower proportion of adults with osteoporosis are meeting the recommended levels of physical activity compared to adults without osteoporosis. Data from the 2004-05 National Health Survey suggest that 70% of Australians aged 15 years and over were classified as having low exercise levels and 48% of this group reported little or no exercise in the past two weeks²⁷.

“I’ve been told that exercise is important for osteoporosis, so I try to do whatever I can to stay active as I know that every little bit helps”

Consumer comment from the Osteoporosis MOC Stakeholder Workshop, Dec 2009

[Living Longer Living Stronger™](#) is a tiered, group-based strength training program targeted towards individuals over the age of 50. Participants are referred by a health professional according to individual assessment.

Community Awareness

Although there are a number of programs and resources currently aimed at raising awareness of osteoporosis, for example through Osteoporosis Australia and the

Arthritis Foundation of Western Australia, the effectiveness of these is unknown. Further, web-based resources for osteoporosis are reported to be of variable quality ²⁸. A suite of [guidelines for preventing falls](#) has been developed for Australia. Implementation of these guidelines will have significant implications for the incidence of low trauma fractures.

The efficacy of mass media campaigns for changing health beliefs and/or behaviour have been established for health issues such as back pain ²⁹, smoking cessation (QUIT) ^{30, 31}, sun protection (Slip, Slop, Slap and SunSmart) ³², and cervical cancer screening ^{33, 34}. Mass media campaigns are most effective when they are prolonged and use multi-media. ³⁵. Although brief and focussed campaigns have been launched for osteoporosis and falls prevention, for example [Healthy Bones Week](#) and [Stay On Your Feet WA®](#), campaigns targeted at health professionals and exercise campaigns for children ³⁶, exhaustive campaigns targeted at a societal level have not been undertaken for osteoporosis, falls prevention and bone health in Australia, despite the burden of disease and recommendations of the Australian Fracture Prevention Summit ¹⁶. The efficacy of an intensive and prolonged osteoporosis health promotion campaign in Belgium has been reported ³⁷, and a similar model may be appropriate for WA. Including health promotion messages about osteoporosis in existing campaigns that target risk factors such as nutrition, physical activity, smoking cessation and excessive alcohol consumption, is another way to deliver messages to the community.

A major consumer barrier to the maintenance of optimal bone health and prevention of osteoporosis is the lack of awareness of osteoporosis amongst the general population and a lack of recognition of the personal risk associated with the condition for those that have been diagnosed ³⁸.

"I was diagnosed with osteoporosis 15 years ago. At that time I realised how little I knew about osteoporosis and how important it was to gain as much knowledge as I could in order to make the impact on myself and my family as minimal as possible".

Consumer comment from the Osteoporosis MOC Stakeholder Workshop, Dec 2009

Summary of current gaps and priorities in health promotion approaches:

- Raising awareness of osteoporosis in childhood and adolescence to ensure maximal peak bone mass is attained and optimal bone health maintained throughout adulthood.
- Current awareness raising campaigns/efforts are limited and lack intensity and longevity.
- Education about the importance of vitamin D for bone health is not well delivered across the lifecourse, especially in residential care facilities.
- Difficulties in balancing the promotion of adequate sun exposure for vitamin D intake with safe sun exposure messages for skin cancer.
- Despite current social marketing campaigns, many Australians are not reaching adequate levels of physical activity and calcium intake.
- Lack of tailored educational materials for target groups such as children, premenopausal female athletes, people in residential care.
- A national approach to increase the uptake of Vitamin D in residential care.

RIGHT CARE

While whole of population health promotion and healthy lifestyle strategies to optimise bone health are important and should be developed for WA, particular attention should focus on specific at-risk population groups, including:

- People presenting to hospitals with falls and/or low trauma fractures
- Older/ elderly people, including men and Aboriginal Australians and those in residential aged care.
- Pregnant women and their child *in utero*
- Children and adolescents who are in a period of progressive bone growth
- Middle-aged and postmenopausal women including dark skinned and veiled communities
- Premenopausal female athletes
- People taking medications or treatments that have a deleterious affect on bone, particularly glucocorticoid medications.
- People who have conditions or diseases associated with impaired bone health such as inflammatory bowel disease and rheumatoid arthritis.

Parents, carers and educators are other key target groups for health promotion messages. Key messages in health promotion campaigns should include:

- Importance of identifying people early with osteoporotic fracture(s) and initiating appropriate treatment
- Importance of overall nutrition, particularly calcium and vitamin D, consistent with the ANZBMS [position statements](#). The NHMRC has released a suite of [dietary guidelines](#) and resources for all Australians that contain essential and evidence-based messages about nutrition for optimal health and [recommendations for nutrient intake](#).
- Importance of skeletal loading such as weight bearing physical activity, especially during growth
- Importance of avoiding poor health behaviours such as smoking and excessive alcohol intake for bone health
- Importance of discussing bone health with your health care provider
- Importance of falls risk screening and falls prevention strategies
- Importance of prescription of Vitamin D to the frail housebound and those in residential care.

Such messages can be disseminated through social marketing strategies such as mass media campaigns, school education and education by health professionals. Health promotion through community pharmacies may be particularly useful.

According to the findings of the [ACE-Prevention Study](#), mass media campaigns targeting physical activity in women aged 25–60 years are considered to be a cost-effective intervention with positive health outcomes¹⁷. Evidence suggests that media campaigns are more successful when there is also the availability and access to services and products and legislation and policy to support the behaviour change³⁹. Refer to Table 2 for an overview of strategies for specific target groups. It is important that health promotion messages and programmes are delivered in areas outside metropolitan Perth, such as regional WA. For regional WA in particular, health promotion initiatives should be coupled with local services and programmes so that messages are reinforced and implemented in a manner applicable to the local community.

Falls prevention strategies should be considered hand in hand with osteoporosis treatments for those with those with fragility fractures caused by falling and those with osteoporosis and at risk of falling. These interventions should be consistent with the strategies outlined in the [Falls Prevention MOC](#) and [national falls prevention guidelines](#).

For advice on smoking cessation interventions and treatments refer to the [Framework for the Treatment of Nicotine Addiction](#).

Where possible, health promotion efforts to improve knowledge should be combined with strategies aimed at improving the self efficacy of the patient as evidence suggests this is linked with better patient outcomes in terms of behaviour change^{38, 40}.

RIGHT TIME

Health promotion efforts to prevent and manage bone loss and prevent falls and minimal trauma fractures should occur across the lifecourse. In particular, awareness raising messages should be aimed at changing perceptions of osteoporosis as a condition of the 'older person' and falls as 'an inevitable part of aging' so that prevention strategies are adopted earlier in life. One of the most important initiatives for minimising the burden of osteoporosis related fractures is to identify people who have sustained a minimal trauma fracture early and initiate appropriate treatments.

RIGHT TEAM

A key aspect of the success of the [Ontario Osteoporosis Strategy](#)⁵ was appointing of area managers who were responsible for disseminating education and information across their region. Consideration must be given to appointing dedicated personnel with a background in health/health promotion and with the ability to collaborate and communicate across professions and in the broader community. Although evidence on the effectiveness of coordinators for osteoporosis-specific health promotion activities is limited, there are numerous studies from health promotion programs which support the importance of such roles^{41, 42}. Similarly, 'champions' should be identified to further promote messages^{43, 44}.

RIGHT PLACE

The form of media chosen to deliver the health promotion messages should be tailored to suit the needs of the individual or target groups and their place of residence (e.g. regional vs. metropolitan WA). Table 2 outlines suggested communication strategies to target 'at-risk' groups. For a more comprehensive list of organisations, services and institutions that can be involved or targeted for health promotion activities see [Appendix 1](#).

ENABLERS

Health promotion resources and information should be accessible to all, using easy to understand language and made available in languages other than English and in a culturally appropriate manner. This is particularly relevant for Aboriginal people and individuals of culturally and linguistically diverse backgrounds. All messages promoting bone health and reducing the risk of falls need to be consistent and simple with terminology explained. The target audience should be consulted during the development of resources to determine their appropriateness and effectiveness³⁹. Organisational support and reform are critical to the effective implementation and

sustainability of osteoporosis prevention program ⁴⁵.

Strategic partnerships should be established to facilitate the development and dissemination of health promotion resources and activities, these include:

- [Public Health Division, Department of Health](#)
- [WA Health Networks](#)
- Community Pharmacies
- [General Practice Networks/Divisions](#) and Medicare Locals
- [Arthritis and Osteoporosis WA](#)
- [Osteoporosis Australia](#)
- Health professional associations and colleges such as the [Royal Australian College of General Practitioners \(RACGP\)](#), [Australian Physiotherapy Association \(APA\)](#), [Australian Nursing Federation](#) and the [Pharmaceutical Society of WA](#).
- Professional societies such as [Australian and New Zealand Bone and Mineral Society \(ANZBMS\)](#) and [Australian Rheumatology Association \(ARA\)](#)
- [Carers WA](#)
- [Exercise & Sports Science Australia \(ESSA\)](#)
- [Education sector](#) such as universities and schools
- Better Health Improvement Program, Health Networks
- [Health Consumers Council WA](#)
- [Council of the Ageing \(COTA\)](#)
- [WA Falls Prevention Health Network](#) and WA Falls Prevention Community of Practice
- [WA Aged Care Health Network](#)
- [WA Primary Care Health Network](#)

Refer to [Appendix 1](#) for a list of additional organisations and institutions for collaborations and partnerships.

Table 2. Target groups and how to reach them

Target groups	Key messages	Channels
Older/ elderly people	<ul style="list-style-type: none"> ▪ Fracture prevention is critically important ▪ The rate of bone loss increases with age. ▪ Healthy bone habits including calcium intake, vitamin D, skeletal loading, avoidance of smoking and alcohol intake are important to minimise age-related bone loss. ▪ Falls prevention techniques are important in preventing fractures. ▪ People in aged care facilities are at risk of vitamin D deficiency due to inadequate sun exposure. ▪ It is important to be informed about osteoporosis and discuss investigation and treatment options with a health care professional. 	<ul style="list-style-type: none"> ▪ Displays, presentations or information sharing at: <ul style="list-style-type: none"> ▪ Lions Australia ▪ Probus South Pacific ▪ RSL of Australia WA ▪ Living Longer Living Stronger™ ▪ Outpatient Day Therapy Centres, eg Moss Street Centre ▪ Integrate messages with existing social marketing campaigns such as Stay On Your Feet® ▪ Mass media - television and radio campaigns or talk back radio ▪ Run healthy lifestyle programs at aged care facilities for staff and residents ie. Exercise, falls prevention ▪ Ensure mandatory requirements are in place at aged care facilities to create safe environments that support maintenance of healthy bone
Pregnant women and their child in utero	<ul style="list-style-type: none"> ▪ A balanced diet, high in calcium and vitamin D, during pregnancy can promote healthy bone formation for the child in utero. 	<ul style="list-style-type: none"> ▪ Antenatal clinics ▪ Encourage GPs to discuss bone health with patients who are pregnant ▪ Raising awareness of importance of nutrition during pregnancy for bone health amongst health professionals. Target through: <ul style="list-style-type: none"> ▪ Australian College of Midwives ▪ Royal Australian & NZ College of Obstetricians & Gynaecologists
Children and adolescents	<ul style="list-style-type: none"> ▪ Osteoporosis is not just a condition of the 'older person' as prevention begins early in life. ▪ Healthy bone habits including a well balanced diet, calcium intake, vitamin D and skeletal loading are important during growth to reach a high peak bone mass. ▪ Nutritional habits and eating disorders are a risk factor for osteoporosis later in life 	<ul style="list-style-type: none"> ▪ Schools <ul style="list-style-type: none"> ▪ Distribute information through school nurses ▪ Greater emphasis on bone health in health and sport curriculum ▪ Provide education to parents on how to promote their children's bone health by targeting P&Cs ▪ Educate physical education teachers ▪ School art competitions to convey bone health messages ▪ Promotion of high calcium foods through school canteens ▪ Local junior sporting clubs

		<ul style="list-style-type: none"> ▪ Child and adolescent health services such as Princess Margaret Hospital, child health clinics ▪ Mass media – television, web-based and radio campaigns ▪ Online forums – Facebook, Twitter ▪ Use young media personalities as spokespersons
Middle age and postmenopausal women	<ul style="list-style-type: none"> ▪ Rapid bone loss occurs in the years following menopause and it is a common time for women to develop osteoporosis. ▪ Calcium absorption becomes less efficient during this stage of life. ▪ Healthy bone habits including calcium intake, vitamin D, skeletal loading, avoidance of smoking and alcohol intake are important to maintain bone mass and minimise age-related bone loss. ▪ It is important to be informed about osteoporosis and discuss it with your health care professional if you think you are at risk. The Osteoporosis Self-Assessment Tool is a simple way to assess risk. 	<ul style="list-style-type: none"> ▪ Displays, presentations or information sharing at: <ul style="list-style-type: none"> ▪ Hairdressers ▪ Women’s Gyms ▪ Naturopaths ▪ Herbalists ▪ Sports clubs or events ▪ Bus/train stations ▪ Day Spas ▪ Manicurists ▪ Beauty Therapists ▪ Coffee Shops ▪ Public toilets ▪ Health Consumers Council WA ▪ Mass media - television and radio campaigns or talk back radio ▪ Encouraging GPs and Pharmacists to discuss bone health with patients at risk of developing osteoporosis. ie. During the MBS 45-49 year old Health Assessment and the ATSI Peoples Health Assessment
Men	<ul style="list-style-type: none"> ▪ Men can develop osteoporosis and it is often under-diagnosed and undertreated, more so than in women. ▪ Healthy bone habits including calcium intake, vitamin D, skeletal loading, avoidance of smoking and alcohol intake are important to maintain bone mass and minimise age-related bone loss. 	<ul style="list-style-type: none"> ▪ Displays, presentations or information sharing at: <ul style="list-style-type: none"> ▪ Gyms, sports clubs/events ▪ Mens Groups ▪ Rotary Australia ▪ Returned & Services League of Australia WA ▪ Bus/train stations ▪ WA Men’s Shed Association ▪ Men’s Advisory Network (M.A.N) ▪ Health Consumers Council WA ▪ Public toilets ▪ Mass media - television and radio campaigns or talk back radio ▪ Using male media personalities as spokespersons ▪ Encouraging GPs and Pharmacists to discuss bone health with patients at risk of developing osteoporosis. ie. During the MBS 45-49 year old Health Assessment and the ATSI Peoples Health Assessment
Pre-menopausal female	<ul style="list-style-type: none"> ▪ Female athletes are at risk of developing amenorrhea which can affect the ability to maintain bone mass. 	<ul style="list-style-type: none"> ▪ Advertisements at sporting events ▪ Mass media - television and radio campaigns or talk back radio ▪ Raising awareness of the risks amongst sporting health professionals.

athletes	<ul style="list-style-type: none"> ▪ Healthy bone habits including calcium intake, vitamin D, skeletal loading & avoidance of smoking/ alcohol are important to maintain bone mass. 	<p>Target through:</p> <ul style="list-style-type: none"> ▪ Exercise & Sports Science Australia (ESSA) ▪ Sports Dieticians Australia
People taking certain medications or treatments	<ul style="list-style-type: none"> ▪ People undergoing chemotherapy and long term users of glucocorticoid therapies are at increased risk and should discuss prevention/treatment options with a health care professional. ▪ Healthy bone habits including calcium intake, vitamin D, skeletal loading, avoidance of smoking and alcohol intake are important to maintain bone mass. 	<ul style="list-style-type: none"> ▪ Education for pharmacists to highlight risks. Target through: <ul style="list-style-type: none"> ▪ Australian Association of Consultant Pharmacy ▪ Pharmaceutical Society of Western Australia ▪ Education for GPs to highlight risks. Target through: <ul style="list-style-type: none"> ▪ General Practice Networks/ Divisions & Medicare Locals ▪ Australian Medical Association (AMA) ▪ Educate public about the risks through National Prescribing Service ▪ Education of relevant health professionals regarding risks (see Appendix 1)
People with co-morbid conditions	<ul style="list-style-type: none"> ▪ Certain conditions or diseases can increase the risk of developing osteoporosis, sometimes earlier in life. ▪ Healthy bone habits including calcium intake, vitamin D, skeletal loading, falls prevention, avoidance of smoking and alcohol intake are important to maintain bone mass and minimise age-related bone loss. 	<ul style="list-style-type: none"> ▪ Education for GPs to highlight risks. Target through: <ul style="list-style-type: none"> ▪ General Practice Networks/ Divisions & Medicare Locals ▪ Australian Medical Association (AMA) ▪ Educate public about the risks through presentations and information sharing. Target through: <ul style="list-style-type: none"> ▪ Asthma Foundation of WA ▪ Arthritis Foundation WA (AFWA) ▪ Kidney Health Australia ▪ Education of relevant health professionals regarding risks (see Appendix 1 for list of health professional organisations)

3.2 Lifetime fracture risk assessment

Introduction

Awareness of the importance of assessing skeletal integrity and falls risk is important for all healthcare professionals who encounter patients with risk factors for osteoporosis and minimal trauma fractures. This is particularly important for health professionals in primary care, such as pharmacists, allied health professionals and GPs. Early diagnosis, fracture risk assessment and fracture prevention are important aspects of managing impaired bone health and osteoporosis. Secondary fracture prevention is of particular importance, as mortality and morbidity rates increase within the first year after sustaining an initial fracture⁴⁶. It is important that risk assessment measures are focussed not only at the right place and right time, but also to the *right people*, that is those at risk of fracture.

Although fracture risk is directly influenced by bone strength, reliance on bone mineral density (BMD) alone (a surrogate measure of bone strength) is often insufficient in providing reliable information about fracture risk in individual patients, highlighting that other clinical risk factors should also be considered. In particular, the risk of falls should be considered, especially for inferring the risk of hip fracture. In the context of vertebral fractures, consideration of clinical risk factors is particularly important for inferring fracture risk^{47,48}. In addition, there are several other risk factors that also should be taken into consideration when assessing individuals for fracture risk, including previous fragility fracture, family history, gender (female), age, back pain and significant height loss^{38,49}. An awareness and understanding of these risk factors can inform health professionals about fracture risk status⁴⁹. Importantly, the cumulative history of these risk factors across the lifecourse should be considered when inferring fracture risk. This highlights the importance of a lifecourse approach to managing bone health, incorporating multiple lifestyle, biomedical, and genetic factors.

Current situation

Recently, a number of fracture risk assessment tools have been developed to inform clinicians about *absolute* fracture risk for patients, based on BMD values and other clinically-relevant risk factors, often weighted according to importance. Examples of these online tools include [FRAX™](#), the [Garvan Institute Fracture Prognostic Tool](#), and the [University of Western Australia Fracture Risk Calculator](#). Although the risk algorithms differ between the tools, these resources provide users with an absolute fracture risk, rather than a relative fracture risk for their patients based on BMD values alone, and most tools have comparable validity⁵⁰. Bone mineral density data are critical to assessing and monitoring skeletal integrity and determining eligibility for therapy in Australia. Access to BMD testing, specifically DXA scanners, is important, although in WA access is limited in some areas while units are under-utilised in others.

Early diagnosis, fracture risk assessment for osteoporosis, that is measurement of BMD in the absence of prevalent osteoporotic fractures, is important for those patients who are deemed 'at risk' of fracture, based on established clinical risk factors such as those individuals who have already sustained a low trauma fracture and individuals aged ≥ 70 years of age. Unlike other health conditions such as skin and cervical cancer, population based screening is neither cost effective nor feasible. Therefore, priority and resources should be directed to 'at risk' individuals, rather than a population-based approach. The Federal Government recognised this importance by establishing a Medicare rebate for BMD testing for Australians aged 70 years and over in 2007, although it may be cost effective to lower this age threshold further, consistent

with the position statement of the [International Society of Clinical Densitometry](#) (ISCD)⁹.

Screening for osteoporosis and implementation of a treatment plan is particularly important for those individuals who sustain low trauma fractures and present to Emergency Departments (EDs) or other health providers. Evidence suggests that many patients who sustain an initial low trauma fracture are not assessed for osteoporosis⁵¹⁻⁵³. Similarly, many people with established risk factors for falls may not be assessed for falls and referred to falls clinics. A hospital-based [falls risk management tool](#) has been endorsed for use in WA by the Falls Prevention Health Network.

The ACE-Prevention Study identified screening programs for low BMD in elderly women as a missed opportunity at a national level despite the fact that there is strong evidence to support screening as a cost-effective intervention with a moderate impact on population health¹⁷.

The diagram in Appendix 2, produced by Osteoporosis Australia, provides an overview of the screening, diagnosis and treatment process for women and men over 50 years.

Summary of current gaps in lifetime fracture risk assessment

- Lack of screening for 'at risk' individuals, especially those who present to ED with low trauma fractures and risk factors for falls
- Under-utilisation of DXA units within the community
- Poor awareness and utilisation of absolute fracture risk tools

Model of care for lifetime fracture risk assessment

RIGHT CARE

The [RACGP Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men](#),⁶ the [RACGP Algorithm](#) and the [2007 Position Statement of the International Society for Clinical Densitometry](#) (ISCD)⁹ provide guidance on the screening for osteoporosis. All patients who have had a minimal trauma fracture or patients with multiple risk factors for osteoporosis should undergo diagnostic assessment (see Table 3 for a list of risk factors)⁵⁴.

It is recommended that diagnostic assessment for osteoporosis and fracture risk consist of medical history, clinical examination, and DXA BMD measurements⁵⁴.

Screening and diagnosis of osteoporosis in children differs greatly from that in adults and should be based around the recommendations of the ISCD⁹. The diagnosis of osteoporosis in children should not be based on BMD alone and requires the presence of a significant fracture history i.e. long bone fracture of the lower extremities, vertebral compression fracture, two or more long bone fractures of the upper extremities⁹.

RIGHT TIME

According to the [2007 Position Statement of the International Society for Clinical Densitometry](#)⁹, the indications for Bone Mineral Density (BMD) testing are⁹:

- Women aged 65 and older
- Postmenopausal women under age 65 with risk factors for fracture
- Women during the menopausal transition with clinical risk factors for fracture, such as low body weight, prior fracture or high risk medication use
- Men aged 70 and older
- Men under age 70 with clinical risk factors for fracture
- Adults with a fragility fracture
- Adults with a disease or condition associated with low bone mass or bone loss
- Adults taking medications associated with low bone mass or bone loss
- Anyone being considered for pharmacotherapy
- Anyone being treated, to monitor treatment effect
- Anyone not receiving therapy in whom evidence of bone loss would lead to treatment

The [Osteoporosis Self Assessment Tool \(OST\)](#) is a simple instrument which uses age and body mass to predict an individual's BMD. Encouraging the use of this tool within the community provides a cost-effective way of identifying men and women for BMD assessment through DXA^{10, 12}. More research and comparative analysis of a high methodological quality is recommended⁵⁵. The International Osteoporosis Foundation has also released a [One-Minute Osteoporosis Risk Test](#) for consumers. Community pharmacists and nurse practitioners are in an ideal position to promote self-assessment tools.

Recently, the Male Osteoporosis Screening Tool (MOST) was evaluated in a large cohort of men from the MrOS study and found to be effective for Chinese and Caucasian men⁵⁶. The MOST is similar to the OST, except that it uses body weight and a quantitative ultrasound index (QUI). Both OST and MOST have been used to assess risk in men with equal validity and either when used as screening tools may save approximately one third of screening DXA studies in elderly male populations⁵⁶.

The [PROSPECT](#) tool has been developed in Australia to help guide general practitioners to identify women aged 70 years and older who are at risk of fracture and should be referred for radiological screening. An evaluation of the tool found that its use facilitates targeted screening, therefore reducing the need for unnecessary radiology tests¹¹.

Monitoring should be done at intervals according to each patient's clinical status and level of risk⁵⁴. Monitoring through BMD testing is generally not recommended at intervals of less than 2 years⁵⁴, unless in certain circumstances such as in patients with conditions associated with rapid bone loss⁹ or patients receiving treatment where assessments at yearly intervals are recommended.

RIGHT TEAM

Education and training to promote adherence to clinical guidelines amongst health professionals will have a significant impact on ensuring patients at risk of osteoporosis and fracture are identified and diagnosed in a timely manner (See section 3.4 for the model of care for workforce development). Raising awareness of simple assessment tools such as [OST](#), [PROSPECT](#) and MOST may encourage health professionals to undertake assessments more readily when shown the process can be relatively quick and easy. An audit of uptake of these resources by health professionals is also critical.

RIGHT PLACE

Screening of individuals for osteoporosis and fracture risk should primarily take place in the primary care setting. The involvement of community pharmacy and community-based nurse practitioners in pre-screening using QUI of the heel as well as social marketing resources may be useful in raising awareness about osteoporosis, identifying 'at risk individuals' and reducing the need for more expensive screening tools^{50 57}. However the measurement of QUI requires appropriate training and rigorous adherence to quality control. To that end, professional practice standards, with external assessment of technique and record-keeping is important⁵⁸.

There are significant differences in the DXA reference ranges currently used in Australia for both the proximal femur and the lumbar spine. These differences may lead to differences in the diagnosis of osteoporosis, and hence differences in therapeutic decisions. To overcome these problems the ANZBMS recommends that the [Geelong Osteoporosis Study \(GOS\) reference range](#) is used in Australia for interpretation of DXA scans in Caucasians.

When patients present to emergency department with minimal trauma fractures they should be referred to a fracture clinic and GP to initiate appropriate assessment and treatment.

ENABLERS

The [RACGP clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men](#) and the associated nomogram provide a detailed resource to guide clinicians in the assessment and management of osteoporosis⁶.

Existing fracture risk calculators may be utilised to provide 5-10 year estimates of absolute fracture risk. These tools may be used in the absence of BMD data offering an advantage in circumstances where DXA data are not available. Clinical judgement must be used when interpreting results, as a tool does not account for dose responses where 'yes' or 'no' answers are provided and in some cases may underestimate the risk of fracture. Also, these tools may show modest predictive power when applied to local populations. In one recent study neither the FRAX nor Garvan Institute tools discriminated prospective fractures better than age combined with BMD⁵⁹ and a similar finding was identified in a systematic review⁵⁰.

The [WHO Fracture Risk Assessment Tool \(FRAX\)](#) evaluates the major fracture risk of patients 40 years and over⁶⁰. A number of models using data from population-based cohorts have been developed for different countries, including Australia. The algorithms use clinical risk factors, either with or without hip BMD, to give the 10-year probability of a femoral neck fracture⁶⁰.

The clinical risk factors assessed by FRAX include:

- age
- sex
- weight and height
- previous fracture
- parent fractured hip
- glucocorticoid medication use
- rheumatoid arthritis
- secondary osteoporosis
- three or more units of alcohol per day
- current smoking

The [Garvan Institute Fracture Risk Calculator](#) is based on Australian data from the Dubbo Osteoporosis Epidemiology Study conducted by the Bone and Mineral Research Program. This tool can only be used for those above the age of 60 years and takes into account the following factors:

- sex
- age
- number of fractures since age 50
- falls over the last 12 months
- BMD measurement

A [University of Western Australia \(UWA\) fracture risk calculator](#) has also been developed using data from women aged over 70 years. The tool can be used for patients aged ≤ 70 years based on mathematical extrapolation.

The WA [Health Diagnostic Imaging Pathways e-resource for suspected osteoporosis](#) also provides information about appropriate screening and management pathways.

Appropriate ICT systems will provide prompts for follow-up and recall of patients who are identified as being at risk of fracture or developing osteoporosis and need to be reassessed regularly. In particular, effective and timely communication between hospitals and GPs is critical to initiating treatment and screening for patients who present to EDs with low trauma fractures. One strategy may be that radiology reports could highlight the presence of a minimal trauma fracture and recommend considering referral for BMD screening.

The establishment of a register of DXA units in WA would be a useful resource for both research and clinical practice.

The Medicare Benefits Schedule (MBS) provides reimbursement for BMD testing for a number of defined categories of patients. A summary has been compiled by Osteoporosis Australia: [Medicare Items](#). Although according to the evidence, BMD testing may be warranted in some individuals who do not comply with the MBS eligibility criteria.

3.3 Treatment

There are a number of treatments available to prevent or slow the progression of bone loss and minimise the risk of osteoporotic fractures. Efforts should be targeted at ensuring these treatments are appropriately utilised¹⁶. Importantly, falling is the strongest single risk factor for bone fracture, rather than osteoporosis. Falls prevention interventions are therefore equally, if not more, important than treatments for osteoporosis *per se*⁸. The [WA Falls Prevention Model of Care](#) and [national falls prevention guidelines](#) provide recommendations to address falls risk.

Current situation

Evidence suggests there is a large disconnect in terms of current practice and recommendations outlined in evidence based clinical guidelines^{2, 38, 61 62 63}. Possible reasons for this disconnect include a lack of continuity of care between health systems, lack of familiarity with osteoporosis screening, BMD measurement and osteoporosis treatment amongst health professionals, the cost of prescription drugs, and a general lack of knowledge about osteoporosis amongst health consumers⁶¹.

This lack of adherence to best practice results in the under-treatment of osteoporosis in Australia^{61 62}. An Australian review of 88,000 postmenopausal women attending GPs found that 29% had at least one osteoporotic fracture, yet less than one third of these women were receiving specific treatment for osteoporosis and 7% of these women were taking calcium only⁶⁴. Similar results were found among patients presenting to Australian emergency departments with low trauma wrist fractures⁵¹ while a recent Australian study reported that 75.9% who had sustained an incident fracture remained untreated for osteoporosis 12 months after sustaining the fracture⁶².

Consumer compliance with osteoporosis medication is also a barrier to effective treatment regimes. Access Economics estimated that some 2,759 fractures occurred in Australia in 2005 due to non-adherence to medication⁶⁵. Given the costs, difficulty experienced by consumers in taking some medications, complex administration of some agents, and side effects of some osteoporosis medications⁶⁶, patients are sometimes unmotivated to take them which impacts on carer time and responsibilities⁶⁷.

The diagram in Appendix 2, produced by Osteoporosis Australia, provides an overview of the screening, diagnosis and treatment process for women and men over 50 years. This diagram should be used as a guide only, and be used in conjunction with the [RACGP clinical guidelines for osteoporosis](#)⁶.

Summary of current gaps in treatment of osteoporosis

- Disconnect between current clinical practice and that recommended by clinical guidelines.
- Low rates of identification of osteoporosis, particularly of individuals in the 70+ year age group and other at risk groups (eg users of glucocorticoid medications and men), and initiation of treatment.
- Patient adherence to medication is low.
- Lack of recognition of the significance of high fracture risk and osteoporosis by the general public and health practitioners.
- Disconnect between eligibility for PBS-subsidised medications and the evidence suggesting drug treatment efficacy in some groups of patients.
- Lack of providing falls risk assessment and intervention plan for older people who present with a fall to either primary care or hospital

RIGHT CARE

The first step to optimal treatment of osteoporosis is improving rates of diagnosis to increase opportunities to initiate treatment (see section 3.3 Lifetime Fracture Risk Assessment). Following diagnosis, secondary causes of osteoporosis should be addressed. Health professionals should consider their patients' clinical risk factors⁶⁸ and use evidence based guidelines (such as the [RACGP Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men](#)⁶) to guide the prescription of treatments for their patients. The physical, psychosocial and economic impacts of osteoporosis and fragility fractures should be considered in all aspects of treatment, consistent with the National Service Improvement Framework principles⁴.

Exercise

Regular, low impact, weight bearing exercise can be recommended to those diagnosed with osteoporosis in an attempt to reduce bone loss²⁶. Exercise also has benefit in improving balance and reducing falls risk^{13, 14}. Refer to the [ANZBMS Exercise Recommendations for Osteoporosis](#).

Drug treatments

Pharmacotherapies available for the treatment of osteoporosis include⁵⁴:

- Bisphosphonates
 - alendronate
 - risedronate
 - zoledronic acid
- Strontium ranelate
- Denosumab
- Selective oestrogen receptor modulators (SERMs)
- Parathyroid hormone (including teriparatide) (PTH)
- Hormone therapy (HRT)

Calcium and Vitamin D

- Calcium (diet and supplementary) with other key nutrients such as protein and magnesium^{7, 66, 68-70}.
Refer to the [ANZBMS, Osteoporosis Australia and Endocrine Society of Australia position statement on calcium and bone health](#)
- Vitamin D (diet and supplementary and education on safe/adequate sun exposure)^{7, 66, 68-70}.
Refer to the [ANZBMS, Endocrine Society of Australia and Osteoporosis Australia position statement on vitamin D and adult bone health \(2010 draft revised version available\)](#) and the recommendations for Australian residential aged care facilities⁷.

Possible risks associated with treatments

Evidence continues to emerge on the effectiveness of relevant treatments and in some cases, possible links with adverse health outcomes. Health professionals should remain aware of emerging evidence and ensure patients are well informed of any risks and the likelihood of these occurring relative to the benefit of the treatment – that is the number needed to treat and the number needed to harm – and relative to the risk of not initiating treatment. Importantly, the effectiveness of therapy for reducing the risk of osteoporotic fracture^{50, 71} should be considered against the small risk of developing adverse side effects (eg oesophagitis, atypical femoral fractures, osteonecrosis of the jaw). For example, the risk of developing osteonecrosis of the jaw in patients with osteoporosis or Paget's disease who are taking bisphosphonates is between 1 in 10,000 to 1 in 100,000⁷².

Surgical management

For some fractures, orthopaedic surgery is indicated (e.g. hip fracture). Refer to the [Orthogeriatric Model of Care](#) and the [Elective Joint Replacement Service Model of Care](#) for further information on post fracture surgical interventions. Although vertebroplasty has been used to treat vertebral fractures commonly associated with osteoporosis, results from two recent randomised control trials reported no differences between treatment groups (intervention and placebo) for any measures throughout the trials^{73, 74}, raising major uncertainty about the efficacy of this procedure^{75, 76}.

Residents of aged care facilities

Older people living in residential aged care facilities are at considerably higher risk of suffering fractures than older people living in the community⁷ and have a much higher incidence of falls¹³. A recent [position statement for the treatment of osteoporosis in Australian residential aged care facilities](#) provides recommendations on the use of pharmacotherapies (vitamin D supplementation, bisphosphonates and strontium ranelate) as well as non-pharmacologic treatment opportunities for this population⁷. Similarly, specific [guidelines for falls prevention](#) in this population have been developed.

Self management

Self management is an important aspect of overall osteoporosis treatment as it empowers people with the skills to slow disease progression and reduce the risk of further fractures⁴⁹. The [Osteoporosis Australia website](#) is a useful resource for consumers in this context. Community pharmacies are an ideal vehicle to disseminate self-management information about osteoporosis to consumers. A review of public health interventions found that community-based self management programs were found to promote knowledge of osteoporosis and encourage self-efficacy with healthy lifestyle behaviours³⁸. Health literacy surrounding osteoporosis has been suggested as a barrier to engaging in self management and should be addressed⁷⁷. The [Stay On Your Feet WA® website](#) contains consumer-based information about falls prevention.

Where patients are reluctant to adhere to treatments, health professionals should identify the cause and propose solutions or alternatives. Ensuring patients are well educated about osteoporosis and falls risk, and the risks involved with refusing treatment is one strategy for improving adherence^{78 79}. The Medicare Chronic Disease Management (CDM) plans provide an opportunity for interdisciplinary health professionals to deliver self management information to patients with osteoporosis.

RIGHT TIME

Pharmacological treatment should be considered in the following circumstances^{16, 54, 68}.

- Individual with osteopenia (T score between -2.5 and -1) and a fracture
- Individual with fragility fracture independent of bone density⁸⁰
- Individual with osteoporosis (T score \leq -2.5), with or without a fracture
- Individuals receiving a sustained high dose of glucocorticoid medications (\geq 7.5mg of steroid medication for 3 months or more)
- Individuals aged 70 years and over with a T \leq -3.0.

For patients with osteopenia or normal BMD and no history of fracture, lifestyle measures should be encouraged and pharmacologic treatment should be deferred. Evidence-based prevention strategies should be recommended, such as adequate levels of calcium and vitamin D, exercise and falls prevention activities (refer to the [National Guidelines for Falls Prevention](#)). In some circumstances, people with identified clinical risk factors for osteoporosis are ineligible for PBS-subsidised drug treatments. Nonetheless, it may still be appropriate to initiate therapy for these patients. Treatment eligibility criteria and algorithms for local sites may need to be developed through Drug and Therapeutics Committees to optimise access for patients to therapeutic agents.

It is recommended that general practitioners follow up with patients at 3 to 6 months after the initiation of pharmacological treatment and on an annual basis thereafter⁵⁴. Formal processes of review should also be put in place for patients with whom the decision is made not to recommend specific preventive anti-osteoporotic therapy⁵⁴.

Multi-factorial assessment and intervention should be considered for all those presenting to hospital with a fall.

RIGHT TEAM

Fracture liaison (coordination) positions (e.g. trained specialist nurses) should be established within hospitals to coordinate care between hospital and community-based care settings⁸¹. This is particularly important for optimally managing patients who present to EDs with minimal trauma fractures. These positions are critical to ensure that patients have access to interdisciplinary care which is based around an appropriate and evidence-based management plan including falls prevention interventions. The use of an interdisciplinary approach for the identification and treatment of osteoporosis (eg physiotherapy, occupational therapy, pharmacy, dietetics) has been demonstrated to improve fragility fracture management^{38, 82 83, 84} and has been shown to be cost effective⁸⁵. A recent review describes the components of various coordinator positions around the world, including the elements of an effective service and implementation issues⁸⁴. Notably, network-supported models tend to achieve better sustainability and outcomes⁸⁴.

GPs should utilise [Chronic Disease Management \(CDM\) Medicare Items](#) where possible to plan, review and coordinate the care of patients with osteoporosis.

Community pharmacists have a role to play in identifying patients at risk of fracture or falls, improving adherence to medication and linking eligible individuals with programs such as the [Home Medicines Review](#) and other community-based services in their area. In addition, a medication management review conducted by a pharmacist in collaboration with a GP is available for every resident in an aged care facility on an annual basis. This is an ideal opportunity to identify residents at risk and optimise medications; both anti-osteoporotic treatment and review of medications which can increase falls risk.

RIGHT PLACE

The identification of osteoporosis and initiation of appropriate treatment in primary care facilities is likely to lower the incidence of low trauma fractures, thus minimising emergency department presentations. However, hospitals need adequate procedures and systems in place to ensure patients that do present to emergency departments are promptly identified, recorded and referred to relevant community-based care for osteoporosis treatment and secondary fracture prevention⁸². The efficacy of fracture liaison services in this context has been widely reported⁸⁴.

Densitometry utilisation rates are significantly lower in rural and remote areas than in metropolitan areas, possibly due to access issues to primary health care⁵⁴.

More attention should be targeted towards educating health professionals who have the opportunity to identify, refer and treat at risk patients with non-pharmacologic modalities.

ENABLERS

Health professional compliance with best practice guidelines for the treatment of osteoporosis can be encouraged through the promotion of easy to use resources, such as those produced by [Osteoporosis Australia](#) and the [RACGP](#), which outline simple treatment algorithms.

Ensuring the availability of consumer and carer-specific information on osteoporosis treatments, including side effects, risks, costs and benefits will help address issues relating to patient adherence to medications. Furthermore, raising awareness and utilisation of osteoporosis treatments listed on the MBS and PBS (visit Osteoporosis Australia for a list of [Subsidised Items](#)) may provide further motivation to commence treatment.

The use of telemedicine and involvement of nurse practitioners to ease the burden on health professionals in under-resourced areas⁸⁶.

The introduction of comprehensive electronic discharge summaries from hospitals to GPs which outline an appropriate management plan will provide GPs with more robust information in order to undertake appropriate care coordination. This process may also be facilitated with hospital liaison GP roles. High level evidence substantiates the clinical benefit⁸⁷ and cost effectiveness⁸⁸ of implementing standardised communication strategies including evidence-based treatment guidelines to primary care physicians.

The broader dissemination of detailed clinical guidelines and treatment algorithms, especially for specific 'at risk' groups, will assist GPs to undertake appropriate and evidence-based management.

Implementation of the Falls Prevention and Aged Care Models of Care will also address the burden of low trauma fractures in WA.

3.4 Workforce development

Introduction

Having an adequately educated and trained health workforce is essential to ensure people receive the *right care* at the *right time* for osteoporosis. In particular, the early detection of osteoporosis and secondary prevention of minimal trauma fractures is reliant upon the capacity of the health workforce, particularly those health professionals in primary care, to recognise the public health significance of osteoporosis, identify individuals at risk of osteoporosis and initiate appropriate management strategies. The role of carers is also recognised as critical to optimising bone health and preventing minimal trauma fractures.

Current situation

A large number of health professionals are involved in the diagnosis, treatment and management of osteoporosis. Nonetheless, current evidence suggests that Australians with osteoporosis are not receiving the *right care* at the *right time*, discordant with clinical guidelines^{51, 53, 64, 89-91 62}. The failure to detect bone fragility and initiate treatment is also an international problem⁹². These data highlight that professional development of the health workforce and improved inter-professional practice are critical in order to meet the predicted escalating burden of osteoporosis and minimal trauma fractures. Indeed, the need for further education for health professionals across the spectrum of musculoskeletal conditions has been recognised in Australia through the [Musculoskeletal Core Competencies Project](#)⁹³ and internationally⁹⁴.

Appropriate integration and communication between health professionals will provide ample opportunities to identify and treat osteoporosis and minimal trauma fractures. Moreover, better utilisation of the existing workforce, such as allied health professionals and community pharmacy staff, may provide more comprehensive and timely services to consumers. The importance of integration and strategies to achieve this are outlined in the WA Primary Care Strategy (consultation document) and WA Chronic Conditions Framework (draft). When the roles and responsibilities of each of these health professionals are unclear, opportunities for identification and treatment can be missed³⁸. For instance, an Australian study reviewed almost 30,000 patient records from 23 GPs and found the rate of diagnosis of osteoporosis for those aged over 59 years of age was 12.6 per cent for women and 3.8 per cent for men⁹⁵. This indicates rates of diagnosis are well below the national estimated prevalence of osteoporosis in Australia. Both GPs and orthopaedic surgeons saw the benefit of having Osteoporosis Nurse Specialists to recruit appropriate patients to Osteoporosis Clinics⁹⁶.

The appointment of suitably qualified practitioners (eg nurse, nurse practitioner, physiotherapist) to coordinate care for individuals who sustain incident minimal trauma fractures is a key recommendation of a recent report from Osteoporosis Australia and International Osteoporosis Foundation ⁸¹, the Australian Fracture Prevention Summit ¹⁶ and the draft [NSW Model of Care for Osteoporotic Fracture Prevention](#) ⁹⁷. The efficacy of such a position in the Australian public health system has been established ^{82, 98} and highlights a critical area of workforce development for Western Australia and internationally ⁹⁹.

Summary of current gaps in workforce development

- Lack of clarity regarding the responsibility of different health professions in diagnosis and treatment of bone fragility and falls risk factors.
- Inadequate professional development opportunities for health professionals in the context of osteoporosis.
- Poor communication between care providers and a lack of coordinated multidisciplinary teams to manage patients with identified bone fragility.
- Lack of awareness amongst health professionals to identify the link between minimal trauma fractures and osteoporosis ⁸⁶.

Model of Care for workforce development

RIGHT CARE

Educational strategies should be developed to broaden the awareness of health professionals that osteoporosis and bone fragility is not just seen as a condition affecting postmenopausal women. Evidence suggests women are more likely to receive treatment than men and that people aged over 95 are not as likely to receive post fracture treatment than those aged 65 to 69 years ^{100, 101}. In addition to providing education to health professionals it is equally important to evaluate the uptake of information, knowledge shift, and changes in practice behaviours associated with any interventions.

Pharmacists, nurses in aged care facilities and practice nurses are in an ideal position to easily provide opportunistic education and they should be provided with educational strategies in a simple format for bone health and falls risk. However, education interventions in isolation are unlikely to be effective ¹⁰², and therefore linkages with other services are important.

RIGHT TIME

Education about osteoporosis and falls risks should be delivered during university education to capture undergraduate health professionals. Where possible, this should be incorporated as a mandatory component of the health curriculum. Key educational messages include:

- To ensure the patient receives best-practice continuous care, all health professionals need to be adequately educated to identify points of referral and follow up across the healthcare system.
- To consider the prevention and management of osteoporosis across the lifecycle and within a multidisciplinary context, consistent with Models of Care for other chronic conditions and evidence which supports inter-professional collaboration ¹⁰³.

Opportunities for ongoing information sharing, professional development and skills maintenance in the diagnosis and treatment of osteoporosis are required for all health professionals. Maintaining the capacity and competency of the workforce needs to be considered by WA Health Area Health Service workforce planners.

Vertebral fractures, one of the most common osteoporotic fractures and significant predictors of future fracture and morbidity, are largely under-diagnosed¹⁰⁴. Education aimed at radiologists¹⁰⁵ and internal medicine specialists may be beneficial in improving diagnosis rates¹⁰⁶.

RIGHT TEAM

Strategies to optimise care for bone health and minimal trauma fracture include:

- Support the dissemination of education and training resources related to bone health, falls risk and minimal trauma fractures, such as the [Osteoporosis Australia Awareness Campaigns](#) “Think Osteoporosis!” and “Prevent the Next Fracture”, [Healthy Bones Week](#) and the [Stay On Your Feet®](#) Campaign
- Support the further development of educational materials using evidence-based methods of delivery. Evidence suggests that educational interventions targeting patients and all care providers involved in osteoporosis management, in combination with a practice structure that is supportive of change, are more likely to have a positive impact on rates of screening and treatment for osteoporosis in comparison to isolated educational interventions targeting a single care provider^{102, 107-109}.

Fracture liaison (coordination) positions (eg. trained specialist nurses, nurse practitioners or physiotherapists) should be established within hospitals to coordinate care between hospital and community-based care settings⁸¹. This is particularly important for optimally managing patients who present to EDs with minimal trauma fractures. These positions are critical to ensure that patients have access to interdisciplinary care⁸².

The provision of post-fracture care is out of scope for emergency departments and fracture clinics but it is their responsibility to refer patients to their primary care practitioner with a flag for osteoporosis⁸⁶. Post fracture management should not be the sole responsibility of the GP as other health professionals such as pharmacists, rehabilitation professionals, practice nurses and dieticians should play a role^{86, 109}. For instance, a trial of a pharmacist-initiated osteoporosis screening program found that the number of patients tested or treated for osteoporosis doubled within 4 months when compared to usual care, although there were still a number of patients who did not receive appropriate care suggesting the need for a more intensive intervention¹¹⁰.

Primary care clinicians have an important role to play in osteoporosis care. However, evidence suggests there is confusion amongst this cohort in terms of the use of screening bone densitometry, who to treat and what treatment to provide, as existing guidelines can be too complicated¹⁰⁰. A study of family physicians in Ontario in 2000 suggested the use of simple, easy to understand, one page information that can be displayed in the surgery to improve adherence to clinical guidelines¹⁰⁰. The provision of simple flow charts for practice nurses to follow would also be beneficial. The study participants also highlighted the need to address patient education so they were adequately informed to be able to know what to ask for and when, therefore providing a prompt for the physician¹⁰⁰. Primary care clinicians also express a lack of time to address the prevention of osteoporosis and fractures¹⁰⁰. Resources developed by [Osteoporosis Australia](#) should be promoted to all health professionals.

RIGHT PLACE

Ongoing opportunities for training should be accessible to all health professionals and available in both face-to-face and online programs. A study of the effect of an online lecture in influencing health professionals approach to osteoporosis found that there were improvements in knowledge however this did not translate into changes to patient care¹¹¹. It was suggested case-based learning may be more effective in providing practical techniques and knowledge that can be easily translated into practice¹¹¹.

A UK study suggests that a structured training program delivered by specialist osteoporosis nurses to residential care facility staff increased rates of prescription of calcium, vitamin D and bisphosphonate therapies, although not to the extent to meet current guideline standards¹¹². Training materials included a half-day face to face training session and a written resource pack¹¹². In Australia, the [National Prescribing Service](#) provided an educational outreach program in 2007/2008 focussed on preventing osteoporosis¹¹³. Upskilled facilitators provided current, evidence based messages and resources to 8,982 GPs through either a 1:1 educational visit, or a small group case study.

ENABLERS

Discussions with frontline staff, including practice nurses and nurse practitioners, to understand barriers and enablers to delivering best practice care should be the first step in ensuring that strategies for workforce development are appropriate and effective. In particular, education provided to practice nurses on brief intervention strategies would be beneficial given the many opportunistic occasions to promote bone health within general practice.

Adequate information communication and technology (ICT) infrastructure support is required to facilitate referrals and communications between health professionals.

Evidence suggests that having printed materials such as brochures to give to patients would be beneficial from both a patient and physician perspective^{86, 100}.

Integration with local initiatives such as the [Friend-In-Need-Emergency \(FINE\) Scheme](#) will help to ensure those working with target groups such as the elderly are well placed to identify and refer those at risk and prevent minimal trauma fractures. The FINE Scheme aims to improve access to health care for people with chronic health conditions and the frail aged who could be cared for in their home rather than being admitted to hospital. Similarly, integrating with the [National Prescribing Service \(NPS\)](#) may be a way to deliver osteoporosis specific education to pharmacists and GPs within the existing program.

Adopting interdisciplinary models of professional education for osteoporosis, utilising a range of delivery methods – online learning, case studies, workshops, lectures, practice guidelines and electronic clinical support tools – will improve workforce development outcomes ^{102, 107-109}.

3.5 Research, evaluation and horizon scanning

Although the mortality associated with musculoskeletal health conditions is low relative to other chronic disease, the morbidity and costs imposed on the individual and community are enormous. Research efforts should therefore continue to be progressed into priority areas of musculoskeletal health, especially the prevention and management of osteoporosis and minimal trauma fracture.

In 2010 [NHMRC](#) research funding expenditure for arthritis and osteoporosis was more than \$32 million for 186 active research grants. More than \$215 million has been invested in this priority area in the ten years since 2001. Within the context of this MOC, the following areas require further research and evaluation:

- The effectiveness and reach of osteoporosis-specific social marketing campaigns and the targeted health promotion messages with the greatest impact for high risk groups (refer to Table 2).
- Improving the coordination of osteoporosis management through interdisciplinary teams.
- The efficacy of fracture coordinators for osteoporosis treatment and management in WA.
- Effective forms of education, training and information distribution to health professionals¹⁰².
- Strategies for improving health professional adherence to clinical guidelines.
- An examination of the cost effectiveness and clinical outcomes of changing the MBS and PBS criteria so that screening and treatment options may be initiated earlier for patients with established risk factors for osteoporotic fracture.

At the time of producing this Model of Care, the information presented reflected the state of evidence and health policy at that time. Users should be aware that as evidence changes constantly, further evidence may have emerged since publication. The content and recommendations of the Model of Care should be reviewed within 5 years. Findings from the implementation of other health service Models of Care for osteoporosis should also be considered for Western Australia, in particular the [NSW Model of Care for Osteoporotic Fracture Prevention](#) and its associated data acquisition projects regarding minimal trauma fractures.

4. Implementation and recommendations matrix

Model of Care Goal	Focus area				
	Health promotion	Lifetime fracture risk assessment	Treatment	Workforce development	Research and evaluation
RIGHT CARE	<p>Ensure health promotion messages and methods of delivery are evidence-based and suited to target groups. In particular, healthy lifestyle habits which are known to positively influence bone health and falls prevention should be emphasised.</p> <p>The use of exhaustive mass media campaigns should be prioritised for the 25-60 yr age group.</p> <p>Identify the most effective health promotion strategies to reach 'at risk' groups in the context of bone health.</p> <p>Facilitate the dissemination of established health promotion guidelines to consumers and health professionals, especially falls prevention guidelines.</p>	<p>Improve compliance with evidence based guidelines on screening including the RACGP Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men⁶ and the 2007 Position Statement of the International Society for Clinical Densitometry (ISCD)⁹. The national guidelines for falls prevention should also be disseminated through the WA Falls Prevention Health Network.</p>	<p>Ensure health professionals consider the clinical risk factors of patients and use evidence based guidelines (such as the RACGP Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men⁶ and the recommendations for the treatment of osteoporosis in Australian residential aged care facilities⁷ to guide the prescription of treatments. Consumers should be educated about the efficacy of pharmacologic treatments for osteoporosis, in particular the significant benefits of treatment relative to the risks of not receiving treatment, side effects and ceasing treatment.</p> <p>Appropriate therapy for residents of aged care facilities should be promoted through dissemination of treatment guidelines.</p> <p>A focus on falls prevention</p>	<p>Develop educational strategies to broaden health professionals' knowledge and awareness of:</p> <ul style="list-style-type: none"> ▪ The significance of bone fragility and that osteoporosis is not just a condition affecting postmenopausal women. ▪ Appropriate points of referral and follow up across the health system. ▪ Prevention and management of osteoporosis and falls risk across the lifecourse, especially within the primary care setting, involving GPs, pharmacy, practice nurses, nurse practitioners, and allied health professionals ▪ Working within a multidisciplinary context to optimise patient care. <p>Support the dissemination of resources aimed at health professionals which outline best practice management</p>	<p>Evaluate the efficacy of resources aimed at increasing consumer awareness of osteoporosis, and encourage the roll-out of those resources which are shown to be effective.</p> <p>Collate and synthesise evidence-based pharmacologic treatment recommendations for particular 'at risk' groups for use in primary care.</p>

Model of Care Goal	Focus area				
	Health promotion	Lifetime fracture risk assessment	Treatment	Workforce development	Research and evaluation
			should accompany all osteoporosis targeted treatment strategies.	of osteoporosis and falls prevention (eg evidence-based recommendations about calcium-rich foods).	
RIGHT TIME	<p>Deliver bone health messages across the lifespan towards particular 'at risk' groups, emphasising the role of prevention in osteoporosis. eg target children and adolescents who are still accumulating bone mass</p> <p>Optimise nutritional content of meals provided in health and aged care facilities and home deliveries, especially calcium content.</p>	<p>Ensure health professionals initiate BMD testing in those outlined by the RACGP Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men⁶ and the 2007 Position Statement of the International Society for Clinical Densitometry (ISCD)⁹.</p> <p>Utilise pre-screening tools (such as OST and PROSPECT) to reduce the occurrence of unnecessary radiology tests. Raising awareness of these tools in primary care would assist with screening initiatives.</p> <p>Refer patients who have a history of falls or identified risk factors for falling to a falls clinic.</p>	<p>Ensure timely initiation of treatment through compliance with evidence based guidelines such as RACGP Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men⁶ and the use of clinical discretion.</p> <p>Establish review processes in clinical settings to monitor patient treatment outcomes.</p> <p>Initiate evidence-based, multimodal interventions for individuals who have identified risk factors for falling</p>	<p>The significance of osteoporosis and treatment opportunities within a multidisciplinary context should be included in University curricula.</p> <p>Identify training needs by consulting with 'frontline' providers, eg carers, pharmacists, practice nurses, allied health professionals, GPs.</p>	
RIGHT TEAM	Ensure health professionals in all settings play a role in health promotion, including falls prevention.	Promote awareness among health professionals and consumers regarding the importance of assessing	Promote the importance of self management in the prevention and treatment of osteoporosis, falls	Ensure all health professionals are aware of the role they play in osteoporosis and falls risk	Investigate more thoroughly the barriers and enablers to undertaking evidence-

Model of Care Goal	Focus area				
	Health promotion	Lifetime fracture risk assessment	Treatment	Workforce development	Research and evaluation
RIGHT TEAM (cont.)	<p>Appoint coordinators to reduce duplication and improve dissemination of bone health promotion resources and activities.</p> <p>Identify champions to improve the reach of health promotion efforts.</p> <p>Engage community pharmacy in health promotion activities and messages.</p>	<p>skeletal integrity for 'at risk' groups.</p> <p>Promote screening for osteoporosis, fracture risk and falls risk among primary care providers especially community pharmacists, practice nurses and nurse practitioners.</p>	<p>prevention and post fracture care.</p> <p>Establish fracture liaison positions to coordinate care between hospital and community settings. Hospital GP Liaison Officers can contribute to this role.</p> <p>Engage pharmacists in identifying patients at risk of fracture or falls, improving adherence to medication and linking eligible individuals with programs such as the Home Medicines Review. Residential Medication Management Reviews in collaboration with a GP should be available for every resident in an aged care facility on an annual basis.</p> <p>Facilitate coordinated GP care through Chronic Disease Management Medicare Items.</p> <p>Improve knowledge among primary care providers regarding pharmacologic treatment options for osteoporosis.</p>	<p>identification, assessment and treatment. The use of case-based learning in this context may be particularly helpful, particularly during University training.</p> <p>Identify ongoing opportunities for information sharing, professional development and skills maintenance. Ensure they are accessible to all health professionals and available in both face to face and online programs with case-based learning incorporated where possible. Accrediting professional development opportunities for CPD points may be an enabler to stakeholder engagement.</p>	<p>based and/or guideline consistent care for osteoporosis by engaging with 'front line' professionals, eg GPs, pharmacists, practice nurses and carers.</p> <p>Collect prospective clinical and economic data to substantiate the need for fracture liaison positions in WA.</p>

Model of Care Goal	Focus area				
	Health promotion	Lifetime fracture risk assessment	Treatment	Workforce development	Research and evaluation
RIGHT PLACE	Disseminate health promotion messages through a broad variety of channels to maximise reach.	<p>Promote screening of individuals for osteoporosis and fracture risk in primary care settings.</p> <p>Refer all patients presenting to emergency departments with minimal trauma fractures to a fracture clinic and their GP to initiate appropriate assessment and treatment.</p>			
ENABLERS	<p>Form strategic partnerships to facilitate the development and dissemination of health promotion resources and activities. Eg engage with schools</p> <p>Develop health promotion resources and information that is specific to the needs of those at risk of developing osteoporosis.</p>	<p>Utilise Information Communication and Technology (ICT) systems to:</p> <ul style="list-style-type: none"> ▪ provide prompts for follow-up assessments ▪ improve referrals from EDs to primary care facilities <p>Establish a register of DXA units in WA.</p> <p>Raise awareness of online fracture risk calculator tools, particularly in settings where DXA data are not available.</p> <p>Increase awareness of the MBS criteria for osteoporosis screening among health professionals.</p>	<p>Use telemedicine to ease the burden on health professionals in under-resourced areas.</p> <p>Introduce comprehensive electronic discharge summaries from hospitals to GPs which outline an appropriate management plan.</p> <p>Increase awareness and compliance of evidence based guidelines through the promotion of simple to use resources eg. Osteoporosis Australia and RACGP resources</p> <p>Increase awareness and utilisation of osteoporosis</p>	<p>Improve access to Information Communication and Technology (ICT) infrastructure support to facilitate referrals and communications between health professionals.</p> <p>Integrate with local initiatives such as the Friend-In-Need-Emergency (FINE) Scheme and the National Prescribing Service to improve opportunities for identification and treatment.</p> <p>Adopt interdisciplinary models of professional education for osteoporosis, utilising a range of delivery methods.</p>	

Model of Care Goal	Focus area				
	Health promotion	Lifetime fracture risk assessment	Treatment	Workforce development	Research and evaluation
			<p>treatments listed on the MBS and PBS.</p> <p>Develop consumer and carer resources with information on medications and treatments to increase patient adherence.</p> <p>Broader dissemination of detailed clinical guidelines and treatment algorithms to assist GPs to undertake appropriate and evidence-based management.</p>		

5. Osteoporosis: Background, epidemiology and diagnosis

5.1 Osteoporosis: background and epidemiology

Osteoporosis is a systemic skeletal condition characterised by low mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility¹. Osteoporosis may be classified as primary or secondary:

- Primary osteoporosis is associated with hormonal changes which accompany menopause (Type 1) usually between the ages of 50-70 years, or with the aging process in people aged more than 70 years (Type 2).
- Secondary osteoporosis may occur as a result of many other conditions associated with chronic medical conditions, drug treatments e.g. glucocorticoid or thyroxine treatment or lifestyle diseases.

Bone tissue is remodelled through resorption and formation across the lifecourse as a normal physiologic process. Peak bone mass is reached in adolescence, highlighting a window of opportunity to optimise bone health during growth, while bone resorption occurs in later adulthood, accelerating after menopause. Osteoporosis manifests when the rate of bone resorption exceeds that of bone formation, resulting in a loss of bone mass and disruption in bone quality¹¹⁴, leading to reduced bone strength and increased propensity to fracture. Low trauma fractures are the most significant outcome of osteoporosis and occur most frequently at the hip, spine and distal forearm. Osteoporotic fractures occur as a consequence of a triad of factors: osteoporosis, falls and the interface/impact. Notably, the strongest single risk factor for fracture is falling, rather than osteoporosis per se^{8 115, 116}.

Osteoporosis is recognised as a National Health Priority Area in Australia owing to the burden imposed on the Australian community as a result of the condition, in particular the personal and societal impact of fractures. A [National Service Improvement Framework for osteoarthritis, rheumatoid arthritis and osteoporosis](#) was established in 2005 to outline strategies to address the population burden of the condition⁴. The burden of disease, expressed in disability-adjusted life years, is greater for osteoporotic fractures than for many other chronic conditions, including common cancers¹¹⁷. The annual direct healthcare cost attributable to osteoporosis in Australia is estimated to be \$1.9 billion¹¹⁸.

“More than half of older Australian women and perhaps a third of older Australian men will suffer an osteoporotic fracture during their lifetime.”¹¹⁸

A recent report estimates that 2.2 million Australians have an osteoporosis-related condition and the prevalence is expected to rise to 3 million by 2021. In parallel, the number of Australians expected to sustain a hip fracture is estimated to increase by 15% every 5 years until 2026, representing a four-fold increase in hip fractures by 2051¹¹⁹. This estimate is largely based on the projected age distribution of the Australian population which reflects an absolute and relative increase in population within the 60-85+ years age bracket¹²⁰. Population projections also suggest that the rate of spine, pelvic and arm fractures will increase by 12% every five years until 2036 and subsequently by 6% every five years until 2051¹²¹.

Although osteoporosis is most commonly associated with females, the prevalence of osteoporosis in older men is often under-recognised. For example, recent data from the Concord Health and Ageing in Men Project (CHAMP) highlighted that 90% of men who satisfied the criteria for federally subsidised osteoporosis medication were unaware they had osteoporosis and only a small proportion were receiving osteoporosis-specific treatment⁸⁹. These findings suggest that the self-reported prevalence of osteoporosis in elderly men may be substantially underestimated. This raises concern considering that osteoporotic fractures in elderly men are associated with greater morbidity, mortality, functional decline and health cost compared to women^{122, 123}.

The burden and prevalence of osteoporosis in Australia is mirrored by reports in the United States¹²⁴ and the United Kingdom¹²⁵. Strategies to optimise health service delivery to meet the challenge osteoporosis presents are therefore required.

In recognition of this burden and projected population demographics for Western Australia, development of a Model of Care for osteoporosis was prioritised by the Diabetes and Endocrine, Musculoskeletal, Aged Care and Falls Prevention Health Networks. The aim of a Model of Care is to outline a framework for WA that describes how health services should be delivered to prevent bone loss and manage low trauma fractures so that the **right care** is delivered at the **right time**, by the **right team**, in the **right place**¹⁵.

5.2 Development of osteoporosis and fragility fracture

Bone mass in adulthood depends on the peak amount of bone accrued during growth and the subsequent rate of bone loss later in life¹²⁶. Although a range of genetic and environmental risk factors have been identified for bone loss¹²⁷ (see Table 3), the importance of bone accretion during childhood and maximising peak bone mass during adolescence is increasingly recognised. Evidence suggests that childhood represents a window of opportunity to strengthen the skeleton¹²⁸, and reinforces the need for health promotion initiatives to be directed towards this age group. Although physical activity during growth contributes to greater gains in bone accrual into young adulthood relative to less physical activity^{129, 130}, there remains insufficient evidence to conclude that exercise during growth prevents fragility fractures in late adulthood¹³¹. This evidence gap largely reflects the difficulty in undertaking robust research to address this question. The importance of the *in utero* period for influencing peak bone mass, particularly with respect to nutrition during foetal development, is also recognised^{126, 132}. Fracture risk is dependent not only on osteoporosis but also on exposure of the skeleton to trauma, in the older age groups most commonly as falls. Many of the risk factors for falls are modifiable and there is robust evidence for the effectiveness of multimodal interventions to prevent falls in people in the community and in care facilities^{13, 14}.

Table 3. Established risk factors for osteoporosis, falls and fracture

<ul style="list-style-type: none">▪ An inactive lifestyle and/or low levels of physical activity▪ Cigarette smoking▪ Regular and excessive alcohol intake▪ A diet low in calcium▪ Vitamin D deficiency▪ Frequent falls▪ Eating disorders▪ Being female▪ Being Caucasian or Asian▪ A small body frame▪ Previous osteoporotic/fragility/minimal trauma fracture▪ Maternal family history of osteoporosis▪ Being over 60 years of age▪ Low body mass and/or low body mass index▪ Delayed puberty (menarche) or early menopause▪ Low testosterone levels (men)	<ul style="list-style-type: none">▪ Rheumatoid arthritis, chronic liver disease, renal failure▪ Malabsorption syndromes such as inflammatory bowel disease and coeliac disease.▪ History of over-active thyroid or parathyroid glands▪ Prolonged exposure to corticosteroid therapy▪ Prolonged bed rest or immobilisation▪ Polypharmacy▪ Malnutrition▪ Visual impairments▪ Foot impairments▪ Inappropriate walking aids▪ Poor balance▪ Cognitive impairment▪ Impaired mobility and gait▪ Reduced muscle strength
---	---

5.3 Epidemiology of Osteoporosis in Western Australia

The self-reported prevalence of osteoporosis in WA for men and women aged ≥ 16 years was estimated to be 4.6% in 2009 (Epidemiology Branch, Department of Health). Further breakdown of prevalence is provided in Tables 4 and 5. All information in the tables is based on self-reported data from the [Health and Well Being Surveillance System \(HWSS\)](#) (January to December 2009). Data are weighted to account for the oversampling in the rural and remote areas of WA and then standardized to the age and sex distribution of the 2009 Estimated Resident Population. The HWSS is managed by the Health Outcomes Assessment Unit of Epidemiology and Analytical Services, Department of Health, Western Australia, under the direction of the Health Surveys Advisory Group. The data are collected via a monthly Computer Assisted Telephone Interview involving 550 randomly selected Western Australians of all ages who are asked a range of questions about their health and lifestyle.

Table 4 Prevalence of osteoporosis in WA, 16 years & over, Health and Wellbeing Surveillance System, Jan to Dec 2009

	Osteoporosis	
	%	95% CI
16 to 44 yrs		
Males	0.4	(0.1 - 1.0)
Females	0.7	(0.3 - 1.3)
Persons	0.5	(0.3 - 0.9)
45 to 64 yrs		
Males	2.0	(1.3 - 3.3)
Females	7.0	(5.7 - 8.6)
Persons	4.5	(3.7 - 5.4)
65 yrs & over		
Males	8.5	(6.5 - 11.0)
Females	28.5	(25.5 - 31.7)
Persons	19.2	(17.3 - 21.4)
Total		
Males	2.0	(1.6 - 2.6)
Females	7.2	(6.5 - 8.0)
Persons	4.6	(4.1 - 5.1)

(Epidemiology Branch, Public Health Division, WA Department of Health)

The prevalence of osteoporosis increased significantly with age (Table 4). Respondents aged 65 years & over, were 37 times as likely to report osteoporosis compared with those aged 16 to 44 years (19.2% compared with 0.5%). Females were also significantly more likely to report osteoporosis.

Table 5 shows the standardised annual prevalence of osteoporosis for adults aged 25 years and over. There has been no significant change over time for the prevalence of osteoporosis for either males or females.

Table 5 Trend for the prevalence (%) of osteoporosis in WA, 25 years & over, Health and Wellbeing Surveillance System, 2003-2009

	Osteoporosis		
	Males	Females	Persons
2003	2.1	8.1	5.1
2004	2.1	9.8	6.0
2005	2.8	8.8	5.8
2006	2.7	8.4	5.6
2007	2.9	8.2	5.5
2008	2.4	9.1	5.7
2009	2.4	8.5	5.5

(Epidemiology Branch, Public Health Division, WA Department of Health)

Using 2009 resident population estimates, a prevalence of 5.5% equates to 81,476 people aged 25 years and over. Assuming that the prevalence of osteoporosis remains at 2009 levels, the projected population estimates for WA suggest that the number of people aged 25 years and over with osteoporosis will increase by 9-15% every five years, up to 2025. The prevalence of osteoporosis in Australia is likely to be underestimated using National Health Survey Data since these data only capture diagnosed osteoporosis¹³³

The prevalence of low trauma fractures is high (>80%) in people who do not have osteoporosis¹³⁴, thus highlighting the need for effective fracture prevention strategies, in particular falls prevention strategies.

5.4 National and State epidemiology of low trauma fractures.

The incidence of low trauma fracture is most easily monitored through hospitalisation. However, hospitalisation data for low trauma fracture will most likely underestimate the true incidence since many low trauma fractures neither require hospitalisation nor come to clinical attention, especially vertebral fractures. In 2008-09 over 56,000 hospitalisations for low trauma fracture in people aged 55 years and over were recorded in Australia. More than half those hospitalised were aged 80 years and over and the majority were female. Hip fractures were the most common reason for hospitalisation, accounting for 39% of all minimal trauma fractures in people aged 55 years and over and 54% in those aged 80 years and over¹³³. Over 95% of osteoporotic hip fractures are due to falls¹³³. Although the age-adjusted incidence of osteoporotic hip fracture has decreased by 14% among males and 20% among females over the last decade to 2006-07, the number of cases continues to increase in accordance with changes in the age distribution of the population¹³³. This finding is consistent with recent reports from Austria¹³⁵ and France¹³⁶ that have described a decreasing age-standardized incidence of hip fracture. Nonetheless, the absolute number of hip fractures is likely to continue to increase as the population ages¹³⁵.

The [WA Hospital Morbidity Data System \(HMDS\)](#) contains information concerning all inpatient discharge summary data from all public and private hospitals in Western Australia. A list of collected data items is updated and published annually in the HMDS Reference Manual, to meet state and national requirements. Consistent with national data, the HMDS highlights a greater incidence of low trauma fractures with increasing age and female gender, with the majority of hospitalisations due to hip fractures (Figure 1) and the vast majority attributable to falls.

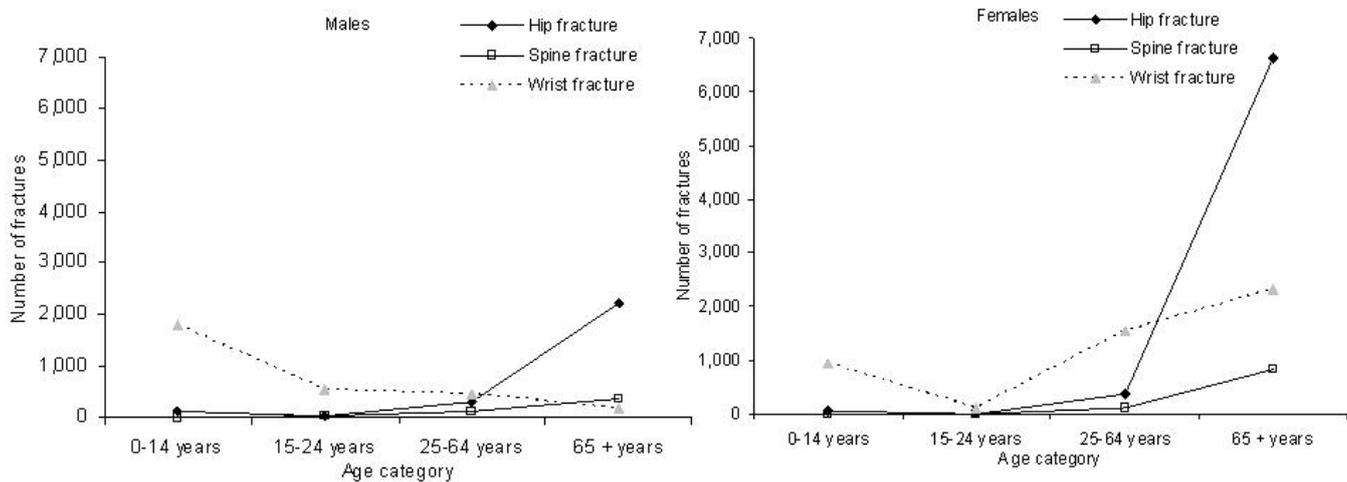


Figure 1 Incidence of hip, spine and wrist low trauma fractures requiring hospitalisation for individuals by age and gender (2000-2009) using data from the WA Hospital Morbidity Data system.

When comparing age-standardised rates of low trauma hip fracture across WA the Goldfields, Kimberley, Mid West and Pilbara regions had a greater rate of fracture compared to the State as a whole over 2000-2009. Similarly, national data suggest that females living outside major cities have an increased risk of sustaining an osteoporotic hip fracture ¹³³.

Aboriginal and Torres Strait Islander (ATSI) people are more likely to be hospitalised for osteoporotic hip fracture than other Australians. Data from the AIHW which represent hospitalisations for osteoporotic hip fracture between 2005-07 indicate that indigenous males are twice as likely to sustain an osteoporotic hip fracture and indigenous females 26% more likely to sustain an osteoporotic hip fracture than non-indigenous Australians ¹³³. The AIHW data are based on the number of hospital separations for hip fracture, rather than number of persons, which may create inaccuracies in the results. To overcome this limitation, a recent study in WA was conducted using linked data over the period 1999-2000 to 2008-09. Indigenous males were hospitalised for osteoporotic hip fractures at 3.29 times the rate of other males (95% CI 2.66-4.05) while indigenous females were hospitalised for osteoporotic hip fractures at 1.79 times the rate of other females (95% CI 1.48-2.17). The average age at which Indigenous Western Australians experienced a hip fracture was much younger than that of other Western Australians – 66 for Indigenous males (compared with 80 for other males) and 73 for Indigenous females (compared with 83 for other females) (Waldron et al, unpublished data).

5.5 Outcomes of fractures

Osteoporotic fractures are most commonly sustained at the hip, spine and wrist and are associated with both mortality and morbidity¹³⁷. Hip fractures in particular are associated with significant mortality and morbidity. For example, up to 36% of individuals who sustain a hip fracture die within one year¹³⁸, and this rate increases among older populations and those with underlying co-morbidities. Excess mortality after hip fracture persists over time, particularly in men¹³⁹. Increasing age, co-morbidity, pre-fracture disability and time to surgery exceeding 48 hours have been identified as factors predictive of mortality within 6 months of incident fracture¹⁴⁰. Elderly individuals who sustain hip fractures are particularly susceptible to acute complications such as infections, pressure sores and bronchopneumonia which contribute to mortality¹³⁷ and experience a significant deterioration in quality of life¹⁴¹.

Vertebral (spinal) fractures are recognised as a hallmark of osteoporosis, accounting for 46% of all osteoporotic fractures¹⁴², although only about one third come to clinical attention¹⁴³. Although not associated with mortality to the same extent as hip fractures¹²¹, vertebral fractures are associated with significant functional disability, reduced quality of life and often chronic back pain^{47, 144}.

Of particular concern is that the risk of sustaining subsequent vertebral and hip fractures increases markedly after an initial vertebral fracture is sustained, in the order of 7-10 and 2-4 fold, respectively^{47, 145, 146}. Both Australian and international data highlight an increased risk of subsequent fracture after **any** low trauma fracture, particularly at the hip and spine^{147, 148} and beyond which can be explained by low bone mineral density alone¹⁴⁹. This phenomenon, termed the 'fracture cascade', highlights the need to identify and treat individuals at risk of fracture in a timely fashion in an attempt to arrest the fracture cascade and minimise disability. Recent data from the NSW Agency for Clinical Innovation highlight the public health burden of the fracture cascade. Data examined from the NSW Department of Health from June 2002-June 2008 across all area health services identified that 35% of individuals admitted to a hospital over the 6 year period with a minimal trauma fracture were re-admitted to the same hospital for a secondary fracture. Re-admissions accounted for over 97,000 bed days which equated to an average annual cost of over \$12 million to the NSW health system budget. These data do not represent those individuals who were admitted with a secondary fracture to a different hospital and therefore the estimates may under-represent the total health system costs¹⁵⁰. Recent evidence suggests that targeted therapy for those patients at risk of subsequent non-vertebral fracture is effective, resulting in a risk reduction for subsequent fracture of up to 5.3 fold¹⁵¹. Of concern is that patients admitted with hip fracture may not receive a standard falls risk assessment and referral to treatment¹⁵².

5.6 Diagnosis of osteoporosis

A diagnosis of osteoporosis may be reached on the basis of one of two criteria, including

- (i) The presence or history of a minimal trauma fracture
 - A minimal trauma fracture is caused by a fall from standing height or less, or a fracture caused by an activity which would not normally cause a bone to fail
- (ii) The finding of low bone mass in the absence of fracture, usually measured by dual-energy x-ray absorptiometry (DXA).
 - DXA is used to measure areal bone mineral density (BMD), which is defined as the amount of mineral measured within the scanned skeletal region which is partially adjusted for the bone size.¹⁶ Osteoporosis is defined as a deficit in BMD of at least 2.5 standard deviations (T score ≤ -2.5) below the young adult (30 year old) reference mean in male and female Caucasian populations. Osteopenia is defined as T score between -2.5 and -1 (WHO, 2007). Normal BMD is defined as a T score of greater than -1.0. Generally, the risk of bone fracture doubles with every one standard deviation decrease in BMD. In addition to T scores by skeletal site, bone densitometers also calculate a Z score. The Z score indicates the number of standard deviations a person's BMD differs from the average of their age, gender and ethnicity.

A recent Australian study evaluated the lifetime risk of osteoporotic fracture according to BMD level. Residual lifetime risk of fracture, adjusted for mortality, for all females and males from 60 years of age was estimated to be 44% and 25%, respectively, while the risk for those females and males who had a BMD score of $T \leq -2.5$ the risk increased to 65% and 42%, respectively¹⁵³. Although this study provides evidence of increased fracture risk among individuals with a BMD threshold for osteoporosis, other data highlight that attention should also be directed towards individuals with osteopenia who also have a higher risk of fracture, particularly when associated with a prevalent fracture^{148, 154}. Increasingly, interest is being directed toward the calculation of absolute fracture risk using tools such as FRAX, rather than relative fracture risk using BMD data derived from DXA^{155, 156} (refer to section 3.2 of the Model of Care).

The RACGP Clinical guideline for the prevention and treatment of osteoporosis⁶ recommend that DXA scans should be performed every two years for those identified as being at risk of developing osteoporosis to monitor bone status. In the two years prior to the 2007-08 National Health Survey 356,000 people (51.5% of people with osteoporosis) reported having their bone mineral density measured¹³³.

Apart from the fracture event *per se*, the burden of osteoporotic fractures fall into three broad categories: worsened quality of life, substantial health care costs and associated premature morbidity and mortality.⁵⁴

6. References

1. NIH Consensus Development Panel on Osteoporosis Prevention DaT, . Osteoporosis prevention, diagnosis and therapy. *JAMA* 2001;285(6):785-95.
2. Ebeling PR. Osteoporosis: it's time to 'mind the gap'. *Intern Med J* 2007;37(10):672-3.
3. Briffa K, Briggs AM, France L. Development of a model of care for osteoporosis in Western Australia utilising Health Networks. In: Australian and New Zealand Bone and Mineral Society Meeting; 2010; Adelaide: ANZBMS; 2010.
4. National Health Priority Action Council. National Service Improvement Framework for Osteoarthritis, Rheumatoid Arthritis and Osteoporosis. Canberra: Australian Government Department of Health and Ageing; 2006.
5. Jaglal SB, Hawker G, Cameron C, Canavan J, Beaton D, Bogoch E, et al. The Ontario Osteoporosis Strategy: implementation of a population-based osteoporosis action plan in Canada. *Osteoporos Int* 2010;21(6):903-8.
6. Royal Australian College of General Practitioners. RACGP Clinical Guideline for the Prevention and Treatment of Osteoporosis in Postmenopausal Women and Older Men. Melbourne: RACGP; 2010.
7. Duque G, Close J, de Jager J, Ebeling PR, Inderjeeth C, Lord SR, et al. Treatment for osteoporosis in Australian residential aged care facilities: consensus recommendation for fracture prevention. *MJA* 2010;193(3):173-9.
8. Jarvinen TL, Sievanen H, Khan KM, Heinonen A, Kannus P. Shifting the focus in fracture prevention from osteoporosis to falls. *BMJ* 2008;336(7636):124-6.
9. International Society for Clinical Densitometry. 2007 Official Positions; 2007.
10. Adler R, Tran M, Petkov V. Performance of the Osteoporosis Self-assessment Screening Tool for osteoporosis in American men. *Mayo Clin Proc* 2003;78:723-7.
11. Davis S, Kirby C, Weekes A, Lanzafame A, Piterman L. Simplifying screening for osteoporosis in Australian primary care: the Prospective Screening for Osteoporosis; Australian Primary Care Evaluation of Clinical Tests (PROSPECT) study. *Menopause* 2010;18(1).
12. Gourlay M, Miller W, Richy F, Garrett J, Hanson L, Rehinster J. Performance of osteoporosis risk assessment tools in postmenopausal women aged 45-64 years. *Osteoporos Int* 2005;16(921-7).
13. Cameron ID, Murray GR, Gillespie LD, Robertson MC, Hill KD, Cumming RG, et al. Interventions for preventing falls in older people in nursing care facilities and hospitals (review). *Cochrane Database of Systematic Reviews* 2010;Issue 1. Art.No.: CD005465. DOI: 10.1002/14651858.CD005465.pub2.
14. Gillespie LD, Robertson MC, Gillespie WJ, Lamb SE, Gates S, Cumming RG, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews* 2009;Issue 2. Art.No.: CD007146. DOI: 10.1002/14651858.CD007146.pub2.
15. Health Networks Branch. Model of Care Overview and Guidelines. Perth: Department of Health (WA); 2007.
16. Sambrook PN, Seeman E, Phillips SR, Ebeling PR. Preventing osteoporosis: outcomes of the Australian Fracture Prevention Summit. *Med J Aust* 2002;176 Suppl:S1-16.

17. Vos T, Carter R, Barendregt J, Mihalopoulos C, Veerman L, Magnus A, et al. Assessing cost-effectiveness in Prevention (ACE-Prevention): Final Report. Melbourne: University of Queensland, Brisbane and Deakin University; 2010.
18. Compston J. Action plan for the prevention of osteoporotic fractures in the European Community. *Osteoporosis International* 2004;15(4):259 - 62.
19. Cashman K. Diet, nutrition and bone health. *Nutrition* 2007;137(11):2507S-12S.
20. Commonwealth Scientific Industrial Research Organisation (CSIRO) Preventative Health National Research Flagship & University of South Australia. 2007 Australian National Children's Nutrition and Physical Activity Survey: Main findings. Canberra: Commonwealth of Australia; 2008.
21. Bailey DA, Martin AD, McKay HA, Whiting S, Mirwald R. Calcium accretion in girls and boys during puberty: a longitudinal analysis. *J Bone Miner Res* 2000;15(11):2245-50.
22. National Health & Medical Research Council. Nutrient reference values for Australia and New Zealand including recommendary dietary intakes. Canberra: Commonwealth of Australia; 2006.
23. Australian and New Zealand Bone and Mineral Society, Osteoporosis Australia, Australasian College of Dermatologists, Cancer Council Australia. Risks and benefits of sun exposure position statement. In; 2007.
24. Diamond TH, Eisman JA, Mason RS, Nowson CA, Pasco JA, Sambrook PN, et al. Vitamin D and adult bone health in Australia and New Zealand: a position statement. *Medical Journal of Australia* 2005;182(6):281-5.
25. Flicker L, Mead K, MacInnis RJ, Nowson C, Scherer S, Stein MS, et al. Serum vitamin D and falls in older women in residential care in Australia. *Journal of the American Geriatrics Society* 2003;51(11):1533-8.
26. Nikander R, Sievanen H, Heinonen A, Daly RM, Uusi-Rasi K, Kannus P. Targeted exercise against osteoporosis: A systematic review and meta-analysis for optimising bone strength throughout life. *BMC Med* 2010;8:47.
27. Australian Bureau of Statistics. Physical Activity in Australia: A Snapshot, 2004-05. Canberra: ABS; 2006.
28. Perez-Lopez FR, Roncero GRP. Assessing the content and quality of information on the treatment of postmenopausal osteoporosis on the World Wide Web. *Gynecological Endocrinology* 2006;22(12):669-75.
29. Buchbinder R, Jolley D, Wyatt M. 2001 Volvo Award Winner in Clinical Studies: Effects of a media campaign on back pain beliefs and its potential influence on management of low back pain in general practice. *Spine (Phila Pa 1976)* 2001;26(23):2535-42.
30. Miller CL, Wakefield M, Roberts L. Uptake and effectiveness of the Australian telephone Quitline service in the context of a mass media campaign. *Tobacco Control* 2003;12:53-8.
31. Hurley SF, Matthews JP. Cost-effectiveness of the Australian National Tobacco Campaign. *Tobacco Control* 2008;17(6):379-84.
32. Montague M, Borland R, Sinclair C. Slip! slop! slap! and SunSmart, 1980-2000: Skin cancer control and 20 years of population-based campaigning. *Health Education & Behavior* 2001;28(3):290-305.
33. Morrell S, Perez DA, Hardy M, Cotter T, Bishop JF. Outcomes from a mass media campaign to promote cervical screening in NSW, Australia. *Journal of Epidemiology and Community Health* 2010;64(9):777-83.

34. Mullins R, Wakefield M, Broun K. Encouraging the right women to attend for cervical cancer screening: results from a targeted television campaign in Victoria, Australia. *Health Education Research* 2008;23(3):477-86.
35. Buchbinder R, Gross DP, Werner EL, Hayden JA. Understanding the characteristics of effective mass media campaigns for back pain and methodological challenges in evaluating their effects. *Spine (Phila Pa 1976)* 2008;33(1):74-80.
36. Hughes JM, Novotny SA, Wetzsteon RJ, Petit MA. Lessons learned from school-based skeletal loading intervention trials: putting research into practice. *Med Sport Sci* 2007;51:137-58.
37. Tellier V, De Maeseneer J, De Prins L, Ben Sedrine W, Gosset C, Reginster JY. Intensive and prolonged health promotion strategy may increase awareness of osteoporosis among postmenopausal women. *Osteoporosis International* 2001;12(2):131-5.
38. Brand C, Elkadi S, Amatya B. A literature review of public health interventions for rheumatoid arthritis, osteoarthritis and osteoporosis. Melbourne: Clinical Epidemiology and Health Service Evaluation Unit, The Royal Melbourne Hospital; 2005.
39. Wakefield M, Loken B, Hornik R. Use of mass media campaigns to change health behaviour. *Lancet* 2010;376(9748):1261-71.
40. Rollnick S, Butler CC, McCambridge J, Kinnersley P, Elwyn G, Resnicow K. Consultations about changing behaviour. *BMJ* 2005;331(7522):961-3.
41. Hall D, Dubruel N, Elliot T, Glanz K. Linking agents' activities and communication patterns in a study of the dissemination of an effective skin cancer prevention program. *J Public Health Manag Pract* 2009;15(5):409-15.
42. Nordqvist C, Timpka T, Lindqvist K. What promotes sustainability in Safe Community programmes? *BMC Health Services Research* 2009;9(4).
43. Barrett LL, Plotnikoff RC, Raine K. Organizational leadership and its relationship to regional health authority actions to promote health. *J Health Organ Manag* 2007;21(3):259-82.
44. O'Loughlin J, Renaud L, Richard L, Gomez LS, Paradis G. Correlates of the sustainability of community-based heart health promotion interventions. *Preventive Medicine* 1998;27(5):702-12.
45. Whitehead D, Keast J, Montgomery V, Hayman S. A preventative health education programme for osteoporosis. *Journal of Advanced Nursing* 2004;47(1):15-24.
46. Lindsay R, Silverman SL, Cooper C, Hanley DA, Barton I, Broy SB, et al. Risk of new vertebral fracture in the year following a fracture. *Jama-Journal of the American Medical Association* 2001;285(3):320-3.
47. Briggs AM, Greig AM, Wark JD. The vertebral fracture cascade in osteoporosis: a review of aetiopathogenesis. *Osteoporos Int* 2007;18(5):575-84.
48. Tsang SW, Bow CH, Chu EY, Yeung SC, Soong CC, Kung AW. Clinical risk factor assessment had better discriminative ability than bone mineral density in identifying subjects with vertebral fracture. *Osteoporos Int* 2011;22(2):667-74.
49. Australian Institute of Health and Welfare. A picture of osteoporosis in Australia. In: *Arthritis series no 6 Cat no PHE 99*. Canberra: AIHW, 2008; p. 1 -30.
50. Nelson HD, Haney EM, Dana T, Bougatsos C, Chou R. Screening for osteoporosis: an update for the U.S. Preventive Services Task Force. *Ann Intern Med* 2010;153(2):99-111.

51. Kelly AM, Clooney M, Kerr D, Ebeling PR. When continuity of care breaks down: a systems failure in identification of osteoporosis risk in older patients treated for minimal trauma fractures. *Medical Journal of Australia* 2008;188(7):389-91.
52. Smith MD, Ross W, Ahern MJ. Missing a therapeutic window of opportunity: An audit of patients attending a tertiary teaching hospital with potentially osteoporotic hip and wrist fractures. *Journal of Rheumatology* 2001;28(11):2504-8.
53. Teede HJ, Jayasuriya IA, Gilfillan CP. Fracture prevention strategies in patients presenting to Australian hospitals with minimal-trauma fractures: a major treatment gap. *Internal Medicine Journal* 2007;37:674-9.
54. Royal Australian College of General Practitioners. Clinical guideline for the diagnosis and management of early rheumatoid arthritis. Melbourne: RACGP; 2009.
55. Rud B, Hilden J, Hyldstrup L, Hrobjartsson A. The Osteoporosis Self-Assessment Tool versus alternative tests for selecting postmenopausal women for bone mineral density assessment: A comparative systematic review of accuracy. *Osteoporos Int* 2009;20:599-607.
56. Lynn HS, Woo J, Leung PC, Barrett-Connor EL, Nevitt MC, Cauley JA, et al. An evaluation of osteoporosis screening tools for the osteoporotic fractures in men (MrOS) study. *Osteoporos Int* 2008;19(7):1087-92.
57. Kraemer DF, Nelson HD, Bauer DC, Helfand M. Economic comparison of diagnostic approaches for evaluating osteoporosis in older women. *Osteoporos Int* 2006;17(1):68-76.
58. Professional Practice Standards Version 4, 2010. (Accessed 07/02/2011, at <http://www.psa.org.au/site.php?id=6040>.)
59. Bolland MJ, Siu AT, Mason BH, Horne AM, Ames RW, Grey AB, et al. Evaluation of the FRAX and Garvan fracture risk calculators in older women. *J Bone Miner Res* 2011;26(2):420-7.
60. Kanis JA, Johnell O, Oden A, Johansson H, McCloskey E. FRAX and the assessment of fracture probability in men and women from the UK. *Osteoporos Int* 2008;19(4):385-97.
61. Feldstein AC, Nichols GA, Elmer PJ, Smith DH, Aickin M, Herson M. Older women with fractures: Patients falling through the cracks of guideline-recommended osteoporosis screening and treatment. *Journal of Bone and Joint Surgery* 2003;85A(12):2294-301.
62. Otmar R, Henry MJ, Kotowicz MA, Nicholson GC, Korn S, Pasco JA. Patterns of treatment in Australian men following fracture. *Osteoporos Int* 2011;22(1):249-54.
63. Fraser LA, Ioannidis G, Adachi JD, Pickard L, Kaiser SM, Prior J, et al. Fragility fractures and the osteoporosis care gap in women: the Canadian Multicentre Osteoporosis Study. *Osteoporosis International* 2011;22(3):789-96.
64. Eisman J, Clapham S, Kehoe L. Osteoporosis prevalence and levels of treatment in primary care: The Australian BoneCare Study. *Journal of Bone and Mineral Research* 2004;19(12):1969-75.
65. Access Economics. Breaking point: The economic cost of not adhering to bisphosphonate treatment for osteoporosis: Access Economics; 2006.
66. Body J, Bergman P, Boonen S, Boutsen Y, Devogelaer J, Goemaere S, et al. Evidence-based guidelines for the pharmacological treatment of post menopausal osteoporosis: A consensus document by the Belgian Bone Club. *Osteoporos Int* 2010;21:1657-80.

67. Kanakamani J, Tandon N. Newer therapies in osteoporosis. *Indian Journal of Rheumatology* 2008;3(4):148-57.
68. Seeman E, Eisman J. Treatment of osteoporosis: why, whom, when and how to treat. *MJA* 2004;180(6):298-303.
69. Keen R. Osteoporosis: strategies for prevention and management. *Best Practice & Research in Clinical Rheumatology* 2007;21(1):109-22.
70. Compston J, Cooper A, Cooper C, Francis R, Kanis J, Marsh D, et al. Guidelines for the diagnosis and management of osteoporosis in post menopausal women and men from the age of 50 years in the UK. *Maturitas* 2009;62:105-8.
71. Imaz I, Zegarra P, Gonzalez-Enriquez J, Rubio B, Alcazar R, Amate JM. Poor bisphosphonate adherence for treatment of osteoporosis increases fracture risk: systematic review and meta-analysis. *Osteoporosis International* 2010;21(11):1943-51.
72. Khosla S, Burr D, Cauley J, Dempster DW, Ebeling PR, Felsenberg D, et al. Bisphosphonate-associated osteonecrosis of the jaw: report of a task force of the American Society for Bone and Mineral Research. *J Bone Miner Res* 2007;22(10):1479-91.
73. Buchbinder R, Osborne RH, Ebeling PR, Wark J, Mitchell P, Wriedt C, et al. A randomised trial of vertebroplasty for painful osteoporotic vertebral fractures. *New England Journal of Medicine* 2009;361(6):567-8.
74. Kallmes D, Comstock B, Heagerty P, Turner J, Wilson D, Diamond T, et al. A randomised trial of vertebroplasty for osteoporotic spinal fracture. *New England Journal of Medicine* 2009;361(6):569-79.
75. Buchbinder R, Kallmes D, Glasziou P. Vertebroplasty versus conservative treatment for vertebral fractures. *Lancet* 2010;376(9758):2070-1.
76. Buchbinder R, Osborne RH, Kallmes D. Invited editorial presents an accurate summary of the results of two randomised placebo-controlled trials of vertebroplasty. *Medical Journal of Australia* 2010;192(6):338-41.
77. Jordan JE, Briggs AM, Brand C, Osborne RH. Enhancing patient engagement in chronic disease self-management support initiatives in Australia: the need for an integrated approach. *MJA* 2008;186(10):S9-S13.
78. Berry S, Misra D, Hannan M, Kiel D. Low acceptance of treatment in the elderly for the secondary prevention of osteoporotic fracture in the acute rehabilitation setting. *Aging-Clinical and Experimental Research* 2010;22(3):231-7.
79. Huas D, Debiais F, Blotman F, Cortet B, Mercier F, Rousseaux C, et al. Compliance and treatment satisfaction of post menopausal women treated for osteoporosis. *Compliance with osteoporosis treatment. BMC Women's Health* 2010;10(26).
80. Inderjeeth C, Glennon D, Poland K, Ingram K, Prince R, Van V, et al. A multimodal intervention to improve fragility fracture management in patients presenting to emergency departments. *MJA* 2010;193(3):149-53.
81. Department of Medicine, University of Melbourne, Footscray Hospital. The burden of brittle bones: Epidemiology, costs and burden of osteoporosis in Australia 2007. Melbourne: Osteoporosis Australia & International Osteoporosis Foundation; 2008.
82. Giles M, Van Der Kallen J, Parker V, Cooper K, Gill K, Ross L, et al. A team approach: implementing a model of care for preventing osteoporosis related fractures. *Osteoporos Int* 2010.

83. Majumdar SR, Johnson JA, Bellerose D, McAlister FA, Russell AS, Hanley DA, et al. Nurse case-manager vs multifaceted intervention to improve quality of osteoporosis care after wrist fracture: randomized controlled pilot study. *Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA* 2011;22(1):223-30.
84. Marsh D, Akesson K, Beaton DE, Bogoch ER, Boonen S, Brandi ML, et al. Coordinator-based systems for secondary prevention in fragility fracture patients. *Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA* 2011;22(7):2051-65.
85. McLellan AR, Wolowacz SE, Zimovetz EA, Beard SM, Lock S, McCrink L, et al. Fracture liaison services for the evaluation and management of patients with osteoporotic fracture: a cost-effectiveness evaluation based on data collected over 8 years of service provision. *Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA* 2011;22(7):2083-98.
86. Jaglal SB, Cameron C, Hawker GA, Carroll J, Jaakkimainen L, Cadarette SM, et al. Development of an integrated-care delivery model for post-fracture care in Ontario, Canada. *Osteoporosis International* 2006;17(9):1337-45.
87. Majumdar SR, Johnson JA, McAlister FA, Bellerose D, Russell AS, Hanley DA, et al. Multifaceted intervention to improve diagnosis and treatment of osteoporosis in patients with recent wrist fracture: a randomized controlled trial. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne* 2008;178(5):569-75.
88. Majumdar SR, Lier DA, Rowe BH, Russell AS, McAlister FA, Maksymowych WP, et al. Cost-effectiveness of a multifaceted intervention to improve quality of osteoporosis care after wrist fracture. *Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA* 2011;22(6):1799-808.
89. Bleicher K, Naganathan V, Cumming RG, Seibel MJ, Sambrook PN, Blyth FM, et al. Prevalence and treatment of osteoporosis in older Australian men: findings from the CHAMP study. *Med J Aust* 2010;193(7):387-91.
90. Chen JS, Hogan C, Lyubomirsky G, Sambrook PN. Management of osteoporosis in primary care in Australia. *Osteoporosis International* 2009;20(3):491-6.
91. Nguyen TV, Center JR, Eisman JA. Osteoporosis: underrated, underdiagnosed and undertreated. *Medical Journal of Australia* 2004;180(5):S18-S22.
92. Giangregorio L, Papaioannou A, Cranney A, Zytaruk N, Adachi JD. Fragility fractures and the osteoporosis care gap: an international phenomenon. *Semin Arthritis Rheum* 2006;35(5):293-305.
93. Chohade MJ, Bachorski A. Development of the Australian Core Competencies in Musculoskeletal Basic and Clinical Science project - phase 1. *Med J Aust* 2008;189(3):162-5.
94. Wadey VM, Tang E, Abelseth G, Dev P, Olshen RA, Walker D. Canadian Multidisciplinary Core Curriculum for Musculoskeletal Health. *Journal of Rheumatology* 2007;34:567-80.
95. Chiang A, Jones J, Humphreys J, Martin C. Osteoporosis--diagnosis and treatment in a general practice population. *Aust Fam Physician* 2006;35(3):166-8.

96. Chami G, Jeys L, Freudmann M, Connor L, Siddiqi M. Are osteoporotic fractures being adequately investigated? A questionnaire of GP & orthopaedic surgeons. *BMC Fam Pract* 2006;7:7.
97. NSW Agency for Clinical Innovation. Draft NSW Model of Care for Osteoporotic Fracture Prevention: NSW Musculoskeletal Health Network; 2010.
98. Vaile J, Sullivan L, Bennett C, Bleasel J. First Fracture Project: addressing the osteoporosis care gap. *Intern Med J* 2007;37(10):717-20.
99. Majumdar SR, Johnson JA, Bellerose D, McAlister FA, Russell AS, Hanley DA, et al. Nurse case-manager vs multifaceted intervention to improve quality of osteoporosis care after wrist fracture: randomized controlled pilot study. *Osteoporos Int* 2011;22(1):223-30.
100. Jaglal SB, Carroll J, Hawler G, McIsaac WJ, Jaakkimainen L, Cadarette SM, et al. How are family physicians managing osteoporosis? Qualitative study of their experiences and educational needs. *Canadian Family Physician* 2003;49:462-8.
101. Block AE, Solomon DH, Cadarette SM, Mogun HE, Choudhry NK. Patient and physician predictors of post-fracture osteoporosis management. *J Gen Intern Med* 2008;23(9):1447-51.
102. Jaglal SB, Hawker G, Bansod V, Salbach NM, Zwarenstein M, Carroll J, et al. A demonstration project of a multi-component educational intervention to improve integrated post-fracture osteoporosis care in five rural communities in Ontario, Canada. *Osteoporosis International* 2009;20(2):265-74.
103. Zwarenstein M, Goldman J, Reeves S. Interprofessional collaboration: effects of practice-based interventions on professional practice and healthcare outcomes. *Cochrane Database Syst Rev* 2009(3):CD000072.
104. Delmas PD, van de Langerijt L, Watts NB, Eastell R, Genant H, Grauer A, et al. Underdiagnosis of vertebral fractures is a worldwide problem: The IMPACT study. *Journal of Bone and Mineral Research* 2005;20(4):557-63.
105. Link TM, Guglielmi G, van Kuijk C, Adams JE. Radiologic assessment of osteoporotic vertebral fractures: diagnostic and prognostic implications. *European Radiology* 2005;15(8):1521-32.
106. Casez P, Uebelhart B, Gaspoz JM, Ferrari S, Louis-Simonet M, Rizzoli R. Targeted education improves the very low recognition of vertebral fractures and osteoporosis management by general internists. *Osteoporosis International* 2006;17(7):965-70.
107. Solomon DH, Katz JN, La Tourette AM, Coblyn JS. Multifaceted intervention to improve rheumatologists' management of glucocorticoid-induced osteoporosis: A randomized controlled trial. *Arthritis & Rheumatism-Arthritis Care & Research* 2004;51(3):383-7.
108. Solomon DH, Katz JN, Finkelstein JS, Polinski JM, Stedman M, Brookhart MA, et al. Osteoporosis improvement: A large-scale randomized controlled trial of patient and primary care physician education. *Journal of Bone and Mineral Research* 2007;22:1808-15.
109. Laliberte MC, Perreault S, Dragomir A, Goudreau J, Rodrigues I, Blais L, et al. Impact of primary care physician workshop on osteoporosis medical practices. *Osteoporosis International* 2010;21(9):1471-485.
110. Yuksel N, Majumdar SR, Biggs C, Tsuyuki RT. Community pharmacist-initiated screening program for osteoporosis: Randomized controlled trial. *Osteoporos Int* 2010;21:391-8.

111. Hansen KE, Rosenblatt ER, Gjerde CL, Crowe ME. Can an online osteoporosis lecture increase physician knowledge and improve patient care? *Journal of Clinical Densitometry* 2007;10(1):10-20.
112. Cox H, Puffer S, Morton V, Cooper C, Hodson J, Masud T, et al. Educating nursing home staff on fracture prevention: a cluster randomised trial. *Age and Ageing* 2008;37(2):167-72.
113. National Prescribing Service Limited. 2007-2008 Progress, achievements and future directions: Evaluation Report No. 11; 2009.
114. Seeman E. Invited review: Pathogenesis of osteoporosis. *Journal of Applied Physiology* 2003;95(5):2142-51.
115. Kannus P, Niemi S, Parkkari J, Palvanen M, Heinonen A, Sievanen H, et al. Why is the age-standardized incidence of low-trauma fractures rising in many elderly populations? *Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research* 2002;17(8):1363-7.
116. Kannus P, Sievanen H, Palvanen M, Jarvinen T, Parkkari J. Prevention of falls and consequent injuries in elderly people. *Lancet* 2005;366(9500):1885-93.
117. Johnell O, Kanis JA. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. *Osteoporosis International* 2006;17(12):1726-33.
118. Access Economics. *The Burden of Brittle Bones: Costing Osteoporosis in Australia*. Canberra: Access Economics; 2001.
119. Sanders KM, Seeman E, Ugoni AM, Pasco JA, Martin TJ, Skoric B, et al. Age- and gender-specific rate of fractures in Australia: A population based study. *Osteoporosis International* 1999;10(3):240-7.
120. Australian Bureau of Statistics. 3222.0 Population projections Australia 2006 to 2101. In. Canberra: Commonwealth of Australia; 2008.
121. Center JR, Nguyen TV, Schneider D, Sambrook PN, Eisman JA. Mortality after all major types of osteoporotic fracture in men and women: an observational study. *Lancet* 1999;353(9156):878-82.
122. Gennari L, Bilezikian JP. Osteoporosis in men. *Endocrinol Metab Clin North Am* 2007;36(2):399-419.
123. Bass E, French DD, Bradham DD, Rubenstein LZ. Risk-adjusted mortality rates of elderly veterans with hip fractures. *Ann Epidemiol* 2007;17(7):514-9.
124. US Department of Health and Human Services. *Bone health and osteoporosis: A report from the surgeon general*. Rockville, MD, USA; 2004.
125. van Staa TP, Dennison EM, Leufkens HG, Cooper C. Epidemiology of fractures in England and Wales. *Bone* 2001;29:517-22.
126. Cooper C, Westlake S, Harvey N, Javaid K, Dennison E, Hanson M. Review: developmental origins of osteoporotic fracture. *Osteoporosis International* 2006;17(3):337-47.
127. Mattingly BE, Pillare AC. *Osteoporosis: Etiology, Diagnosis and Treatment*. New York: Nova Biomedical; 2009.
128. Khan K, McKay HA, Haapasalo H, Bennell KL, Forwood MR, Kannus P, et al. Does childhood and adolescence provide a unique opportunity for exercise to strengthen the skeleton? *J Sci Med Sport* 2000;3(2):150-64.
129. Baxter-Jones ADG, Kontulainen SA, Faulkner RA, Bailey DA. A longitudinal study of the relationship of physical activity to bone mineral accrual from adolescence to young adulthood. *Bone* 2008;43(6):1101-7.

130. Lloyd T, Chinchilli VM, Johnson-Rollings N, Kieselhorst K, Egli DF, Marcus R. Adult female hip bone density reflects teenage sports-exercise patterns but not teenage calcium intake. *Pediatrics* 2000;106(1):40-4.
131. Karlsson M, Bass S, Seeman E. The evidence that exercise during growth or adulthood reduces the risk of fragility fractures is weak. *Best Practice & Research in Clinical Rheumatology* 2001;15(3):429-50.
132. Winsloe C, Earl S, Dennison EM, Cooper C, Harvey NC. Early life factors in the pathogenesis of osteoporosis. *Curr Osteoporos Rep* 2009;7(4):140-4.
133. Australian Institute of Health and Welfare. The problem of osteoporotic hip fracture in Australia. Canberra: AIHW; 2010.
134. Stone KL, Seeley DG, Lui LY, Cauley JA, Ensrud K, Browner WS, et al. BMD at multiple sites and risk of fracture of multiple types: long-term results from the Study of Osteoporotic Fractures. *Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research* 2003;18(11):1947-54.
135. Dimai HP, Svedbom A, Fahrleitner-Pammer A, Pieber T, Resch H, Zwettler E, et al. Epidemiology of hip fractures in Austria: evidence for a change in the secular trend. *Osteoporos Int* 2011;22(2):685-92.
136. Maravic M, Taupin P, Landais P, Roux C. Change in hip fracture incidence over the last 6 years in France. *Osteoporosis International* 2011;22(3):797-801.
137. Harvey N, Dennison E, Cooper C. Osteoporosis: impact on health and economics. *Nature Reviews Rheumatology* 2010;6(2):99-105.
138. Abrahamsen B, van Staa T, Ariely R, Olson M, Cooper C. Excess mortality following hip fracture: a systematic epidemiological review. *Osteoporosis International* 2009;20(10):1633-50.
139. Haentjens P, Magaziner J, Colon-Emeric CS, Vanderschueren D, Milisen K, Velkeniers B, et al. Meta-analysis: Excess Mortality After Hip Fracture Among Older Women and Men. *Annals of Internal Medicine* 2010;152(6):380-+.
140. Maggi S, Siviero P, Wetle T, Besdine RW, Saugo M, Crepaldi G, et al. A multicenter survey on profile of care for hip fracture: predictors of mortality and disability. *Osteoporosis International* 2010;21(2):223-31.
141. Pande I, Scott DL, O'Neill TW, Pritchard C, Woolf AD, Davis MJ. Quality of life, morbidity, and mortality after low trauma hip fracture in men. *Annals of the Rheumatic Diseases* 2006;65(1):87-92.
142. Oleksik AM, Ewing S, Shen W, van Schoor NM, Lips P. Impact of incident vertebral fractures on health related quality of life (HRQOL) in postmenopausal women with prevalent vertebral fractures. *Osteoporos Int* 2005;16(8):861-70.
143. Ensrud K, Nevitt, MC., Palermo., et al., . What proportion of incident morphometric vertebral fractures are clinically diagnosed and vice versa. *J Bone Miner Res* 1999;14(S138).
144. Hallberg I, Bachrach-Lindstrom M, Hammerby S, Toss G, Ek AC. Health-related quality of life after vertebral or hip fracture: a seven-year follow-up study. *Bmc Musculoskeletal Disorders* 2009;10.
145. Ismail AA, Cockerill W, Cooper C, Finn JD, Abendroth K, Parisi G, et al. Prevalent vertebral deformity predicts incident hip though not distal forearm fracture: results from the European Prospective Osteoporosis Study. *Osteoporos Int* 2001;12(2):85-90.

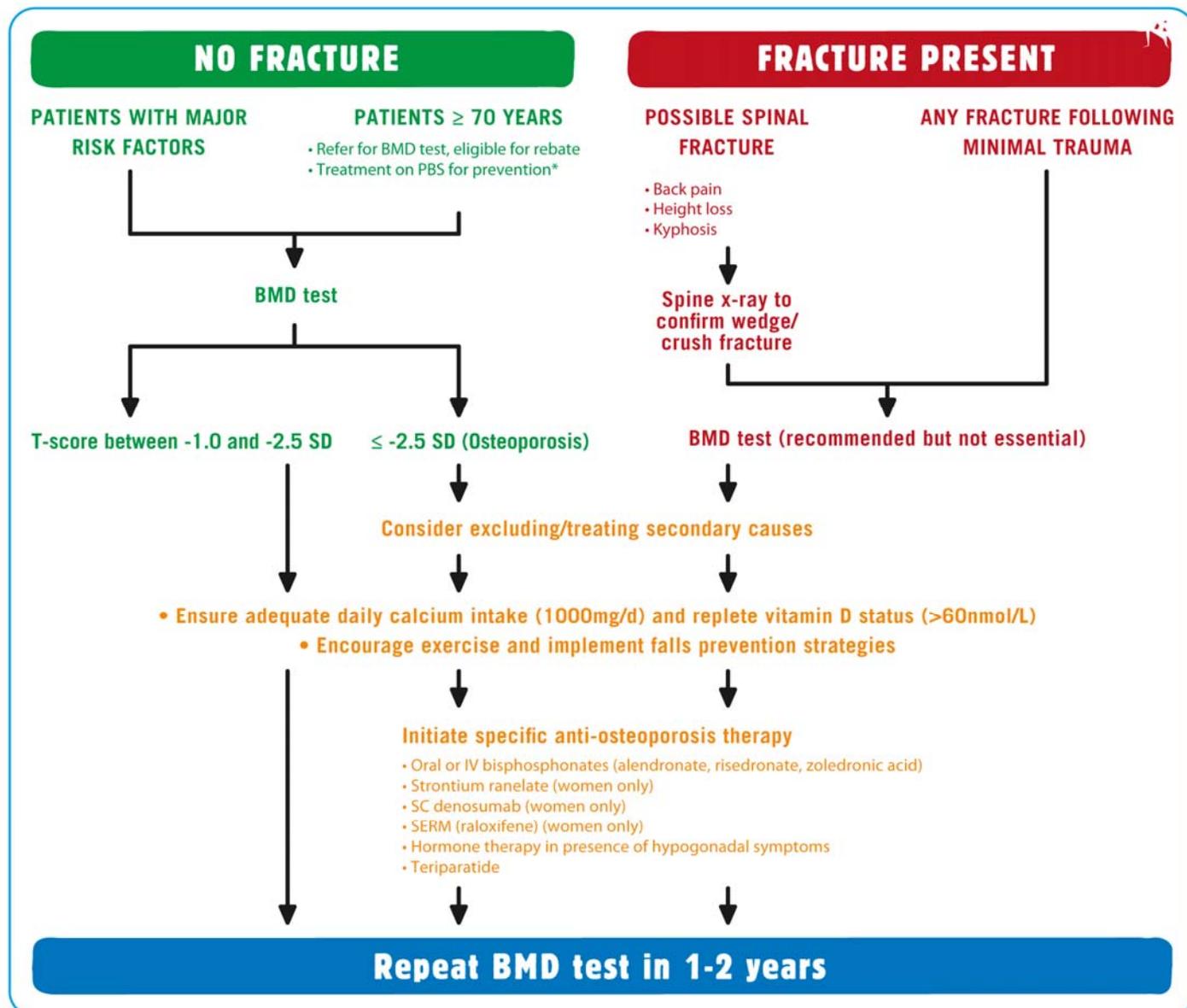
146. Ross PD, Davis JW, Epstein RS, Wasnich RD. Pre-existing fractures and bone mass predict vertebral fracture incidence in women. *Ann Intern Med* 1991;114(11):919-23.
147. Center JR, Bliuc D, Nguyen TV, Eisman JA. Risk of subsequent fracture after low-trauma fracture in men and women. *JAMA* 2007;297(4):387-94.
148. Langsetmo L, Goltzman D, Kovacs CS, Adachi JD, Hanley DA, Kreiger N, et al. Repeat Low-Trauma Fractures Occur Frequently Among Men and Women Who Have Osteopenic BMD. *Journal of Bone and Mineral Research* 2009;24(9):1515-22.
149. Kanis JA, Johnell O, De Laet C, Johansson H, Oden A, Delmas P, et al. A meta-analysis of previous fracture and subsequent fracture risk. *Bone* 2004;35(2):375-82.
150. NSW Agency for Clinical Innovation. NSW Re-fracture admission data 2002-2008. Analysis discussion. Sydney: NSW Agency for Clinical Innovation; 2009.
151. Lih A, Nandapalan H, Kim M, Yap C, Lee P, Ganda K, et al. Targeted intervention reduces refracture rates in patients with incident non-vertebral osteoporotic fractures: a 4-year prospective controlled study. *Osteoporos Int* 2011;22(3):849-58.
152. British Orthopaedic Association. The care of patients with fragility fracture. London: British Orthopaedic Association; 2007.
153. Nguyen ND, Ahlborg HG, Center JR, Eisman JA, Nguyen TV. Residual lifetime risk of fractures in women and men. *Journal of Bone and Mineral Research* 2007;22(6):781-8.
154. Pasco JA, Seeman E, Henry MJ, Merriman EN, Nicholson GC, Kotowicz MA. The population burden of fractures originates in women with osteopenia, not osteoporosis. *Osteoporosis International* 2006;17(9):1404-9.
155. McCloskey EV, Johansson H, Oden A, Kanis JA. From relative risk to absolute fracture risk calculation: the FRAX algorithm. *Curr Osteoporos Rep* 2009;7(3):77-83.
156. Siris E, Delmas PD. Assessment of 10-year absolute fracture risk: a new paradigm with worldwide application. *Osteoporosis International* 2008;19(4):383-4.

Appendices

Appendix 1: Organisations, services and institutions to involve in Osteoporosis MOC implementation

Community Health Organisations	Community Organisations	Health Professional organisations
<ul style="list-style-type: none"> • Asthma Foundation of WA • Arthritis Foundation WA (AFWA) • Australian and New Zealand Bone and Mineral Society (ANZBMS) • Breast Cancer Care WA • Cancer Council WA • Carers WA • Commonwealth Respite & Carelink Centres – access to Aged Care Assessment Teams (ACAT) providers and carers • Council of the Ageing (COTA) • Diabetes WA • Family Planning Association of WA (FPWA) • Health Consumers Council WA • Injury Control Council of WA (ICCWA) • Kidney Health Australia • National Prescribing Service • Osteoporosis Australia • Prostate Cancer Foundation of Australia • Silver Chain • Stay On Your Feet WA® (SOYFWA®) • Day Therapy Centres 	<ul style="list-style-type: none"> • Association for Tertiary Education Management • Association of Independent Schools of WA • Australian Council of Deans of Education • Catholic Education Office of WA • Country Women’s Association of WA • Lions Australia • Playgroup WA • Probus South Pacific • Returned & Services League of Australia WA • Rotary Australia • Universities in WA • WA Council of State School Organisations (WACSSO) • WA Department of Education & Training • WA Men’s Shed Association 	<ul style="list-style-type: none"> • Allied Health Professions Australia • Australian & NZ Society for Geriatric Medicine • Australian & NZ Society of Nephrology • Australian Association of Consultant Pharmacy • Australian Association of Occupational Therapists WA • Australian Association of Practice Managers • Australian Medical Association (AMA) • Australian Health Practitioner Regulation Agency • Australian Institute of Radiography (AIR) • Australian Physiotherapy Association (APA) • Australian Rheumatology Association (ARA) • Department of Veteran’s Affairs • Dietitians Association of Australia (DAA) • General Practice Networks/ Divisions & Medicare Locals • Endocrine Society of Australia • Exercise & Sports Science Australia (ESSA) • Local Hospital Networks • Pharmaceutical Society of Western Australia • Rural Health West • Royal Australasian College of Physicians • Royal Australian & NZ College of Radiologists • Royal Australian College of General Practitioners (RACGP) • Royal College of Nursing WA • Society of Hospital Pharmacists of Australia • Sports Dieticians Australia • Thoracic Society of Australia & NZ • WA Practice Nurses Association

Appendix 2: Osteoporosis diagnosis and treatment algorithm for men and women over 50 years



- * People ≥70 years with a BMD T-score ≤-3.0 can receive treatment on the PBS, without having sustained a fracture (ie for primary prevention).
- Patients of any age with osteoporosis who have sustained a minimal-trauma fracture can also receive treatment on the PBS.
- Patients on prolonged (at least 3 months), high dose (≥7.5 mg per day prednisolone or equivalent) corticosteroid treatment with a BMD T-score ≤-1.5 can receive treatment on the PBS.

For more information refer to the [RACGP Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men](#)⁶

Algorithm reproduced with permission from Osteoporosis Australia
http://www.osteoporosis.org.au/health_resources.php



Delivering a **Healthy WA**

Health Networks Branch
Department of Health
2C, 189 Royal Street
East Perth WA 6004