Irish Osteoporosis Society

OSTEOPOROSIS GUIDELINES

FOR HEALTH PROFESSIONALS

[These are not actors]

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The Irish Osteoporosis Society wish to acknowledge the support of an unrestricted educational grant from Amgen and GSK in producing the booklet.

AMGEN

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Acknowledgements

The Irish Osteoporosis Society would like to sincerely thank Professor Moira O'Brien, Michele O'Brien, Genette Owens (NOS) and Dr John Carey for their help in different area's of the guidelines.

Contents

Introduction

Osteoporosis is a systemic skeletal disease characterised by low bone mass, micro architectural deterioration of bone tissue and compromised bone strength, with a consequent increase in bone fragility and susceptibility to fracture, particularly of the wrist, hip and spine [1].

Osteoporosis is the commonest bone disease worldwide and is a major Public Health Hazard, with a high morbidity, mortality and socio-economic costs [2].

[1] It is a silent painless disease until a fracture occurs. Fracture is the most important clinical feature of osteoporosis, many of which are preventable. Although effective treatments have been available for more than a decade studies show many persons who fracture, or are at risk of fracture, are never evaluated or treated for their underlying osteoporosis, who subsequently go on to have additional fractures and the associated morbidity. [3]

Osteoporosis is most common in postmenopausal white women, but it is not just a disease of old ladies. Osteoporosis can occur at any age in both males and females, and persons of all races [4]. Approximately 25% of all fractures occur in men. **1 in 5 men (over 50) and 1 in 2 postmenopausal women (over 50) will develop a fracture during their lifetime. A postmenopausal woman's annual risk of fracture is greater than her combined risk of cardiovascular disease and breast cancer.**

Osteoporosis is treatable and fractures are preventable. One low trauma fracture increases the risk of a second in the near future, if not diagnosed and treated. [6, 7]

Social & Economic Cost of Fractures in Ireland

Osteoporotic Fractures Impose a Huge Social Cost in Ireland, approximately **€402** Million per annum is spent to treat all falls and fractures which occur in senior citizens with Osteoporosis in Ireland [9, 10]

In addition to Healthcare costs, vertebral fractures can cause back pain, loss of height, deformity, depression and low esteem. [12]

If current trends continue it is estimated that costs will be:

€520 - €551 million by 2010
€922 - €1077 million by 2020
€1587 - €2043 million by 2030

Extent of Problem

Osteoporosis is now a major health problem worldwide and it is increasing due to increased life expectancy. Approximately 300,000 Irish people aged 50 years and over may have osteoporosis. [10, 13]

- The life expectancy in 1995 was 75 years.
- In 2030 the predicted life expectancy is 84 years and Ireland has an ageing population.
- Today 11% are aged 65 years or over (468,000).
- By 2031 that proportion will increase to 18% i.e. to over one million older people.
- The biggest increase will be among those who are over 80 years of age [10]
- In 2004 there were 6,113 hospital episodes where a diagnosis of osteoporosis was recorded but this represents the 'tip of the iceberg' [13].

The number of osteoporosis sufferers is increasing at an alarming rate. This is mainly due to people living longer, exercising less, poor nutrition particularly inadequate daily intake of calcium and vitamin D.

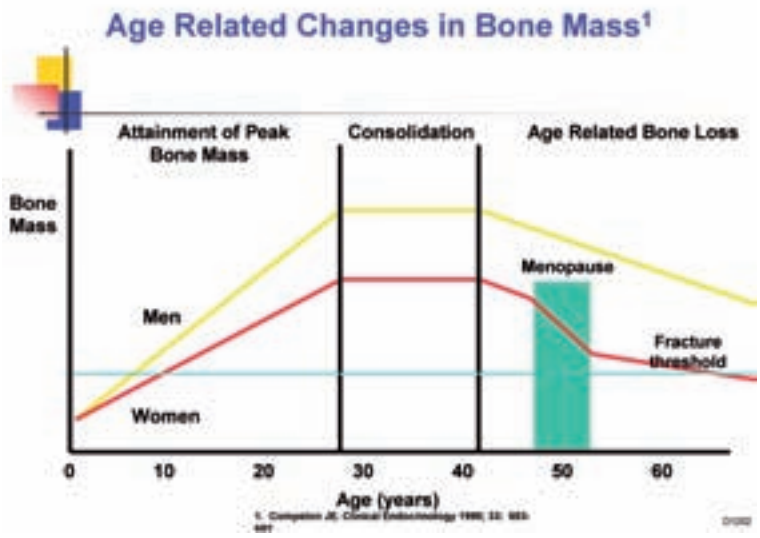
There are now five times as many fractures each year due to osteoporosis as there were in the 1960s. The number of people suffering from osteoporosis is set to double in the next 20 years. [13]

NOTE: More women die from complications of osteoporotic fractures, (mainly hip and vertebral fractures) than from a combination of all cancers of the ovary, uterus and cervix, yet only approximately 15% of people with osteoporosis are diagnosed.

Up to 30% of men will die in the year following a hip fracture which is almost double the mortality of women. This sentinel event has a greater mortality in men than heart disease and most cancers, yet men are less likely to be diagnosed and treated for their osteoporosis than women. The only cancer that supersedes Osteoporosis is lung cancer.

Bone

Bone is a living tissue that is constantly being removed and replaced. Building a large bone mass early in life, can help to reduce the risk of developing osteoporosis in later life.[14] Bone mineral density normally increases steadily from birth and approaches its peak value by early adult life, depending on the skeletal site, and remains stable for some years.[5] The greatest increase in bone occurs pre-pubertal 8-12, depending on the child to the early 20's, due to the hormones that are produced around puberty[15]. This is a very important period of bone growth, during these years, the greatest amount of bone is formed and this is known as "Peak Bone Mass"[15] For instance Peak bone mass occurs at the proximal femur in women at about 18-20 years of age, spine 20-25 years of age and the skull may continue to gain bone mass right through the 4th and 5th decades of life. Peak bone mass occurs at a similar but slightly later age at these sites in men.



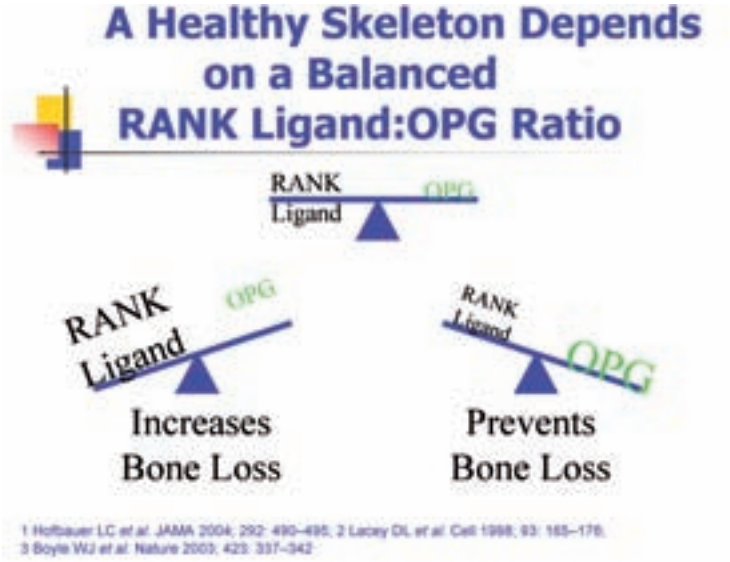
BMD is on average lower in women than in men, because women have smaller bones and smaller trabeculae. Women lose more bone on average in their lifetime than men, as they also go through the menopause, 35-40% in men Vs 50% in women. Muscle contraction increases bone strength[16] and immature bone responds better to the stimulus of muscle contraction than mature bone.[17] Weight bearing exercise is essential in young people, as not only can it reduce their risk of developing osteoporosis but also many other problems such as: obesity, hypertension, Type 2 diabetes, heart disease, strokes, low self esteem and depression.

Bone mass is the result of a dynamic lifetime balance between two processes: bone formation and bone resorption. Bones require normal levels of sex

hormones, adequate caloric intake, particularly protein, calcium and vitamin D and regular weight bearing exercise. The rate of bone turnover is determined by hormonal and local factors, as well as systemic factors, illnesses and genetics. Up to the age of 20, more bone is laid down than is lost. Following that, depending on the skeletal site, the amount of bone lost and replaced is approximately the same, between the late twenties and early forties in healthy persons. The rate of bone turnover is affected by many factors, including sex hormones such as oestrogen and testosterone, vitamin D and parathyroid hormone, and many cytokines and chemokines including tumour necrosis factor alpha, Receptor Activator of Nuclear Factor Kappa B (RANK), RANK Ligand, and its naturally occurring decoy receptor osteoprotegerin (OPG) [18, 19, 20].

Throughout the skeleton there are basic remodelling units where signals from a resorption pit signals through a variety of factors resulting in activation of osteoclasts and bone resorption at that site, known as a resorption pit. This results in a coupled signal to osteoblasts which form new bone. When more bone is formed there is net bone gain and vice versa as bone is lost. It is estimated that each human skeleton is remodelled in its entirety several times in the average adults living into their 8th decade.

In today's life style, too little or excessive exercise, combined with a low calorie diet, low intake of calcium and vitamin D and an excessive fibre content, are counter productive to achieving an adequate peak bone mass. Adolescence is also the time, when there is an increased risk of eating disorders. [15]



1 Hofbauer LC *et al.* JAMA 2004; 292: 490–495. 2 Lacey DL *et al.* Cell 1998; 93: 165–176. 3 Boyle WJ *et al.* Nature 2003; 423: 337–342

Vertebral fractures

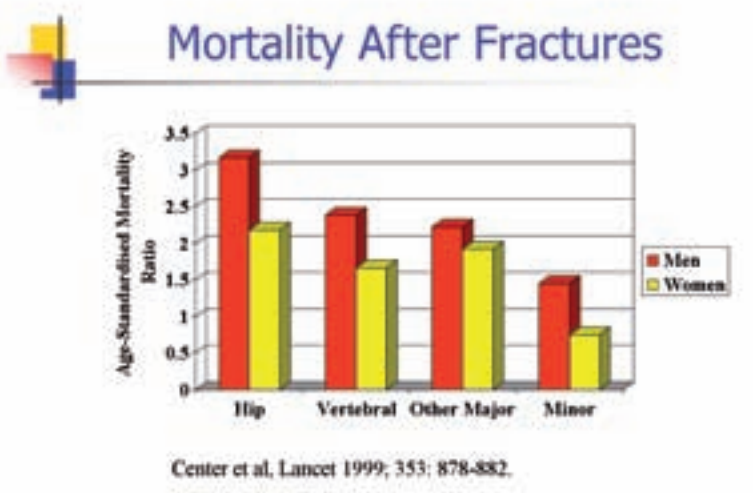
- Vertebral fractures are the commonest osteoporotic fracture, accounting for almost 50% of all fractures in most epidemiologic studies.

- The incidence of vertebral fractures begins to increase in late middle age, mirroring the age related decrease in bone mass.

- **Only 1/3 of vertebral fractures are painful, with the remaining 2/3 being clinically silent.** [8]

- Patients may present with height loss, kyphosis, back pain or restrictive lung disease. Patients may find it difficult to reach previously accessible shelves due to loss of height, a dowager's hump and back pain, and it is the loss of height that can be a strong indication for possible osteoporosis. These patients should be sent for a DXA scan to see if they have osteopenia and/or osteoporosis. When possible a DXA with a lateral view otherwise a lateral thoracic x-ray, to see if there are spinal fractures present on x-ray.

- Similar to hip fractures, vertebral fractures are associated with a higher risk of future fracture, increased morbidity and mortality. Most studies show that osteoporosis therapies reduce the risk of future vertebral fracture by approximately 50 to 60% and by as much as 70% in those with a prior fracture.



Hip Fractures

- Hip fractures represent the single most important clinical event in osteoporosis. They are associated with the greatest cost, highest morbidity and mortality of any fractures.

- Although hip fractures can be missed, they are usually clinically obvious.

- In contrast to vertebral fractures and distal radial fractures the incidence of hip fractures increases exponentially after age 70, so that 90% of hip fractures occur after this age. One particularly high-risk group for hip fractures is nursing home residents. The rate of hip fracture among residents of nursing homes is between 3 and 11 times that of age-matched community-dwellers. [11]

- **20% of people aged 60+ who fracture their hip will die from complications within six months to one year.** The secondary complications of a hip fracture are: a blood clot, pneumonia or infection. Men account for approximately 25% of all fractures and are twice as likely to die as women following such fractures.

- 50% aged 60+ who fracture their hip will be unable to wash, dress or walk across a room unaided. [12]

- Only 30% aged 60+ who fracture their hip will regain their independence.

- There is a hip fracture every 30 seconds in the EU, approximately 1700 per day. This number is expected to double by 2050.

- Most studies show that where there is evidence of therapeutic efficacy for preventing hip fractures such therapy reduces the risk of future hip fracture by approximately 55%.

Other Fractures

The next most common fracture site is the distal radius accounting for 10-15% of all fractures in postmenopausal women.

The risk of distal radial, especially Colles' fracture type, rises after the age of 40 in women and 50 in men. However this risk appears to plateau at about the age of 60 whereupon it is surpassed by the risk of vertebral and later, hip fracture.

Although not as costly as hip fractures, and without the same mortality, studies show treatment of such fractures remains costly, and many patients have significant morbidity following such a fracture.

Other skeletal sites at risk of fracture include the long bones of the skeleton and pelvic bones. Generally fractures of the fingers and toes are not considered osteoporotic fractures.

Signs and Symptoms of Osteoporosis

- A fragility fracture is generally agreed to be when someone suffers a broken bone from a force that is less than or equal to that sustained from a fall from a standing position, e.g. from a wrist or hip fracture following a trip and fall. With severe osteoporosis even forces as little as a cough, sneeze, turning over in bed or lifting a bag of groceries can result in a fracture. **NOTE: If a person's bones are healthy, they should not break from a trip and fall or less as an adult.**

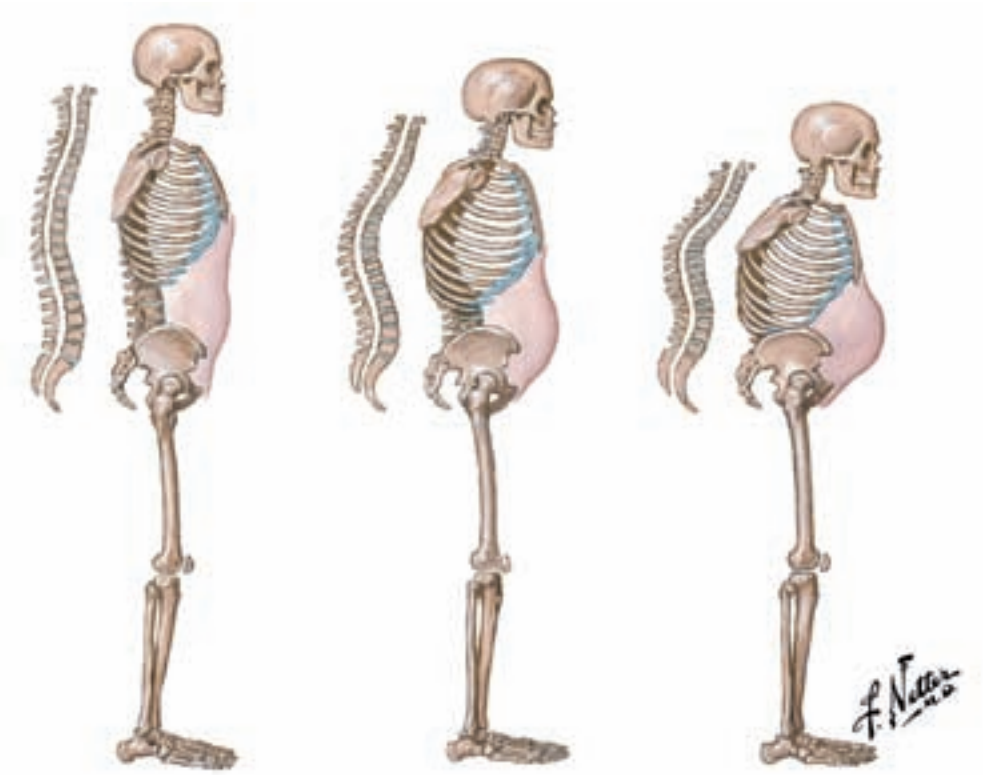
- Although 50% of children will have broken a bone by adulthood, the vast majority of these fractures are usually due to an injury, rather than osteoporosis. However if more than one low trauma break occurs, an assessment of that person including a careful history and examination is warranted.

- Development of a kyphosis - A persons head is bent forward – may result from anterior wedge fractures of the spine. In severe cases a hump may develop on a person's upper back (Dowager's hump) which is a strong indication that osteoporosis should be considered.

- Loss in height 2-16cm. It is not normal at any age to suddenly loose height. Height loss of >2 inches is an important sign of an asymptomatic vertebral fracture and such persons should be evaluated for osteoporosis. A person can loose height due to wear and tear of vertebrae and/or disc but >2 inches is unusual in degenerative joint and disc disease. Unfortunately some persons are measured incorrectly but when the history fits with the measurement, evidence of vertebral fractures should be screened.

- Change in body shape or size is usually associated with loss of height. A distended abdomen can then develop as there is no place for the stomach and intestines to go, other than outwards followed by the rib cage ending up resting on the pelvis. These changes can cause difficulty in breathing, back pain, depression, loss of functional independence and gastrointestinal symptoms.

- Persons who experience sharp sudden pain in the low, middle or upper back, especially with height loss should be evaluated for vertebral fractures as this may be the first presentation of an osteoporotic fracture. When plain films are normal and symptoms persist, repeat X-rays several weeks later or additional imaging may show a fracture. Cause of back pain should always be addressed and vertebral fractures ruled out.



The devastating effects of undiagnosed osteoporosis

How is Osteoporosis Diagnosed?

Osteoporosis can be diagnosed in the appropriate clinical setting one of 3 ways:

1. The presence of a fragility fracture
2. Measurement of bone mineral density (BMD)
3. Histomorphometric analysis of tetracycline-labelled Bone biopsy.

1. Fragility Fractures

Studies show that fracture risk is highest before the age of 20 years and after the age of 50 years. In addition they also show the majority of fractures occurring after 50 years of age are osteoporotic. However not all fractures are low trauma, e.g. falling off ladders, bicycles, skiing accidents etc. All persons presenting with a fragility fracture after 50 years of age or menopause should be considered as possibly osteoporotic. A detailed history of the fracture occurrence, physical examination, evaluation for other fractures, (note presence of back pain, kyphosis, and height loss) and additional testing is warranted. Additional testing should include measurement of bone mineral density where possible and if there is height loss and/or back pain, imaging of the spine. Blood and urine tests should also be considered. Remember clinicians diagnose osteoporosis.

2. Measurement of BMD

Studies show BMD accounts for 70% of bone strength in men and women. The accepted gold standard for non-invasive measurement of BMD today is central DXA (Dual-energy X-ray Absorptiometry). This method uses very low dose radiation to measure BMD at the lumbar spine (L1-4) and proximal femur. Criteria have been developed for diagnosing osteoporosis by measuring BMD at these sites and only with these devices.

However BMD can be measured in a variety of other ways including ultrasound of the heel and other small bones, CT scans of the lumbar spine, peripheral DXA devices and single X-ray absorptiometry. At this time the Irish Osteoporosis Society only recommends a DXA scan of the spine and hips to diagnose osteoporosis.

Measurement of BMD remains a critical component of osteoporosis assessment to establish a diagnosis and monitor therapy. Most currently available therapies have generally only been evaluated in clinical trials of persons with low BMD. All guidelines use BMD T-scores and Z-scores as the basis for their recommendations on who to treat and when. Site specific BMD is a better predictor of fracture risk and since approximately 70-75% of all osteoporotic fractures occur at the

spine and hip, and fractures at these sites have the greatest socioeconomic cost, morbidity and mortality, they remain the most important skeletal sites for diagnosis and prevention.

3. Bone Biopsy

This last method is not routinely used or available. This should never be undertaken without consultation with a specialist in osteoporosis and metabolic bone disease.

What to measure?

The currently recommended international standard for bone densitometry is to measure the lumbar spine (L1-L4) and proximal femur. Although central DXA can measure BMD of the forearm, such measurement is not routinely recommended. However in certain circumstances this may be of value e.g. patient too heavy for the DXA scanner (most have cut-offs in the region of 250-280lbs), if the patient has hyperparathyroidism, or the patient is unable to get up on a scanner without assistance, patient has severe disorders of spine and hip, making measurement impossible to interpret at these sites.

In 1994 the World Health Organisation proposed osteoporosis diagnostic criteria for BMD measured at the proximal femur in postmenopausal women.[21] These have been modified somewhat over the years and currently the ISCD recommends that such criteria may be applied to postmenopausal women and men over 50 years of age.

These criteria use the T-score for diagnostic classification into three main groups:

1. Normal BMD: T-score > or equal to -1.0.
2. Low bone mass or osteopenia: T-score -1.5 to -2.49
3. Osteoporosis: T-score -2.5 or less. Example: -3.5
4. A footnote to these criteria stated that persons with prevalent fragility fractures and T-scores <-2.5 could be classified as 'severe osteoporosis'.

Almost every epidemiological study and drug trial of patients over 50 years with fragility fractures has shown that the majority of persons who experience these fractures do not have WHO criteria osteoporosis. Approximately 10% have normal BMD 50% have 'osteopenia' and only 40% have osteoporosis.

For all other persons the ISCD currently recommends that a Z-score be used. Persons with a Z-score that is <-2.0 should be classified as 'low bone mass for age', while those with >-2.0 should be considered 'normal for age'. A diagnosis of osteoporosis in these persons (premenopausal women, men less than 50 years of age and children) should **not** be based on bone densitometry criteria alone.

Although other techniques can be used to measure BMD they cannot be used for diagnosis of osteoporosis and they have other problems. For instance Quantitative Computed Tomography (QCT) is more costly and has significantly greater radiation doses, ultrasound is less reliable and cannot be used for monitoring and is affected by other factors such as whether the patient has just been running or walking. MRI is more costly Single Energy X-Ray Absorptiometry SXA is portable, has low radiation, high accuracy and a relatively low cost. But it does not measure the Spine and the Hips, which are the most vulnerable areas.

Standard radiographs of the spine are widely available and may show distinctive radiographic features of osteoporotic fractures. They are insensitive indicators of bone loss, since bone density must be decreased by at least 30-50% before reduction can be appreciated. If osteopenia (that is, low bone mass) is suggested on an x-ray this is an indication for a DXA scan.

Like all diagnostic tests, DXA is imperfect. BMD is a continuous measure and threshold values will result in misclassification of some individuals. DXA is a 2-dimensional test which measures bone mineral density of a 3-dimensional structure. Thus persons with very large or very small bones and those with mineral disorders may have alterations in their BMD that are not due to osteoporosis. Thus not all persons with 'low BMD' have 'osteoporosis' or 'osteopenia' and not everyone with 'normal BMD' has normal healthy bone. Thus DXA needs to be interpreted in the appropriate clinical context and should not be taken as a panacea for diagnostic and treatment decisions. Note clinicians diagnose osteoporosis.

New developments in DXA technology enables patients to have a scan of their spine if appropriate at the same time as they are having their BMD measured. This technique known as LVA (lateral vertebral assessment) obtains a single view of the spine (usually T5-L5) where most vertebral fractures occur. Thus clinicians can evaluate for vertebral fractures in patients on corticosteroids, with height loss or undiagnosed back pain at the time of their DXA scan if required. Studies show persons with prevalent vertebral fractures and low BMD are at much higher risk of future fracture than persons with either low BMD or prevalent fracture alone.

Note: More details of what to measure and how to interpret bone densitometry are available from many sources, example: The International Society for Clinical Densitometry (www.iscd.org) and discussed later in this publication.

Note: All devices using ionising radiation in Ireland are governed by the 1991 Radiological Protection Act and also the 2005 Safety, Health and Welfare at work Act (details available at The Radiological Protection Institute of Ireland at: www.rpii.ie. The amount of radiation for a central DXA today is similar to ambient daily exposure.

Causes of Osteoporosis

Osteoporosis is multifactorial in origin. Generally it is classified as "primary" or "idiopathic" and "secondary". Others have chosen the term 'involutional' osteoporosis to reflect the "normal" bone loss and fracture risk increase that is evident in otherwise healthy persons as they age. The problem with these terms is that as our understanding of osteoporosis increases, little is idiopathic and most persons with "primary" or "involutional" have identifiable risks that are amenable to intervention, making the term problematic.[3, 24] Secondary osteoporosis refers to the condition when it arises as the result of a specific condition, e.g. rheumatoid arthritis, or medication, e.g. corticosteroids. The problem with this term is similar to what has been already stated since not everyone with these conditions may develop osteoporosis and oversimplification has meant that other disorders such as osteomalacia are often confused with osteoporosis by clinicians who base their diagnosis solely on DXA readings.

Current best evidence suggests that the majority of BMD in most populations is accounted for by genetic factors (approx 70%) being greatest in monozygotic twins (80%). **Genes and lifestyle have their greatest impact on peak bone mass.** Calcium rich balanced diets, adequate vitamin D intake (either dietary or from sun exposure), regular weight bearing exercise, avoidance of illness or medications that impair bone growth have all been shown to optimize peak bone mass. Peak bone mass is achieved at different times in different parts of the skeleton and generally slightly earlier in women than men. Peak bone mass is generally greater in men than women and lowest in those of Caucasian, and some Asian races.

Bone loss occurs throughout the rest of adult life in healthy individuals but varies in rate between individuals and skeletal sites. Many factors influence this rate of loss including lifestyles, certain illnesses and medications and also hormonal changes such as menopause. In healthy persons little bone loss occurs in the 20s and 30s in men and premenopausal women. Accelerated bone loss will increase a person's fracture risk and result in lower BMD over time than persons with attenuated bone loss, thus putting persons at greater fracture risk.

Hormonal Changes

The commonest cause of osteoporosis is the loss of sex hormones, oestrogen in females and perhaps testosterone in males (oestrogen may actually be more important!) [5, 15].

The female hormone oestrogen may be lost due to a variety of causes, e.g. the menopause, stress, irregular periods or no periods for 3 months or longer (not due to pregnancy) or eating disorders. Loss of oestrogen can result in significant and accelerated bone loss, particularly in the first 5-10 years following menopause. Oestrogen deficient bone loss appears to be primarily mediated by tumour necrosis factor alpha, stimulation of osteoclastogenesis in a dose dependent manner. Oestrogen deficient bone loss can be attenuated somewhat, though not completely, by healthy lifestyle including adequate calcium intake, regular weight-bearing exercise and adequate or supplemental vitamin D. However pharmacological therapy that reverses or inhibits this bone loss is usually required if this is to be prevented in the long-term.

Although testosterone deficiency is clearly associated with osteoporosis in men, unlike women a cause and effect relationship has not been established. Oestrogen in fact may be more important, at least for bone growth. The relationship is likely more complex than was originally thought. The best evidence of the role of testosterone comes from prostate cancer therapies where androgen deprivation therapies have been shown to increase bone loss and consequently fracture risk. However there is little evidence that testosterone replacement reduces fracture risk. Signs of low testosterone levels (Hypogonadism) are: loss of sex drive, loss of erections, depression, and/or fatigue. The leading world experts on male osteoporosis today generally recommend that osteoporosis and testosterone deficiency be treated as separate entities. [26]

Due to the increase in sedentary life style, particularly in children and teenagers and the increasing number of senior citizens, the incidence of osteoporosis will significantly increase.

The good news is that the risk of developing osteoporosis can be reduced, by taking appropriate preventative measures (such as diet and lifestyle changes), and through early diagnosis and treatment.

An extensive risk factor questionnaire is available from the charities web site: www.irishosteoporosis.ie

Factors that Predispose to Osteoporosis

Multiple factors contribute to low bone mass and osteoporotic fractures. Many medical conditions, or their medications, can increase the risk of osteoporotic fractures. Not all risk factors have had extensive research, however all can place a person at risk of developing osteoporosis. All causes should be found and addressed [5].

- **Genetic:** A family history of osteoporosis is a very strong risk factor, particularly if it includes a history of hip fracture/s, as approximately 80% of a persons bone is genetic.
- **Age, Senior citizens are more at risk:** Senior citizens are more likely to have low oestrogen and testosterone levels, low vitamin D levels, poor nutrition, take less exercise and have other medical conditions or be on a medication that can increase bone loss.
- Previous Fracture after minor trauma
- Low Bone Mineral Density by DXA of spine and hips
- Loss of height – more than 2cm
- Undiagnosed upper, middle or low back pain
- Undiagnosed hip pain
- Low body weight for height
- **Endocrine Disorders** such as Hypogonadism for any reason, e.g. Surgical removal of ovaries/s or testes, or infections such as mumps after puberty in males.
- All forms of Turner's syndrome in females and Klienfelter's Syndrome in males.
- Late menarche, after age 15, prolonged amenorrhea or history of very irregular menstruation, frequent loss of periods for more than 3 months (not due to pregnancy).
- Endometriosis
- Premature menopause (before 45 years)/ Oophorectomy or early menopause, either natural, surgical or due to radiation or chemotherapy are also at increased risk.
- Depo-Provera contraceptive has been proven to cause bone loss, particularly high risk if given during adolescence when bone is being laid down.
- Eating disorders (Anorexia Nervosa and/or Bulimia – past or present)
- Athletic Triad (Amenorrhea, Eating Disorder and Osteoporosis or osteopenia) [15]
- Osteoporosis of pregnancy or lactation: Osteoporosis of pregnancy may occur during the third trimester of pregnancy or postpartum. Calcium and vitamin D should be given, however a DXA scan and treatment should not be initiated till after the birth of the infant.
- **Males:** Low levels of the male hormone

- Hyperadrenocorticism: endogenous or exogenous, e.g. Cushing's Syndrome
- Hyperthyroidism
- Hyperparathyroidism (Primary or secondary due to low vitamin D or poor renal function)
- Acromegaly
- Hypopituitarism.
- Hyperprolactinaemia
- Insulin dependent Diabetes
- Haemochromatosis
- Hypophosphataemia
- Hypercalcuria

Renal

- Renal Osteodystrophy,
- Chronic renal insufficiency,
- Renal tubular acidosis

Mobility

- Inactivity, or prolonged immobility (especially bed or wheelchair bound) for more than six weeks or long term, especially in childhood when bone is being laid down.

Race

- Asian and Caucasians are more at risk, however **ALL** races can develop osteoporosis. **NOTE: Dark skinned people tend to have larger bones, however they have decreased ability to absorb vitamin D from the sun.**

Vitamin D Deficiency

- Vitamin D resistant rickets
- Low Vitamin D
- Osteomalacia

Nutritional and Lifestyle

- Excessive protein increases calcium loss
- Excessive fibre, over 40g a day
- Excessive caffeine intake
- Excessive alcohol intake >7 pints for women (14 units a week) & 11 pints for men a week (21 units a week)
- Smoking
- Excessive exercise, particularly with inadequate caloric intake
- Excessive psychological stress
- Excessive physiological stress

Gastrointestinal Disorders

- Malabsorption problems; Coeliac or Gluten sensitivity, lactose intolerance or Cystic Fibrosis
- Inflammatory Bowel Disease; Chron's Disease, Irritable Bowel, Ulcerative Colitis.
- Gastrectomy or small bowel resection
- Severe liver disease
- Chronic obstructive jaundice
- Primary Biliary cirrhosis
- Amyloidosis
- Gaucher's disease
- Severe malnutrition

Bone Marrow Disorders

- Multiple Myeloma
- Systemic Mastocytosis
- Lymphoma
- Disseminated Carcinomatosis

Collagen Disorders and other medical conditions

- Rheumatoid Arthritis
- Osteogenesis Imperfecta
- Childhood Idiopathic Osteoporosis
- Ehlers-Danlos Syndrome
- Marfan's Syndrome
- Homocystinuria
- Polymylagia
- Sarcoidosis
- Psoriatic arthritis
- Ankylosing Spondylitis

Neurological

- Stroke
- Dementia
- Multiple Sclerosis
- Spinal cord lesions
- Muscular Dystrophy
- Idiopathic Scoliosis

Other conditions

- Psychotic patients
- Down syndrome or similar with secondary complications
- Pernicious Anaemia
- Thalassemia

- Haemophilia
- Congenital Porphyria
- Cancer; Leukaemia, Lymphoma
- Severe eczema
- COPD
- AIDS/ HIV

Drug Induced

- Long-term use of Corticosteroids (e.g. Cortisone, Prednisolone, Delta Cortril, dexamethasone etc). Corticosteroids, are used for the treatment of many conditions, and are the most common cause of secondary osteoporosis.
  - Main bone loss occurs in the first six months of treatment.
  - Corticosteroids 7.5 mg a day for more than 3 months in a year. Bone loss may occur at lower doses in some people, particularly if there are other risk factors[5] or if they already have undiagnosed low bone density.
- Chemotherapy
- Radiation
- Thyroxine, if serum levels are high
- Post organ transplant
- Anticonvulsant therapy, Anti-epileptic medications (phenytoin, phenobarbitone) can interfere with calcium absorption and the production of vitamin D.
- Chronic heparin or Warfarin therapy
- Long term lithium therapy
- GnRh analogues
- LHRH analogues; testosterone suppression ;leuprorelin
- Prolactin raising drugs, Antipsychotic medication, e.g. some SSRI
- Aromatase inhibitors for the treatment of Prostatic and Breast Cancers: Arimidex for breast cancer
- Diuretics such as Burinex, Lasix.
- Proton Pump Inhibitors
- Tranquillizers and sedatives may increase the risk of a fall

Diagnosis of Osteoporosis by DXA

Dual Energy X-ray Absorptiometry (DXA), is a non-invasive method and currently is the most precise and widely used method of assessing Bone Mineral Density. In the majority of cases, a DXA is a large non-mobile machine and should be set to measure the bone density of the spine and both hips.
Bone mineral density measurements are currently the best predictors of fractures, but are site specific.

For every one standard deviation decrease in BMD, the relative risk of fracture is significantly increased. Bone mineral density varies at different sites. In a large majority of cases the spine is the first region to lose a significant amount of bone mineral density, but in a percentage of women, the loss occurs first in the hip. Therefore it is essential that both hips are scanned, as fractures of the hip have the highest mortality and morbidity rates.

It is a painless method for measuring bone mineral density (BMD) and is the Gold standard for diagnosing osteoporosis, and is recommended by the International Osteoporosis Foundation.

NOTE: If the patient has had a previous DXA scan, the new DXA results should be compared to the previous DXA result.

NOTE: The lower the BMD result, the greater the risk of fracture. Low bone density in the hip and vertebrae are more dangerous as they are associated with a high mortality rate post fracture.

Lateral Vertebral Assessment: a lateral view of the thoracic and lumbar spine is available on some DXA machines and shows if there is compression of the vertebral bodies. This is recommended especially, if there is loss of height or a kyphosis has developed on the upper back. If not available, a Lateral thoracic X-ray of the upper back can be done.

Dual (DXA) and Single' (SXA) Energy X-Ray Absorptiometry both use an x-ray source with low levels of radiation. The x-ray radiation is 10% of a normal chest x-ray; hence the level of exposure is much lower.

Contraindications to a DXA scan

- Pregnant or possibility of being pregnant
- If a patient has had an investigation using contrasts material recently, e.g., barium meal or barium enema or an intravenous pyleogram, there needs to be one week between the tests.
- The patient should inform the DXA operator if they have a metal Implant in the spine or hip, or if they have any metal body piercing.

DXA Tips

- Do not place a DXA machine by a radiator
- Both hips should be scanned, there may be a discrepancy between the BMD of the two hips, one hip may be normal but not the other.
- Individual T scores should be looked at, not just the total: L1, L2, L3 & L4
- Both areas of the hip should be looked at, as the neck of femur could be lower.
- LVA, if there is loss of height or a dowager's hump, as the software is only available recently, many machines can not scan the upper back. Lateral thoracic X-ray should be done if the software is not available.
- Repeat DXA should preferable be on the same machine.

What a patient can expect when having a DXA scan

- Patient's height and weight should be measured.
- Patients will be asked to remove any metal, such as belts, body piercings and a bra with an under wire.
- There must be no metal in the area that is to be scanned e.g. If a patient has a hip replacement, the other hip and the lumber vertebrae (L1-L4) can be scanned.
- They will be asked to lie still on the machine during a scan. An electronic arm will slowly travel over the area of the body to be scanned. It is important for the patient to be able to remain still, so the images recorded are not distorted.
- The patient will lie down on the machine for 5-15 minutes while the moving arm of the machine passes over them, to take an image of their spine and hips.
- The test is not claustrophobic, is not painful and costs approximately €100.

Why a DXA scan is important

The disease is silent and since it affects the inside of a person's bone, a person can look perfectly fine on the outside, yet have severe osteoporosis. "Not so usual suspects" picture on this cover is available from the IOS charity.

The most efficient way to monitor a patient's response to treatment is with a repeated DXA scan, as bone markers are not always available.

The bone mineral density result can help to encourage the patient to make a decision about compliance of treatment and help to encourage them to change their life style.

A DXA scan can is particularly important in young people with poor diets or eating disorders, so that they can see if they survive, they could end up being disfigured. It is also an excellent tool to monitor these patients for compliance.

DXA Rescanning

It is recommended to be re-scanned on the same machine, when possible, for greater accuracy in monitoring the response to treatment. Most people are re-scanned every 2 years, however in certain cases, if compliance is an issue, a scan could be done after 12 to 18 months to help increase compliance. There is a world wide compliance problem with osteoporosis patients, which is why it is so important to monitor a patient.

Example: Eating disorders: seeing significant improvement or decline can help to increase compliance and patient motivation.

Example: In the case of someone who does not start or stops their medication, a decline in their bone health can assist with compliance.

Who needs a DXA scan?

If a person has one or more risk factors for Osteoporosis, regardless of age, male or female, a DXA scan should be considered. Since it is a silent disease, there are no signs or symptoms prior to fractures. Compliance with taking the medications along with calcium, vitamin D and weight bearing exercise is much higher when results show loss of bone and risk of fracture. It is much cheaper to scan if in doubt, than wait to see if a patient fractures. One fractured hip including rehabilitation costs approximately €31,000. A DXA scan costs approximately €100.

Clinical Indications for bone mass measurements

- 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.
- Women discontinuing oestrogen or oestrogen deficient
- Early menopause, secondary amenorrhoea, athletic triad
- Anorexia and/or bulimia
- Men aged 70 and older
- Men under age 70 with clinical risk factors for fracture: hypogonadism
- Adults with a fragility fracture.
- Men, women or children with a disease or condition associated with low bone mass or bone loss.
- Men, women or children being considered for pharmacologic therapy that is known to cause bone loss. e.g. Steroid therapy > 5mg or 7.5 mg Prednisolone daily
- Men, women or children, to monitor treatment effect.
- Men, women or children not receiving therapy in who evidence of bone loss would lead to treatment.
- Menopausal women in whom result will influence treatment
- Recurrent stress fractures not due to biomechanical causes
- Drugs associated with osteoporosis, e.g. Anti-coagulants, Epinutin Aromatase inhibitors etc
- Radiographic indication of vertebral deformity or osteopenia

Fracture Risk Assessment (FRAX)

The FRAX tool has been developed by WHO to evaluate the fracture risk of patients.[21, 22, 23] FRAX is based on individual patient models, that integrate the risks associated with clinical risk factors, as well as bone mineral density (BMD) at the femoral neck. Assessment of fracture risk can be improved by the use of clinical risk factors, which act independently of bone mineral density to increase the risk of fracture, and this forms the basis of the WHO approach.

The aims of FRAX are to optimize sensitivity (i.e. detection rate) of fracture risk prediction, using a case finding strategy in men and, women that can be widely implemented in primary care. FRAX tool [23, 22, 23] computes the 10-year probability of a hip fracture or a major osteoporotic fracture (Clinical spine, hip, forearm or humerus).

However only eight easily identifiable risk factors shown to improve the prediction of fracture risk are included in FRAX: age, family history of hip fracture, glucocorticoid (steroid) use, current smoking, alcohol use >2 units/day and, rheumatoid arthritis. Individually, the presence of these risk factors were shown to increase the risk of hip fracture at least 1.5 to 2-fold after adjustment for bone mineral density.[3, 22, 23] FRAX has some limitations, as it only accepts one risk factor; while many cases of Osteopenia and/or Osteoporosis have multiple risk factors, which can significantly increase their risk of fractures, but this will not show up on FRAX. [23]

Results of a DXA scan

The results will be presented in the form of a computerised printout that gives the Bone Mineral Density in Grams/cm^2 and a T-score value of the hips and lumbar Spine.

A T-score compares the patient's results with the mean peak bone mass (BMD) of a large number of normal females or males between the ages of 20-40 years. T scores should only be used in the diagnosis of adults over 21 years of age.

A Z score compares the patient's results with a large number of normal females or males of the same age group.

WHO defines a Normal BMD as a T score value greater than -1, which indicates that the bone mineral density is normal. **Example:** +1.2, -0.5

Osteopenia is a T-score value of between -1 and -2.5, which is the precursor to osteoporosis, therefore it is essential to put preventative measures in place.

The IOS has broken up the scores in the Osteopenia range, to make it easier for people to know exactly where they are on the scale. There is a significant difference in fracture risk between a person with mild osteopenia and marked osteopenia.

Normal	T-score	=	0 to - 1.0
Mild Osteopenia	T-score	=	-1.0 to -1.49
Mod Osteopenia	T-score	=	-1.5 to -1.9
Marked Osteopenia	T-score	=	-2.0 to -2.49
Osteoporosis	T-score	=	Greater than -2.5

Or

A low trauma fracture (broken bone from a trip and fall from a standing position or less) is also considered to be osteoporosis unless proved otherwise.

* Research shows that most fractures occur within a T score of -1.5 to -2.49 which is the moderate to marked osteopenia range. Therefore it is essential that those in this range are treated preventively, depending on the cause/s, calcium and vitamin D and life style changes may not be enough.

If a patients T score has declined

If a decline has occurred, the cause/s should be found and addressed. Malabsorption is one of the major reasons why a person may have lost BMD.

Example: Undiagnosed Coeliac or Undiagnosed gluten sensitivity. Changing a medication due to a decline in bone density, without finding the cause of this decline, can place the patient at the risk of possible fracture/s and medical costs which could possibly be avoided.

Example: A patient may have high parathyroid hormone levels due to either primary hyperparathyroidism, or secondary due to low serum vitamin D levels.

Example: A patient may have developed another pathology.

Example: The patient may not have taken the medication or may not have taken it correctly.

Example: The patient may not have taken their calcium and vitamin D.

Example: It could be a combination of several examples listed above.

NOTE: Calcium, Vitamin D and weight bearing exercise are essential combined with the osteoporosis medication for optimal results.

NOTE: It is important to explain to the patient their risk of fracture or re-fracture, to help improve compliance, as with most treatments they will not feel any different when they take the medication.

Coeliac Disease/gluten sensitivity

Ireland has one of the highest rates of Coeliac disease in the world. However there are many people who appear not to be “true” Coeliac. Many people think that bloating of the stomach after food, is because they have eaten too much or eaten too fast. This is why every patient should be asked if they have any symptoms of Coeliac disease.

If you have a patient who presents with any of the following symptoms and their Coeliac test has come back negative, a trial of gluten free food is suggested to see if they are “gluten sensitive”.

Symptoms – a person can have one or more of these problems:

- Bloating of abdomen after food, especially white bread, pasta, cakes, beer: Foods that contain gluten.
- Stomach pain
- Diarrhoea (loose stools, stools float in toilet, lighter colour, bad smell)
- Constipation
- Mouth ulcers
- Chronic tiredness
- Anaemia
- Weight loss
- Bone pain
- Moodiness
- Depression
- Flatulence

Investigations for Secondary Osteoporosis (depending on history and age)

- Full blood count
- Erythrocyte sedimentation rate
- Serum Ferritin, (Ferritin saturation, if ferritin is high)
- Renal function including Urea and electrolytes + Creatinine clearance
- Blood sugar
- Liver function tests
- Serum Calcium, phosphate, and alkaline phosphatase to exclude osteomalacia or primary hyperparathyroidism.
- Parathyroid hormone and serum 25(OH) vitamin D
- It is advisable to measure the serum PTH (Parathyroid Hormone) prior to prescribing 1-34 PTH (Forsteo) or 1-84 PTH (Preotact)
- Thyroid function tests
- Serum protein and electrophoresis to exclude multiple myeloma
- Coeliac Disease antibodies IGA tissue transglutaminase Antibodies (tTG, less than 1.9U/ML = negative if positive EmA test. Gluten Gliadin There is a possibility of gluten sensitivity even if these tests are negative, if symptoms are present, as many people are not true Coeliacs and a patient going gluten free, may help to eliminate these symptoms.
- Prostate specific antigen in men
- Cortisol levels
- Follicle stimulating hormone, luteinizing hormone, sex hormone binding globulin, testosterone (in men) and oestradiol in males and females and also progesterone in females. Blood tests should be taken in the Luteal phase, after the 21st day of cycle in premenopausal women, to determine progesterone levels.
- Prolactin
- Insulin Growth Factor I, (IGFI) in anorexics and bulimics
- 24 hour urinary Calcium and Protein
- Bone markers if available. Serum Osteocalcin (Intact), Serum bone alkaline phoshatase PINP, Serum CTx (Fasting Bloods)

Vitamin D and Calcium

Calcium and vitamin D are an essential part of the prevention and treatment of osteoporosis, particularly in housebound and nursing home elderly. Bone is a major store of calcium and phosphate. Every cell in the body including those in the heart, nerves and muscles require calcium. Vitamin D helps to regulate cell growth and the immune system.Vitamin D is essential for the absorption of calcium; it increases the body's ability to absorb calcium by 30-80%. It is the only vitamin you do not have to consume in food or supplements, as it can be manufactured through the skin, when it is exposed to the sun.

Vitamin D

The sun is the most potent source of Vitamin D. When a persons skin is exposed to ultraviolet B rays, the skin makes vitamin D. Vitamin D is a fat-soluble vitamin that when consumed or made in the skin, can be stored in the blood and body fat, for several months. About 15 minutes of sunlight a day, without sun block on the face and arms during the summer months, will enable the body to store vitamin D.

The amount formed depends on the age of the person and the amount of sun block and/or make up used. It is very important to avoid over exposure resulting in sunburn, as we are all aware of the damaging effects of the sun, therefore sun block should be applied after 15 minutes. Wearing sun block or make up continuously can inhibit vitamin D absorption.

There may be inadequate amounts of Vitamin D in the diet, and supplementation is necessary when dietary intake of vitamin D is inadequate. **NOTE: Normal levels of oestrogen and testosterone are required to form vitamin D. It is important also to determine whether there is lack of absorption of vitamins D.**

Substantial clinical evidence demonstrates that low calcium and vitamin D intake, or poor absorption are linked to an increased risk of hip fractures in the elderly. Calcium and Vitamin D supplementation has been shown to reduce the risk of fracture and falls and improve muscle function in the elderly.

In Ireland we have a lack of sunshine and only a few foods naturally contain vitamin D. Due to Ireland's northerly latitude, very little UV light is available between October and March, which can result in low levels of Vitamin D. The Vitamin D that we store in the summer months has to last through the winter season.

NOTE: We have not had much sun in the summer for years; therefore vitamin D levels may not be met in our "summer" months.

A growing number of human metabolic, epidemiologic, and animal studies are indicating that low levels of Vitamin D, appear to be linked to the following conditions: Immune function diseases such as: Type 1 diabetes, multiple sclerosis and rheumatoid arthritis. Some cancers (breast, colon and prostate) but further research is required to prove/understand these links.

Low Vitamin D levels have also been associated with TB and fibromyalgia. A Vitamin D deficiency is thought to cause aches and pains, which are similar symptoms to fibromyalgia. A deficiency of Vitamin D can cause rickets in children

and osteomalacia in adults. Babies who are just fed breast milk, consume little vitamin D, unless given a supplement.

NOTE:

- In Ireland 74% of adults and 88% of primary school children, have less than half of the recommended daily amount of vitamin D.
- Many people do not get the recommended amounts of vitamin D through food, therefore supplements are usually recommended.
- Senior citizen's ability to produce Vitamin D in their skin from the sun, is reduced with age and they are less able to convert it into the Vitamin D hormone that the body needs.
- Senior citizens tend to spend very little time outside in the sun, especially those who have limited mobility or are living in nursing homes.
- People who are obese are at risk of low Vitamin D levels, as body fat has a tendency to hold onto vitamin D, thus reducing its overall availability to the rest of the body.
- Those with darker skin (e.g. Africans) do not absorb Vitamin D from the sun, as easily as lighter skinned people.
- Low levels of vitamin D can result in an increased production of Parathyroid hormone, which can cause calcium to be taken from bone, to maintain levels of calcium in the blood, which results in increased bone loss.
- Lack of absorption of vitamin D may occur in gastrointestinal disorders such as Coeliac Disease (Gluten sensitivity), Crohn's and Ulcerative Colitis or Primary biliary cirrhosis.

To determine how much vitamin D is needed from food and supplements, the following should be considered:

- Age, as a person ages their ability to produce Vitamin D from the sun is reduced.
- The time of year - Summer or winter
- Where a person is living - What latitude
- The amount of time they spend outside in the sun
- Use/level of sunscreens
- Make up can inhibit Vitamin D and many have sun block in them
- Skin color - darker skinned people absorb less Vitamin D
- Berkas for religious reasons

Everyone from birth throughout life should be taking the daily amounts of calcium and vitamin D in food, or medically approved supplements.

Low Levels of vitamin D may be due to:

- Low levels of sex hormones: Low levels of Oestrogen
  Low levels of Testosterone
- Low intake of vitamin D

- Poor absorption due to gastrointestinal disorders, particularly, gluten intolerance.
- Serum 25(OH)D levels and Serum parathyroid levels should be carried out to determine whether there is a primary or secondary hyperparathyroidism.
- Poor kidney function
- Poor liver function

Prolonged Low levels of vitamin D

Prolonged Low levels of vitamin D may lead to sub-optimal calcium absorption, which may increase the levels of Parathyroid Hormone i.e. secondary hyperparathyroidism, with a high bone turnover and an increased risk of fractures, especially in older people (≥65 years) and those with osteoporosis. Low levels of vitamin D will also increase the risk of falls and as a result, the risk of fractures increases.[28-35]

Studies indicate that insufficient intake of vitamin D is associated with an increased risk of fractures, and that vitamin D supplementation may prevent them, especially when vitamin D is taken in conjunction with calcium. Vitamin D is also thought to help to increase muscle strength, which in turn helps to prevent falls.

Vitamin D can be found in some foods

- Fortified dairy products, margarine and eggs.
- Fish oils and species of fish such as salmon, tuna, sardines, mackerel, halibut and herring.
- Breakfast cereals, soya milk and rice milk may also be fortified with vitamin D. Please check individual labels for vitamin D amounts as they can vary.

Recommended amounts of Vitamin D

Currently 10ug or 800iu are the current recommended daily dose of vitamin D for adults 65+.

NOTE: The recommended dose of Vitamin D for adults and children may be increased in the near future, as research has shown that serum Vitamin D levels above 100nmol/l protects against a much larger variety of diseases.

NOTE: Calcitriol is a Vitamin D analogue. It is licensed for the treatment of established post-menopausal osteoporosis. Patients should have serum calcium and creatinine monitored for hypercalcaemia.

Vitamin D and the EU

In the last decade, the increasing importance of Vitamin D to health has been highlighted in several reports. It was part of Recommendation 4 of the European Osteoporosis Consultation Panel in 1998. In 2004, the US Surgeon General issued the first-ever report on bone health and osteoporosis and emphasized the importance of vitamin D, stating that vitamin D is necessary for adequate absorption of calcium.

"Vitamin D Nutritional Policy in Europe - The Need for Prevention, Education and Consumer Choice" 23rd March 2010 in the European Parliament, Brussels.

CPME and PA International Foundation: In October 2009 the Comité Permanent des Médicines Européen, adopted the "Vitamin D nutritional policy in Europe", which stated: "It is now also known that the vitamin D endocrine system, is not only important for bone and muscle health, but also influences many other tissues such as the immune system, the cardiovascular, metabolic system, cell proliferation and cancer". This is based on well documented biochemical, cellular and animal data generated in many research laboratories around the world. The greatest risk for bone and several major diseases and preventable health conditions are associated with 25(OH) D levels below 50 nmol/L.

Calcium

Calcium is the most abundant mineral found in our bones and helps to give bones strength and rigidity. Every cell in our body, including those in the heart, nerves and muscles rely on calcium.

It has been said that osteoporosis is a childhood disease that manifests itself in adult years. As children, it is necessary to grow a strong healthy skeleton that will last a lifetime. Typically we reach our peak bone mass by age 25-30, and the density of our bones will depend in part upon the calcium and vitamin D intake in childhood and teen years. Calcium is also particularly important at the time of menopause, because calcium absorption slows down, due to low levels of oestrogen.

Calcium is best absorbed from dairy products. The best sources of calcium are milk, cheese and yoghurt. Bread, almonds and tinned fish also contain calcium, as do some dark green vegetables. Some brands of orange juice and most breakfast cereals have added calcium.

Note: that calcium alone is **not** enough to treat bone loss and is not a substitute for drug therapies that treat bone loss.

How much do I need?

Adults (Men) 1000 mg per day
Adults (Women) 1000 mg per day
Pregnant Women (2nd half)* 1200 mg per day
Breastfeeding Women (1st 6 months)* 1500 mg per day
Children (1-10 years) 800 mg per day
Teenagers (11-18 years)* 1200 mg per day

* Teenagers & pregnant/breastfeeding mothers may need to increase to 1500 mg calcium per day if they have Osteopenia or Osteoporosis.

Milk, cheese and yoghurt are some of the best sources of calcium. Low fat options are available for those with high cholestral. The servings below, each contain between 250-300mg of calcium. Pregnant women and teenagers require 1200mg/day of calcium and will need at least 5 of these servings to get the recommended daily intake.

- A glass of milk: 'Fortified milk' is fortified with added calcium and vitamin D and is low fat.
- A matchbox-sized piece of cheese
- A carton of yoghurt

Calcium and Vitamin D Supplements

Calcium and vitamin D supplements are recommended for anyone who is unable to get the daily recommend amounts of calcium and vitamin D through food. Supplements help provide building blocks for healthy bone production. Several of these are available on prescription, as some over-the-counter supplements do not contain adequate amounts of calcium and vitamin D. Recommended supplements include Calcichew D3 Forte, Osteofos D3, Caltrate and Ideos.

It is important that patients when possible drink 6-8 glasses of water a day for overall health and also to prevent constipation when taking calcium and vitamin D supplements.

Exercise

Exercise is essential for all age groups, starting in childhood and continuing right throughout life. Exercise can help to increase bone density in children, especially pre-puberty/puberty[15], when bones are growing. Exercise during and after the menopause can improve muscle tone and decrease bone resorption.

Swimming is a great form of exercise however it is not weight bearing. It can be very beneficial for those with arthritis, as gravity is eliminated, therefore muscle strength and endurance can be built up with very little stress placed on their joints. Riding a bike is a great form of exercise however it is not true weight bearing.

The type of exercise a person does should be based on: the patient's age, ability, DXA scan results, risk of fracture/re-fracture and medical history.

Weight bearing activities:

Dancing	Football
Walking	Hockey
Jogging	Basketball
Running	Skipping
Tennis	

NOTE: Up and down a flight of stairs ten times, is a third of an adult's daily weight bearing.

NOTE: Dancing is one of the best forms of weight bearing, as weight is constantly being adjusted.

NOTE: When a person walks at the same pace and the same direction each time, the bones adjust and long term is not the most beneficial for bone. When walking the speed and direction needs to be adjusted for bones to benefit.

Example: If a person is walking at a speed of 4 out of 10, (only if stable on their feet), they should try to adjust their speed to a 5 out of 10 and than adjust back down to a 4. Also if a person turns right out of their driveway every day, they should turn left every second day or walk on a different path when able.

Prevention of Falls:

- Improve muscle strength and co-ordination
- Vision should be checked annually.
- If a patient is thin, wearing hip protectors may help to decrease the risk of a hip fracture.
- Avoid or monitor medications that can cause hypotension or those that can sedate a patient including alcohol.
- Encouraging patients to have their homes de-cluttered, which can help reduce their risk of a fall. Example: By removing loose mats and have grandchildren put toys away.
- Assessment of a mobility device if at risk of a fall or prior falls.
- Balance: A programme could be put together by a physiotherapist to help maintain/increase a patients balance, coordination, strength and endurance which can help to reduce a patient's risk of falls.
- An Occupational therapist/community nurse can help assess if a patient can benefit from assistive devices for activities of daily living.

NOTE: Encourage your patients to buy a pair of walking shoes to wear inside their home. Many slippers have no support and many senior citizens wear open back slippers which can cause falls.

Medical risk for falls, which may increase a patient's risk of fractures

- Poor vision for example: cataract, macular degeneration or glaucoma
- Cardiovascular syncope, postural hypotension, arrhythmia, drop attacks
- Disorders of gait and balance; Stroke, cerebellar disease, myelopathy, Meniere's syndrome and Parkinson disease.
- Lower limb dysfunction; Foot problems, peripheral neuropathy, muscle weakness, arthritis and Rheumatoid Arthritis.
- Cognitive dysfunction; dementia, depression and anxiety
- Medication; sedatives, psychotropic, antihypertensive and some diuretics.

NOTE: A fall prevention booklet which gives tips to senior citizens on how to prevent falls is available from the Irish Osteoporosis Society charity.

NOTE: A fall prevention poster is available from the Irish Osteoporosis Society charity.

Managing pain

Many of the consequences of osteoporosis, particularly vertebral fractures, are associated with severe pain. Forsteo and Protelos can help with the pain of vertebral fractures.

There are a number of ways, some involving painkillers and some non-pharmaceutical measures, in which this pain can be alleviated. Patients should be advised of all the options, and encouraged to try different approaches until they find one that works well for them. It is important to stress that patients do not need to “Live with pain”, but should discuss it and the problems it causes with their doctor.

Management of Osteoporosis

All medications have potential side effects whether they are for osteoporosis or another condition. When dealing with osteoporosis, the risk of fracture usually far out weights the possible risk of side effects. Patients should be told that side affects are rare, however it is important that they contact you if they occur, versus just stopping their medications.

Ideally each patient should have the appropriate investigations and be monitored by bone mineral density assessment, hormone levels and bone markers if indicated. If available, assessment of bone markers before and at three and six months after the commencement of treatment will give an earlier indication of the response to treatment.

Patients with established osteoporosis should be treated for pain relief and physiotherapy offered for the secondary effects of osteoporosis.

It is usually never too late to treat osteoporosis. however early detection is essential and all the cause/s should be found and addressed to prevent further problems. Treatment of osteoporosis should if possible have a multidisciplinary approach.

NOTE: Osteoporosis medications should not be stopped until the patient has been assessed by a DXA scan to ensure they no longer are in the fracture zone. If a patient experiences side effects, an alternative treatment should be considered.

NOTE: The Irish Osteoporosis Society does not support the treatment of Osteoporosis by generic medications

Choosing the right treatment

With a number of effective treatments now available for osteoporosis, the pain and disability associated with the disease can be greatly alleviated. All treatments are aimed at reducing the risk of fracture preventing bone loss or increasing bone formation.

People who have been diagnosed with osteoporosis should be put on an osteoporosis medication, as well as calcium, vitamin D 3 and given advice about appropriate weight-bearing exercise. The treatment prescribed will depend on a number of factors, including age, sex, risk of fracture or re-fracture, cause or causes of their osteoporosis, DXA scan results of their spine and hips, and medical history. Discovering the cause or causes of the osteoporosis and addressing each one is hugely important for their treatment.

There are many types of treatment now available. Treatments focus on slowing down or stopping bone loss, increasing bone density, preventing fractures and increasing a person's quality of life. As with all medications, treatments for osteoporosis may have possible side effects, but the risk of fracture usually far outweighs the chance of any side effects. The recommended daily amounts of calcium, vitamin D and weight-bearing exercise are essential parts of a treatment plan, as well as being essential for the prevention, of osteoporosis.

Calcium and Vitamin D should be recommended along with osteoporosis medications, unless already included in the medication.

* Patients who have been on Bisphosphonates for more than 5 years should be reassessed in view of the recent reports of femoral shaft fractures.[12]

* Osteonecrosis of the jaw is rare and is usually associated with cancer patients or people with poor dental hygiene and periodontal disease and who have had Bisphosphonates by IV.

Osteoporosis Treatments

Denosumab – The brand name is **Prolia**

Denosumab is a new Monoclonal antibody which binds to RANK Ligand, inhibiting the maturation of osteoclasts, thus protecting the bone from degradation, preventing bone loss and osteoporosis.

It reduces the risk of vertebral, non vertebral and hip fractures.[36] It is given as a 60mg subcutaneous injection every 6 months.

Indications

- Treatment of osteoporosis in postmenopausal women at increased risk of fractures.
- Prolia significantly reduces the risk of vertebral, non vertebral and hip fractures.
- Treatment of bone loss associated with hormone ablation therapy in men with prostate cancer at increased risk of fractures.

Contraindications

- Hypocalcaemia
- Hypersensitivity to the active substance or to any of the excipients.

Alendronate combined with vitamin D – The brand name is **Fosavance 5600**

It acts on bone and has an inhibitory effect on osteoclasts. It decreases bone resorption and decreases risk of fractures in both the spine and the hips.

It is a tablet which contains alendronate 70mg with vitamin D (5600iu). It is taken once a week.

Indications

- Fosavance is indicated for the treatment of Postmenopausal Osteoporosis in patients at risk of Vitamin D insufficiency.
- Fosavance reduces the risk of vertebral and hip fractures

* Fosavance 5600 has the full recommended amount of vitamin D. Patients will need the recommended daily amounts of calcium to be obtained by food or supplements and appropriate weight bearing exercise.

Contraindications

- If the patient has problems with oesophageal abnormalities
- If the patient has a Hiatus hernia
- If the patient has Gastritis
- If the patient has impaired renal function
- If the patient has ulcers

Risedronate - The brand name is **Actonel® Plus Calcium and D**
It acts on bone and has an inhibitory effect on osteoclasts. It reduces the risk of vertebral fractures.

1 tablet (**35mg**) which can be taken weekly and one sachet taken daily for the next 6 days.

Indications
- Actonel Plus Ca and D is a treatment for established post-menopausal osteoporosis to reduce the risk of vertebral fractures.
- Treatment of established post menopausal osteoporosis, to reduce the risk of hip fractures.

* Each sachet has recommended daily amounts of 1000mg of calcium and 880iu vitamin D.

Contraindications
- If the patient has problems with oesophageal abnormalities
- If the patient has a Hiatus hernia
- If the patient has Gastritis
- If the patient has impaired renal function
- If the patient has gastric or duodenum ulcers

Zoledronic Acid – The brand name is **Aclasta**
Aclasta acts on bone and has an inhibitory effect on osteoclasts. It decreases bone resorption and decreases risk of fractures in both the spine and the hips, including those with recent low trauma fractures.

It is a once-a-year IV infusion given slowly, which usually takes at least 15 minutes.

Indications
- Aclasta is a treatment for osteoporosis in post menopausal women and men at increased risk of fracture and those with a recent low trauma fracture.
- Aclasta is also a treatment of osteoporosis associated with long-term systemic glucocorticoid therapy in menopausal women and men at increased risk of fracture.
- Treatment of Pagets disease of the bone in adults.

Contraindications
- Patients with below normal vitamin D levels.
- Patients with poor renal function.
- Patients with Hypocalcaemia
- Patients who are pregnant or lactating

Flu like symptoms, may occur post treatment which can be modified by taking paracetamol prior to the infusion

Parathyroid Hormone - (PTH). The brand name is **Preotact (1-84)**
It can only be prescribed by a Consultant, as it is a High Tech drug for severe osteoporosis. It is a bone forming agent that stimulate the formation of new bone. It is given as a daily 100mcg per dose, subcutaneous injection in the thigh or abdomen for 24 months. Patients need to have follow up tests done at 1, 3 and 6 months, for elevated serum or urinary calcium. The patient should then have a repeat DXA scan and a new treatment plan should be implemented at the end of the course of treatment.

Indications
- Osteoporosis in postmenopausal women and at high risk of vertebral fractures.

Contraindications
- Those who are pregnant or lactating
- Hypercalcaemia
- Severe renal impairment
- Metabolic bone disease except osteoporosis
- Patients who have had radiation, or have high Serum Parathyroid levels
- Special care must be taken if a patient is on digoxin.
- Paget's disease, hypercalcaemia, multiple myeloma and bone secondaries.

The following investigations are recommended prior to putting a patient on **Preotact**:
- Normal serum and urinary calcium, normal PTH, and normal vitamin D levels, normal renal (kidney) function.

* If a patient has a high PTH, they should **not** be put on this treatment.

Risedronate - The brand name is **Actonel Combi (with Calcium)**
It acts on bone and has an inhibitory effect on osteoclasts. It decreases bone resorption and decreases risk of fractures in both the spine and the hips. It should be taken first thing in the morning, a half hour before food, with plenty of water (not with coffee or orange juice) and the patient must avoid lying down and remain upright for half an hour after taking the medication.

1 tablet (**35mg**) which can be taken weekly and 1 capsule of Calcium (**500mg**) taken daily for the next 6 days.

Recommended daily calcium is 1000mg, additional calcium needs to be obtained by food or supplements.

Indications
- Actonel Combi is a treatment for postmenopausal osteoporosis to reduce the risk of vertebral fractures.
- Actonel is a treatment for established postmenopausal osteoporosis, to reduce the risk of hip fractures.

Contraindications

- If the patient has problems with oesophageal abnormalities
- If the patient has a Hiatus hernia
- If the patient has Gastritis
- If the patient has impaired renal function
- If the patient has gastric or duodenum ulcers

Ibandronate – The brand name is **Bonviva**

It acts on bone and has an inhibitory effect on osteoclasts. It decreases bone resorption and decreases risk of fractures. It is available as a 150 mg tablet taken once monthly, on the same date each month. It is taken first thing in the morning, one hour before food, with plenty of water (not with coffee or orange juice) and the patient must avoid lying down and remain upright for half an hour after taking the medication.

Indications

- Bonviva is indicated in the treatment of Osteoporosis in postmenopausal women at increased risk of fracture.
- Bonviva has been shown to reduce the risk of vertebral fractures.

Contraindications

- If the patient has problems with oesophageal abnormalities
- If the patient has a Hiatus hernia
- If the patient has Gastritis
- If the patient has impaired renal function.

Ibandronate – Bonviva by IV

It acts on bone and has an inhibitory effect on osteoclasts. 3 mg are given by IV every three months

Indications

- Bonviva is a treatment of Osteoporosis in postmenopausal women at increased risk of fracture.
- Bonviva has shown to reduce the risk of vertebral fractures.

* Patients will need the recommended daily amounts of calcium to be obtained by food or supplements and appropriate weight bearing exercise.

Contraindications of Bonviva by IV:

- Hypocalcaemia
- Renal Impairment

Alendronate combined with vitamin D – The brand name is **Fosavance 2800**

It acts on bone and has an inhibitory effect on osteoclasts. It decreases bone resorption and reduces the risk of vertebral and hip fractures. It is available as a once-weekly 70mg tablet plus 2800 iu of vitamin D.

Indications

- Fosavance is indicated for the treatment of Postmenopausal Osteoporosis in patients at risk of Vitamin D insufficiency.
- Fosavance reduces the risk of vertebral and hip fractures.

Contraindications

- If the patient has problems with oesophageal abnormalities
- If the patient has a Hiatus hernia
- If the patient has Gastritis
- If the patient has impaired renal function
- If the patient has gastric or duodenum ulcers

NOTE: Fosavance has 2800 iu , which is half the daily/weekly recommended amount of vitamin D, therefore a patient will need to get the other half of the recommended Vitamin D by food or supplements.

Risedronate – The Brand name is **Actonel – Daily**

It acts on bone and has an inhibitory effect on osteoclasts.[38] It decreases bone resorption and decreases risk of fractures in both the spine and the hips. It is available in a daily **5mg** tablet. It should be taken first thing in the morning, a half hour before food, with plenty of water (not with coffee or orange juice) and the patient must avoid lying down and remain upright for half an hour after taking the medication.

Indications

- Actonel is a treatment for postmenopausal osteoporosis to reduce the risk of vertebral and hip fractures.
- Prevention of osteoporosis in postmenopausal women with increased risk of osteoporosis.
- Actonel helps to maintain or increase bone mass in postmenopausal women undergoing long term (months) systemic corticosteroid treatment of doses 7.5mg/day prednisone or equivalent..

Contraindications

- If the patient has problems with oesophageal abnormalities
- If the patient has a Hiatus hernia
- If the patient has Gastritis
- If the patient has impaired renal function
- If the patient has gastric or duodenum ulcers

Risedronate – The Brand name is **Actonel - Weekly**

It acts on bone and has an inhibitory effect on osteoclasts. It decreases bone resorption and decreases risk of fractures in both the spine and the hips.[38] It is a once-weekly **35mg** tablet. It should be taken first thing in the morning, a half hour before

food, with plenty of water (not with coffee or orange juice) and the patient must avoid lying down and remain upright for half an hour after taking the medication.

Indications

- Actonel is indicated as a treatment for postmenopausal osteoporosis to reduce the risk of vertebral and hip fractures.
- Treatment of established postmenopausal osteoporosis to reduce the risk of fractures.
- Treatment of osteoporosis in men at high risk of fractures.
- Actonel maintains or increases bone mass in postmenopausal women undergoing long term systemic corticosteroid treatment of doses 7.5mg/day prednisone or equivalent.

Patients will need the recommended daily amounts of calcium and vitamin D and appropriate weight bearing exercise.

Contraindications

- If the patient has problems with oesophageal abnormalities
- If the patient has a Hiatus hernia
- If the patient has Gastritis
- If the patient has impaired renal function
- If the patient has gastric or duodenum ulcers

Strontium Ranelate – The brand name is **Protelos**

Protelos has a dual action, it reduces bone resorption, prevents bone loss and increases bone formation and bone mineral density (BMD) through the formation of new normal strong bone[37].

Protelos can help decrease pain of vertebral fractures.

Protelos is taken daily, one 2G Sachet with water and no calcium containing food should be taken 2 hours before or 2 hours after taking the medication, as it competes with calcium.

Protelos can be taken during the day, at bedtime or during the night.

Indications

- Protelos is indicated as a treatment of osteoporosis in post-menopausal women to reduce the risk of vertebral and hip fractures.

Contraindications

- Severe renal impairment
- Patients at risk of venous thromboembolism.
- It is extremely rare, but if a rash develops, discontinue treatment and switch to another.

Alendronate - The brand name is **Fosamax** – Once weekly

It acts on bone and has an inhibitory effect on osteoclasts. It decreases bone resorption and reduces the risk of fractures in both the spine and the hips. It should be taken first thing in the morning, a half hour before food, with plenty of water (not with coffee or orange juice) and the patient must avoid lying down and remain upright for half an hour after taking the medication.

Once-weekly **70mg** tablet

Indications

Treatment of postmenopausal osteoporosis.Fosamax reduces the risk of vertebral and hip fractures.

Contraindications

- If the patient has problems with oesophageal abnormalities
- If the patient has a Hiatus hernia
- If the patient has Gastritis
- If the patient has impaired renal function
- If the patient has gastric or duodenum ulcers

Parathyroid Hormone - (PTH) Teriparatide. The brand name is **Forsteo**

Forsteo is a recombinant human parathyroid hormone 1-34. It is a bone forming agent that stimulates the formation of new bone.

It can only be prescribed by a Consultant, as it is a High Tech drug. It is given as a daily 20mcg, subcutaneous injection in the thigh or abdomen for 24 months. The patient should then have a repeat DXA scan and a new treatment plan should be implemented at the end of the course of treatment.

PTH is usually recommended for those with severe osteoporosis or fractures and those who cannot tolerate other medications. Forsteo can help with the pain of vertebral fractures and the reduction of vertebral and non-vertebral fractures in women.

Indications

- Forsteo is indicated in the treatment of Osteoporosis in postmenopausal women and in men at increased risk of fracture.
- In postmenopausal women a significant reduction in the incidence of vertebral and non vertebral fractures have been found with Forsteo.
- Forsteo is also a treatment of osteoporosis associated with sustained systemic glucocorticoid therapy in men and women at risk of fractures.

Contraindications

- Those who are pregnant or lactating
- Hypercalcaemia
- Severe renal impairment
- Metabolic bone disease except osteoporosis

- Patients who have had radiation, or have high Serum Parathyroid levels
- Special care must be taken if a patient is on digoxin.
- Paget's disease, hypercalcaemia, multiple myeloma and bone secondaries.

The following investigations are recommended prior to putting a patient on Forsteo:

- Normal serum and urinary calcium, normal PTH, and normal vitamin D levels, normal renal (kidney) function.

* If a patient has a high PTH they should **not** be put on this treatment.

Alendronate - The brand name is Fosamax Daily

It acts on bone and has an inhibitory effect on osteoclasts. It is a daily **10mg** and it should be taken first thing in the morning, a half hour before food, with plenty of water (not with coffee or orange juice) and the patient must avoid lying down and remain upright for half an hour after taking the medication.

Indications

- In post-menopausal women with osteoporosis, Fosamax (take out: It is) is indicated for the treatment of osteoporosis fractures, including those of the hip and spine (vertebral compression fractures.)
- Fosamax is indicated for the treatment of osteoporosis in men to prevent fractures.
- In post-menopausal women who are at risk of developing osteoporosis Fosamax is indicated for the prevention of osteoporosis to reduce the risk of future fracture.

Contraindications

- If the patient has problems with oesophageal abnormalities
- If the patient has a Hiatus hernia
- If the patient has Gastritis
- If the patient has impaired renal function
- If the patient has gastric or duodenum ulcers

Selective Estrogen Receptor Modulators (SERMs) - Raloxifene – The brand name is Evista

Evista helps to maintain bone density and reduce fracture rates, specifically at the spine. It is a 60mg tablet once daily. Evista can be taken with or without food or drink and at the same time as calcium/vitamin D supplements. Appropriate weight bearing exercise is also necessary.

Indications

- Evista is approved for the prevention and treatment of osteoporosis in postmenopausal women.
- Evista has been shown to have a significant reduction in the incidence of vertebral fractures.

Contraindications:

- Premenopausal women or pregnant women.
- People who are experiencing hot flushes due to menopause, as it can increase flushes.
- A patient who has a history of venous thromboembolic events, including deep vein thrombosis (DVT) and/or a pulmonary embolism.

HRT - Oestrogen/Hormone Therapy

Sex hormones play a vital role in determining the onset of osteoporosis. Both testosterone in males and the female hormone, oestrogen have a protective effect on bones and help prevent the breakdown of bone.

Oestrogen deficiency at any age, but particularly after the menopause in thin females, is one of the main reasons for bone loss. Teenagers with an Eating disorder usually have very low oestrogen and progesterone levels and are often diagnosed with osteopenia and/or osteoporosis[15]. Those with eating disorders, past or present, male or female, should have a DXA scan urgently. The earlier this disease is diagnosed, the more effective the recovery, in dealing with the cause as well as their reduced bone density.

It may be part of the "Athletic Triad", which consists of amenorrhea, an eating disorder and osteopenia and/or osteoporosis.[15] A Multidisciplinary approach including athlete, coach, doctor, physiologist, psychologist and nutritionist when ever possible and a parent if it is a teenager. If there are low progesterone and oestrogen levels, this must be addressed and an eating disorder ruled out. The majority of people with eating disorders are highly intelligent and are very good at hiding the condition, as it is their way of being in control. Reduction of "over" training maybe necessary, adequate nutrition and either the pill or HRT. It is essential that if HRT is prescribed in a premenopausal woman, emphasise should be made that HRT is not a contraceptive. Some contraceptive "Pills" may increase mood swings and the patient should be informed.

HRT is usually the first choice for treatment of menopausal symptoms provided there are no contraindications. It is not usually recommended just for prevention or treatment of osteoporosis, unless the person has had an early menopause (before 45 years). HRT is not suitable for people who have a history of breast cancer in their family, particularly in early menopausal patients or patients who have had a history of deep vein thrombosis.

The most important benefit to be gained from the use of hormone replacement therapy (HRT) is the relief of menopausal symptoms, e.g. flushes, sweats and vaginal dryness, and difficulty with sleep and mood changes. They are usually recommended for post menopausal symptoms to help improve the person's quality of life (and their families!). The patient should be informed of the benefits and negative side effects of HRT treatment. Patients on HRT should be monitored.

Types of HRT

There are many varieties of oestrogen replacement for women going through the menopause, which will help to maintain bone density and reduce fracture rates, for the duration they are on the treatment. The lowest most effective dose is the one recommended. HRT prevents the relatively rapid bone loss in the first three to five years following menopause, and maintains this while on treatment, particularly if the patient has had an early menopause and is thin.

Women who have had a hysterectomy are suitable for oestrogen only, particularly if they have had an early menopause. Otherwise oestrogen and progesterone on a cyclical basis when bleeding occurs, or continuous combined at least one year post menopause when no bleeding occurs.

Oestrogen is available in tablets, patches, gels or implants. Oestrogen and a variety of different progestogens = either sequential combined or continuous combined.

Where substantial bone loss has already occurred, with or without fractures, the benefits of HRT are more limited, but there is evidence that further bone loss and risk of further fractures are both reduced.

Recent studies where HRT was started in women who were in the late sixties and seventies have raised concerns about the safety of HRT in the prevention of osteoporosis in this age group. If used only for the prevention of post-menopausal osteoporosis, the risks of using HRT may outweigh the benefits and it is not recommended as a first line therapy for the prevention or treatment of osteoporosis, particularly in older post menopausal women. The risks and benefits must be explained to the patient [22].

HRT should be combined with daily amounts of Calcium and Vitamin D and appropriate weight bearing exercise.

Contraindications to HRT treatment include

- Cancer of the breast in the patient or a close relative, genital tract or any other oestrogen dependant carcinoma.
- Undiagnosed vaginal bleeding, endometriosis.
- History of deep vein thrombosis or pulmonary embolism or increased risk of thromboembolic disorders.
- Severe hepatic renal or liver disorders, otosclerosis.

Each case must be individually assessed and all the factors considered, when prescribing treatment.

Monitoring of HRT includes

Breast examination should be carried out every 12 months and a mammogram every 2-3 years. If the patient still has a uterus, they should have a pelvic examination and a cervical smear every 3-5 years.

Vertebroplasty

This is a non surgical treatment which involves a needle with "bone cement" (polymethylmethacrylate) in it, which is inserted through the skin into the fractured bone under imaging guidance. The cement hardens which helps to stabilize the bone and hopefully prevent further collapse.

This can help to reduce pain by preventing bone rubbing on bone. For best results a patient should be referred as soon as possible following a fracture.

Indications:

- Intractable non-radicular pain caused by compression fractures due to osteoporosis, myeloma, metastases and aggressive vertebral haemangioma

Contraindications:

- Bleeding disorder
- Unstable fracture and lack of definable vertebral collapse
- Epidural abscess
- Sepsis
- Osteomyelitis
- Discitis
- Symptomatic spinal-cord compression at the level of the fracture
- Severe cardiopulmonary disease

Relative contraindications

- Inability of the patient to lie prone for the duration of the procedure
- Acute burst fractures
- Complete loss of vertebral height (vertebra plana)

* It should be combined with daily amounts of Calcium and Vitamin D. Osteoporotic medication and weight bearing exercise should be initiated post surgery.

The main complication of percutaneous Vertebroplasty is inadvertent epidural and foraminal leakage of PMM.

Kyphoplasty

This is a surgical treatment which involves a balloon being placed within the fractured vertebrae, followed by "bone cement" being injected into the balloon. This treatment is mainly used for pain control, some height restoration can occur. The decision to perform these techniques is made by a multi-disciplinary team to insure that this is the correct approach to managing the collapse.

Prior to the surgery, x-rays and computed tomography are done to assess the extent of the collapse and if there are any other involvements.

For best results a patient should be referred as soon as possible following a fracture. An MRI STIR sequence is required.

Indications

The procedures result in similar relief of pain due to vertebral compression fractures.

- Significant and sustained reduction in back pain
- Sustained vertebral body height restoration
- Significant and sustained improvement in quality of life
- Significant and sustained improvement in mobility
- Significant and sustained improvement in ability to perform activities of daily living
- Significant reduction in number of days per month that a patient remains in bed due to back pain
- Significant and sustained reduction in number of days per month when pain interferes with daily activities such as walking, hobbies, and work

Contraindications to Kyphoplasty

- Active infection
- Epidural abscess
- Sepsis
- Osteomyelitis
- Discitis
- Uncorrectable coagulopathy
- Pregnancy
- Contrast allergy
- Pain unrelated to the vertebral collapse
- Fractured pedicles
- Burst fractures
- Young age
- Solid tissue or osteoblastic tumors

* Combined with Daily amounts of Calcium and Vitamin D. Osteoporotic medication and appropriate weight bearing exercise should be initiated post surgery.

Educating patients on the risk factors that will prevent the development of osteoporosis is essential.

Approved Osteoporosis Treatments in Ireland

Drug	Supported by Results from at least 1 R.C.T. or Meta-analysis										
	Postmenopausal Osteoporosis			Male Osteoporosis	Glucocorticoid Induced Osteoporosis		Prevention of the Following				
	Prevention	Rx	Established		Prevention	Rx	Hip	Vertebra	Non-Vertebra
Estradiol	Y	Y	-	-	-	-	Y	Y	Y
Tibolone	Y	-	-	-	-	-	-	-	-
Raloxifene	Y	Y	-	-	-	-	-	Y	-
Alendronate	Y	Y	Y	Y	-	Y	Y	Y	Y
Etidronate	Y	Y	-	-	Y	Y	-	Y	-
Ibandronate	Y	Y	-	-	-	Y	-	Y	-
Risedronate	Y	Y	Y	Y	Y	Y	Y	Y	-
Zoledronate	-	Y	Y	Y	-	Y	Y	Y	Y
Strontium Ranelate	-	Y	Y	-	-	-	Y	Y	Y
Parathyroid Hormone	-	Y	-	-	-	-	-	Y	-
Teriparatide	-	Y	Y	Y	-	Y	-	Y	Y
Denosumab	-	Y	Y	Y*	-	-	Y	Y	Y

Life style advice for all age groups

- Regular weight bearing exercise e.g. 30 minutes daily for adults (60 minutes for children/teenagers). It can be broken up into segments of 3 sets of 10 or 3-5 minutes, jogging on the spot, stair climbing and dancing.
- All forms of exercise should be started slowly, and appropriate foot wear is essential. A Chartered Physiotherapist can assess a patient's ability and provide an appropriate exercise programme.
- A well balanced diet containing sufficient calories that does not contain excessive fibre.
- Adequate vitamin D and calcium intake is essential during the whole of the life cycle, from birth, particularly during childhood, adolescence, pregnancy and lactation; 1500mg, (including 2/3rds from dairy products).
- Reduce alcohol intake, excessive caffeine and cease smoking.
- Stress reduction should be encouraged as it can affect sex hormone levels, which can affect bone.

Prevention

Prevention of osteoporosis should ideally start in utero. The HSE have implemented a recommendation that all babies from 0-12 months should be supplemented with Vitamin D, as Rickets is now back in Ireland. The Irish Osteoporosis Society recommends that from birth throughout life, everybody should be on the daily amounts of calcium and vitamin D, not only to help prevent osteoporosis but for overall health. Osteoporosis is a disease which manifests itself in childhood.

Bone growth depends on many variables:

- A well balanced diet containing sufficient calories, with adequate proportions of carbohydrates, fats, protein and minerals as they are essential for bone formation; it should not contain excessive fibre >40g.
- Reduction of alcohol intake and cessation of smoking.[27]
- The diet should include 1000mg a day of calcium and 800 international units, iul. of vitamin D. Calcium and vitamin D supplements are available.
- Calcium intake from dairy products is extremely important at all ages, especially during childhood when 60% of bone is laid down to achieve an adequate peak bone mass.[15] Low fat dairy has the same amount of calcium as full fat dairy.
- Regular weight bearing exercise, should be continued throughout life to minimise bone loss.

Children and Adolescences at risk

The factors that put children at risk of problems with bone health are similar to those in adults but there are additional risk factors:

- Genetics: Family history, especially if combined with a second risk factor.
- Metabolic disorders: e.g. Homcystinuria
- Osteogenesis imperfecta: a genetic abnormality which affects collagen in the bone, characterized by bones that break easily, often from no apparent cause.
- Idiopathic juvenile osteoporosis (IJO): no cause can be found.
- Marfan's and other collagen abnormalities
- Cerebral Palsy: Especially if mobility or nutrition affected.
- Decreased mobility for 6 weeks or longer, especially pre-puberty when bone is being laid down. Wheelchair bound or bed bound long term, as bone is not stimulated from non weight bearing.
- Muscular Dystrophy: The secondary affects of immobility
- Juvenile arthritis or rheumatoid arthritis: The disease itself and steroids which are used to treat these diseases, can both affect bone and/or if the child's walking is impaired.
- Asthma: being treated with steroids: low dose, long-term or high dose short-term can place a child at risk.
- Malabsorption problems: such as Coeliac disease, Gluten sensitivity and irritable bowel syndrome, can mean calcium, vitamin D and other nutrients are not properly absorbed from the intestine which affects bone.
- Ulcerative colitis and Chron's disease: the treatments are usually steroid based.
- Corticosteroid medications
- Chemotherapy and/or radiation
- Anorexia Nervosa and/or bulimia: past or present.
- Over exercising: associated with inadequate nutrition, resulting in loss of periods or no period: for more than 3 months (other than pregnancy).
- Amenorrhea: Athletes who have an eating disorder and who over train and lose their periods.
- Thyrotoxicosis: overactive thyroid gland increases bone loss.

- Hypothyroid: under active thyroid, thyroxine must be monitored.
- Cushing's syndrome
- Hyperparathyroidism: primary or secondary results in increased loss of bone.
- Cystic fibrosis, steroids, lack of mobility and problems with absorption.
- Rickets: severe vitamin D deficiency.
- Diabetes: Insulin dependant
- Excessive psychological stress
- Excessive physiological stress

Childhood and teenage years, are critical periods for developing a strong healthy skeleton, especially before puberty, between the ages of 8 and 12 years. Research shows that bone can be significantly increased at this time and weight bearing activities should be encouraged. [15]

Our genes mainly determine the potential height and strength of the skeleton, but lifestyle factors can influence the amount of bone you build (peak bone mass). A good balanced diet, containing calcium rich foods, vitamin D, adequate proteins and calories, normal hormones, plus regular weight-bearing/strengthening exercise can help to make and maintain strong bones.

Peak bone strength is reached by the early 20's and stabilizes until the age of 35-40, when natural bone loss begins. If good peak bone strength is achieved in early childhood, the risk of osteoporosis in later life is reduced.

Impact loading exercise such as skipping, jumping, hopping, team sports and running are the best types of exercise for bone health, especially in young children. **NOTE: Dancing is excellent for bones due to the variety of weight bearing. Research shows that weight bearing exercise especially before puberty, can significantly improve bone density.** [15]

Children and Adolescences

Children can break bones as their bones are still developing however the majority of these fractures are usually due to an injury, rather than osteoporosis. If a child breaks a bone (low trauma) from a trip and fall, a questionnaire should be filled out to see if they have any risk factors for osteoporosis. If they have no risk factors, healthy eating including, adequate calories, calcium, vitamin D, proteins and weight bearing exercise should be encouraged.

If a child has had a broken bone after only a minor bump or has unexplained persistent back pain, it is important that osteoporosis is ruled out, as it is a silent disease.

- A risk assessment for osteoporosis should be filled out (www.irishosteoporosis.ie).
- If the child has more than one risk factor, then a DXA scan of the spine should be considered.
- Refer to a specialist: An osteoporosis specialist, pediatric rheumatologist, or a pediatric endocrinologist.
- In order to exclude any underlying causes for the broken bones, blood and urine tests are necessary.
- X-Rays may be taken to rule out fractures.

DXA scanning in under 20 years of age

Measuring Bone mineral density in children and adolescence by DXA requires special training and requires Paediatric software. Currently the ISCD recommends that BMD measurement should be of the 'whole body less head' in such persons. Bone age is determined by x-ray of the non dominant hand, using the Greulich Pyle Atlas, [39] Z score of less than – 2 is considered "low bone density for age". A diagnosis of osteoporosis can be considered in the appropriate clinical context, where there is 'low BMD for Age' and when there has been 2 or more long-bone fractures. Whether you use Z-scores on the chronological age', the 'bone age' or' height age' depends on the clinical scenario. It would appear therefore that it is in the patient's best interests today, that BMD measurement is only ordered, performed and interpreted by specialists with appropriate training and familiarity with this complex and evolving field.

Treatments for Children

Treatment of children with osteoporosis requires specialist help for diagnosis and treatment. All children with suspected osteoporosis should be referred to a specialist.

This depends on what is causing the osteoporosis and what can be done to reduce the affect it has on the child's bone health. Usually lifestyle changes are the main treatment for children.

Nutrition

It is essential that every child from birth gets the recommend daily amount of calcium and vitamin D for healthy bones. If a child is lactose intolerant or does not like dairy products or can not get the required daily amount of calcium and vitamin D, calcium and vitamin D supplements may be recommended, depending on the child's risk of a fracture or re-fracture. Breast fed infants need additional vitamin D.

Exercise

Refer to a Chartered physiotherapist with an interest in bone health, so that they can initiate an appropriate exercise program to improve a child's bone health. A

copy of the DXA results will assist in planning an appropriate program. Extra caution should be taken when manipulations are done, as most people are not diagnosed and if the child has undiagnosed osteoporosis, the bones can fracture easily.

Weight bearing and strengthening exercise are essential, but should be done on an individualized basis and should be based on DXA scan results, medical history, cause/s of osteoporosis and the ability of the child. Contact sports such as rugby and hurling are usually not recommended due to the increased risk of fracture. Skateboarding, ice-skating and skiing would not usually be recommended. It is important that children be encouraged to lead as normal a life as possible. Swimming and riding a bicycle are excellent forms of exercise, as they can help to strengthen muscles; however, they are not weight-bearing as the body is not supporting itself and therefore should not be the only form of exercise.

Treatments
Alendronate, Clodronate, Etidronate and Pamidronate, are all types of Bisphosphonates. Research shows these drugs help to reduce the activity of osteoclasts, which are the bone removing cells, in adults. There is some concern about prescribing them for children, as they stay in the skeleton for an unknown amount of time and we do not know what their long term effect may be. However, in some children with osteoporosis they may be the best treatment option, compared to their risk of multiple fractures.

Growth Hormone
If a child has a growth hormone deficiency, replacement therapy may be advised by a specialist.

Sex Hormones
After a thorough and detailed investigation, in select cases of delayed puberty, testosterone or oestrogen may be used to treat boys and girls. This type of treatment must be monitored closely because it brings on puberty. It can cause unwanted side effects, e.g., it may result in reduced adult height.

Monitoring response to treatment
A repeat DXA scan should only be done when the least significant change (LSC) is known for that scanner and after the minimal time required for the intervention to have affected that change.

It is essential that the cause/s of bone loss is investigated and addressed.

Example: If a child has developed osteoporosis due to being an undiagnosed Coeliac, the underlying problem should be addressed otherwise they will continue to have a problem with absorption.

Prevention in Children and teenagers

"**Bones**" by Brent Pope is a book aimed at 8-11 year olds, to encourage them to look after their bones, by eating healthy and doing weight bearing exercise.

The Irish Osteoporosis Society has developed an "**Osteoporosis Educational Pack**" which is aimed at 12-18 year olds. The pack consists of a DVD presented by teenagers, Q & A for the DVD and a 140 power point presentation, which can be adjusted for the different age groups.

The Bones book and the educational DVD package are available through the Irish Osteoporosis Charity.

Low call: 1890 252 751
Tel: 01 637 5050
Email: info@irishosteoporosis.ie
Web: www.irishosteoporosis.ie

Case History 1

Fifty year old thin framed woman, tripped and fell fracturing her right wrist. She was advised to have a DXA scan.

The detailed Questionnaire revealed that she had a family history of osteoporosis, she had her first period at 14 years, her periods were always regular, and she had no loss of periods except during her three pregnancies.

She had an early menopause at 43 years of age, she had not gone on HRT. She took no dairy products, did minimal weight bearing exercise and smoked. A DXA revealed that she had osteoporosis of her lumbar spine, with a BMD of 0.950gm/cm^2 and a T score of -2.8 with an increased risk of fracture The Lateral Vertebral Assessment (LVA) showed a normal lateral view of the lower thoracic and lumbar vertebrae. There was osteoporosis of both neck of femurs with a T score of -2.5 and a Total hip of -2.8, with an increased risk of fracture.

The results of her DXA scan were explained to her, and also her increased risk of further fractures.

The following investigations were advised to out rule other possible causes:

- Full blood count
- Serum Ferritin, a Serum Ferritin saturation would be done, if there was an abnormally high Ferritin to out rule Haemochromatosis.
- Erythrocyte sedimentation rate. (ESR).
- Renal Function tests, including, creatinine clearance.
- Liver function tests
- Thyroid function tests
- Serum electrolytes and blood sugar.
- Calcium, phosphate, and alkaline phosphatase to exclude osteomalacia
- Serum Parathyroid hormone to out rule Primary or Secondary Hyperparathyroidism
- Serum 25(OH) vitamin D for all patients, but particularly in patients with malabsorption or elderly housebound.

Most of the above tests were normal except that the patient had a low vitamin D, 30nmol/L (>50nmol/Lconsidered normal) and a Serum PTH of 68ng/L (64 n/L upper limit of normal) low vitamin D resulting in the high PTH. She was prescribed calcium and vitamin D3 and advised to try and take milk fortified with vitamin D and to go out in the sun, without sun block for 15 minutes a day. Stop smoking and reduce excessive alcohol, decrease fibre if more than 40 grams a day and excessive caffeine. Adequate fluid intake and 30 minutes weight bearing exercise.

An osteoporosis medication was also prescribed. If she had any problems with the medication, she should contact the doctor , as there are other alternative medications. Repeat Serum vitamin D and PTH was arranged for 3 months time. Repeat DXA in 18 months to two years.

30 minutes weight bearing exercise daily, suitable for the person's age, medical history and ability. The 30 minutes can be divided into segments of 3-5 minutes such as marching or running on the spot, stair climbing and, dancing. Walking is weight bearing however; the speed should be altered for the most benefit.

All the above are an essential part for the prevention and treatment for all patients along with their osteoporosis medication.

Fall Prevention programme by a Chartered Physiotherapist for those with a prior fall or at risk to fall

Case History 2

Father and mother both had osteoporosis; they have three sons, aged 15, 17 and 19. The two younger boys were involved in sports and did a minimum of 60 minutes weight bearing exercise a day and they both drank at least 1 litre of calcium and vitamin D fortified milk a day.

The nineteen year old did not exercise, took no dairy products and smoked. His DXA scan showed that he had osteoporosis of his lumbar spine with a total T score of –2.8 for his lumbar spine (L1, L2, L3, L4) however L2 was –3.1.High risk of fracture, He also had marked osteopenia of both necks of femurs with a T score of -2.3. His LVA was normal.

It was important to determine any other causes, particularly if he had low Testosterone levels.

Sex hormones play a vital role in determining the onset of osteoporosis. Both testosterone in males and the female hormone, oestrogen have a protective effect on bones and help prevent the breakdown of bone.

He was sent for the following investigations:

- Full blood count
- Serum Ferritin, a Serum Ferritin saturation would be done, if there was an abnormally high Ferritin to out rule Haemochromatosis.
- Erythrocyte sedimentation rate. (ESR)
- Renal Function tests, including, creatinine clearance.
- Liver function tests
- Thyroid function tests
- Serum electrolytes and blood sugar.
- Calcium, phosphate, and alkaline phosphatase to exclude osteomalacia
- Serum Parathyroid hormone to out rule Primary or Secondary Hyperparathyroidism
- Serum 25(OH) vitamin D particularly in patients with malabsorption or elderly housebound
- Serum and 24hour urinary calcium and protein, electrophoresis may be required to exclude multiple myeloma
- Serum sex hormone binding Globulin
- Serum testosterone
- Serum Prolactin
- Serum Cortisol

* All the blood test results were normal, the osteoporosis was due to Family history, low calcium and vitamin D intake, smoking and lack of exercise.

He was advised that it was essential to take at least 1000mg of Calcium and 800 international units of vitamin D daily. He was also advised on the importance of weight bearing exercise particularly as he had low bone density in his hips and that he needed to do at least 30 minutes daily, which could be divided into segments of 3-5 minutes, running on the spot, stairs, dancing, brisk walking, altering the speed. He was advised to stop smoking. He is scheduled for a repeat DXA in 12 months to ensure compliance. If there is no improvement, additional treatments will be considered.

Nationwide list of DXA Scanners

Cavan	Cavan Osteoporosis Screening, Elm House, Cavan	049 4372655
Cavan	X-Ray Department, Cavan General Hospital, Cavan, Co Cavan	049 4361399
Cork	The Mallow DXA Service, Barty Sullivans, 63 Main St. Mallow, Co Cork	022 21574
Cork	South Infirmary/Victoria Hospital, Old Blackrock Road, Cork	021 492 6100
Cork	South Terrace Medical Centre, Infirmary Road, Cork	021 431 9995
Cork	Bone Mineral Densitometry Unit, Bon Secours Hospital, College Road, Cork	021 454 2807
Cork	DXA Scanning Unit, Cork University Hospital, Wilton, Cork	021 492 2549
Cork	Euromedic, The Eylsian, Cork City Centre	021 431 9995
Donegal	Lifford Health Centre, Lifford, Co Donegal	074 9141024
Donegal	Scally Medical Practice, Justice Walsh Road, Letterkenny, Co Donegal	074 9121955
Dublin	Euromedic Dundrum, 1st Floor, Rockfield Medical Centre, Dundrum, Dublin 14	1890 595959
Dublin	Beaumont Private Clinic, Beaumont, Dublin 9	01 837 5400
Dublin	DXA Unit, Blackrock Clinic, Suite 37, Blackrock Clinic, Blackrock, Co Dublin	01 288 0315
Dublin	Bon Secours Private Clinic, Glasnevin, Dublin 9	01 806 5316
Dublin	Charter Medical Diagnostic Imaging, The Forge, Smithfield Market, Smithfield, Dublin 7	01 657 9000
Dublin	Diagnostic Imaging, The Sports Surgery Clinic Santry Demesne, Santry, Dublin 9	01 526 2060
Dublin	Charlemont Clinic, Charlemont Mall, Dublin 2	01 418 8465
Dublin	DXA Dept, Northwood Imaging, TLC Centre, Northwood Park, Santry, Dublin 9	01 862 7333
Dublin	Exwell Medical, DCU Sports Ground Ballymun Road, Glasnevin, Dublin 9	01 804 0659
Dublin	Greenlea Clinic, 118 Greenlea Rd., Terenure, Dublin 6W	01 490 8979
Dublin	Imaging Department, Cappagh Orthopaedic Hospital, Finglas, D11	01 834 1211
Dublin	Irish Health Care, Hermitage Clinic, Suite 23, Old Lucan Rd, Palmerstown, Dublin 20	01 645 9500
Dublin	James Connolly Memorial Hospital, The Cherry Ward, Blanchardstown, Dublin 15	01 821 3844
Dublin	Mater Private Hospital, Eccles Street, Dublin 7	01 885 8174
Dublin	Mater Public Hospital, Eccles Street, Dublin 7	01 803 2274
Dublin	Menopause Clinic, Rotunda Hospital, Parnell Street, Dublin 1	01 873 0700
Dublin	Meridian Clinic, 1 The Avenue, Ongar Village, Dublin 15	01 861 4040
Dublin	Mount Carmel Hospital, Breamor Park, Churchtown, Dublin 14	01 406 3443
Dublin	**National Rehab Hospital, Dun Laoghaire Only scan their own patients.**	**01 285 4777**
Dublin	St Mary's Hospital Osteoporosis Clinic, c/o Healthy Aging Clinic, Phoenix Park, D 20	01 677 8132
Dublin	St. Anthony's Rehabilitation Unit, Bone & Joint Unit, St. Vincent's, Herbert Ave, D4	01 209 4138
Dublin	St. James Private Clinic, St. James Hospital, Rialto Gate, Dublin 8	01 474 2424
Dublin	St. Michael's Hospital, Dun Laoghaire, Co Dublin	01 280 6901
Dublin	The Surgery, 7 Strand Street, Skerries, Co Dublin	01 849 0678

Dublin	X-Ray Department, St. Columcille's Hospital, Loughlinstown, Co Dublin	01 211 5149
Dublin	X-Ray Department, Tallaght Hospital, Tallaght, Dublin 24	01 414 3700
Dublin	UPMC Beacon Hospital, Sandyford, Dublin 18	01 293 6625
Dublin	The Well, Beacon Clinic, Sandyford, Dublin 18	01 294 5444
Galway	Bon Secours Hospital, Renmore, Galway	091 381922
Galway	Ionad Leighis Medical Centre, Spiddal, Co Galway	091 553135
Galway	Irish Health Care, Suite 26, Galway Clinic, Dougiska, Co Galway	091 720130
Galway	Merlin Park Hospital, Galway	091 775775
Galway	Portiuncula Hospital, Ballinasloe, Co Galway	090 964 8200
Galway	Regional Medical Centre, Newcastle Road, Galway	091 524355
Galway	The Galway Clinic, Doughiska, Co Galway	091 785450
Kerry	Kerry Clinic, Bon Secours Hospital, Strand Street, Tralee	066 714 9800
Kildare	Naas General Hospital, Naas, Co Kildare	045 897221
Kildare	DXA Scan Dept, Clane Hospital, Prosperous Road, Clane, Co Kildare	045 982345
Kilkenny	Aut Even Private Hospital, Freshford Road, Kilkenny	056 777 5251
Kilkenny	St. Luke's General Hospital, Kilkenny	056 778 5000
Leitrim	Rheumatology & Rehabilitation Unit, Our Lady's Hospital, Manorhamilton, Co Leitrim	071 982 0410
Limerick	Barrington's Medical Centre, Georges Quay, Limerick	061 490590
Limerick	DXA Unit, Clinical Age Assessment Unit, Regional Hospital, Dooradoyle, Limerick	061 482623
Limerick	DXA Unit, Medical Day Hospital, St. Camillus Hospital, Shelbourne Rd., Limerick	061 326677
Louth/ Meath	DXA Protection, 7 Fair St., Drogheda, Co Louth	041 9803703
Mayo	Tobin's Health Centre, Station Road, Castlebar, Co Mayo	094 9021119
Tipperary	South Tipperary General Hospital, Clonmel, Co Tipperary	052 77000
Tipperary	Mary Street Medical Centre, Mary Street, Clonmel, Co. Tipperary	052 21288
Tipperary	Premier Health Clinic, Kickham Street, Thurles, Co Tipperary	0504 21331
Tipperary	Roscrea Osteoporosis Clinic, Frawley's Pharmacy, 11 Main St., Roscrea, Co Tipperary	0505 31733
Tipperary	Western House Medical Centre, Clonmel, Co Tipperary	052 25312
Waterford	Gate Lodge Private Clinic, Waterford Regional Hospital, Dunmore Road, Waterford	051 873475
Waterford	Broadwater Private Clinic, Dunmore Road, Waterford	051 850388
Waterford	Rowe Creavin Medical Practice, Waterford Health Park, Slievekeale Road, Waterford	051 370057
Westmeath	X-Ray Dept, Midlands Regional Hospital, Mullingar, Co Westmeath	044 9340221
Westmeath	St. Francis' Private Hospital, Ballinderry, Mullingar, Co Westmeath	044 9341500
Wexford	Ely Hospital, Wexford, Co. Wexford	053 23522
Wicklow	Wicklow Pharmacy, Unit 56, Supervalu Shopping Centre, Wicklow Town, Co Wicklow	0404 61948

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The Irish Osteoporosis Society wish to acknowledge the support of an unrestricted educational grant from Amgen and GSK in producing the booklet.

The Irish Osteoporosis Society,
12 Burlington Road,
Garden Level,
Ballsbridge,
Dublin 4.

Tel: Lo-call 1890 252751
Tel: 01 637 5050
Fax: 01 668 0098
Email: info@irishosteoporosis.ie
Web: www.irishosteoporosis.ie