

Original article

# Perception of severe osteoporosis amongst medical doctors in South Korea: Awareness, impact, and treatment

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Received 4 December 2015; revised 3 February 2016; accepted 5 February 2016

Available online 2 March 2016

## Abstract

**Objectives:** Little is currently known about the issues surrounding management and treatment of severe osteoporosis in South Korea. Our objective was to assess doctors' views on the perception, diagnosis, and treatment of severe osteoporosis.

**Methods:** Face-to-face interviews were conducted (16 February–13 March 2015) with 100 doctors (specialists in orthopedic surgery, endocrinology, neurosurgery, family medicine, or rheumatology) who treated  $\geq 5$  severe osteoporosis (T-score  $\leq -2.5$ , plus fracture) patients per month. Respondent demographic characteristics, their perception of severe osteoporosis, its impact and treatment, and their views on current practice and unmet needs were assessed.

**Results:** Of 416 doctors approached, 100 completed the survey (24% response rate). Most doctors (90%) specialized in orthopedic surgery, endocrinology, or neurosurgery. When diagnosing severe osteoporosis, most doctors (79%) considered both bone mineral density and fracture. Almost all doctors ( $\geq 91\%$ ) ranked disease impact and seriousness highly, but much fewer ( $\leq 25\%$ ) doctors thought society agreed. Most doctors (89%) had concerns with current treatments, switching treatments because of the efficacy and safety of bisphosphonates ( $>89\%$ ), the efficacy of selective estrogen receptor modulators ( $>71\%$ ), and the high cost of parathyroid hormone ( $>73\%$ ). Parathyroid hormone was ranked highest for efficacy and was preferentially prescribed to severe osteoporosis patients (mean 32.2% of prescriptions) compared with osteoporosis patients overall (3.7%). “Limitations with reimbursement” was the most commonly cited (76%) unmet need.

**Conclusions:** There are concerns with the safety, efficacy, and affordability of current treatments for severe osteoporosis in South Korea, as well as a perceived lack of disease awareness amongst patients and doctors.

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**Keywords:** Bisphosphonates; Korea; Osteoporosis; SERMs; Teriparatide

## 1. Introduction

Osteoporosis is a worldwide health burden, especially amongst the elderly [1], and osteoporosis-related fractures,

especially hip fractures, are associated with substantial disability, morbidity, mortality, and economic cost [2]. Furthermore, the presence of a fracture is associated with increased risk of future fracture; hence, reduction of this fracture risk and its concomitant impact on health is one of the main goals of treatment [3].

In South Korea, osteoporosis is a growing health and economic concern that requires improved management. Osteoporosis is estimated to affect 38% of women and 7.3% of men

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Peer review under responsibility of The Korean Society of Osteoporosis.

over 50 years of age in South Korea [4]. A recent review comparing the age-standardized incidence of hip fractures in 62 countries suggested that the incidence rate in South Korea (231 per 100,000 population) may be one of the highest reported in Asia (only Taiwan [264 per 100,000] and Singapore [248 per 100,000] are higher) and may be higher than the rates in some countries in Europe and North America (for example, United Kingdom: 201 per 100,000; Canada: 211 per 100,000) [5]. Moreover, the proportion of the South Korean population over 50 years of age is expected to increase from 33% in 2013 to 57% by 2050, substantially expanding the number of osteoporosis patients [6]. The costs associated with osteoporosis and osteoporotic fractures in 2010 were 796 billion Korean Republic Won (707 million USD) and are predicted to increase [7]. However, South Korea, like many countries, has shown suboptimal use of osteoporosis treatments in patients with hip fracture [1]. More effective strategies to manage the increasing numbers of osteoporosis-related fractures in South Korea are urgently needed.

In order to improve management of osteoporotic fractures in South Korea, it is essential to evaluate the views held by doctors directly responsible for treating osteoporosis. A recent survey examined doctors' attitudes to several osteoporosis-related issues, including screening methods, secondary osteoporosis, long-term bisphosphonate (BP) use, and barriers to treatment [8]. However, this survey by Ha and coworkers did not distinguish between osteoporosis with and without fracture, nor did it consider the opinions of doctors on commonly used treatments for osteoporosis other than BPs. The presence of a fracture, combined with a T-score  $\leq -2.5$  standard deviations (SD) below the mean bone mineral density (BMD) of a young adult, has been classified as severe osteoporosis [9]. Given the serious impact of osteoporotic fractures on health and society, doctors' perspectives, specifically on the awareness, diagnosis, management, and treatment of severe osteoporosis, require further investigation.

Therefore, the aim of our study was to assess perceptions of severe osteoporosis amongst doctors in South Korea, including their views of the disease and its impact, their concerns with current treatments, and their views on the areas of disease management that require improvement.

## 2. Materials and methods

### 2.1. Study design

This survey consisted of face-to-face interviews with doctors in South Korea between 16 February and 13 March 2015. A sample size of 100 respondents was chosen and Gallup Korea (Seoul, South Korea), a market research company, was employed to carry out the interviews with doctors, through the use of paid assistants. Survey responses and the identities of the respondents were kept confidential, and doctors surveyed were provided with an honorarium for their participation. The study was conducted in compliance with the ethical principles of the Declaration of Helsinki.

### 2.2. Study population

A purposive sampling method was used to identify potential survey respondents who were members of academic societies related to orthopedics, endocrinology, neurosurgery, and rheumatology. To achieve a representative sample of doctors involved in osteoporosis treatment, a minimum of 20 respondents was required to be drawn from each of the three specialties reported to diagnose and treat large numbers of osteoporosis patients (based on data from the Health Insurance Review and Assessment Service [10]): orthopedic surgery, endocrinology, and neurosurgery. Survey responses from specialists in family medicine and rheumatology were also considered, but a minimum number of respondents from these two specialties was not required. The survey was discontinued or the data were not included for analysis if the doctors were working outside of a university hospital or a general hospital, did not have orthopedic surgery, endocrinology, neurosurgery, family medicine, or rheumatology as their primary medical specialty, or if they treated, on average, fewer than five patients with severe osteoporosis (T-score  $< -2.5$ ;  $\geq 1$  previous fracture) per month. With these criteria, the aim of the study was to obtain viable responses from 100 doctors.

### 2.3. Questionnaire development

The questionnaire was in Korean and consisted of four parts: (i) demographic characteristics, (ii) perception of severe osteoporosis, its impact, and its treatment, (iii) current practice, and (iv) unmet needs (English language translation of questionnaire provided in [Supplementary Material](#)). The demographic characteristics of the respondents were assessed using questions based on a survey of doctors in South Korea conducted by Ha and coworkers [8]. The study authors and Gallup Korea developed the questions in parts (ii)–(iv) of the questionnaire. The survey consisted of open-ended questions, multiple-choice questions (most of which accepted multiple responses), and rank order questions. Doctors were also asked to rate various topics on a 5-point Likert scale. When assessing satisfaction with different treatment aspects, a rating of 1 indicated “not satisfied” and 5 indicated “very satisfied”. Similarly, for doctors' perceptions of different aspects of disease, a rating of 1 was “low” and 5 was “high”. The questionnaires were completed through face-to-face interviews, which lasted approximately 15 min.

### 2.4. Survey outcomes

The demographic characteristics of the doctors surveyed, including gender, age, type and years of experience in specialty, hospital type, and number of osteoporosis patients seen per month, were recorded. Doctors were then asked to define their criteria for the diagnosis of osteoporosis and to compare their views against society's views of the disease and its impact. Doctors' perceptions of the issues associated specifically with severe osteoporosis (as opposed to osteoporosis in

general), along with their goals for treatment of the disease, were also recorded. Doctors quantified the proportion of each of the three main osteoporosis treatments they prescribed, as well as their levels of satisfaction with various aspects of each treatment. The concerns that doctors had with each treatment and their reasons for switching to different treatments or maintaining current treatments were then explored in detail. Lastly, doctors were asked to outline aspects of treatment that they thought required improvement.

### 2.5. Analysis

Gallup Korea was responsible for collecting and compiling the survey responses. For questions in which respondents failed to provide at least one answer, the percentage of responses was still calculated based on a total sample size of 100. Survey responses were summarized using descriptive statistics, but no comparative statistical analyses were carried out.

## 3. Results

### 3.1. Survey response rate

A total of 416 doctors were approached and 100 doctors who treated at least five patients with severe osteoporosis per month completed the interview (response rate of 24%). Most of the remaining 316 doctors were excluded during the initial screening (see [Supplementary Material for survey screening questions Q1 to Q8](#)).

### 3.2. Demographic profile of doctors surveyed

Doctors from five different specialties were interviewed, representing a number of different ages, years in specialist practice, and number of osteoporosis patients managed ([Table 1](#)).

The majority of doctors were male (84%), more than half were aged between 40 and <50 years (58%), and half had spent between 10 and <20 years in their specialty (52%). Substantial representation of specialists in orthopedic surgery, endocrinology, and neurosurgery was achieved, as planned, along with a smaller number of specialists in family medicine and rheumatology.

### 3.3. Number of patients managed

On average, patients with severe osteoporosis constituted more than one third of the osteoporosis patients managed by doctors in the survey. Orthopedic surgeons managed the highest average number of severe osteoporosis patients per month, which constituted close to half of their total osteoporosis patients ([Table 1](#)).

### 3.4. Definition and perception of severe osteoporosis

The majority of doctors (79%) indicated that the criteria for diagnosing severe osteoporosis included both the BMD (T-score) and presence of a fracture. When asked to provide the threshold values for BMD, fracture number, and age

Table 1  
Demographic profile of doctors interviewed ( $N = 100$ )

| Characteristics   | <i>n</i>               |
|---|------------------------|
| Gender  |                        |
| Male  | 84                     |
| Female  | 16                     |
| Age   |                        |
| 30 to <40 years   | 17                     |
| 40 to <50 years   | 58                     |
| 50 to <60 years   | 22                     |
| ≥60 years   | 3                      |
| Specialty   |                        |
| Orthopedic surgery  | 40                     |
| Endocrinology   | 30                     |
| Neurosurgery  | 20                     |
| Family medicine   | 7                      |
| Rheumatology  | 3                      |
| Years in specialty  |                        |
| 5 to <10 years  | 26                     |
| 10 to <20 years   | 52                     |
| 20 to <35 years   | 22                     |
| Hospital type   |                        |
| University hospital   | 48                     |
| General hospital  | 52                     |
| Geographic region   |                        |
| Seoul   | 63                     |
| Gyeonggi  | 29                     |
| Incheon   | 8                      |
| Average number of osteoporosis patients per month                     |                        |
| <100 patients   | 42                     |
| 100 to <200 patients  | 37                     |
| ≥200 patients   | 21                     |
| Average number of osteoporosis patients with fracture per month       |                        |
| 5 to <15 patients   | 8                      |
| 15 to <30 patients  | 42                     |
| 30 to <100 patients   | 37                     |
| ≥100 patients   | 13                     |
| Average number of severe osteoporosis patients per month by specialty |                        |
| Orthopedic surgery  | 59.4 (49.6% of all OP) |
| Endocrinology   | 33.8 (27.1% of all OP) |
| Neurosurgery  | 37.9 (29.5% of all OP) |
| Family medicine   | 45.0 (40.4% of all OP) |
| Rheumatology  | 28.3 (32.7% of all OP) |

As the total number of respondents ( $N$ ) was 100,  $n$  represents both the number of respondents and the percentage of respondents in each category, except for the category listing the average number of severe osteoporosis patients per month by specialty, where the percentage of patients with severe osteoporosis is listed in brackets. Abbreviation: OP, osteoporosis patients.

required for a diagnosis of severe osteoporosis, the most common responses were one fracture (86%), T-scores of  $-3.0$  (42%) or  $-2.5$  (40%), and age brackets of 65–69 years (43%) or 70–74 years (22%). In ranking these factors in order of importance for diagnosing osteoporosis, 52% of respondents ranked fracture as most important, followed by BMD (47%). Fracture and BMD were ranked either first or second in importance by 96% and 93% of doctors, respectively.

There was a large difference between doctors' perceptions of severe osteoporosis and how doctors thought society perceived

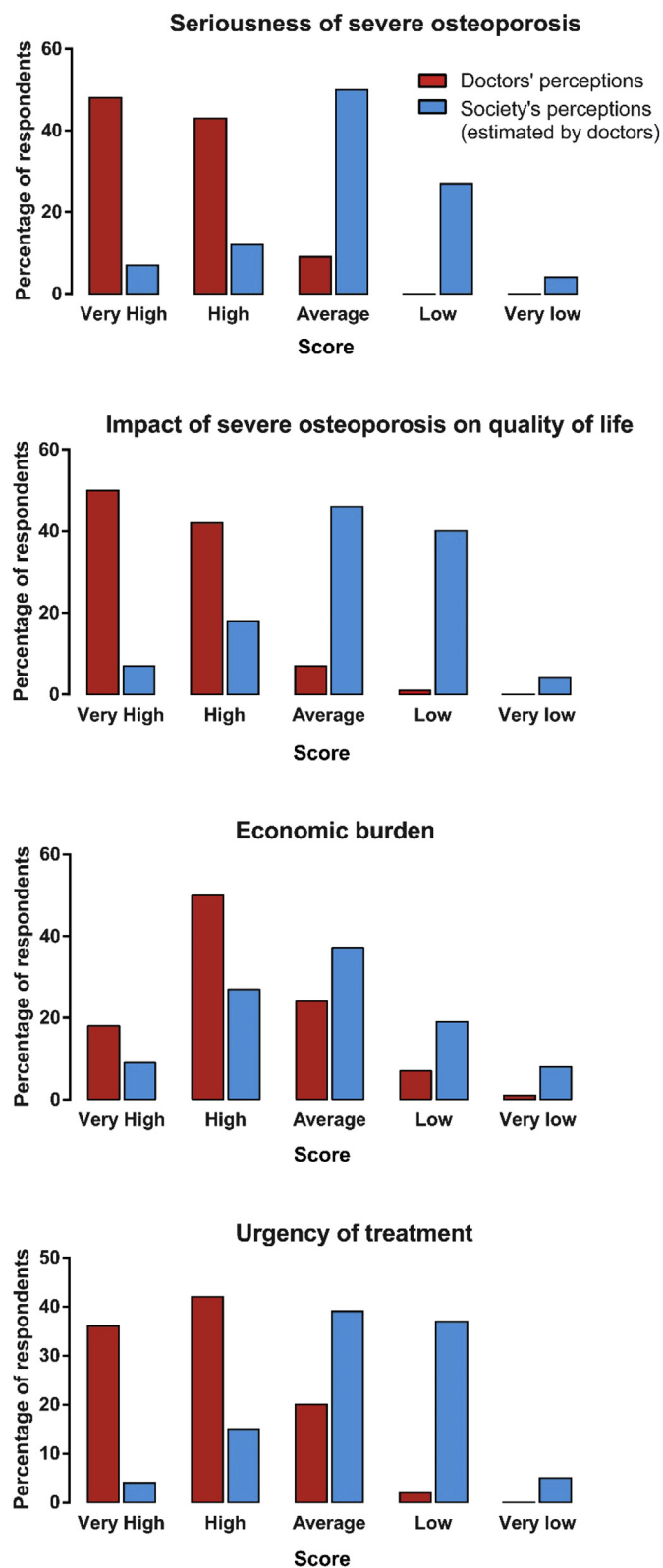


Fig. 1. Doctors' perceptions (red) of aspects of severe osteoporosis compared with their view of society's perceptions (blue).

the disease (Fig. 1). Most doctors ( $\geq 91\%$ ) ranked the seriousness of severe osteoporosis and its impact on quality of life as either 4 or 5 (with 1 being the lowest and 5 the highest). In contrast, few doctors ( $\leq 25\%$ ) thought that society ranked the seriousness of

the disease and its impact on quality of life as high. Similarly, more than half ( $\geq 68\%$ ) of the doctors surveyed ranked the economic burden and urgency of treatment associated with severe osteoporosis as either 4 or 5, whereas less than half ( $\leq 36\%$ ) thought that society would rank these aspects as high.

### 3.5. Impact of severe osteoporosis and treatment goals

More than half of the doctors (65%) thought that patients with osteoporotic fracture (severe osteoporosis) would experience differences in treatment and disease conditions compared to those without a fracture. Doctors thought that patients with fracture required more active treatment (43.1%) and experienced limitations with reimbursement of treatment (33.8%). These patients were also thought to experience greater impact on their quality of life due to disease or a lack of recognition of the seriousness of the disease (16.9%), in addition to problems with treatment efficacy and safety (10.8%). Doctors indicated that their patients with severe osteoporosis experienced serious disability (37.8%), additional fractures (29.6%), extended recovery time from surgical procedures (27.6%), economic difficulty (25.3%), and death (3.9%). When asked to rank the importance of treatment goals for severe osteoporosis, the majority of doctors (82.0%) ranked prevention of fracture as most important, followed by improvement of BMD (12.0%), and pain relief (6.0%).

### 3.6. Treatments for severe osteoporosis

A range of osteoporosis treatments are available in South Korea, many of which are eligible for reimbursement (Supplementary Material). In addition to vitamin D and calcium supplementation, the most commonly prescribed treatments for osteoporosis were BPs, selective estrogen receptor modulators (SERMs), and parathyroid hormone (PTH). Of the three treatments, PTH constituted a much higher (almost 10-fold) proportion of treatments prescribed to patients with severe osteoporosis, compared with osteoporosis overall (Fig. 2). Unlike PTH, there was little or no difference in the proportion of BPs or SERMs prescribed for severe osteoporosis compared with osteoporosis overall. Doctors were asked to indicate their level of satisfaction with various aspects of BPs, SERMs, and PTH (Fig. 3). In terms of treatment cost, patient compliance, and a lack of serious side effects, SERMs were rated highest, whereas PTH was rated highest in terms of prevention of further fracture, improvement of BMD and markers of bone metabolism, and efficacy (pain relief). Notably, doctors were far less satisfied with PTH in terms of treatment cost and reimbursement, compared with BPs and SERMs.

### 3.7. Doctors' concerns with treatment

Almost all doctors (89.0%) expressed concerns with treatments for severe osteoporosis. The two most commonly raised concerns were safety (66.3%) and efficacy (64.0%), followed

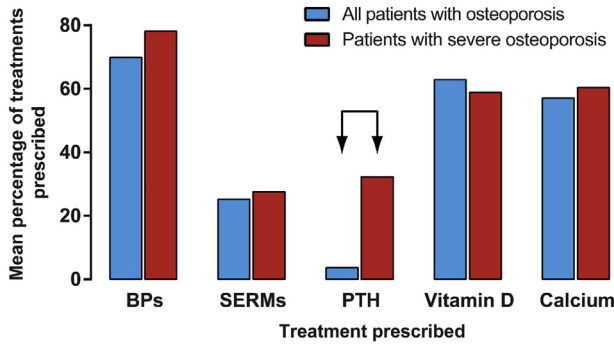


Fig. 2. The proportion of BPs, SERMs, PTH, vitamin D, and calcium prescribed for overall osteoporosis (blue) compared with severe osteoporosis (red). Arrows indicate a large difference in the proportion of PTH prescribed to osteoporosis patients overall compared with severe osteoporosis patients. Patients may be prescribed more than one drug at a time. Abbreviations: BPs, bisphosphonates; SERMs, selective estrogen receptor modulators; PTH, parathyroid hormone.

by patient compliance (56.2%), medicine cost (40.4%), and others (2.2%). Necrosis of the jaw and atypical fracture of the femur were the most commonly cited specific concerns with safety. Each of the three treatments was found to be ineffective or was not able to be used (unusable) in a subset of patients (Fig. 4). In this subset of patients, more than half ( $\geq 52.5\%$ ) had their prescriptions switched to another drug class (Fig. 4). The proportion of patients being treated with SERMs and PTH who were switched to drugs from a different class was much

higher ( $>70\%$ ) than for patients being treated with BPs (52.5%; Fig. 4).

### 3.8. Switched treatments

For patients whose prescriptions were switched from BPs, most were switched to SERMs (Fig. 4). The most common reason given for switching to SERMs was the side effects of BPs (100%). Most doctors who prescribed a switch from BPs to PTH cited PTH's greater efficacy (89.7%). For patients whose prescriptions were switched from SERMs, almost all were switched to BPs (Fig. 4). The most common reason given for switching from SERMs to BPs (71.2%) or to PTH (72.2%) was lack of efficacy. For patients whose prescriptions were switched from PTH, most were switched to BPs (Fig. 4). The most common reason given for switching from PTH to BPs (74.6%) or SERMs (73.3%) was the high cost of PTH treatment.

### 3.9. Maintained treatments

Patients who were not switched were maintained on the current drug or were prescribed a different brand of drug in the same class. Ineffective or unusable BP treatment was more likely to be maintained than ineffective or unusable SERM or PTH treatment. The most common reason provided for maintaining treatment with BPs and SERMs despite the existing treatment being ineffective or unusable was a lack of

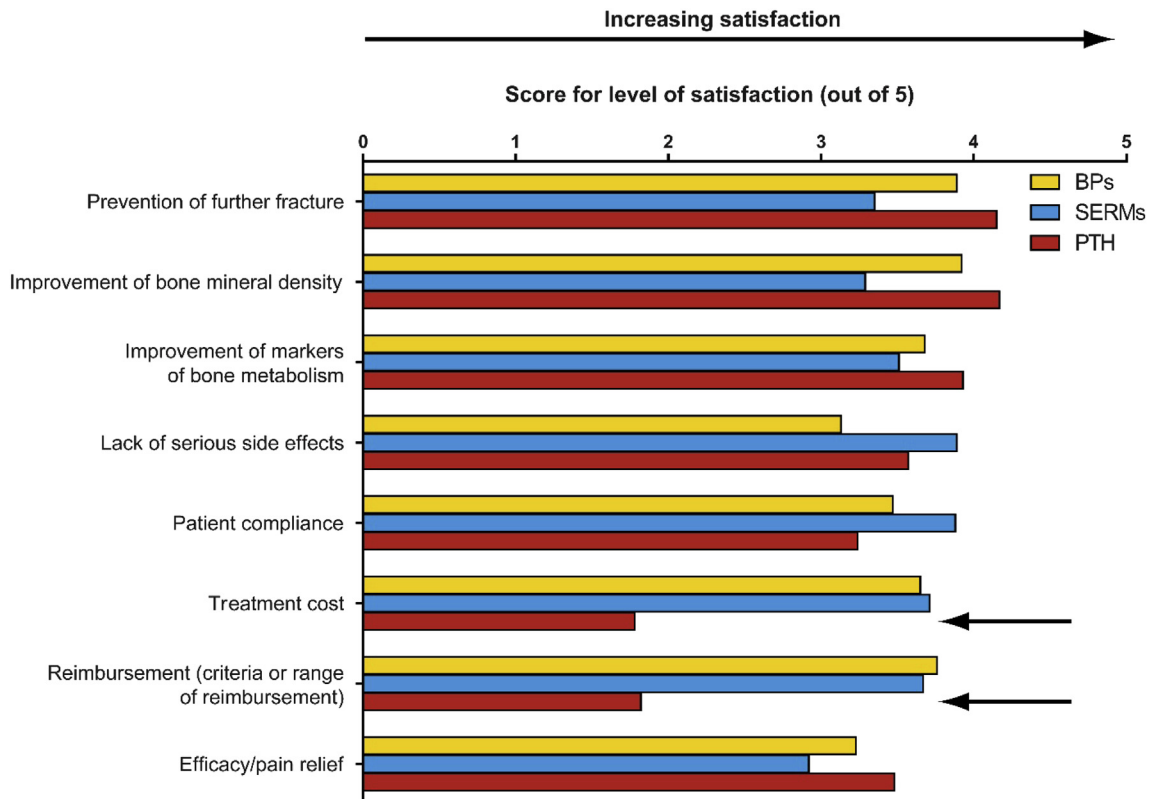


Fig. 3. Doctors' levels of satisfaction with aspects of BPs (yellow), SERMs (blue), and PTH (red). Arrows indicate large differences in satisfaction scores for PTH compared with BPs and SERMs. Abbreviations: BPs, bisphosphonates; PTH, parathyroid hormone; SERMs, selective estrogen receptor modulators.

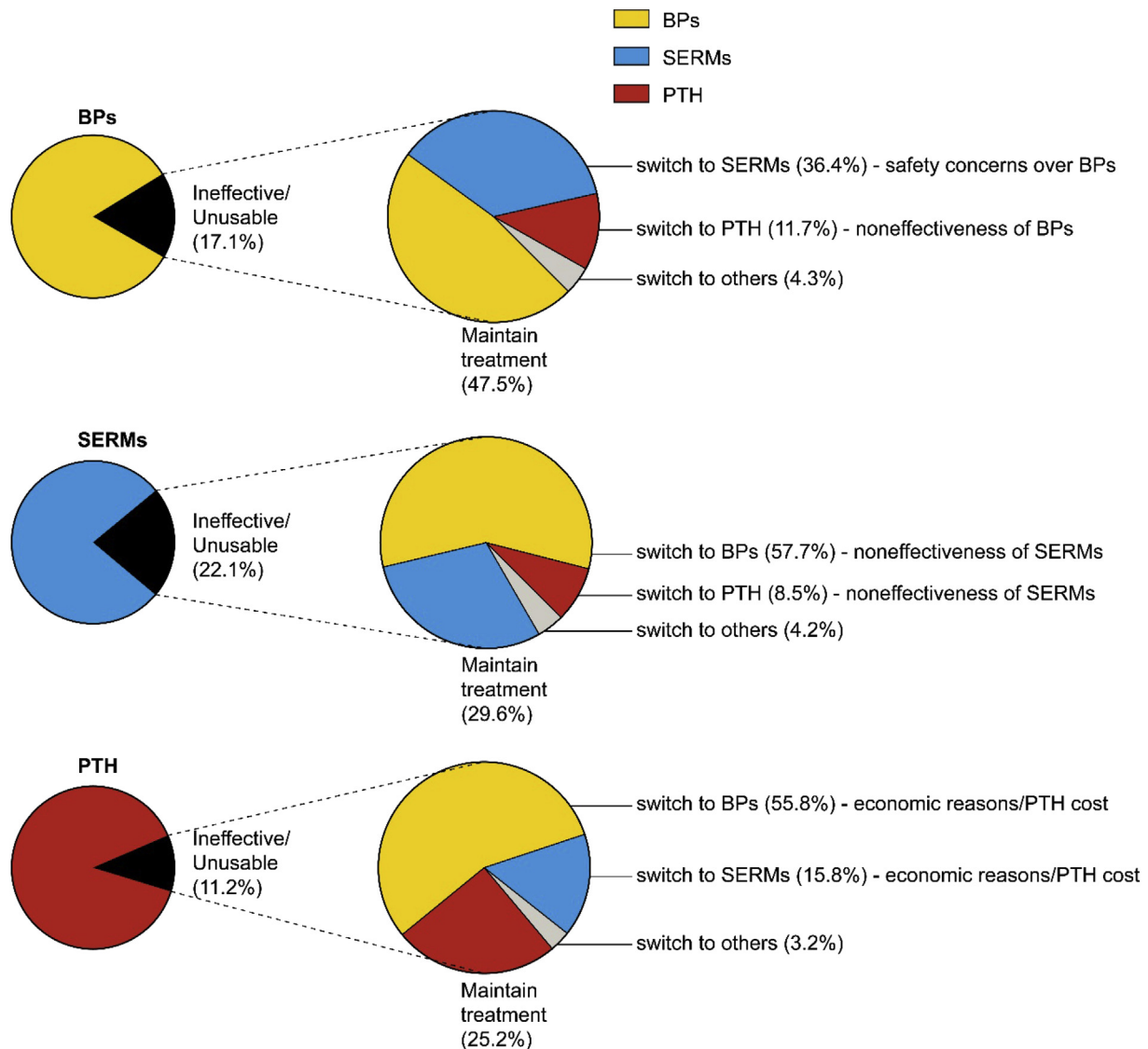


Fig. 4. Percentage of patients whose prescriptions were maintained or switched to a different drug class when treatments were deemed ineffective or unusable. The most common reason for each switch is provided following the percentage of treatments switched to BPs (yellow), SERMs (blue) and PTH (red). Abbreviations: BPs, bisphosphonates; PTH, parathyroid hormone; SERMs, selective estrogen receptor modulators.

alternatives (65.5–73.7%). Doctors cited issues such as the expense of PTH, side effects of BPs, patient refusal, and that the use of BPs was better than no treatment, as reasons for not switching to another drug class and maintaining existing treatment.

### 3.10. Aspects of treatment that require improvement

From a list of options (Question 23, [Supplementary Material](#)), the aspect of treatment most commonly identified by doctors as needing improvement was limitation of reimbursement (76%). Other aspects of treatment identified as needing improvement were a lack of recognition of the seriousness of disease by patients (57%), a lack of variety in treatment options (50%), treatment efficacy (45%), treatment safety (34%), and a lack of guidelines for treatment (33%).

## 4. Discussion

In order to effectively manage severe osteoporosis and its associated (and increasing) morbidity, mortality, and economic burden in South Korea, it is necessary to identify the current issues in diagnosis and treatment faced by doctors directly managing the disease. Although awareness of osteoporosis in general is increasing, much less information is available on severe osteoporosis. To our knowledge, this is the first study to survey doctors in South Korea on issues associated specifically with severe osteoporosis. Our study identified a number of important issues surrounding the diagnosis and perception of severe osteoporosis, as well as with each of the three drug classes most commonly used in its treatment. Despite the perceived efficacy of PTH amongst doctors surveyed, especially in the treatment of severe

osteoporosis, doctors indicated that prescription of PTH was limited by its high cost and lack of reimbursement from the National Health Insurance program. Addressing the issues surrounding reimbursement of PTH may provide doctors with more effective options for treatment, especially in cases where previous treatments have proven ineffective or unusable.

One of the most surprising findings in this survey was that almost all doctors (89%) surveyed had concerns about treatments for severe osteoporosis. The safety and efficacy of BPs, the efficacy of SERMs, and the high cost of PTH were the major concerns with each treatment. Doctors appeared to be very aware of the safety issues surrounding BP use (necrosis of the jaw and atypical femoral fracture) and the need to switch to alternative treatments in preference to long-term BP use [11]. Increased awareness of these safety issues was also reflected in surveys of doctors in South Korea and other countries in the Asia-Pacific region [8,12]. In terms of safety, SERMs were viewed most favorably, as judged from doctors' levels of satisfaction with this aspect of SERMs and their preference for switching to SERMs following concerns with the safety of BPs. However, the efficacy of SERMs, particularly for treatment of severe osteoporosis, was perceived as being lower than that of BPs and PTH (Fig. 2). For example, raloxifene, a commonly prescribed SERM, has been suggested to have reduced efficacy in reducing bone loss and fractures compared with BPs [11]. Overall, PTH was viewed as having the highest efficacy by doctors, specifically with regard to increasing BMD and preventing further fracture. Despite PTH's perceived efficacy, doctors viewed PTH as expensive, particularly as its cost is not currently reimbursed by the National Health Insurance program, in contrast to BPs and SERMs. The high cost of PTH is likely to be a barrier to some osteoporosis patients receiving effective treatment, particularly those with severe osteoporosis, a higher proportion of whom are prescribed PTH, compared with osteoporosis patients overall. Even after PTH treatment is initiated, in many cases, its lack of affordability appears to result in prescriptions being switched to BPs or SERMs. As a result, doctors often felt that there were no alternatives when BPs and SERMs were ineffective or unusable.

A lack of variety in treatment options was nominated by 50% of doctors as one of the points that needed improvement in the management of severe osteoporosis. Given the risks associated with long-term BP use, it is important that patients are not maintained on BP treatment (especially if ineffective) simply because there are no affordable alternatives. The high cost of medicines has been identified as one of the major barriers to optimal osteoporosis (including severe osteoporosis) treatment in South Korea, the Asia-Pacific region, and the United States [8,12,13]. Health insurance restrictions were also seen as a major issue by doctors from Taiwan, Indonesia, Thailand, and Vietnam [12]. Although PTH treatment has been calculated to be cost-effective when compared with no treatment [14], its cost-effectiveness compared with other osteoporosis treatments, especially

BPs, is yet to be conclusively established [15,16]. However, PTH's perceived efficacy and apparent underutilization in the current management of severe osteoporosis in South Korea argue strongly for a re-examination of the reimbursement criteria for osteoporosis treatments or for the development of separate criteria to evaluate treatments for severe osteoporosis. Increasing the affordability of PTH may have a substantial impact on improving disease management in South Korea.

This study suggests that although doctors are aware of the impact of severe osteoporosis on areas such as quality of life and economic burden, they believe that there is much lower awareness of these issues amongst patients and amongst society as a whole. Previous surveys on osteoporosis in South Korea, Asia, Britain, and the United States also identified a lack of knowledge and awareness of the disease amongst patients as being one of the main barriers to effective disease management [8,12,17,18]. Increasing awareness of osteoporosis, especially amongst patients, may improve treatment and management of the disease [19,20].

Interestingly, this survey indicates that there may be a lack of awareness about the criteria for diagnosis of severe osteoporosis, even amongst doctors treating the disease. The National Institutes of Health in the US and the International Osteoporosis Foundation both define severe osteoporosis as having a T-score of  $-2.5$  or lower and at least one fracture, and these same criteria are used in South Korea. However, some of the doctors surveyed did not define severe osteoporosis using these criteria, stating that classification of severe osteoporosis was only based on either BMD or fracture alone. More than 40% of doctors also stated that severe osteoporosis was indicated by a T-score of  $-3.0$  or lower (instead of  $-2.5$ ). Previous surveys have also identified a lack of disease awareness amongst doctors as being another barrier to optimal disease treatment [8,12]. Not using the relevant criteria may lead to misdiagnosis and failure to apply the appropriate treatment. Further education of both doctors and patients about osteoporosis, especially severe osteoporosis, may improve disease diagnosis and management. Education programs aimed at orthopedic surgeons in South Korea have been shown to improve the detection and treatment rate for osteoporosis following hip fracture [21].

To date, this study is the most comprehensive survey of the opinions and practices of South Korean doctors (from various specialties) with respect to their perception, diagnosis, and treatment of severe osteoporosis. Another strength of this study is that it provides insights into the use of leading treatments for severe osteoporosis in real-world clinical practice, as opposed to within the tightly controlled setting of a clinical trial. The study also provides a qualitative comparison of the efficacy, safety, and cost of BPs, SERMs, and PTH, as perceived by doctors who regularly prescribe these medications. The limitations of this study include the small sample size, the lack of comparative statistical analyses, and the fact that the survey was not pre-tested. Another limitation was that doctors were asked to estimate the numbers and percentages of patients treated with various medications, as opposed to

having these values calculated directly from their patient databases, which may have led to recall bias. All the doctors surveyed also practiced at large, urban hospitals, rather than smaller hospitals or in rural areas.

## 5. Conclusion

In conclusion, this survey has identified a number of critical issues surrounding the diagnosis and treatment of severe osteoporosis in South Korea. Reassessment of the reimbursement criteria for PTH treatment may be required in order to provide doctors with much-needed treatment alternatives and thereby maximize effective treatment of patients with severe osteoporosis. Such measures, in combination with further education of doctors and patients about the disease, are likely to make a substantial impact on nationwide management of this disease and the increasing disability, morbidity, and economic burden resulting from it.

## Funding support

This study was sponsored by Lilly Korea Ltd, manufacturer/licensee of teriparatide (PTH; Forteo<sup>®</sup>). The study was conducted by the market research company Gallup Korea, which was funded by Lilly Korea Ltd. Medical writing assistance was provided by Rebecca Lew, PhD, CMPP, and Chu Kong Liew, PhD, of ProScribe – Envision Pharma Group, and was funded by Lilly Korea Ltd. ProScribe's services complied with international guidelines for Good Publication Practice (GPP2).

## Role of the sponsor

Lilly Korea Ltd was involved in the study design, data analysis, and preparation of the manuscript.

## Role of contributors

All authors participated in the interpretation of study results, and in the drafting, critical revision, and approval of the final version of the manuscript. JHK, KJO, SaeYL, SunYL, SKL, and YSC were involved in the study design. JHK, YSP, KJO, SaeYL, and YSC were involved in data analyses. YSC and SaeYL were investigators in the study and SaeYL conducted the statistical analysis.

## Conflicts of interest

SaeYL, SunYL, and SKL are employees of Lilly Korea Ltd. YSC has received funding and/or honoraria from Pfizer, Takeda, MSD, Sanofi, Yuyu, Hanlim, Kwangdong, and GSK, and is a member of the advisory boards of MSD and Yuyu. YSP has received funding and/or honoraria from Novartis, Pfizer, Sanofi, Hanlim, Yuhan, Janssen, Mundipharma, Hanmi, Ildong, Daewoong, MSD, Takeda, and Handok, and is a member of the advisory board of Hanmi Medicare. JHK and KJO have no conflicts of interest to declare.

## Other contributors/acknowledgments

The authors would like to thank all survey participants.

## Appendix A. Supplementary material

Survey questionnaire (English translation)

| RESPONDENT INFO    |              |                      |  |
|--------------------|--------------|----------------------|--|
| Respondent's name  |              | Hospital's address   |  |
| Hospital's name    |              | Respondent's contact |  |
| Interviewer's name | (ID : _____) |                      |  |



Appendix A1. A. Screener

**A. Screener**

**Q1. Please check the respondent’s gender.** (Do not ask. Check one that applies)  
 1. Male 2. Female

**Q2. May I ask how old you are?** *Single choice*  
 1. 30 years old – less than 40 years old  
 2. 40 years old – less than 50 years old  
 3. 50 years old – less than 60 years old  
 4. 60 years old and above

**Q3. How many years have you been in practice since your residency?**  
 [TERMINATE IF LESS THAN 5, OR MORE THAN 30]  
 \_\_\_\_\_ year(s)

**Q4. What is the type of hospital you are working at?** *Single choice*  
 1. University Hospital 2. General Hospital 3. Others ▶ **Terminate**

**Q5. What is your primary medical specialty?** *Single choice*

| Specialty                  |                    |
|----------------------------|--------------------|
| 1. Orthopedic Surgery (OS) | → Quota check      |
| 2. Endocrinology (Endo)    | → Quota check      |
| 3. Neurosurgery (NS)       | → Quota check      |
| 4. Family Medicine (FM)    | → Quota check      |
| 5. Rheumatology (RH)       |                    |
| 6. Others                  | ▶ <b>Terminate</b> |

**Q6.** (Ask if answered ‘2. Endocrinology (Endo)’ or ‘4. Family Medicine (FM)’ or ‘5. Rheumatology (RH)’ in Q5)  
**Are you a member of KSO (The Korean Society of Osteoporosis)?**  
 1. Yes 2. No

**Q7. How many osteoporosis patients did you see/treat per month?**  
 \_\_\_\_\_ (Average number of osteoporosis patients / 1 month)

**Q8. How many osteoporosis patients who had a T-score below -2.5SD and experienced at least one osteoporotic fracture, did you see/treat per month?**  
 [TERMINATE IF LESS THAN 5]

**Patients who has a T-score below -2.5SD and experienced at least one osteoporotic fracture**  
 : \_\_\_\_\_ (Patient(s) / 1 month)

## Appendix A2. B. Perception

## B. Perception

**Q9. What's the definition of 'severe osteoporosis' to you?***Please write down verbatim of respondent's answer*


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**Q10. When you diagnose 'severe osteoporosis',****1) What are the level of each criteria that you consider as severe osteoporosis?****2) Please rank criteria according to relative importance in diagnosing severe osteoporosis.**

|                               | 1) Criteria                 | 2) Importance |
|-------------------------------|-----------------------------|---------------|
| 1. Bone mineral density (BMD) | BMD less than - __ SD       |               |
| 2. Fracture                   | More than __ times          |               |
| 3. Age                        | Aged more than __ years old |               |
| 4. Others                     | Please specify it:          |               |

**Q11. Please rank treatment goal according to relative importance in severe osteoporosis.**

|                                      | Importance |
|--------------------------------------|------------|
| 1. Prevention of further fracture    |            |
| 2. Improvement of BMD                |            |
| 3. Pain Relief                       |            |
| 4. Others (Please specify it: ____ ) |            |

\* From Q12, define ‘severe osteoporosis’ in this study as ‘T-score is below -2.5’ and ‘experienced at least one osteoporotic fracture’.

**Q12. Regarding severe osteoporosis,**

**1) Personal perception – What are your personal scores on these 4 aspects: Seriousness of disease, Impact on Quality of Life (QOL), Economic burden, Urgency of Treatment? Please give scores using 5 point scales. 5 points means high and 1 point means low.**

**1. Seriousness of disease**

|                                  |               |             |
|----------------------------------|---------------|-------------|
| <b>Low</b>                       | <b>medium</b> | <b>High</b> |
| 1 ----- 2 ----- 3 ----- 4 -----5 |               |             |

**2. Impact on QOL**

|                                  |               |             |
|----------------------------------|---------------|-------------|
| <b>Low</b>                       | <b>medium</b> | <b>High</b> |
| 1 ----- 2 ----- 3 ----- 4 -----5 |               |             |

**3. Economic Burden**

|                                  |               |             |
|----------------------------------|---------------|-------------|
| <b>Low</b>                       | <b>medium</b> | <b>High</b> |
| 1 ----- 2 ----- 3 ----- 4 -----5 |               |             |

**4. Urgency of Treatment**

|                                  |               |             |
|----------------------------------|---------------|-------------|
| <b>Low</b>                       | <b>medium</b> | <b>High</b> |
| 1 ----- 2 ----- 3 ----- 4 -----5 |               |             |

**2) Social perception - In your opinion, what are the scores of social perceptions on these 4 aspects: Seriousness of disease, Impact on QOL, Economic burden, Urgency of Treatment? 5 points means high and 1 point means low.**

**1. Seriousness of disease**

|                                  |               |             |
|----------------------------------|---------------|-------------|
| <b>Low</b>                       | <b>medium</b> | <b>High</b> |
| 1 ----- 2 ----- 3 ----- 4 -----5 |               |             |

**2. Impact on QOL**

|                                  |               |             |
|----------------------------------|---------------|-------------|
| <b>Low</b>                       | <b>medium</b> | <b>High</b> |
| 1 ----- 2 ----- 3 ----- 4 -----5 |               |             |

**3. Economic Burden**

|                                  |               |             |
|----------------------------------|---------------|-------------|
| <b>Low</b>                       | <b>medium</b> | <b>High</b> |
| 1 ----- 2 ----- 3 ----- 4 -----5 |               |             |

**4. Urgency of Treatment**

|                                  |               |             |
|----------------------------------|---------------|-------------|
| <b>Low</b>                       | <b>medium</b> | <b>High</b> |
| 1 ----- 2 ----- 3 ----- 4 -----5 |               |             |

|                           | 1) Personal | 2) Social |
|---------------------------|-------------|-----------|
| 1. Seriousness of disease | Point(s)    | Point(s)  |
| 2. Impact on QOL          | Point(s)    | Point(s)  |
| 3. Economic Burden        | Point(s)    | Point(s)  |
| 4. Urgency of Treatment   | Point(s)    | Point(s)  |

**Q13. What are the problems faced by severe osteoporotic patients whom you have treated in the last 6 months?**

| Category   | Percentage (%) |
|--|----------------|
| 1. Death with related complications  | /100%          |
| 2. Necessity of long-term recuperation from surgical procedures and operations | /100%          |
| 3. Economic difficulty   | /100%          |
| 4. A serious level of malfunction causing discomforts in daily life            | /100%          |
| 5. Additional fracture happened  | /100%          |

**Q14. Currently, are there any concerns in prescribing medicines for severe osteoporotic patients?**

1. Yes

2. No

**Q15. (Ask if answered '1. Yes' in Q14)**

**Currently what are the concrete concerns in prescribing medicines for severe osteoporotic patients?**

|   | Category           | Select all that apply |
|---|--------------------|-----------------------|
| 1 | Safety             | 1                     |
| 2 | Efficacy           | 2                     |
| 3 | Patient Compliance | 3                     |
| 4 | Price of medicines | 4                     |
| 5 | Others             | 5                     |

**Q16.** (Ask reason for each category answered in Q15)

**What are the specific issues with ‘Safety/ Efficacy/ Patient Compliance/ Price of medicines’ that you face when prescribing treatment for severe osteoporosis patients?**

|          | <b>Category</b>    | <b>Reason</b> |
|----------|--------------------|---------------|
| <b>1</b> | Safety             |               |
| <b>2</b> | Efficacy           |               |
| <b>3</b> | Patient Compliance |               |
| <b>4</b> | Price of medicines |               |
| <b>5</b> | Others             |               |

Appendix A3. C. Current Practice

**C. Current Practice**

**Q17. Among the patients you have prescribed medicines in the last 6 months,**

- 1) What was the percentage of each drug prescribed for overall osteoporotic patients in the last 6 months?
- 2) What was the percentage of each drug prescribed for severe osteoporotic patients in the last 6 months?

3) What were the percentages of severe osteoporotic patients for whom prescribed medicines were not effective or prescribed medicines were not applicable in the last 6 months?

*Interviewer: please ask the 5 of patients who prescribed medicines were not effective or prescribed medicines were not applicable assuming the severe osteoporotic patients as 100. If the % is 0, please write down '0%' on the table.*

4)(Ask if answered > 0% in Q17\_3)

**Q. What were the percentages of medicines 'maintained' and 'switched' when prescribed medicines were not effective or prescribed medicines were not applicable?**

5)(Ask if answered > 0% in Q17\_4)

**Q. What was the percentage of each medicine series that was switched when prescribed medicines were not effective or prescribed medicines were not applicable?**

|  | 17_1   | 17_2   | 17_3   | 17_4  | 17_5   |
|--|--|--|--|---|--|
|  | All osteoporosis patients (T-score) less than -2.5 | *Severe osteoporosis patients 'T-score is below -2.5' and 'experienced more than one osteoporotic fracture.' | Among patients in Q17_2, percentage for which 'prescribed medicines were not effective' or 'prescribed medicines are not applicable' | Among patients in Q17_3, percentage of patients 'maintained (switched to other brand of same medicine series or maintained)' Or 'switched (switched to other medicine series) | Among patients in Q17_4, percentage that were switched to other treatments |
| 1. Bisphosphonate (BP)                           | ① _____ %  | ① _____ %  | ① _____ /100 %   | ① maintained _____ %<br>② Switched _____ %  | ①SERM _____ %<br>②PTH _____ %<br>③Others _____ %                           |
| 2. Selective Estrogen Receptor Modulator (SERM ) | ② _____ %  | ② _____ %  | ② _____ /100 %   | ① maintained _____ %<br>② Switched _____ %  | ①BP _____ %<br>②PTH _____ %<br>③Others _____ %                             |
| 3. Parathyroid Hormone(PTH)                      | ③ _____ %  | ③ _____ %  | ③ _____ /100 %   | ① maintained _____ %<br>② Switched _____ %  | ①BP _____ %<br>②SERM _____ %<br>③Others _____ %                            |
| 4. Vitamin D                                     | ④ _____ %  | ④ _____ %  |  |   |  |
| 5. Calcium                                       | ⑤ _____ %  | ⑤ _____ %  |  |   |  |
| 6. Others  | ⑥ _____ %  | ⑥ _____ %  |  |   |  |
| <b>Total</b>                                     | <b>100% or more</b>                                | <b>100% or more</b>  |  |   |  |

**Q18.** (Ask if ① maintenance > 0% Q17\_ 4)

**What were the reasons that you maintained existing medicines even if they (BP/SERM/PTH) were not effective, or it was not possible to use them?**

*Probing points: Lack of variety in treatment options, Limitation of reimbursement, etc*

| Treatment                                       | Reason |
|---|--------|
| 1. Bisphosphonate (BP)                          |        |
| 2. Selective Estrogen Receptor Modulator (SERM) |        |
| 3. Parathyroid Hormone (PTH)                    |        |

**Q19.** (Ask if answered > 0% in Q17\_ 5)

**What are the reasons for switching to ‘Bisphosphonate (BP)/ Selective Estrogen Receptor Modulator (SERM)/ Parathyroid Hormone (PTH)’ when existing medicines are ineffective or unusable?**

| Treatment                                       | Main reasons of switching |
|---|---------------------------|
| 1. Bisphosphonate (BP)                          | ① BP → SERM:              |
|   | ② BP → PTH:               |
| 2. Selective Estrogen Receptor Modulator (SERM) | ① SERM → BP:              |
|   | ② SERM → PTH:             |
| 3. Parathyroid Hormone (PTH)                    | ① PTH → BP                |
|   | ② PTH → SERM              |

**Q20. What are your satisfaction level of each aspect of each medicine? Please give scores using 5 point scales. 5 points mean very satisfied and 1 point means not satisfied at all.**

|                                   |                           |
|-----------------------------------|---------------------------|
| <b>Not satisfied<br/>at all</b>   | <b>Very<br/>satisfied</b> |
| 1 ----- 2 ----- 3 ----- 4 ----- 5 |                           |

|   | 1. Bisphosphonate (BP) | 2. Selective Estrogen Receptor Modulator (SERM) | 3. Parathyroid Hormone (PTH) |
|---|------------------------|---|------------------------------|
| 1. Prevention of further fracture                         | 1 - 2 - 3 - 4 - 5      | 1 - 2 - 3 - 4 - 5                               | 1 - 2 - 3 - 4 - 5            |
| 2. Improvement of BMD                                     | 1 - 2 - 3 - 4 - 5      | 1 - 2 - 3 - 4 - 5                               | 1 - 2 - 3 - 4 - 5            |
| 3. Improvement of biochemical markers of bone metabolism  | 1 - 2 - 3 - 4 - 5      | 1 - 2 - 3 - 4 - 5                               | 1 - 2 - 3 - 4 - 5            |
| 4. There's no serious side effect                         | 1 - 2 - 3 - 4 - 5      | 1 - 2 - 3 - 4 - 5                               | 1 - 2 - 3 - 4 - 5            |
| 5. Patient compliance is good                             | 1 - 2 - 3 - 4 - 5      | 1 - 2 - 3 - 4 - 5                               | 1 - 2 - 3 - 4 - 5            |
| 6. Proper medicine price                                  | 1 - 2 - 3 - 4 - 5      | 1 - 2 - 3 - 4 - 5                               | 1 - 2 - 3 - 4 - 5            |
| 7. Reimbursement (eg. Criteria or range of reimbursement) | 1 - 2 - 3 - 4 - 5      | 1 - 2 - 3 - 4 - 5                               | 1 - 2 - 3 - 4 - 5            |
| 8. Efficacy : Relief of Pain                              | 1 - 2 - 3 - 4 - 5      | 1 - 2 - 3 - 4 - 5                               | 1 - 2 - 3 - 4 - 5            |





### Treatments for Osteoporosis in South Korea

| Treatment                                     | Availability | Reimbursement |
|---|--------------|---------------|
| <i>Bisphosphonates</i>                        |              |               |
| Risedronate                                   | Yes          | Yes           |
| Alendronate                                   | Yes          | Yes           |
| Ibandronate                                   | Yes          | Yes           |
| Zoledronic acid                               | Yes          | Yes           |
| Pamidronate                                   | Yes          | Yes           |
| Clodronate                                    | No           | NA            |
| <i>Selective estrogen receptor modulators</i> |              |               |
| Raloxifene                                    | Yes          | Yes           |
| Bazedoxifene                                  | Yes          | Yes           |
| <i>Parathyroid hormone analogs</i>            |              |               |
| Teriparatide                                  | Yes          | No            |
| Parathyroid hormone 1-84                      | No           | NA            |
| <i>Vitamin D analogs</i>                      |              |               |
| Vitamin D/calcium supplements                 | Yes          | Yes           |
| Alfacalcidol                                  | Yes          | Yes           |
| Calcitriol                                    | Yes          | Yes           |
| <i>Other</i>                                  |              |               |
| Elcatonin                                     | Yes          | Yes           |
| Estrogen replacement therapy                  | Yes          | Yes           |
| Vitamin K2                                    | Yes          | Yes           |
| Denosumab                                     | No           | NA            |
| Strontium ranelate                            | No           | NA            |

Abbreviation: NA, not applicable.

Adapted from International Osteoporosis Foundation. Asia-Pacific Regional Audit. 2013 [cited 2016 Jan 27]; Available from:

[http://www.iofbonehealth.org/sites/default/files/media/PDFs/Regional%20Audits/2013-Asia\\_Pacific\\_Audit-Rep\\_Korea\\_0\\_0.pdf](http://www.iofbonehealth.org/sites/default/files/media/PDFs/Regional%20Audits/2013-Asia_Pacific_Audit-Rep_Korea_0_0.pdf). Updated as of December 2015.

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