Osteoporosis International (2025) 36:1495–1507
https://doi.org/10.1007/s00198-025-07628-5

POSITION PAPER

Barriers and solutions for global access to osteoporosis management: a Position Paper from the International Osteoporosis Foundation

Nicholas C. Harvey · Nasser Al-Daghri · Charlotte Beaudart · Maria Luisa Brandi · Nansa Burlet · Claudia Campusano, et al. ***[full author details at the end of the article]***

Received: 28 May 2025 / Accepted: 10 July 2025 / Published online: 22 August 2025

Abstract

Our ability to optimally manage bone health across the lifecourse, and so minimise the risk of fractures, has advanced substantially in recent decades. Whilst fractures and osteoporosis in older age were historically viewed simply as inherent in normal ageing, they are now recognised as manifestations of age-related disease. Key to advancing the field was the development of conceptual (relating to impaired bone mass and microarchitecture with increased propensity to fracture), and subsequent World Health Organization densitometric definitions of osteoporosis, cementing the role of dual-energy X-ray absorptiometry in bone health management. However, whilst low bone mineral density is a strong risk factor for fracture, many individuals who do fracture have normal or only modestly reduced bone mineral density. Furthermore, the existence of two definitions constituting a condition called "osteoporosis", one based on a measurement, and the other conceptual, has led to uncertainty in clinical practice. The field is therefore moving towards calculation of an individual's absolute fracture risk, based on clinical risk factors, with the option to incorporate bone mineral density (if available) as a risk factor rather than as an indication for treatment. Uptake of this new direction has been variable internationally, with many parts of the world, particularly low- and middle-income countries, still predicating treatment (where osteoporosis services exist) on bone mineral density, despite poor availability of densitometry in many such settings. In this Position Paper, on behalf of the International Osteoporosis Foundation, we review the current barriers which prevent equitable access to optimal bone health management worldwide and recommend potential solutions which might be implemented to overcome them.

Key messages

- Access to optimal bone health management is highly variable worldwide, with most patients at high fracture risk not receiving appropriate care.
- Confusion between diagnostic and intervention thresholds, together with lack of access to bone densitometry and other screening technologies, is a key consideration.
- The original WHO densitometric osteoporosis definition has advanced the field substantially and should be retained as a diagnostic criterion but not necessarily as an intervention criterion.
- Formalising the clinical use of the conceptual definition of osteoporosis may be superficially attractive but would be operationally limited.
- Moving to individualised absolute fracture risk, using clinical risk factors and additionally incorporating bone mineral density where available, theoretically offers the most equitable solution.
- Implementation would require recognition of a fracture risk criterion for reimbursement, for example "high fracture risk syndrome", or simply "high fracture risk".
- As is currently espoused in most guidelines, the occurrence of a fracture should remain an indication for consideration of anti-osteoporosis treatment.
- We set out a "call to action" to the World Health Organization, nation states and the global field to implement measures to ensure that all individuals at high fracture risk worldwide receive appropriate assessment and treatment to optimise their bone health.

Keywords Access · Bone health · Epidemiology · Inequity · Management · Osteoporosis

Introduction

Access to optimal bone health management is highly variable across the world [1, 2]. The reasons for this are multiple and include variation in approaches to diagnostic and treatment thresholds, provision of clinical infrastructure, and issues of policy prioritisation. Within Europe, for example, on average, 71% of older women at high fracture risk do not receive appropriate assessment and treatment to improve their bone health [3]. Across the world, differences are even more stark with access particularly scarce in low- and middle-income countries (LMIC) [4]. It has been estimated that there are 37 million fractures worldwide each year in those over 55 years old [5]. Whilst age- and sex-specific rates of hip fracture have plateaued, or are even declining, in some higher income populations, incidence rates appear to be rising in many LMIC [6, 7]. Furthermore, with global population expansion, and a shift towards an older demographic, particularly in LMIC, it is estimated that fracture numbers will increase markedly worldwide in coming decades (Fig. 1) [7–11].

This inexorably increasing burden resulting from fractures in older age is in sharp contrast to the quantum of resource allocated for their prevention [3]. Key barriers have been identified across clinical provision, policy and government and patient awareness [1, 12]. However, even within the field, advances in management have not universally helped provision across the world. Thus, the disparity between the conceptual and densitometric definitions of osteoporosis, use of the dual-energy x-ray absorptiometry (DXA) bone mineral density (BMD) diagnostic threshold as an intervention criterion, lack of DXA provision in many countries and variation in the implementation of absolute fracture risk thresholds all contribute to limiting access.

In this Position Paper, resulting from an International Osteoporosis Foundation (IOF) Working Group held on 30th January 2025, we describe the history of approaches to the definition of osteoporosis, both conceptual and densitometric, and the benefits that these have brought for epidemiology and clinical care, recognising the imperative to distinguish between diagnostic and intervention thresholds. We describe the development of absolute fracture probability calculation, incorporating BMD as a risk factor where available and facilitating truly individualised risk assessment and management. We evaluate the gaps in care and barriers to optimal management worldwide, noting that the substantial variation in fracture risk internationally is not explained by BMD, and that DXA assessment is often the basis of reimbursement even if not actually available. Finally, we recommend possible ways to optimise access to bone health management globally, documenting universally applicable principles for local pragmatic adaptation.

Bone mineral density: strength and weaknesses

The conceptual description of osteoporosis dates back more than 30 years, arising from an international consensus conference sponsored by the National Institute of Arthritis and Musculoskeletal and Skin Diseases, the European Foundation for Osteoporosis and Bone Disease (now the International Osteoporosis Foundation) and the American

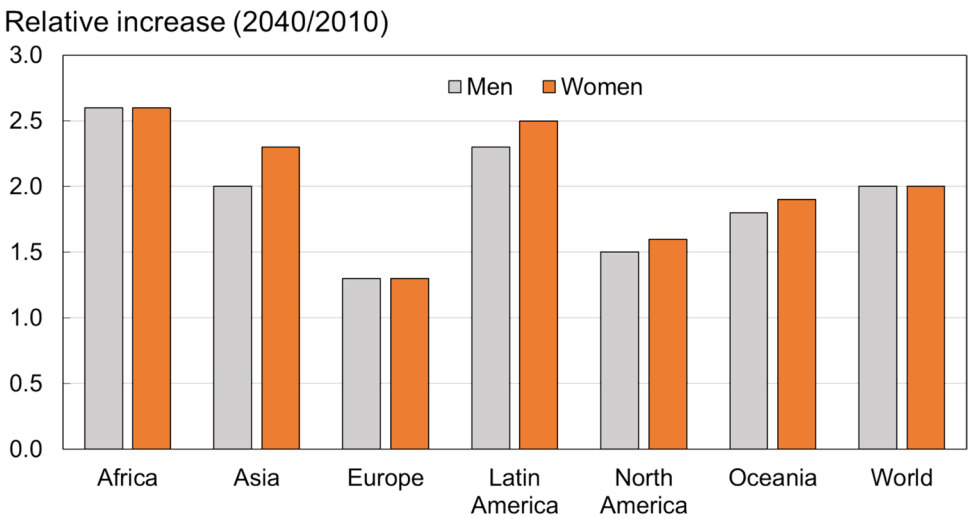

Fig. 1 Relative number of high fracture probability individuals globally in 2040 vs. 2010. Adapted with permission from Oden et al. [7]

National Osteoporosis Foundation (now the Bone Health and Osteoporosis Foundation) [13]. Osteoporosis was described as 'A 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', a conceptual definition supported several years later by the NIH Consensus Development Panel on Osteoporosis [14].

The World Health Organization diagnostic criteria for osteoporosis were developed shortly thereafter, based on the measurement of DXA-assessed BMD. At that time, BMD was the only aspect of skeletal fragility that could be readily measured in clinical practice and so formed the cornerstone for the operational definition of osteoporosis. Osteoporosis was thus defined as a BMD that was 2.5 standard deviations or more below the mean value of young healthy women, i.e. a T-score ≤ -2.5 SD [15, 16]. The criteria were subsequently updated and refined to remove the ambiguity of using multiple sites for BMD measurement, provide reference values for calculating T-scores and a definition for men aged 50 years or more [17]. The reference range for calculating the T-score in both men and women is the Third National Health and Nutrition Examination Survey (NHANES III) database for femoral neck measurements in White women aged 20–29 years [18]. The referents based in women apply equally to men aged 50 years or more since the gradient of risk and the age-adjusted risk of hip fracture for any given BMD at the femoral neck are similar in both sexes [19–21].

An important asset of the definition is that it provides a standardised description which permits the comparison of osteoporosis prevalence across countries and regions, and elucidation of secular trends [22]. In addition, the definition and its stability have yielded a regulatory framework in the USA, Europe, Japan and elsewhere, facilitating the development of a wide array of therapeutic interventions that act predominately by increasing BMD [23–27]. Indeed, it has been a critical component of the field's success in drug development [28–31], contrasting with the experience in other chronic musculoskeletal diseases, such as osteoarthritis and sarcopenia, for which there are no globally accepted diagnostic criteria to underpin the development of treatments [32].

Whereas the use of the BMD threshold for the diagnosis of osteoporosis has advanced the development of effective agents for its management, there are good reasons to believe that a given BMD is less appropriate as the sole intervention threshold. Firstly, BMD alone is a poor screening tool, in that many fractures in the community occur among individuals without BMD-defined osteoporosis [15, 33–35]. In the case of hip fractures, approximately 50% of cases in women will have densitometric osteoporosis [36, 37]. Secondly, femoral neck BMD has a different prognostic significance at different ages (Fig. 2) [38]. Third, it is well established that fracture rates vary widely from country to country, and indeed in some cases within a country according to factors such as race/ethnicity. This is much more so than can be explained by variations in BMD [37, 39, 40], so that for any given fracture risk, the mean T-score will vary from country to country [22]. The conclusion is that diagnostic thresholds (T-score ≤ -2.5) are not appropriate as intervention thresholds since the range of risk varies so markedly for any given BMD [38].

The use of the T-score as an intervention threshold and the sole gateway to therapy has given rise to problems. For example, some healthcare systems limit the reimbursement of treatment costs to those with a BMD T-score fulfilling the criteria for osteoporosis, with individuals at high fracture risk through non-BMD risk factors not eligible for therapy [41, 42]. This is further exacerbated by a relative lack of easy and/or timely access to DXA resources in many healthcare settings: a complete absence of functional DXA instruments is not unusual in LMIC [41–43]. Finally, this situation has also been exacerbated by misleading interpretations of clinical trial data that gave rise to a mistaken belief that osteoporosis treatments do not work in the absence of BMD-defined osteoporosis [44].

These problems arise because BMD captures the likelihood of fracture incompletely. There is an appropriate analogy with several other multifactorial outcomes and single risk factors, such as stroke and hypertension. Blood pressure is continuously distributed in the population (as is BMD), and hypertension is an important cause of stroke (high specificity). But a majority of individuals with stroke are normotensive (low sensitivity) [45]. Indeed, risk assessment

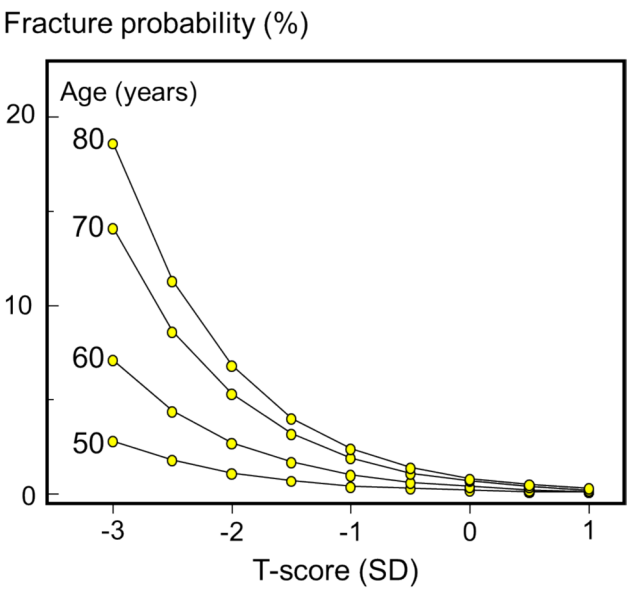

Fig. 2 Fracture probability in women by age and bone mineral density T-score at the hip. Based on data from Kanis et al. [38]

in hypertension has now moved to incorporation of risk calculators alongside use of blood pressure thresholds [46]. Notwithstanding, hypertension management has recently been complicated by a disparity in definition between the USA and other parts of the world [46]. In the context of bone health, these considerations raised the question as to whether the addition of other risk indicators could further improve the sensitivity of a risk assessment algorithm and hence the development of fracture risk prediction models. Of these, FRAX® is the most widely used [47].

Absolute fracture probability: individualised assessment and management

Clinical risk factors for fracture beyond BMD

In osteoporosis, as in many chronically progressive, non-communicable diseases, the clinical outcomes of relevance are best predicted by the combination of multiple risk factors [48]. Risk calculators, frequently provided online, are used in risk assessment for stroke, ischaemic heart disease, type 2 diabetes mellitus and dementia, as well as a number of common cancers [49, 50]. Given that age and sex are frequently identified as risk factors, multivariable risk calculators can usefully be defined as tools that comprise at least three easily accessible clinical risk factors (e.g. from lifestyle, personal and family history, clinical examination) combined with a technology, the latter requiring an investigation/measurement of a parameter that contributes to the assessment of risk (e.g. cholesterol, BMD). In the past 15 years, a great deal of research has taken place to identify factors other than BMD that contribute to fracture risk. Examples include age, sex, body mass index, prior fracture [51], family history of fracture [52], lifestyle risk factors such as smoking [53], alcohol intake [54] and falls [55], as well as medication use (glucocorticoids) and causes of secondary osteoporosis [56]. Many of these risk factors have been incorporated into multi-variable risk algorithms that have been developed and externally validated [57–59].

Development of fracture risk calculators

Three fracture risk assessment tools have been developed and further validated in at least one study outside the cohorts in which they were derived (Table 1), with others developed on a cohort-specific basis, for example as used in German and Italian guidelines [60, 61]. In 2008, the FRAX® tool was launched by the then WHO Collaborating Centre for Metabolic Bone Diseases at the University of Sheffield. Based on international data collected from 9 large cohorts, it comprises 10 risk factors with the optional inclusion of femoral neck BMD to calculate the 10-year probability of hip fracture or major osteoporotic fractures (MOFs: hip, clinical spine, humerus and wrist) [62]. The output is a probability rather than a simple incidence since it takes account of the competing risk of death; as a result, the probability of hip fracture plateaus in old age and then declines at extreme old age as the probability of death becomes dominant. Whilst falls are not included in the current version of FRAX, they constitute an important risk factor [63], are accommodated via FRAXplus® (or via a manual multiplier) and are considered for the next iteration of the FRAX risk engine [64]. The Garvan fracture risk calculator, launched in 2007, is based on 5 risk factors (Table 1) identified from a single cohort (the Dubbo Osteoporosis Epidemiology Study, $n = 2216$). Its outputs are the 5- and 10-year risk (incidence) of hip fracture or any fragility fracture [65]. Finally, a third tool, QFracture, is in its third iteration (2009, 2012 and 2016) and was developed from an electronic health record dataset in the UK. Like Garvan, QFracture does not adjust for the

Table 1 Comparative features of the Garvan, QFracture and FRAX tools

	Garvan	QFracture	FRAX
Development cohorts (*n* (country))	1 (Australia)	1 (UK)	9 (International)
Externally validated (Y/N, number of publications)	Y (< 20)	Y (< 10)	Y > 70
Calibrated	No	Yes (UK, hip only)	Yes
Applicability	Uncertain	UK	87 countries
Number of risk factors	5 (including weight or BMD)	23–25 (depending on sex)	11 (including optional BMD)
Falls as an input variable	Yes	Yes	No[#]
BMD as an input variable	Yes	No	Yes
Prior fracture as input variable	Yes	Yes	Yes
Family history as input variable	No	Yes	Yes
Outcome	All fractures excluding digits	Hip, forearm, spine, shoulder	Hip, forearm, spine, humerus
Outcome metric	Incidence	Incidence	Probability

[#]Available through FRAXplus (www.fraxplus.org) with other adjustments

competing risk of death, but unlike Garvan and FRAX, it does not have the facility to include BMD as a risk factor [66, 67]. A further difference between FRAX and these other tools is that FRAX probability outputs are calibrated to the epidemiology of fracture and death rates in the countries of use. Of the three tools, FRAX is by far the most studied and validated in external cohorts and is incorporated into over 100 clinical guidelines worldwide (Table 1) [68].

Clinical utility of FRAX in the absence of BMD

A core aim during the development of the FRAX algorithms, under a WHO approved programme, was that the tool would be sufficiently flexible to be used globally in the context of many primary care settings, including those where BMD testing was not readily available. While the performance of FRAX is optimal when clinical risk factors are combined with femoral neck BMD, the performance of the clinical risk factors alone in predicting fracture risk is the same as that of BMD alone [62]. Indeed, these risk factors can be used for fracture risk assessment in the absence of BMD tests, thus widening the opportunity for risk assessment in countries and healthcare settings where DXA provision is absent or limited [69, 70]. Early concerns that treatment for osteoporosis would only be effective in the presence of low BMD, usually BMD-defined osteoporosis, were addressed by ensuring that some of the clinical risk factors (e.g. age, BMI, prior fracture) were strongly related to BMD. Since then, a number of studies have demonstrated that osteoporosis therapies are comparably effective in patients with BMD above the osteoporosis threshold as in those with BMD-defined osteoporosis [44, 71]. More recently, several studies of population screening have used FRAX as the initial stage in identifying patients at high risk of fracture, with a meta-analysis showing a significant reduction in hip fractures, major osteoporotic fractures and osteoporotic fractures in the screened population [72]. The ability of FRAX, in the absence of BMD, to accurately stratify fracture risk in the screened population was clearly demonstrated in one of these studies (Fig. 3) [73].

Gaps and barriers in fracture risk management worldwide

There are several further considerations beyond osteoporosis definition and approaches to risk assessment in achieving an equitable approach to bone health management across the globe, particularly in LMIC, where the ageing population will continue to rise exponentially over coming decades [74, 75]. This inevitable expansion is expected to double the prevalence of osteoporosis and fractures in older age, associated comorbidities, and increase associated morbidity and mortality in coming years [7, 10, 11, 76]. Rapid urbanisation, consequences of HIV and its treatment, multimorbidity, malnutrition, changing physical activity patterns and climate change will contribute to this rise [76–78]. Finding a way to move away from a reliance on DXA-based thresholds and context-specific adaptation of fracture risk assessment tools is an urgent priority. Beyond the specifics of osteoporosis diagnosis and care, there are wider barriers at the level of patients and caregivers, healthcare professionals, healthcare systems and policymakers locally, regionally and nationally [75, 77, 78].

Firstly, reliance on DXA-service provision is not an option in many resource-limited settings. DXA scanners are expensive and require specialist software and support, together with a reliable electricity supply. In many countries, if they are available at all, there is less than 1 scanner per million population [75, 79–81]. Widespread DXA scanning provision is therefore not practicable, particularly in the resource-constrained public healthcare settings in which most patients

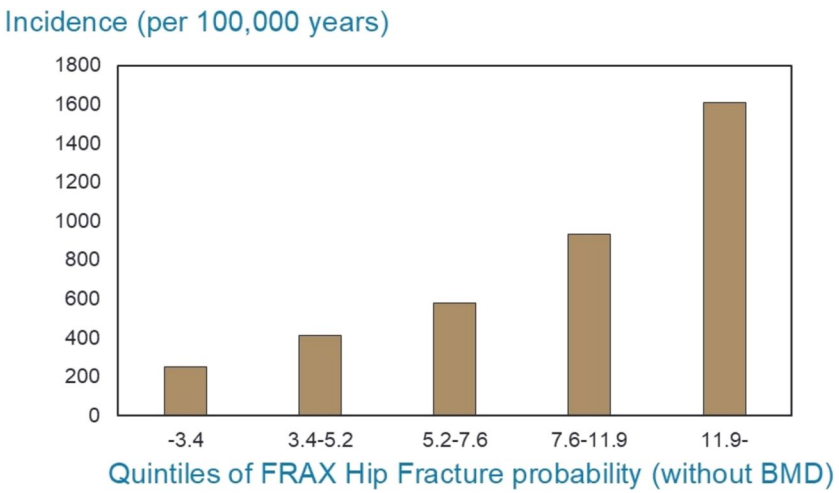

Fig. 3 Association between FRAX probability of hip fracture, assessed without BMD at the femoral neck and subsequent incidence of hip fracture in the control arm of the SCOOP study. Values on the *x*-axis represent the limits of each quintile (% hip fracture probability)

would present. The problem might be mitigated by other less expensive recent technologies that can, or are likely to, provide information on skeletal status over and above that provided by FRAX [82–89]. However, resource constraints are such that even these alternative technologies may have limited scope for implementation in many settings. Where DXA is scarce, simple algorithms such as the Osteoporosis Self-Assessment Tool for Asians (OSTA) can be applied to identify those individuals who may benefit from further DXA evaluation [90–92]. A further critical issue is reimbursement, which varies country by country, from a no reimbursement model in some countries to full reimbursement in others [41, 42, 75, 81, 93]. Reliance on patient financing of tests and medication presents a major challenge, where often osteoporosis care is not a priority for household income. Validation of methods for non-specialist fracture risk assessment presents a potential solution that does not rely on DXA. Whilst the FRAX tool has coverage of over 80% of the world's population, implementation in remaining settings, for example African countries, will necessitate collection of robust epidemiological data for fracture prevalence and incidence. Furthermore, there is currently inadequate understanding regarding the contribution of additional context-specific clinical risk factors such as HIV infection and malnutrition, which are likely to be important beyond age, BMD, prior fracture and alcohol intake [11, 77, 94].

To achieve successful implementation of diagnostic and treatment guidelines, investment in training and increased numbers of primary care providers and medical specialists, such as geriatricians, rheumatologists, radiologists and allied-health professionals will be essential [79, 81]. In some regions, medical pluralism is also common, particularly in West Africa where traditional bone setters are usually the first point of contact on a complex care pathway, which can result in treatment delays.

At governmental level, national fracture risk management guidelines should be written, or if already available, implemented. Since access to medicines used commonly in high-income countries for primary and secondary fracture prevention is most often only possible in private healthcare settings, provision is often extremely limited for those without adequate financial resources. This largely reflects lack of prioritisation of osteoporosis medicines as being 'essential' by the WHO. Therefore, the inclusion of osteoporosis medicines on country-level essential medicines lists should be prioritised. Consideration should be given to fracture risk assessment integration into existing healthcare systems for at risk groups. Where medical pluralism is common, training of traditional bone setters would be advantageous to promote recognition of when medical bone health management might be indicated. Finally, public health campaigns to raise patient and caregiver awareness of the importance of bone health and osteoporosis to healthy ageing are needed.

Currently, ageing populations in low- and middle-income countries do not have equitable access to diagnostic and treatment options to reduce future fracture risk and subsequent disability. Clearly, this is a complex challenge requiring action and prioritisation whilst maintaining realistic goals for resource-poor settings. Awareness is certainly increasing, with recognition of the importance of appropriate diagnostic and management pathways. Healthcare system readiness is essential [95]. The achievement of equitable access to diagnostic services, creation of implementable tools for diagnosis and treatment monitoring, and building capacity in the provision of healthcare and specific expertise in fracture prevention care should be key goals for healthcare services, policymakers and governments.

Achieving equitable global access to bone health care

Barriers to care

It is apparent that in addition to the inadequate levels of care provision in many countries, particularly the lack of access to DXA equipment, there are two key structural barriers to optimal access. Firstly, osteoporosis may be viewed either in terms of its conceptual definition, relating to reduced bone mass and structure, and/or in terms of its densitometric definition, predicated on a T-score threshold of − 2.5 [15]. Usually, only the latter is reimbursable, but it is not uncommon for physicians to diagnose "conceptual" or "clinical" osteoporosis on the basis of a fracture without consideration of BMD. So, a patient may simultaneously be told that they have osteoporosis whilst not being eligible for treatment. This is further compounded by the lack of access to DXA in many LMIC, whereby even if an individual does have a BMD T-score lower than − 2.5, it simply will not be detected.

Osteoporosis qualification

Firstly, in terms of possible solutions, alteration of the densitometric definition BMD threshold would simply frameshift problems described above in either direction and thus would not serve any useful purpose; indeed, the resulting uncertainty and confusion would be highly deleterious to the field [22]. However, in keeping with the approach recently taken in rare bone disease [96], the term "osteoporosis" could be followed by a qualifier, i.e. "osteoporosis-clinical" or "osteoporosis-densitometric" (or more simply "clinical osteoporosis" or "densitometric osteoporosis"). This has the merit of a more precise disease classification, at least for the densitometric part. However, there is no real agreement as to how "clinical" osteoporosis might be defined and whether this should constitute an intervention threshold as

well as a diagnostic threshold. Most guidelines consider the occurrence of a fracture in older age as an indication for consideration of anti-osteoporosis treatment, albeit variably linked to reimbursement [47]. It has been suggested, for example in the USA, that such a fracture occurrence should constitute diagnosis of osteoporosis [97]. However, these two pathways represent fundamentally different concepts, and although laudable in its aims of increasing access to treatment through reimbursement, the latter approach generates further problems [98]. Defining an individual who has experienced a fracture as having osteoporosis is akin to diagnosing hypercholesterolaemia (or maybe hypertension or a smoking history) in somebody who experiences a myocardial infarction, i.e. conflating a selected risk factor with the associated outcome [99]. Furthermore, because fracture risk varies globally tenfold, but BMD only twofold, this approach would lead to differences in fracture risk between densitometric and clinical osteoporosis definitions, generating inequity within what might be viewed as a single disease [99]. Whilst an osteoporosis subtype approach might facilitate access to anti-osteoporosis medications in some scenarios, these would be limited to situations where patients have osteoporotic BMD or have experienced a fracture. Primary fracture prevention would be prohibited in the absence of densitometry, as it is difficult to conceive of a further definition of osteoporosis which could be demarcated clinically without the occurrence of a fracture. Therefore, quite apart from the resulting inequity and potential confusion that two definitions with the same name may cause (indeed as is the case currently), we need an approach which facilitates adjudication of treatment after, but also, before, the occurrence of a fracture.

High fracture risk syndrome

The calculation of individualised absolute fracture probability [100] presents, in principle, a practical solution. Because the metric incorporates individual characteristics, including calibration to the country of origin, it accounts for variation in fracture risk worldwide. Only clinical risk factors are required; where available, DXA BMD may be incorporated, but is not mandatory, for FRAX calculation [64]. Notwithstanding, DXA may provide additional information on prior fracture, revealing occult vertebral fractures ascertained through lateral spinal images [101], and as noted above, the use of additional technology that brings information on skeletal status is appropriate where available. Absolute fracture probability can be linked to intervention thresholds, which may be age-dependent, hybrid or fixed, with the former two approaches espoused by the IOF, and incorporated into many guidelines internationally [47, 102, 103]. Indeed, as discussed above, we support the approach adopted increasingly widely of age-dependent thresholds [47]. The current weak link in the chain however is that, whilst some guidelines do indicate treatment on the basis of fracture probability (see above), there is no clinical condition called "high fracture risk" universally approved as a reimbursement criterion in healthcare systems. Implementation as "high fracture risk syndrome" (or indeed simply "high fracture risk") might be one option. A syndrome has been defined as a recognisable complex of symptoms and physical findings which indicate a specific condition for which a direct cause is not necessarily understood [104]. Thus, the term seems appropriate for a constellation of clinical risk factors for fracture, resulting in a high fracture risk. Achieving traction will undoubtedly require the active involvement of the World Health Organization linked with the health ministries of member states. We thus announce this as a "Call to Action" for the WHO and nations globally (and indeed for the International Osteoporosis Foundation and other societies) to achieve a single reimbursement criterion which would ensure that all people at high fracture risk worldwide be identified and receive appropriate assessment and treatment to optimise their bone health.

Conclusions

Our ability to manage fracture risk has progressed enormously over the last 50 years, with the advent of well-established methods for fracture risk assessment and highly effective treatments to improve bone strength. What is equally clear is that access to optimal bone health management is highly uneven across the world. Lack of DXA provision coupled with densitometry-dependent reimbursement criteria, together with confusion between diagnostic and intervention thresholds, are key concerns. The occurrence of a fracture should remain an indication for treatment consideration and should constitute a criterion for access to anti-osteoporosis medication. Out with the occurrence of a fracture, we conclude that a universally agreed reimbursement criterion based on clinical risk factors, and not solely dependent upon DXA BMD, offers a solution, perhaps termed "high fracture risk syndrome" or more simply "high fracture risk". This should not be misconstrued to mean that DXA is unnecessary for treatment decisions or the monitoring of treatment. Indeed, the converse is true where this is available, supporting treatment stratification, monitoring and detection of occult vertebral fractures [101, 105]. For this approach to achieve traction, the new criterion would require acceptance for reimbursement in country-specific healthcare systems. Whilst the International Osteoporosis Foundation is committed to advance this cause, it is very apparent that optimal implementation is only likely to be achieved via advocacy from the World Health Organization, linked with cooperation from individual nation states, the focus now of our urgent "Call to Action".

Acknowledgements We are very grateful to Dr Dominique Pierroz, Loreleï Demullier and Laura Misteli, International Osteoporosis Foundation, for editorial and administrative support. NCH and KW are supported by the UK Medical Research Council (MRC) [MC_PC_21003; MC_PC_21001], National Institute for Health Research (NIHR) Southampton Biomedical Research Centre, University of Southampton and University Hospital Southampton NHS Foundation Trust, UK. NCH is additionally supported by NIHR (as an NIHR Senior Investigator, NIHR305844).

We are grateful to the following societies and stakeholders for their endorsement of this position paper:

Argentine Association of Osteology and Mineral Metabolism (AAOMM)	Argentina
Asian Pacific Osteoporosis Foundation	Hong Kong
Asociación Mexicana de Metabolismo Óseo y Mineral (AMMOM)	Mexico
Association Française de Lutte Anti-Rhumatismale (AFLAR)	France
Australian Rheumatology Association	Australia
Austrian Society for Bone and Mineral Research (ÖGKM)	Austria
Belgian Ageing Muscle Society	Belgium
Belgian Bone Club	Belgium
Bone Health and Osteoporosis Foundation	United States of America
Bone Research Society	United Kingdom
British Geriatrics Society	United Kingdom
British Menopause Society	United Kingdom
Bulgarian League for the Prevention of Osteoporosis	Bulgaria
Butterfly Bone Health	Greece
Costarican Menopause and Osteoporosis Association (ACCMYO)	Costa Rica
Croatian League Against Rheumatism	Croatia
Cyprus Society Against Osteoporosis and Musculoskeletal Diseases	Cyprus
Czech Society for Metabolic Bone Diseases	Czech Republic
Dachverband Deutschsprachiger Wissenschaftlicher Gesellschaften für Osteologie	Germany
Egyptian Academy of Bone Health and Metabolic Bone Diseases	Egypt
Egyptian Society for Osteoporosis, Joint Diseases and Geriatrics	Egypt
Emirates Osteoporosis Society	United Arab Emirates
Endocrinology and Metabolism Research Institute	Iran
European Calcified Tissue Society (ECTS)	European Region
European Geriatric Medicine Society (EuGMS)	European Region
European M.E.N Alliance e.V	European Region
European Menopause and Andropause Society (EMAS)	European Region
Finnish Bone Association (Suomen Luustoliitto)	Finland
Fondazione Italiana Ricerca sulle Malattie dell'Osso (FIRMO)	Italy
Fragility Fracture Network	Worldwide
Fundacion de Investigaciones Reumatológicas y Osteológicas	Argentina
Fundacion de Osteoporosis y Enfermedades Metabolicas Oseas (FOSEMO)	Panama
Fundación Hispana de Osteoporosis y Enfermedades Metabólicas Óseas (FHOEMO)	Spain
Georgian Association of Skeletal Metabolism Diseases	Georgia
Hellenic Osteoporosis Foundation	Greece
Hellenic Society for the Study of Bone Metabolism	Greece
International Bone Ultrasound Society	Worldwide
International Osteoporosis Foundation (IOF)	Worldwide
International Menopause Society	Worldwide
International Society for Clinical Densitometry	Worldwide
Irish Osteoporosis Society	Ireland
Istanbul Musculoskeletal Health Consortium	Türkiye
Italian Society of Rheumatology	Italy
Japan Osteoporosis Society	Japan
Korean Society of Osteoporosis	South Korea
Kosovo Osteoporosis Association	Kosovo
Kuwait Osteoporosis Society	Kuwait
Malta Osteoporosis Society	Malta
Mansoura University, Faculty of Medicine, Internal Medicine Department, Endocrinology & Metabolism Unit, Specialized Medical Hospital	Egypt
Mongolian Naran Society for Osteoarthritis and Musculoskeletal Health	Mongolia
National Osteoporosis Foundation of South Africa (NOFSA)	South Africa
National Spine Health Foundation	United States of America
Osteoporosförbundet	Sweden
Osteoporosis 2000	United Kingdom
Osteoporosis Canada	Canada
Osteoporosis Dorset	United Kingdom
Osteoporosis New Zealand	New Zealand
Osteoporosis Society of the Philippines Foundation, Inc	Philippines
OSTEORUS	Russia
Polish Osteoarthrology Society	Poland
Primary Care Rheumatology and Musculoskeletal Medicine Society	United Kingdom
Qatar Rheumatology Society	Qatar
Romanian Society of Osteoporosis and Musculoskeletal Diseases (SROBMS)	Romania
Royal Osteoporosis Society	United Kingdom
Russian Association on Osteoporosis (RAOP)	Russia
Saudi Osteoporosis Society	Saudi Arabia
Serbia Osteoporosis Society	Serbia

Slovak Osteoporosis Society	Slovakia
Slovak Society for Osteoporosis and Metabolic Bone Disease	Slovakia
Sociedad Chilena de Endocrinologia y Diabetes (SOCHED)	Chile
Sociedad Espanola de Investigaciones Osea y Metabolismo Mineral (SEIOMM)	Spain
Societa Italiana Osteoporosi e Malattie Metabolismo Minerale e Scheletrico (SIOMMMS)	Italy
Société Francaise de Rhumatologie	France
Society for Endocrinology	United Kingdom
Society of Osteoporosis in the Federation of Bosnia & Herzegovina	Bosnia and Herzegovina
Swedish Osteoporosis Society	Sweden
Taiwanese Osteoporosis Association	Taiwan
Thai Osteoporosis Foundation	Thailand
Thailand Metabolic Bone Disorder and Orthogeriatrics Society	Thailand
Turkish Academic Geriatrics Society	Türkiye
Turkish Joint Diseases Foundation	Türkiye
Turkish Osteoporosis Society	Türkiye
Ukraine Association of Osteoporosis	Ukraine
University Hospitals of Derby and Burton NHS Foundation Trust	United Kingdom
University of Padova, School of Medicine, Department of Medicine DIMED, Division of Rheumatology	Italy
Uruguayan Society of Rheumatology	Uruguay
World Falls Prevention Society (WFPS)	Global

Funding This work was supported by the International Osteoporosis Foundation.

Declarations

Ethics approval This Position Paper article contains no original data and thus issues of ethics, informed consent and patient confidentiality do not apply.

Conflicts of interest NC Harvey reports personal fees, consultancy, lecture fees and/or honoraria from Alliance for Better Bone Health, AMGEN, MSD, Eli Lilly, UCB, Kyowa Kirin, Servier, Shire, Echolight, Consilient Healthcare, Theramex and Internis Pharma outside the submitted work. ML Brandi reports honoraria: Amgen, Ascendis, Bruno Farmaceutici, Calcilytix, Kyowa Kirin; Grants and/or speaker: Alexion, Amgen, Amolyt, Bruno Farmaceutici, CoGeDi, Echolight, Gedeon Richter, Kyowa Kirin, Monte Rosa Therapeutics, UCB; Consultant: Aboca, Alexion, Amolyt, Bruno Farmaceutici, Calcilytix, Echolight, Enterabio, Kyowa Kirin, Personal Genomics, Septerna. C Campusano reports lecture fees and/or honoraria from Faes farma, Novartis, Sandoz, Asofarma. M Chandran reports honoraria and consulting fees from Amgen Asia, Promedius. C Cooper reports personal fees, consultancy, lecture fees and/or honoraria from ABBH, Amgen, Eli Lilly, GSK, Medtronic, Merck, Novartis, Pfizer, Roche, Servier and Takeda. M Lazaretti reports consultancy and lecture fees from Theramex, Sandoz, Astrazeneca, Mantecorp and Myralis. J Kanis is a director of Osteoporosis Research Ltd which maintains FRAX. E McCloskey reports personal fees, consultancy, lecture fees and/or honoraria from Amgen, Fresenius Kabi, Theramex, UCB. Director, Osteoporosis Research Ltd. N Al-Daghri, C Beaudart, N Burlet, E Cavalier, B Dawson-Hughes, P Halbout, T Hough, R Matijevic, A Mithal, N Njeze, R Rizzoli, Y Saleh, K Ward report no disclosures.

References

1. Harvey NC, McCloskey EV, Mitchell PJ, Dawson-Hughes B, Pierroz DD, Reginster JY, Rizzoli R, Cooper C, Kanis JA (2017) Mind the (treatment) gap: a global perspective on current and future strategies for prevention of fragility fractures. Osteoporos Int 28:1507–1529
2. Curtis EM, Dennison EM, Cooper C, Harvey NC (2022) Osteoporosis in 2022: care gaps to screening and personalised medicine. Best Pract Res Clin Rheumatol 36:101754
3. Kanis JA, Norton N, Harvey NC, Jacobson T, Johansson H, Lorentzon M, McCloskey EV, Willers C, Borgström F (2021) SCOPE 2021: a new scorecard for osteoporosis in Europe. Arch Osteoporos 16:82
4. Chattu VK, Singh B, Pattanshetty S, Reddy S (2023) Access to medicines through global health diplomacy. Health Promot Perspect 13:40–46
5. (2021) Global, regional, and national burden of bone fractures in 204 countries and territories, 1990–2019: a systematic analysis from the Global Burden of Disease Study 2019. Lancet Healthy Longev 2:e580-e592
6. Cooper C, Cole ZA, Holroyd CR, Earl SC, Harvey NC, Dennison EM, Melton LJ, Cummings SR, Kanis JA (2011) Secular trends in the incidence of hip and other osteoporotic fractures. Osteoporos Int 22:1277–1288
7. Oden A, McCloskey EV, Kanis JA, Harvey NC, Johansson H (2015) Burden of high fracture probability worldwide: secular increases 2010–2040. Osteoporos Int 26:2243–2248
8. Gullberg B, Johnell O, Kanis JA (1997) World-wide projections for hip fracture. Osteoporos Int 7:407–413
9. Cooper C, Campion G, Melton LJ (1992) Hip fractures in the elderly: a world-wide projection. Osteoporos Int 2:285–289
10. Hawley S, Dela S, Burton A, Paruk F, Cassim B, Gregson CL (2022) Incidence and number of fragility fractures of the hip in South Africa: estimated projections from 2020 to 2050. Osteoporos Int 33:2575–2583
11. Wilson H, Manyanga T, Burton A, et al (2024) Age and sex specific incidence rates and future projections for hip fractures in Zimbabwe BMJ Global Health 10(1):e017365
12. Kanis JA, Svedbom A, Harvey N, McCloskey EV (2014) The osteoporosis treatment gap. J Bone Miner Res 29:1926–1928
13. WA P (1993) Consensus development conference: diagnosis, prophylaxis, and treatment of osteoporosis. Am J Med 94:646–650

14. Klibanski A, Adams-Campbell L, Bassford T, Blair SN, Boden SD, Dickersin K, ... Russell WE (2001) Osteoporosis prevention, diagnosis, and therapy. JAMA 285:785–795
15. WHO (1994) Assessment of fracture risk and its application to screening for postmenopausal osteoporosis. World Health Organization, Geneva
16. Kanis JA, Melton LJ 3rd, Christiansen C, Johnston CC, Khaltaev N (1994) The diagnosis of osteoporosis. J Bone Miner Res 9:1137–1141
17. Kanis JA, McCloskey EV, Johansson H, Oden A, Melton LJ 3rd, Khaltaev N (2008) A reference standard for the description of osteoporosis. Bone 42:467–475
18. Looker AC, Wahner HW, Dunn WL, Calvo MS, Harris TB, Heyse SP, Johnston CC Jr, Lindsay R (1998) Updated data on proximal femur bone mineral levels of US adults. Osteoporos Int 8:468–489
19. Johnell O, Kanis JA, Oden A et al (2005) Predictive value of BMD for hip and other fractures. J Bone Miner Res 20:1185–1194
20. De Laet CE, Van Hout BA, Burger H, Weel AE, Hofman A, Pols HA (1998) Hip fracture prediction in elderly men and women: validation in the Rotterdam study. J Bone Miner Res 13:1587–1593
21. Langsetmo L, Leslie WD, Zhou W et al (2010) Using the same bone density reference database for men and women provides a simpler estimation of fracture risk. J Bone Miner Res 25:2108–2114
22. Kanis JA, Johansson H, Lorentzon M, Harvey NC, McCloskey EV (2025) Conflating the operational definition of osteoporosis with intervention thresholds. Calcif Tissue Int 116:22
23. FDA (1994) Food and Drug Administration Guidelines for preclinical and clinical evaluation of agents used in the prevention or treatment of postmenopausal osteoporosis. Division of Metabolism and Endocrine Drug Products, Food and Drug Administration, Rockville, MD
24. CHMP (2006) Guideline on the evaluation of medicinal products in the treatment of primary osteoporosis. Ref CPMP/EWP/552/95Rev.2, London, UK
25. Reginster JY, Abadie E, Delmas P et al (2006) Recommendations for an update of the current (2001) regulatory requirements for registration of drugs to be used in the treatment of osteoporosis in postmenopausal women and in men. Osteoporos Int 17:1–7
26. WHO (1998) Guidelines for preclinical evaluation and clinical trials in osteoporosis. World Health Organization, Geneva
27. Agency PaMD (2022) Japan Ministry of Health, Japan
28. Wasnich RD, Miller PD (2000) Antifracture efficacy of antiresorptive agents are related to changes in bone density. J Clin Endocrinol Metab 85:231–236
29. Cummings SR, Karpf DB, Harris F, Genant HK, Ensrud K, LaCroix AZ, Black DM (2002) Improvement in spine bone density and reduction in risk of vertebral fractures during treatment with antiresorptive drugs. Am J Med 112:281–289
30. Hochberg MC, Greenspan S, Wasnich RD, Miller P, Thompson DE, Ross PD (2002) Changes in bone density and turnover explain the reductions in incidence of nonvertebral fractures that occur during treatment with antiresorptive agents. J Clin Endocrinol Metab 87:1586–1592
31. Bouxsein ML, Eastell R, Lui LY, Wu LA, de Papp AE, Grauer A, Marin F, Cauley JA, Bauer DC, Black DM (2019) Change in bone density and reduction in fracture risk: a meta-regression of published trials. J Bone Miner Res 34:632–642
32. Harvey NC, Clegg PD, Dennison EM et al (2022) UKRI MRC national musculoskeletal ageing network: strategic prioritisation to increase healthy lifespan and minimise physical frailty. Arch Osteoporos 17:147
33. Cranney A, Jamal SA, Tsang JF, Josse RG, Leslie WD (2007) Low bone mineral density and fracture burden in postmenopausal women. CMAJ 177:575–580
34. Kanis JA, Johnell O, Oden A, Jonsson B, Dawson A, Dere W (2000) Risk of hip fracture derived from relative risks: an analysis applied to the population of Sweden. Osteoporos Int 11:120–127
35. Kanis JA, Johnell O, Oden A, Jonsson B, De Laet C, Dawson A (2000) Prediction of fracture from low bone mineral density measurements overestimates risk. Bone 26:387–391
36. Wainwright SA, Marshall LM, Ensrud KE, Cauley JA, Black DM, Hillier TA, Hochberg MC, Vogt MT, Orwoll ES (2005) Hip fracture in women without osteoporosis. J Clin Endocrinol Metab 90:2787–2793
37. Odén A, McCloskey EV, Johansson H, Kanis JA (2013) Assessing the impact of osteoporosis on the burden of hip fractures. Calcif Tissue Int 92:42–49
38. Kanis JA, Johnell O, Oden A, Dawson A, De Laet C, Jonsson B (2001) Ten year probabilities of osteoporotic fractures according to BMD and diagnostic thresholds. Osteoporos Int 12:989–995
39. Kanis JA, Oden A, McCloskey EV, Johansson H, Wahl DA, Cooper C, Epidemiology IOFWGo, Quality of L (2012) A systematic review of hip fracture incidence and probability of fracture worldwide. Osteoporos Int 23:2239–2256
40. Kanis JA, Cooper C, Dawson-Hughes B, Harvey NC, Johansson H, Lorentzon M, McCloskey EV, Reginster JY, Rizzoli R (2020) FRAX and ethnicity. Osteoporos Int 31:2063–2067
41. Willers C, Norton N, Harvey NC, Jacobson T, Johansson H, Lorentzon M, McCloskey EV, Borgström F, Kanis JA (2022) Osteoporosis in Europe: a compendium of country-specific reports. Arch Osteoporos 17:23
42. International Osteoporosis Foundation (2013) The Asia-Pacific Regional Audit: epidemiology, costs & burden of osteoporosis in 2013. Nyon, Switzerland
43. Kanis JA, Johnell O (2005) Requirements for DXA for the management of osteoporosis in Europe. Osteoporos Int 16:229–238
44. McCloskey E (2016) A BMD threshold for treatment efficacy in osteoporosis? A need to consider the whole evidence base. Osteoporos Int 27:417–419
45. Li Y, Wei FF, Thijs L et al (2014) Ambulatory hypertension subtypes and 24-hour systolic and diastolic blood pressure as distinct outcome predictors in 8341 untreated people recruited from 12 populations. Circulation 130:466–474
46. de la Sierra A (2019) New American and European hypertension guidelines, reconciling the differences. Cardiol Ther 8:157–166
47. Kanis JA, Harvey NC, Cooper C, Johansson H, Oden A, McCloskey EV (2016) A systematic review of intervention thresholds based on FRAX: a report prepared for the National Osteoporosis Guideline Group and the International Osteoporosis Foundation. Arch Osteoporos 11:25
48. Collins GS, Reitsma JB, Altman DG, Moons KG (2015) Transparent reporting of a multivariable prediction model for individual prognosis or diagnosis (TRIPOD): the TRIPOD statement. BMJ 350:g7594
49. Juchli F, Zangger M, Schueck A, von Wolff M, Stute P (2021) Chronic non-communicable disease risk calculators - an overview, part I. Maturitas 143:25–35
50. Juchli F, Zangger M, Schueck A, von Wolff M, Stute P (2021) Chronic non-communicable disease risk calculators - an overview, Part II. Maturitas 143:132–144
51. Kanis JA, Johnell O, De Laet C et al (2004) A meta-analysis of previous fracture and subsequent fracture risk. Bone 35:375–382
52. Kanis JA, Johansson H, Oden A et al (2004) A family history of fracture and fracture risk: a meta-analysis. Bone 35:1029–1037
53. Kanis JA, Johnell O, Oden A et al (2005) Smoking and fracture risk: a meta-analysis. Osteoporos Int 16:155–162

54. Kanis JA, Johansson H, Johnell O, Oden A, De Laet C, Eisman JA, Pols H, Tenenhouse A (2004) Alcohol intake as a risk factor for fracture. Osteoporos Int 16(7):737–42
55. Harvey NC, Oden A, Orwoll E et al (2018) Falls predict fractures independently of FRAX probability: a meta-analysis of the osteoporotic fractures in men (MrOS) study. J Bone Miner Res 33:510–516
56. Kanis J.A. on behalf of the WHO Scientific Group (2008) Assessment of osteoporosis at the primary health-care level. Technical Report. WHO Collaborating Centre, University of Sheffield, UK
57. Marques A, Ferreira RJ, Santos E, Loza E, Carmona L, da Silva JA (2015) The accuracy of osteoporotic fracture risk prediction tools: a systematic review and meta-analysis. Ann Rheum Dis 74:1958–1967
58. Beaudoin C, Moore L, Gagné M, Bessette L, Ste-Marie LG, Brown JP, Jean S (2019) Performance of predictive tools to identify individuals at risk of non-traumatic fracture: a systematic review, meta-analysis, and meta-regression. Osteoporos Int 30:721–740
59. Rubin KH, Friis-Holmberg T, Hermann AP, Abrahamsen B, Brixen K (2013) Risk assessment tools to identify women with increased risk of osteoporotic fracture: complexity or simplicity? A systematic review. J Bone Miner Res 28:1701–1717
60. Cortet B, Guañabens N, Brandi ML, Siggelkow H (2024) Similarities and differences between European guidelines for the management of postmenopausal osteoporosis. Arch Osteoporos 19:84
61. Thomasius F, Kurth A, Baum E, Drey M, Maus U, Schmidmaier R (2025) Clinical practice guideline: the diagnosis and treatment of osteoporosis. Dtsch Arztebl Int 122:12–18
62. Kanis JA, Oden A, Johnell O et al (2007) The use of clinical risk factors enhances the performance of BMD in the prediction of hip and osteoporotic fractures in men and women. Osteoporos Int 18:1033–1046
63. WFPS (2025) Falls guideline algorithm. World Falls Prevention Society
64. Schini M, Johansson H, Harvey NC, Lorentzon M, Kanis JA, McCloskey EV (2023) An overview of the use of the fracture risk assessment tool (FRAX) in osteoporosis. J Endocrinol Invest 47(3):501–511
65. Nguyen ND, Frost SA, Center JR, Eisman JA, Nguyen TV (2007) Development of a nomogram for individualizing hip fracture risk in men and women. Osteoporos Int 18:1109–1117
66. Hippisley-Cox J, Coupland C (2012) Derivation and validation of updated QFracture algorithm to predict risk of osteoporotic fracture in primary care in the United Kingdom: prospective open cohort study. BMJ 344:e3427
67. Hippisley-Cox J, Coupland C (2009) Predicting risk of osteoporotic fracture in men and women in England and Wales: prospective derivation and validation of QFracture scores. BMJ 339:b4229
68. Kanis JA, Harvey NC, Cooper C, Johansson H, Oden A, McCloskey EV, Advisory Board of the National Osteoporosis Guideline G (2016) A systematic review of intervention thresholds based on FRAX: a report prepared for the National Osteoporosis Guideline Group and the International Osteoporosis Foundation. Arch Osteoporos 11:25
69. Leslie WD, Morin S, Lix LM, Johansson H, Oden A, McCloskey E, Kanis JA (2011) Fracture risk assessment without bone density measurement in routine clinical practice. Osteoporos Int 23(1):75–85
70. Kanis JA, McCloskey E, Johansson H, Oden A, Leslie WD (2012) FRAX((R)) with and without bone mineral density. Calcif Tissue Int 90:1–13
71. Reid IR, Horne AM, Mihov B, Stewart A, Garratt E, Wong S, Wiessing KR, Bolland MJ, Bastin S, Gamble GD (2018) Fracture prevention with zoledronate in older women with osteopenia. N Engl J Med 379:2407–2416
72. Merlijn T, Swart KMA, van der Horst HE, Netelenbos JC, Elders PJM (2020) Fracture prevention by screening for high fracture risk: a systematic review and meta-analysis. Osteoporos Int 31:251–257
73. McCloskey E, Johansson H, Harvey NC et al (2018) Management of patients with high baseline hip fracture risk by FRAX reduces hip fractures-a post hoc analysis of the SCOOP study. J Bone Miner Res 33:1020–1026
74. Nations U (2019) Decade of healthy ageing: action plan. United Nations,
75. International Osteoporosis Foundation (2012) The Latin America Regional Audit: epidemiology, costs & burden of osteoporosis in 2012. Nyon, Switzerland
76. Ballane G, Cauley JA, Luckey MM, Fuleihan Gel H (2014) Secular trends in hip fractures worldwide: opposing trends east versus west. J Bone Miner Res 29:1745–1755
77. Ward KA, Madanhire T, Marenah K, Micklesfield LK, Gregson CL (2024) Disparities in fragility fracture and osteoporosis care in Africa. Lancet Diabetes Endocrinol 12(5):294–296
78. Ward KA, Pearse CM, Madanhire T, Wade AN, Fabian J, Micklesfield LK, Gregson CL (2023) Disparities in the prevalence of osteoporosis and osteopenia in men and women living in sub-Saharan Africa, the UK, and the USA. Curr Osteoporos Rep 21(4):360–371
79. Beshyah SA, Al-Saleh Y, El-Hajj Fuleihan G (2019) Management of osteoporosis in the Middle East and North Africa: a survey of physicians' perceptions and practices. Arch Osteoporos 14:60
80. Clynes MA, Westbury LD, Dennison EM et al (2020) Bone densitometry worldwide: a global survey by the ISCD and IOF. Osteoporos Int 31:1779–1786
81. International Osteoporosis Foundation (2011) The Middle East & Africa Regional Audit: epidemiology, costs & burden of osteoporosis in 2011. Nyon, Switzerland
82. Horner K, Allen P, Graham J et al (2010) The relationship between the OSTEODENT index and hip fracture risk assessment using FRAX. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 110:243–249
83. Métrailler A, Hans D, Lamy O, Gonzalez Rodriguez E, Shevroja E (2023) Heel quantitative ultrasound (QUS) predicts incident fractures independently of trabecular bone score (TBS), bone mineral density (BMD), and FRAX: the OsteoLaus study. Osteoporos Int 34:1401–1409
84. Leslie WD, Lix LM, Morin SN, Johansson H, Odén A, McCloskey EV, Kanis JA (2015) Hip axis length is a FRAX- and bone density-independent risk factor for hip fracture in women. J Clin Endocrinol Metab 100:2063–2070
85. Johansson L, Johansson H, Axelsson KF et al (2022) Improved fracture risk prediction by adding VFA-identified vertebral fracture data to BMD by DXA and clinical risk factors used in FRAX. Osteoporos Int 33:1725–1738
86. Lopez B, Meertens R, Gundry M, Scott P, Crone MB, McWilliam R (2024) A comparison between IBEX bone health applied to digital radiographs and dual-energy x-ray absorptiometry at the distal-third and ultra-distal regions of the radius. BMC Musculoskelet Disord 25:575
87. Fuggle NR, Reginster JY, Al-Daghri N et al (2024) Radiofrequency echographic multi spectrometry (REMS) in the diagnosis and management of osteoporosis: state of the art. Aging Clin Exp Res 36:135
88. Jang M, Kim M, Bae SJ, Lee SH, Koh JM, Kim N (2022) Opportunistic osteoporosis screening using chest radiographs with deep learning: development and external validation with a cohort dataset. J Bone Miner Res 37:369–377

89. Tsai DJ, Lin C, Lin CS, Lee CC, Wang CH, Fang WH (2024) Artificial intelligence-enabled chest X-ray classifies osteoporosis and identifies mortality risk. J Med Syst 48:12
90. Huang JY, Song WZ, Zeng HR, Huang M, Wen QF (2015) Performance of the osteoporosis self-assessment tool for Asians (OSTA) in screening osteoporosis among middle-aged and old women in the Chengdu region of China. J Clin Densitom 18:539–545
91. Agarwal K, Cherian KE, Kapoor N, Paul TV (2022) OSTA as a screening tool to predict osteoporosis in Indian postmenopausal women - a nationwide study. Arch Osteoporos 17:121
92. Chandran M, Chin YA, Choo KS et al (2020) Comparison of the Osteoporosis Self-Assessment Tool for Asians and the fracture risk assessment tool - FRAX to identify densitometric defined osteoporosis: a discriminatory value analysis in a multi-ethnic female population in Southeast Asia. Osteoporos Sarcopenia 6:53–58
93. International Osteoporosis Foundation (2022) LATAM Audit 2021: epidemiology, cost and impact of osteoporosis and fragility fractures in Latin America. Nyon, Switzerland
94. Madanhire T, Breasail M, Mukwasi-Kahari C, Kowo-Nyakoko F, Ebeling PR, Ferrand RA, Ward KA, Gregson CL (2024) Prevalence of HIV-associated osteoporosis and fracture risk in mid-life women: a cross-sectional study in Zimbabwe. J Bone Miner Res 39(10):1464–1473
95. Burton A, Manyanga T, Wilson H et al (2025) Challenges to fracture service availability and readiness provided by allopathic and traditional health providers: national surveys across The Gambia and Zimbabwe. J Glob Health 15:04082
96. Bergen DJM, Maurizi A, Formosa MM et al (2023) High bone mass disorders: new insights from connecting the clinic and the bench. J Bone Miner Res 38:229–247
97. Siris ES, Adler R, Bilezikian J et al (2014) The clinical diagnosis of osteoporosis: a position statement from the National Bone Health Alliance Working Group. Osteoporos Int 25:1439–1443
98. Kanis JA, McCloskey EV, Harvey NC, Johansson H, Leslie WD (2015) Intervention thresholds and the diagnosis of osteoporosis. J Bone Miner Res 30:1747–1753
99. Kanis JA, McCloskey EV, Harvey NC, Cooper C, Rizzoli R, Dawson-Hughes B, Maggi S, Reginster JY (2023) The need to distinguish intervention thresholds and diagnostic thresholds in the management of osteoporosis. Osteoporos Int 34:1–9
100. Kanis JA (2007) Assessment of osteoporosis at the primary health care level. WHO Scientific Group Technical Report. World Health Organization, Geneva
101. Lems WF, Paccou J, Zhang J, Fuggle NR, Chandran M, Harvey NC, Cooper C, Javaid K, Ferrari S, Akesson KE (2021) Vertebral fracture: epidemiology, impact and use of DXA vertebral fracture assessment in fracture liaison services. Osteoporos Int 32:399–411
102. Clark P, Denova-Gutiérrez E, Zerbini C et al (2018) FRAX-based intervention and assessment thresholds in seven Latin American countries. Osteoporos Int 29:707–715
103. Naseri A, Bakhshayeshkaram M, Salehi S, Heydari ST, Dabbaghmanesh MH, Dabbaghmanesh MM (2024) FRAX-derived intervention and assessment thresholds for osteoporosis in ten Middle Eastern countries. Arch Osteoporos 19:41
104. Calvo F, Karras BT, Phillips R, Kimball AM, Wolf F (2003) Diagnoses, syndromes, and diseases: a knowledge representation problem. AMIA Annu Symp Proc 2003:802
105. Curtis EM, Reginster JY, Al-Daghri N et al (2022) Management of patients at very high risk of osteoporotic fractures through sequential treatments. Aging Clin Exp Res 34:695–714

Authors and Affiliations

Nicholas C. Harvey[1,2] · Nasser Al-Daghri[3] · Charlotte Beaudart[4] · Maria Luisa Brandi[5] · Nansa Burlet[6] · Claudia Campusano[7] · Etienne Cavalier[8] · Manju Chandran[9,10] · Cyrus Cooper[1,2] · Bess Dawson-Hughes[11] · Philippe Halbout[12] · Teréza Hough[13] · Marise Lazaretti-Castro[14,15] · Radmila Matijevic[16] · Ambrish Mithal[17] · Ngozi Njeze[18] · René Rizzoli[19] · Yousef Saleh[20] · John A. Kanis[21,22] · Kate Ward[1,2] · Eugene McCloskey[23,24]

✉ Nicholas C. Harvey
nch@mrc.soton.ac.uk

Nasser Al-Daghri
ndaghri@ksu.edu.sa

Charlotte Beaudart
charlotte.beaudart@unamur.be

Maria Luisa Brandi
marialuisa.brandi@unifi.it

Nansa Burlet
nansaburlet@gmail.com

Claudia Campusano
ccampusano@gmail.com

Etienne Cavalier
etienne.cavalier@chuliege.be

Manju Chandran
mchandran7@gmail.com

Cyrus Cooper
cc@mrc.soton.ac.uk

Bess Dawson-Hughes
bess.dawson-hughes@tufts.edu

Philippe Halbout
philippe.halbout@osteoporosis.foundation

Teréza Hough
tereza@iafrica.com

Marise Lazaretti-Castro
marise.lazaretti@clinicacroce.com.br

Radmila Matijevic
radmila.matijevic@mf.uns.ac.rs

Ambrish Mithal
ambrishmithal@hotmail.com

Ngozi Njeze
rosemarynjeze@gmail.com

René Rizzoli
rene.rizzoli@unige.ch

Yousef Saleh
alaslawi@hotmail.com

John A. Kanis
w.j.pontefract@shef.ac.uk

Kate Ward
kw@mrc.soton.ac.uk

Eugene McCloskey
e.v.mccloskey@sheffield.ac.uk

[1] MRC Lifecourse Epidemiology Centre, University of Southampton, Southampton, UK

[2] NIHR Southampton Biomedical Research Centre, University of Southampton, Southampton, UK

[3] Chair for Biomarkers of Chronic Diseases, Biochemistry Dept., College of Science, King Saud University, 11451 Riyadh, Saudi Arabia

[4] Public Health Aging Research & Epidemiology (PHARE) Group, Research Unit in Clinical Pharmacology and Toxicology (URPC), Department of Biomedical Sciences-Faculty of Medicine, NAmur Research Institute for LIfe Sciences (NARILIS), University of Namur, Namur, Belgium

[5] FirmoLab, FIRMO Foundation, Florence, Italy

[6] Research Unit in Epidemiology, Public Health and Health Economics, University of Liège, Liège, Belgium

[7] Clínica Universidad de los Andes and Faculty of Medicine, Universidad de los Andes, Santiago, Chile

[8] Department of Clinical Chemistry, CIRM, University of Liège, CHU de Liège, Liège, Belgium

[9] Osteoporosis and Bone Metabolism Unit, Department of Endocrinology, Singapore General Hospital, Singapore, Singapore

[10] DUKE NUS Medical School, Singapore, Singapore

[11] Jean Mayer USDA HUMAN Nutrition Research Center On Aging at Tufts University, Boston, MA, USA

[12] International Osteoporosis Foundation, Nyon, Switzerland

[13] National Osteoporosis Foundation of South Africa (NOFSA), Cape Town, South Africa

[14] Metabolic Bone Diseases Unit, Escola Paulista de Medicina, Universidade Federal de Sao Paulo, Sao Paulo, Brazil

[15] Brazilian Society of Endocrinology and Metabolism (SBEM), Rio de Janeiro, Brazil

[16] Faculty of Medicine, University of Novi Sad, Novi Sad, Serbia

[17] Institute of Diabetes and Endocrinology, Max Healthcare, New Delhi 110017, India

[18] Department of Radiation Medicine, University of Nigeria Medical School, Enugu Campus- Nsukka, Nigeria

[19] Geneva University Hospitals and Faculty of Medicine, Geneva, Switzerland

[20] Health Oasis Hospital Riyadh, Riyadh, Saudi Arabia

[21] Centre for Metabolic Bone Diseases, University of Sheffield, Sheffield, UK

[22] Department of Medicine, School of Clinical Sciences, Monash University, Clayton, Australia

[23] Mellanby Centre for Musculoskeletal Research, Division of Clinical Medicine, School of Medicine and Population Health, Sheffield, UK

[24] Versus Arthritis Centre for Integrated Research in Musculoskeletal Ageing, University of Sheffield, Sheffield, UK