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ORIGINAL PAPER

# A scorecard for osteoporosis in four Latin American countries: Brazil, Mexico, Colombia, and Argentina

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## Abstract

*Summary* The state of osteoporosis care in Latin America is not well known. The results of our scorecard indicate an urgent need to improve policy frameworks, service provision, and service uptake for osteoporosis in Brazil, Mexico, Colombia, and Argentina. The scorecard serves as an important marker to measure future progress.

**Purpose** We developed a scorecard to summarize key indicators of the burden of osteoporosis and its management in Brazil, Mexico, Colombia, and Argentina. The goal of the scorecard is to reduce the risk of osteoporotic fractures by promoting healthcare policies that will improve patient access to timely diagnosis and treatment.

**Methods** We conducted a systematic review of osteoporosis. We also interviewed several key opinion leaders to gather information on government policy, access to fracture risk assessments, and access to medications. We then leveraged a peer-reviewed template, initially applied to 27 European countries, to synthesize the information into a scorecard for Latin America. We presented information according to four main categories: burden of disease, policy framework, service provision, and service uptake and used a traffic light color coding system to indicate high, intermediate, and low risk.

**Results** The systematic review included 108 references, of which 49 were specific to Brazil. The number of osteoporotic fractures in Brazil, Mexico, Colombia, and Argentina was forecasted to increase substantially (34% to 76% in each country) from 2015 to 2030. In general, policy frameworks, service provision, and service uptake were not structured to support current patients with osteoporosis and did not account for the future increases in fracture burden. Across all four countries, there was inadequate access to programs for secondary fracture prevention and only a small minority of patients received treatment for osteoporosis.

**Conclusions** Osteoporosis management, including the rate of post-fracture care, is very poor in Brazil, Mexico, Colombia, and Argentina and needs to be strengthened. Improvements in the rates of care are necessary to curb the debilitating impact of osteoporotic fractures on patients and health systems.

**Keywords** Scorecard · Osteoporosis · Brazil · Mexico · Colombia · Argentina

## Introduction

Osteoporosis is a skeletal disorder characterized by diminished bone mass and increased risk of fragility fractures [1]. Osteoporosis remains severely underdiagnosed and undertreated globally [2]. There is a higher prevalence of osteoporosis among older women, due to accelerated bone loss beginning after menopause. The reported prevalence of osteoporosis among post-menopausal women in Latin America ranges from 17 to 33% [3–6]. In Latin America, the number of persons aged 60 years or over is expected to more than double by 2050 [7]. Osteoporotic fracture incidence is predicted to increase as populations age [8]. This increased incidence, coupled with poor service uptake and service

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provision, is anticipated to pose a serious public health problem in Latin America.

Osteoporosis-related fractures frequently occur at the hip, spine, and wrist [9]. Hip fractures are often considered the most serious, among other fracture types, as they almost always require hospitalization and surgical intervention [10]. In Latin America, over 23% of patients die in the first year following a hip fracture [4, 11–15]. Moreover, the risk of subsequent fragility fracture increases with each fracture sustained [16]. These fractures cause physical disability and are associated with decreased health-related quality of life [17, 18]. Thus, efforts to identify, investigate, and initiate treatment in patients at high risk of osteoporotic fracture are imperative.

In 2012, an independent panel of experts published a visual scorecard for osteoporosis in Europe (SCOPE) as a way to compare and identify gaps in the management of osteoporosis among the 27 states of the European Union [19]. The scorecard focused on burden of disease, policy framework, service provision, and service uptake [19]. To the best of our knowledge, a similar tool to facilitate comparisons of osteoporosis care in Latin America has not yet been developed. In fact, few studies have comprehensively documented the burden of osteoporosis in Latin American countries. A literature review on the burden of osteoporosis in Latin America was published in 2004, though it only considered direct medical costs and did not employ a systematic search strategy to identify the evidence [20]. This paucity of comparative information prompted us to conduct a systematic review and interview several opinion leaders (OLs). We leveraged the information from the systematic review and OL interviews to develop a scorecard. The aim of the scorecard is to draw attention to inequities in the provision of primary and secondary prevention of osteoporotic fractures in four Latin American countries: Brazil, Mexico, Colombia, and Argentina.

## Methods

### Systematic review

We conducted a systematic review to identify and summarize data on osteoporosis care in four Latin American countries: Brazil, Mexico, Colombia, and Argentina. We designed and reported the protocol according to the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) guidelines [21].

An experienced medical information specialist developed the search strategy. Another senior information specialist peer-reviewed the strategy before execution, using the Peer Review of Electronic Search Strategies (PRESS) Checklist [22]. Using the Ovid platform, we searched MEDLINE®, including Epub Ahead of Print and In-Process & Other Non-Indexed Citations, and Embase. We also searched the Cochrane Library. Finally, we undertook additional searching of four relevant Latin American databases (LILACS, Scielo, BVS, and Redalyc). We performed the various search strategies between December 3 and 7, 2017. We limited results to the English, Spanish, and Portuguese languages and the publication years 2010 to the present. Full details of search strategy are reported in Appendix S1. We also performed targeted grey literature searches using a modified version of Grey Matters: a practical tool for searching health-related grey literature, which we adapted for four Latin American countries (Appendix S2) [23].

We sought data from scientific articles of any study design and grey literature references published from 2010 onward in English, Spanish, or Portuguese pertaining to adults (≥ 18 years of age) at risk of osteoporosis. We did not limit studies by interventions or comparators and captured several outcomes including prevalence and incidence of osteoporosis and fractures, health resource utilization, diagnosis, treatment, and management of osteoporosis.

A single reviewer independently reviewed the citation titles and abstracts to assess study eligibility. The reviewer also hand-searched bibliographies from a sample of systematic reviews and meta-analyses identified via the database searches, to cross-reference our study list and verify studies were not missed. If citations were considered to describe potentially eligible articles, the reviewer appraised them in full-text for inclusion in the final review. The reviewer used a standardized template to extract data from the selected articles.

### Interviews with opinion leaders

We interviewed several OLs from Brazil ($n = 2$), Mexico ($n = 3$), Colombia ($n = 3$), and Argentina ($n = 3$) to supplement the findings of the systematic review. This was similar to the SCOPE project, in which OLs from each country were sent a structured questionnaire [19]. The OLs that we interviewed had diverse professional backgrounds and included clinicians (one endocrinologist, three rheumatologists, and one geriatrician), payers, and health technology assessment (HTA) experts. We scheduled and conducted the interviews between January 2018 and February 2018 over conference calls. We required all OLs to provide informed consent before participating in the interviews. We developed four country-specific question guides to facilitate the interviews (Appendix S3). We conducted the interviews in Spanish and Portuguese and later translated the responses into English.

### Scorecard development

Once we had completed the systematic review and the OL interviews, we assessed the availability of evidence in preparation for scorecard development. We sought to create a scorecard that closely aligned to the SCOPE project by replicating

their methodology, where possible, across the same four domains: (1) burden of disease, (2) policy framework, (3) service provision, and (4) service uptake [19]. In the SCOPE project, countries were largely categorized by tertiles of risk [19]. Since our investigation was limited to four Latin American countries, we did not think it was appropriate to assign tertiles, and thus, we primarily applied the scoring criteria from the SCOPE project. We assigned an individual score to each country for each scorecard element. The score allocations corresponded to colors, with high-risk countries coded as red, intermediate-risk countries as yellow, and low-risk countries as green. We then assembled all the scorecard elements into a single grid to provide a visual overview of osteoporosis in four Latin American countries.

### Burden of disease

We leveraged an existing 2012 systematic review by Kanis and colleagues to identify hip fracture incidence rates and to categorize hip fracture risk [24]. We imputed age- and sex-specific incidence of fracture at the spine, forearm, and other sites using the relationship between hip fracture incidence and incidence of fracture at these sites as reported for Sweden [25]. This approach was used in the SCOPE project and has been used in recent FRAX publications from Brazil and Colombia [19, 26, 27]. We multiplied the age- and sex-specific incidence estimates by the corresponding population demography for 2015 to calculate the number of fractures [28]. We expressed the crude incidence in each country as the total number of fragility fractures per 1000 of the population aged 50 to 89.

FRAX is an algorithm that estimates the fracture probability of individuals by adjusting for their distribution of clinical risk factors. We used the publicly accessible FRAX tools to calculate 10-year probability of a major osteoporotic fracture and adopted applicable scoring criteria from the 2012 Kanis systematic review [24, 29].

Unlike in the SCOPE project, we did not have access to a licensed version of the FRAX tool. Consequently, we were not able to run the simulations required to create a distribution of fracture probabilities and estimate the proportion of the population at risk [19]. Instead, we identified published estimates of the prevalence of osteoporosis among post-menopausal women. We chose a single-point estimate from each country. We preferentially selected studies that collected bone densitometry data, recruited patients across multiple sites, and had a larger sample size. Although this element was not scored in the SCOPE project, prevalence estimates in the female population ≥ 50 years were reported for each European country [19]. We ranked the European prevalence estimates and divided the countries into tertiles to create scoring thresholds for use in the Latin American context [19].

We projected the number of fragility fractures by multiplying the age- and sex-specific incidence estimates that had previously been imputed for each anatomical site, by the predicted population demography for each country in 2030 [25, 28]. We subtracted the number of fractures anticipated in 2030 versus 2015 to calculate the percentage change.

### Policy framework

We asked OLs whether fracture registers existed and if osteoporosis was officially documented as a national health priority (NHP) in their respective countries [30]. We adapted the scoring criteria for this element to accommodate cases where the OLs and the 2012 IOF Latin America Regional Audit disagreed on NHP status [30]. The IOF audit, though published in 2012, was the most recent available for Latin America.

We asked OLs if osteoporosis care largely devolved to primary care physicians and if not, what specialties were responsible for most osteoporosis cases. We also asked OLs whether osteoporosis was a recognized specialty in their country or a component of specialty medical training. We documented the names and types of national societies operating in each country by combining information from OLs, local advocacy teams, and the IOF (Appendix S4) [31].

### Service provision

We gathered information on treatment reimbursement via OL interviews. We extracted the number of dual-energy X-ray absorptiometry (DXA) units/million in each country from the IOF Latin America Regional Audit [30]. This differed from the SCOPE project, in which estimates of the number of operational DXA machines were determined from the combined sales information of major providers [19]. We evaluated access to DXA in each country by OL responses and verified these responses with data from the IOF Latin America Regional Audit [30]. We determined the availability of country-specific FRAX models from the FRAX website and leveraged OL feedback to understand whether there was national guidance available on the use of FRAX [29]. Unlike the SCOPE project, we did not explore the availability of other risk engines [19].

We assembled clinical practice guidelines identified in our systematic review and OL interviews. Where multiple guidelines were available, we selected those most frequently used in clinical practice as per OL feedback. We appraised guidelines according to their scope and quality using criteria developed by the Appraisal of Guidelines for Research & Evaluation (AGREE) next steps consortium (Appendix S5) [32].

We referred to the IOF Capture the Fracture Map of Best Practice to determine the number of fracture liaison service (FLS) sites in each country [33]. We asked OLs whether there were national systems in place that systematically collect data

on the quality of care provided to people with osteoporosis or the secondary prevention of fragility fractures.

### Service uptake

We leveraged an existing Kanis et al. 2014 publication to examine the uptake of risk assessment algorithms [34]. We used OL estimates to determine the proportion of patients at high risk for osteoporosis who were untreated. Our approach differed from the SCOPE project, which combined IMS Health sales data and the results of FRAX simulations to determine the percentage difference between the number of women potentially treated and the number of women exceeding the intervention threshold [19]. We used OL estimates to inform the average waiting time for hip surgery following fracture.

## Results

We included 108 unique references in our systematic review, of which 49 were specific to Brazil, 19 to Mexico, 19 to Argentina, 11 to Colombia, and 10 included multiple countries (Fig. 1). The information from these references was combined with the OL interview responses to create the scorecard (Fig. 2).

### Burden of disease

A systematic review of hip fracture incidence in women worldwide categorized level of risk using tertiles of the distribution with an incidence of > 300 hip fractures per 100,000 persons being categorized as high risk, 200–300 as moderate risk, and < 200 as low risk [24]. Based on limited data available in the literature, women in Argentina were classified as having a high risk of hip fracture with an annual, age-standardized incidence rate of 390/100,000 (Table 1) [24]. The risk of hip fracture was determined to be intermediate in Mexico (225/100,000) and was relatively low in Brazil (199/100,000) and Colombia (127/100,000) [24]. The accuracy of some of these estimates remains to be corroborated by more recent, higher-quality, population-level data. Using country-specific fracture risk assessment tools (FRAX®), the 10-year probability of major osteoporotic fracture in women aged 65 years with a prior fragility fracture was found to be low (< 10%) in Brazil and Colombia, but intermediate (10 to 15%) in Argentina and Mexico [29, 35]. The prevalence of osteoporosis among post-menopausal women was higher in Brazil

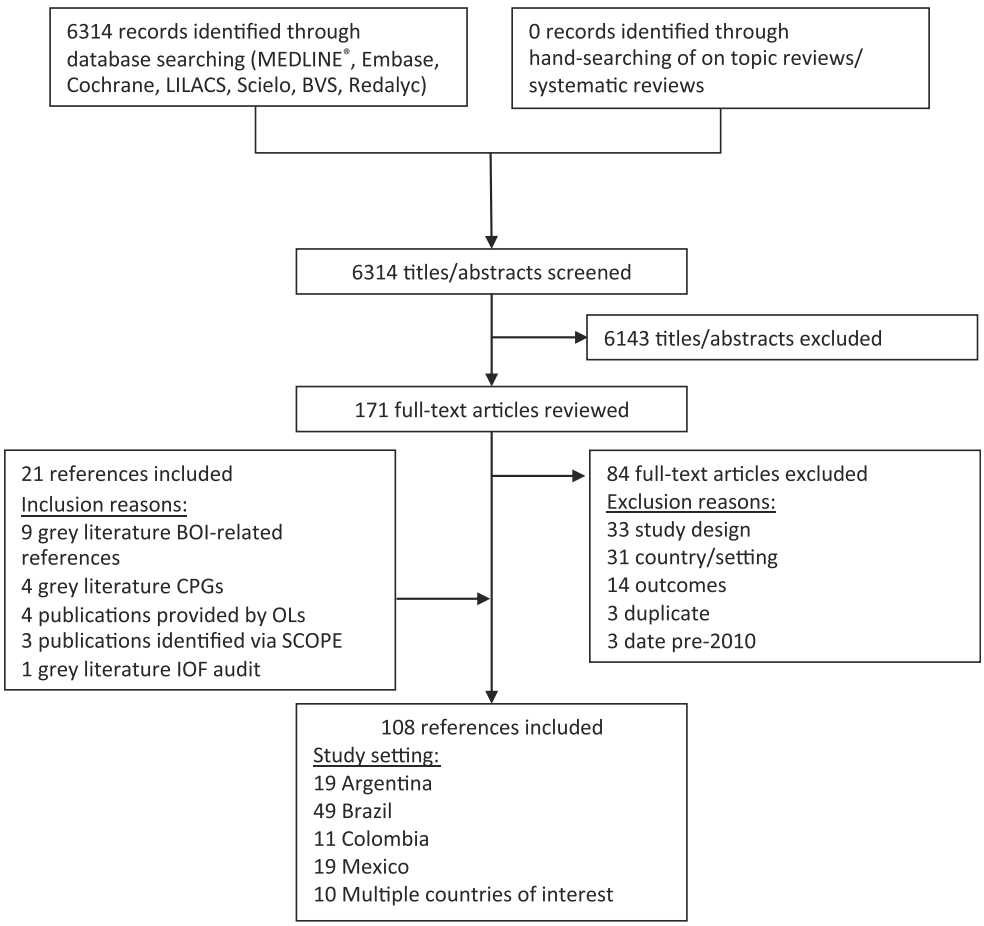


**Fig. 1** PRISMA flow diagram of study selection. BOI, burden of illness; CPG, clinical practice guideline; IOF, International Osteoporosis Foundation; OL, opinion leader; PRISMA, preferred reporting items for systematic reviews and meta-analyses; SCOPE, ScoreCard for OsteoPorosis in Europe

| | Description | Units | Score | | | Argentina | Brazil | Colombia | Mexico |
|---|---|---|---|---|---|---|---|---|---|
| **Burden of Disease** | | | | | | | | | |
| Hip Fracture Risk | Age-standardised incidence of hip fracture in women | rate/100,000 | <200 | 200-300 | >300 | 🔴 | 🟢 | 🟢 | 🟡 |
| Fracture Risk | All osteoporotic fractures in men and women | rate/1000 in the population 50-89 years | <15 | 15-20 | >20 | 🟢 | 🟢 | 🟢 | 🟢 |
| 10-year Risk | 10-year probability of major fracture (women, aged 65 years) | FRAX probability (%) | <10 | 10-15 | >15 | 🟡 | 🟢 | 🟢 | 🟡 |
| Osteoporosis Prevalence | Prevalence of osteoporosis in post-menopausal women | % of post-menopausal women | <21 | 21-22 | >22 | 🟢 | 🔴 | 🔴 | 🟢 |
| Fracture Projections | Increase in fracture number 2015-2030 | % in the population 50-89 years | 0-25 | 26-33 | >33 | 🔴 | 🔴 | 🔴 | 🔴 |
| **Policy Framework** | | | | | | | | | |
| Quality Of Data | Available data on hip fracture rates | Score | Established national hip fracture registries | Good quality national hip fracture rates | Poor quality national data or regional data only | 🔴 | 🔴 | 🔴 | 🟡 |
| National Health Priority | The presence of a government backed National Health Priority (NHP) | Score | NHP and its implementation | NHP but little or no implementation | No NHP | 🔴 | 🟡 | 🔴 | 🟡 |
| Care Pathway | Management in primary care | Score | Osteoporosis mainly managed in primary care | Osteoporosis mainly managed by a single specialty | Osteoporosis mainly managed by multiple specialties | 🔴 | 🔴 | 🔴 | 🔴 |
| Specialist Training | Osteoporosis or metabolic bone disease is an established specialty | Score | Recognized specialty | Recognized component of specialty training | Neither | 🟢 | 🔴 | 🟡 | 🔴 |
| Society Support | Presence of patient support societies | Score | Patient contact society | Patient support society with no patient contact | No patient outreach | 🟢 | 🔴 | 🟡 | 🔴 |
| **Service Provision** | | | | | | | | | |
| Treatment | Levels of reimbursement and availability of osteoporotic treatments | Score | Full reimbursement | Restricted reimbursement, few impediments | Restricted reimbursement, significant impediments | 🟡 | 🟡 | 🟢 | 🔴 |
| Availability Of DXA | DXA units available | Units/million of the general population | >18 (adequate) | 8.4-18 (borderline) | <8.4 (very inadequate) | 🔴 | 🟡 | 🔴 | 🔴 |
| Access To DXA | Levels of reimbursement and availability of DXA | Score | Full reimbursement | Restricted reimbursement, few impediments | Restricted reimbursement, significant impediments | 🔴 | 🔴 | 🔴 | 🔴 |
| Risk Models | Availability of country-specific risk models and guidance of FRAX assessments | Score | Model available with guidance on its use | Model available but no guidance on its use | Model not available | 🟡 | 🟡 | 🟡 | 🟡 |
| Guidelines Quality | Quality and scope of guidelines for assessment and treatment | Score | Extensive and high quality guidelines | Intermediate scope or quality | Poor scope or quality | 🔴 | 🔴 | 🔴 | 🔴 |
| Liaison Service | Provision for fracture liaison services (FLS) | Score | FLS in >10% of hospitals | FLS in 1-10% of hospitals | No FLS | 🟡 | 🟡 | 🟡 | 🟡 |
| Quality Indicators | Presence and use of quality indicators | Score | Systems and performance criteria | Systems but no audit | No systems in place | 🔴 | 🔴 | 🔴 | 🔴 |
| **Service Uptake** | | | | | | | | | |
| Risk Models | FRAX calculations performed | Annual calculations/ million of the population >50 years | >1200 | 320-1200 | <320 | 🟡 | 🔴 | 🟢 | 🟡 |
| Treatment Gap | Proportion at high risk for osteoporosis who are untreated | % of the population | <45 | 45-65 | >65 | 🔴 | 🟡 | 🔴 | 🔴 |
| Waiting Time | Average waiting time for hip surgery | Days | <1 | 1-2 | >2 | 🔴 | 🔴 | 🔴 | 🔴 |

**Fig. 2** Scorecard for osteoporosis in four Latin American countries: Brazil, Mexico, Colombia, and Argentina. Key: The color coding system can be interpreted as follows: red, high risk; yellow, intermediate risk; and green, low risk. DXA, dual-energy X-ray absorptiometry; FLS, fracture liaison service; FRAX, fracture risk assessment tool; maj, major; NHP, national health priority; pop, population; yr, year

(33%) [3] and Colombia (30%) [4] compared with Argentina (19%) [6] and Mexico (17%) [5]. When the crude incidence was computed for each country (expressed as the number of fragility fractures per 1000 of the population aged 50 to 89), all countries fell into the intermediate-risk category. Though when population projections from 2015 to 2030 were considered, the annual number of fractures among those aged 50 to 89 years was predicted to increase by more than 33% in each country (Table 2).

## Policy framework

### Quality of existing information

There were no national hip fracture registries in our countries of interest. Although both the Mexican and Brazilian Ministries of Health recorded the frequency of hospital discharges due to femur fracture, these data were believed to overestimate hip fracture incidence because they were based

**Table 1** Epidemiology of osteoporosis in four Latin American countries: Brazil, Mexico, Argentina, and Colombia

| Epidemiological parameter | Argentina | Brazil | Colombia | Mexico |
|---|---|---|---|---|
| Population estimates (women ≥ 50 years, 2018) [28] | 6,264,639 | 27,783,111 | 6,211,626 | 13,250,104 |
| Prevalence of osteoporosis in post-menopausal women | 19% [6] | 33% [3] | 30% [4] | 17% [5] |
| Age-standardized incidence of hip fracture in women (rate/100,000 person years) [24] | 390 [36] | 199 [38,39,41,40] | 127 [26] | 225 [42] |
| Estimated 1-year mortality rate following hip fracture | 33% [14] | 24% [11] | 23% [13] | 31% [15] |

**Table 2** Current and projected burden of fragility fractures

| Country | Number of fractures in 2015 | Number of fractures in 2030 | Population aged 50 to 89 years in 2015 (000) | Population aged 50 to 89 years in 2030 (000) | Rate per 1000 | Δ fractures from 2015 to 2030 (number) | Δ fractures 2015 to 2030 (%) |
|---|---|---|---|---|---|---|---|
| Argentina | 135,199 | 181,297 | 10,584 | 13,925 | 13 | 46,098 | 34% |
| Brazil | 372,738 | 608,283 | 45,970 | 69,684 | 8 | 235,545 | 63% |
| Colombia | 57,609 | 97,849 | 10,221 | 15,826 | 6 | 40,240 | 70% |
| Mexico | 199,482 | 350,872 | 22,212 | 38,342 | 9 | 151,390 | 76% |

Δ, change

on the International Classification of Diseases Tenth Revision diagnosis codes which did not distinguish where on the femur the fractures occurred (head/neck vs. diaphysis), whether the fractures were traumatic or non-traumatic in origin, and whether the fractures were specific to osteoporosis. Good-quality hip fracture rates were identified in the literature for Argentina; however, the estimates were regional and dated [36, 37]. Similarly, for Brazil, the available estimates identified in the literature were of fair/poor quality and were derived from regional samples prior to 2005 [38–41]. These same estimates were used to develop the Brazilian FRAX model released in 2013 [27]. The hip fracture rates identified for Colombia were again estimated from a regional sample of fair quality [26]. Mexico was the only country in which good quality national hip fracture incidence rates were identified [42].

### National health priority

Both the IOF Latin America Regional Audit and OLs agreed that osteoporosis was not a national health priority (NHP) in Argentina and Colombia [30]. In contrast, there was disagreement between the IOF Latin America Regional Audit and the OLs with respect to Brazil and Mexico; the audit indicated that osteoporosis was considered a NHP while OLs believed that osteoporosis was not a NHP [30]. The OLs from Brazil and Mexico supported their positions by citing a lack of awareness regarding the scope and economic burden of osteoporosis, and limited visibility in comparison with other diseases (e.g., cancer, diabetes).

### Management of osteoporosis

In the Latin American countries of interest, osteoporosis was managed by multiple specialists. The reasons OLs provided for why osteoporosis was not managed in primary care varied. In Brazil, family doctors reportedly focused on more prevalent diseases such as diabetes, whereas in Argentina, the limited number of family doctors was believed to inhibit their involvement. Moreover, osteoporosis and metabolic bone disease was a recognized specialty unto itself in Argentina with a 2-year specialist course to obtain the title of osteologist. In Colombia, osteoporosis and metabolic bone disease was considered a recognized component of specialty training within the disciplines of endocrinology and rheumatology. However, local advocacy teams stressed the need to further incorporate osteoporosis content into the academic curriculums of additional specialties (e.g., family medicine, gynecology). In Brazil and Mexico, osteoporosis and metabolic bone disease were not recognized specialties or components of specialty medical training. Exposure to osteoporosis for physician residents in Brazil and Mexico was dependent on choosing medical rotations that happened to put them into contact with these patients or partaking in training courses offered outside of their curriculum.

### National societies

Argentina had two patient contact societies that engaged in direct interactions with patients. Colombia had a single-patient support society, though the organization was not specific to patients with osteoporosis. National societies in Brazil and Mexico were predominantly geared towards physicians; there were no patient contact or support societies identified in either of these countries (Appendix S4).

## Service provision

### Treatment reimbursement

According to OLs in Colombia, bisphosphonates were fully covered under publicly funded government health plans. Denosumab and teriparatide also received full coverage in Colombia though these treatments had prior authorization criteria. Most treatment interventions were reimbursed in Argentina. However, the level of reimbursement varied by intervention and was dependent on the type of coverage the patient received. For example, it was reported that the Social Security System in Argentina subsidized 40–50% of the costs of bisphosphonates while the public health system provided bisphosphonates free of charge. In Brazil, oral bisphosphonates and generic drugs were subsidized by the

government. However, more costly drugs had to be acquired by legal injunction. This was reported to be highly restrictive for patients and was not considered an access strategy. Mexico received the lowest score relative to the other countries because OLs agreed that reimbursement for osteoporosis treatments was very restricted with significant impediments to access. In Mexico, several heterogeneous health systems (Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado, or ISSSTE; Instituto Mexicano de Seguridad, or IMSS; Seguro Popular) functioned in parallel, each with its own independent network of doctors, clinics, hospitals, and pharmacies. The national formulary of medicines in Mexico, called the Basic Medicine Chart Interinstitutional Table, included medications that could, in theory, be reimbursed by ISSSTE and IMSS without the need for additional payment from patients [43]. However, the institutions within these insurance systems had their own lists of medications that were eligible for coverage. Consequently, while denosumab and teriparatide were included on the national formulary and were covered by ISSSTE institutions, OL feedback indicated that these drugs were not covered by IMSS hospitals. Denosumab and teriparatide were also not registered in the General Health Services Catalogue (Catálogo Universal de Servicios de Salud, CAUSES), indicating a lack of reimbursement for patients covered by Seguro Popular [44]. As a result, many patients in Mexico were required to make significant out-of-pocket payments to access treatment.

#### Access to dual-energy X-ray absorptiometry

Argentina, Colombia, and Mexico were determined to have inadequate provision of dual-energy X-ray absorptiometry (DXA) machines, while Brazil had borderline provision. Despite DXA tests being officially reimbursed in all four countries, access was found to be extremely limited due to the low number of machines and distributional factors. Consistent reports indicated that DXAs were largely concentrated within private clinics and urban centers. The uneven geographical location of DXA equipment was also identified as an important factor contributing to long wait times.

#### Fracture risk assessment tool

Fracture risk assessment tool (FRAX) models were available in all four countries [29], but the countries either did not have national guidance on how to best implement the FRAX results in clinical practice or physicians were not aware of such guidance.

**Clinical practice guidelines** The scope of clinical practice guidelines varied by country (Appendix S5). Guidelines for the management of osteoporosis in post-menopausal women were available for all four countries. Guidelines for the management of osteoporosis in men were available for Argentina, Brazil, and Mexico. All the guidelines had been developed from 2012 onward. Despite their recency, the guidelines scored low on the AGREE criteria, indicating poor quality [32]. Out of a maximum possible score of seven, the average guideline score was four for Argentina, three for Brazil and Colombia, and two for Mexico.

#### Fracture liaison service

The main objectives of a fracture liaison service (FLS) is to identify men and women over age 50 years who present with fragility fracture, investigate those at risk of fracture via bone mineral density testing, and initiate treatment where appropriate [45]. In all four countries, the estimated proportion of hospitals with an FLS scheme in place was below 10%, though several FLS sites were under review or in progress. According to the IOF Map of Best Practice, there was 1 established FLS site in Argentina, 7 established and 13 underway in Brazil, 3 established and 7 underway in Colombia, and 2 established and 12 underway in Mexico [33]. Cost was a limiting factor, particularly concerning the incorporation of FLS in public hospitals. There were no national systems in place to systematically collect data on the quality of care provided to people with osteoporosis or the secondary prevention of fragility fractures. Some of the countries had general procedures to monitor quality control, but the targets of these evaluations were not specific to osteoporosis.

### Service uptake

It was determined that the uptake of FRAX was high in Colombia, intermediate in Argentina and Mexico, and low in Brazil [34]. The proportion of patients at high risk for osteoporosis, including osteoporotic fracture, left untreated was estimated by OLs to exceed 70% in Argentina, Colombia, and Mexico. In Brazil, the proportion was estimated to range from 57 to 60%. The wait time between the occurrence of a hip fracture and surgical intervention was also considered as another key indicator of service uptake because longer wait times are known to associate with increased peri-operative morbidity and mortality. Across all four countries of interest, the average waiting time for surgery after hip fracture was more than 3 days (Table 3).

## Discussion

There is a large treatment gap for osteoporosis in Latin America that will likely increase as populations age. In a recently published consensus statement on osteoporosis prevention and treatment in Latin America, a series of recommendations were developed including improved public and health

**Table 3** Uptake of FRAX, proportion untreated, and hip surgery waiting times

| Country | FRAX calculations/ million of the population aged ≥ 50 years [34] | Proportion at high risk for osteoporosis who are untreated | Average waiting time for hip surgery |
|---|---|---|---|
| Argentina | 586 | > 70% | 14 days |
| Brazil | 216 | 57–60% | 5–7 days |
| Colombia | 1321 | 70% | 3–7 days |
| Mexico | 768 | 80–85% | 15 days |

professional awareness, better diagnostic processes, improved access to care, and greater engagement by health policymakers, government, and a wide variety of private organizations [46]. The panel concluded that health policymakers, healthcare insurance providers, medical societies, employer organizations, hospitals, long-term care facilities, patients, and the general public should work to address the clinical, humanistic, and economic burden of osteoporosis [46]. The panel's conclusions are further supported by a Global Call to Action published in 2018 and endorsed by 81 societies across the world, including national societies in Brazil and regional societies in Latin America for orthopedics, geriatrics, and rheumatology [47]. Similar to the consensus statement, the Call to Action was intended to send a strong message to policymakers and incentivize improvements in the care of people presenting with fragility fractures [47].

In the current study, although Brazil, Mexico, Colombia, and Argentina showed variation within individual scorecard elements, the same overarching message of a marked lack of healthcare provision was reflected across each country. The results of the scorecard indicate a significant need to address existing shortcomings in policy framework, service provision, and service uptake to mitigate the future burden of osteoporosis.

FRAX models are available for Brazil, Mexico, Colombia, and Argentina to assess fracture risk. FRAX-based intervention and assessment thresholds have also been developed for all four of these countries to inform when treatment and BMD testing should be initiated [35]. However, the challenge of spreading awareness and transitioning from awareness to action persists. Where DXA machines are available, the volume is insufficient, and they are unevenly distributed across regions. This creates a barrier between access to timely diagnosis and treatment. In the Latin American countries that we investigated, well over half of the individuals who were at high risk for osteoporotic fracture were believed to be untreated. FLS centers are urgently needed to (1) identify patients over age 50 who have suffered a fragility fracture, (2) investigate those at risk through appropriate testing, and (3) initiate treatment [45]. Increased physician education and higher-quality clinical practice guidelines are also warranted. Argentina was the only country with specialty training for osteoporosis and national societies who engaged with patients. Without receiving specific training on osteoporosis as part of their medical curriculum, health professionals may not be proficient in recognizing osteoporosis and prescribing appropriate treatments [30]. Collaborative efforts between policymakers, physicians, and patients are required to improve the management of patients with osteoporosis.

There are several barriers contributing to the poor osteoporosis care observed in Argentina, Brazil, Mexico, and Colombia. Chief among these barriers may be the lower domestic product per capita reported for Latin American countries compared to most European and North American countries. In Latin American countries, substantive portions of the national health budgets are allocated towards fighting basic health problems, like infant mortality and vaccination [46]. The remaining budgets are then disproportionately allocated to other high cost chronic diseases, like cancer [46]. The absence of centralized healthcare statistics compounds the issue [30]. Without centralized statistics, it is very difficult to estimate the true economic and patient burden of osteoporosis and make the case for increased funding.

At a high level, the results of our scorecard are comparable to the results of several countries in the European scorecard, including Bulgaria, Czech Republic, Lithuania, Malta, Poland, Romania, and Slovakia [19]. This demonstrates that the significant heterogeneity and inadequacies in osteoporosis care provision are not specific to Latin America. Rather, the need to find a balanced, common, and optimal approach to the management of osteoporosis is playing out on a global scale. With that said, there are countries leading the way towards improved patient care. The UK has developed a strong policy framework to collect high-quality data, manage patients in primary care, and reach out to patients via national societies [19]. Similarly, based on its scores, Sweden has tackled issues of treatment reimbursement and has provided comprehensive treatment guidelines and FLS to aid in care [19]. Though contextual factors such as economics, demographics, and health system infrastructure differ between Latin America and Europe, countries like the UK and Sweden may still act as useful benchmarks to inform care development.

Our study has several strengths. To our knowledge, it is the first scorecard developed to assess osteoporosis in Latin America. The scorecard is a unique and innovative tool that has practical applications for healthcare providers and decision makers, thereby fulfilling an important research gap. Furthermore, we informed the scorecard using a rigorous evidence base (systematic review and OL interviews). As part of our systematic review, we conducted a comprehensive grey literature search, a detail missing in prior studies [24, 48]. The grey literature search was imperative in uncovering clinical guidelines for evaluation in the scorecard. Finally, wherever possible, we retrieved country-specific information facilitating valid comparisons across Latin American regions.

Despite its strengths, there were limitations associated with our analysis. First, we were limited by data availability. For some scorecard elements, we had to rely on OL responses because we did not find any primary evidence to support the needed data points. In cases where expert opinion diverged, we informed the final score based on the majority viewpoint. We recognize that this consistency is anecdotal. As such, we have indicated the scorecard elements that are based solely on OL responses. Another limitation was our assumptions of generalizability. For example, we assumed that the scoring criteria originally established for European countries applied to Latin America and were appropriate targets to assess comparative performance. Moreover, we did not have up-to-date incidence rates by fracture site and had to assume that the proportionality remained constant to Sweden across our Latin American countries. Although this approach has been used in other studies examining the burden of osteoporosis, such as the FRAX model used in Brazil [27], a more granular account of data by fracture site and resource usage in all four of these countries would allow for a more accurate picture of the total burden of osteoporosis. The lack of epidemiological information has been a persistent problem inhibiting investigators from fully capturing the extent to which osteoporosis affects Latin American populations [20]. The serious nature of osteoporosis warrants further research to better quantify the fracture burden and allow for tailored resource planning.

Our intention in creating the scorecard was to raise awareness of osteoporosis in Latin America. Based on our findings, there is an opportunity to improve care provision for osteoporosis in Latin America to reflect the severity of the disease. The scorecard is meant to encourage policymakers to take action and to help ensure that citizens in these countries gain timely access to high-quality diagnosis and treatment. Our scorecard can serve as an important starting point to track future progress in Brazil, Mexico, Colombia, and Argentina. Increased prevention will be especially important as the populations in Latin America age.

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## Compliance with ethical standards

**Conflict of interest** Cornerstone received financial support from Amgen for the conduct of this study. RA, MH, and JGP are employees of Amgen. MA was an employee of Amgen at the time of writing the manuscript. RKM, SF, and KS are employees of Cornerstone, while AL is a subcontractor of Cornerstone. CC is an employee and shareholder of Cornerstone Research Group Inc. Cornerstone consults for various pharmaceutical, medical device, and biotech companies.

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