Osteoporosis is defined as a progressive systemic skeletal disease characterised by low bone mass and micro-architectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fracture.

There is still uncertainty about the diagnosis and management of osteoporosis and osteopenia (low bone mass) and the medical management of low trauma (fragility) fractures, particularly in the very elderly. Recommendations from authorities including the National Osteoporosis Foundation of South Africa (NOFSA), National Osteoporosis Foundation of the USA (NOF) and National Osteoporosis Guideline Group of the UK (NOGG) are often not implemented. Responsibility for management moreover is divided between many different specialties.

**Diagnosis**

Osteoporosis and osteopenia (low bone mass) are now widely diagnosed by measuring bone mineral density (BMD) using dual energy X-ray absorptiometry (DEXA) of the upper femur and lumbar spine. The criteria for the diagnosis of osteoporosis and osteopenia, however, vary between the different authorities with regard to the site at which BMD is measured and the number of bone sites included.

The World Health Organization (WHO) designates ‘osteoporosis’ as a BMD 2.5 standard deviations (SD) or more below the young adult mean value for women (a T-score equal to or less than -2.5 SD in postmenopausal women). A BMD measurement of between -1 SD and -2.5 SD is designated as ‘osteopenia’ or ‘low bone mass’. The WHO recommends that osteoporosis and osteopenia be diagnosed solely on the BMD measurement of the femoral neck, using the data of the National Health and Nutrition Examination Survey (NHANES) for Caucasian women aged 20 - 29 years as the normal reference range. The BMD of the femoral neck alone is recommended for diagnosing osteoporosis and osteopenia because of its higher predictive value for future fractures. Prediction of fracture risk is claimed not to be improved by using multiple sites for the measurement of BMD. The spine is not regarded as suitable, particularly in the elderly, because of the high prevalence of osteo-arthritis and spinal abnormalities that may affect BMD measurements.

The International Society for Clinical Densitometry (ISCD) recommends that osteoporosis be diagnosed in postmenopausal women and men aged 50 and older if the lowest level of the T-score of the femoral neck or the total upper femur or the lumbar spine is -2.5 or less, and that osteopenia be diagnosed if the lowest level of the T-score is -1.0 or less but above -2.5. Measurement of the lumbar spine is based on the mean of L1 - L4 vertebrae, excluding any vertebra that is more than 1 SD from an adjacent vertebra but including a minimum of two vertebrae.

NOFSA recommends that osteoporosis and osteopenia be diagnosed by the International. Society for Clinical Densitometry (ISCD) criteria or the presence of a fragility fracture (with or without BMD measurement) in postmenopausal women and men over 50 years of age:  
- T-score ≤-2.5 of the femoral neck or total femur or lumbar spine (inserted) 
- T-score -1.0 to -2.5 (osteopenia) with two or more clinical risk factors including age 75 years or older 
- A prior osteoporotic fracture of hip, humerus, pelvis, rib or wrist, irrespective of BMD.

The female reference data for women are applied to the T-score in men as recommended by the WHO. NOFSA also recommends that all patients qualifying for a BMD measurement should have an X-ray of the spine or a DEXA-based vertebral fracture assessment, using the Genant semi-quantitative system (grade 1 - 3). A reduction in vertebral height of at least 20% or 4 mm is required to diagnose a vertebral fracture.

BMD measurements can be used for diagnosis of osteoporosis and osteopenia in individuals or for population screening to determine those at increased fracture risk. NOGG recommends that BMD measurements should only be used for case finding, as BMD measurements have a high specificity but low sensitivity for future fracture risk.
Assessment of fracture risk

BMD measurements are a continuum, and the risk of fracture approximately doubles with each decrease in SD below the young adult mean. BMD, however, accounts for less than 50% of bone strength, and many factors related to BMD and independent of BMD affect both bone strength and fracture risk.

The WHO combined these factors in a fracture risk assessment, the FRAX score (with or without BMD measurement of the femoral neck), to give a 10-year probability of the risk of future hip fracture or of a major osteoporotic fracture (clinical fracture of the spine, hip, forearm or humerus) in women and men 50 years of age or older (Table 1). A FRAX tool for assessing fracture risk probability is freely available online (www.shef.ac.uk/FRAX). The FRAX score is primarily recommended for identifying individual women or men for specific treatment of osteoporosis.

The FRAX score depends on the prevalence of fractures and the mortality in any group or country. It has been validated in the UK and Sweden and evaluated in other countries with differing fracture and mortality rates, including the USA. Modified FRAX scores and tables of fracture probability have been published for these countries. In the USA FRAX models for Asians, blacks and Hispanics have also been developed because their hip and osteoporotic fracture rates are lower than those in USA whites. No data are available for the fracture rates for different ethnic groups in South Africa.

The FRAX fracture risk assessment tool has limitations, and in particular does not include the number and recentness of previous fractures, the risk of falls and the dose and duration of glucocorticoids. The risk of a further fracture is highest in the first few years after a fracture or of a major osteoporotic fracture (clinical fracture of the spine, hip, forearm or humerus) in women and men 50 years of age or older for BMD testing based on clinical risk factors (including advanced age) and for treatment (Fig. 1).

The problem of osteopenia

The ‘Geoffrey Rose Prevention Paradox’ applies to many chronic diseases, including osteopenia: ‘a large number of people at small risk give rise to more cases than the small number who are at high risk’. In most countries less than half of women and men who sustain a fragility fracture have osteoporosis as diagnosed by DEXA measurements of BMD. The majority have osteopenia (low bone mass). In the NORA (Nordic Research on Ageing) study in the USA using peripheral BMD measurement of 149 562 postmenopausal women aged 50 - 104 years (mean 64.5 years), only 6.4% of women had a BMD of <-2.5 SD (associated with 18% of all fractures and 26% of hip fractures), but 45.3 % of women had a BMD of <1.0 SD (associated with 70% of all fractures and 77% of hip fractures). In the Rotterdam study of 4 878 women who had DEXA measurements of the femoral neck and were followed up for a mean 6.8 years, the rate of self-reported non-vertebral fractures was 44% with osteoporosis, 43.3% with osteopenia and 12.6% with normal BMD. In an Australian community study of 616 women who had DEXA measurements of the total femur, 124 women had one or more fractures.

Table 1. FRAX clinical risk factors for the assessment of fracture probability

<table>
<thead>
<tr>
<th>Age</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male or female</td>
</tr>
<tr>
<td>Low body mass</td>
<td>19 kg/m2</td>
</tr>
<tr>
<td>Previous fracture</td>
<td>Yes/no, clinical or X-ray hip, spine or wrist</td>
</tr>
<tr>
<td>Parental history of hip fracture</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Current glucocorticoid treatment</td>
<td>Yes/no, oral, any dose for &gt;3 months</td>
</tr>
<tr>
<td>Current smoking</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Alcohol intake</td>
<td>Yes/no, 3 or more units daily</td>
</tr>
<tr>
<td>Secondary causes of osteoporosis*</td>
<td>Yes/no</td>
</tr>
</tbody>
</table>

*Rheumatoid arthritis, type 1 diabetes, hyperthyroidism, hypoparathyroidism, gastro-intestinal disease, chronic liver disease, pulmonary disease, organ transplantation.
Management of osteoporosis and osteopenia in the very elderly

Very elderly women and men (aged 80 years and over) are the fastest-growing segment of the population. About 25 - 30% of the population burden of all fragility fractures is in women and men over 80, who are at high risk for fracture, particularly non-vertebral fracture, because of their high prevalence of osteoporosis and osteopenia and high incidence of falls. After a hip fracture approximately 20% of patients do not survive more than a year and 50% do not regain their previous level of independence. Vertebral fractures are associated with back pain, height loss, kyphosis and functional disability. The prevalence of vertebral deformities increases from 5% in women in the 50s to 45-55% of those in the 80s. Only a proportion of older women and men with osteoporosis or osteopenia receive specific treatment. Some clinicians may consider that patients over 80 years are too old, or that it is too late to significantly alter the course of the disease. Based on pooled data of 1 392 women aged 80 or over from the HIP, VERT-MN and VERT-NA trials, risendronate resulted in a 44% reduction in vertebral fractures but not in non-vertebral fractures. In 1 488 women between 80 and 100 years of age from the SOTI and TROPOS trials and followed up for 3 years, strontium ranelate reduced the risk of vertebral, non-vertebral and clinical symptomatic fractures within the first year by 59% (p=0.002), 41% (p=0.027) and 37% (p=0.012), respectively. At the end of 3 years vertebral, non-vertebral and symptomatic clinical fractures were reduced by 32% (p=0.013), 31% (p=0.011) and 22% (p=0.040), respectively. Strontium ranelate was reported to be well tolerated and as safe as in younger patients. Women and men are therefore never too old for treatment, and it is never too late to treat those with osteoporosis or osteopenia, particularly when they have a fragility fracture.

Responsibility for diagnosis and management

Patients with osteoporosis and osteopenia are treated by general practitioners and specialists from various disciplines including orthopaedics, rheumatology, gynaecology, geriatrics and endocrinology. Knowledge and understanding of the diagnosis and treatment of osteoporosis and of fragility fractures is increasing and new treatment options are being developed. Few specialties require training in osteoporosis and metabolic bone diseases for higher professional qualification. A good case can be made for the establishment of local groups, including generalists and specialists who are especially interested in osteoporosis, to agree on referral practices and treatment based on local sources. In large hospitals an ‘osteoporosis clinic’ including different disciplines may facilitate diagnosis and management. There is little doubt that the care of women and men with osteoporosis or osteopenia and those with fragility fractures, particularly the very elderly, can be enormously improved.