Original article

Trends in post osteoporotic hip fracture care from 2010 to 2014 in a private hospital in Malaysia

Swan Sim Yeap a,*, M.F.R. Nur Fazirah b, C. Nur Aisyah b, Siti Yazmin Zahari Sham c, Intan Nureslyna Samsudin c, Subashini C. Thambiah c, Fen Lee Hew a, Boon Ping Lim d, Yew Siong Siow d, Siew Pheng Chan a

a Department of Medicine, Subang Jaya Medical Centre, Subang Jaya, Selangor, Malaysia
b Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang, Selangor, Malaysia
c Department of Pathology, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang, Malaysia
d Department of Orthopaedic Surgery, Subang Jaya Medical Centre, Subang Jaya, Selangor, Malaysia

ARTICLE INFO

Article history:
Received 11 April 2017
Received in revised form 28 April 2017
Accepted 12 May 2017
Available online 3 June 2017

Keywords:
Audit
Osteoporosis
Hip fractures
Treatment
Malaysia

ABSTRACT

Objective: Following an osteoporotic fracture, pharmacological treatment is recommended to increase bone mineral density and prevent future fractures. However, the rate of starting treatment after an osteoporotic hip fracture remains low. The objective of this study was to survey the treatment rate following a low-trauma hip fracture at a tertiary private hospital in Malaysia over a period of 5 years.

Methods: The computerised hospital discharge records were searched using the terms “hip,” “femur,” “femoral,” “trochanteric,” “fracture,” or “total hip replacement” for all patients over the age of 50, admitted between 2010 and 2014. The medical charts were obtained and manually searched for demographic data and treatment information. Hip operations done for non-low-trauma-related fracture and arthritis were excluded.

Results: Three hundred seventy patients over the age of 50 years were admitted with a hip fracture, of which 258 (69.7%) were low trauma, presumed osteoporotic, hip fractures. The median age was 79.0 years (interquartile range [IQR], 12.0). Following a hip fracture, 36.8% (95 of 258) of the patients received treatment, but out of these, 24.2% (23 of 95) were on calcium/vitamin D only. The median duration of treatment was 1 month (IQR, 2.5). In 2010, 56.7% of the patients received treatment, significantly more than subsequent years 2011–2014, where approximately only 30% received treatment.

Conclusions: Following a low-trauma hip fracture, approximately 72% of patients were not started on active antosteoporosis therapy. Of those who were, the median duration of treatment was 1 month. This represents a missed opportunity for the prevention of future fractures.

© 2017 The Korean Society of Osteoporosis. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Osteoporosis is defined as a skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of fracture [1]. Typical osteoporosis fractures occur in the wrist, spine and hip. All osteoporosis fractures, especially at the hip, substantially increase the risk of death in the near term and are a major cause of morbidity in the elderly [2]. One-year mortality rates have ranged from 12% to 37% with approximately 50% of patients unable to regain their ability to live independently [2]. In addition, since a prior fracture is a well-established risk factor for future fracture [3], it is therefore recommended that after a fragility fracture, all patients be assessed and treated for osteoporosis [4,5].

However, rates of treatment following a hip fracture are widely variable; but generally rather poor. An Italian study has shown 78% of patients receiving pharmacological treatment and 68.7% given calcium and vitamin D (CaD) after a hip fracture [6]. Conversely, other studies have shown treatment rates as low as 6% in Belgium [7], 7.2%–13% in USA [8,9], 15% in the Netherlands [10], 25% in Spain [8] to 39% in Finland [11]. In the limited number of studies with Asian patients, it was found that 33% of patients were given medication for osteoporosis after hospitalisation for a hip fracture.
The computerized hospital discharge records were searched using hospital in Malaysia. The trauma hip fracture treatment rate at an urban tertiary care private hospital in Malaysia was assessed between the years 2010–2014. The medical records were obtained and manually searched for information on patients’ demographics and their pharmacological treatment for osteoporosis. Patients who had hip operations for traumatic fractures or for arthritis were excluded.

Ethical approval for the study was obtained from the Independent Ethics Committee, Ramsay Sime Darby Healthcare University (Ethics Committee reference 201211.5) and the Ethics Committee Universiti Putra Malaysia (JKEUPM) (JKEUPM reference No. FPSK [EXP16-Medic]U036).

Statistical analysis was performed using IBM SPSS Statistics ver. 22.0 (IBM Co., Armonk, NY, USA). The analysis of variance (1-way analysis of variance) was used to examine the differences in age and body mass index, and the 2-tailed Student t-test was used to assess any differences between those given treatment and those who were not, between the years 2010–2014.

### 3. Results

From 1 January 2010 to 31 December 2014, there were 370 patients over the age of 50 with hip fractures/operations. After excluding patients who had procedures for trauma (non–low-trauma) or arthritis, there was 258 (69.7%) presumed osteoporotic fractures. There were 193 female (74.8%) and 65 male patients (25.2%). The median age was 79.0 years (interquartile range [IQR], 120.0 years). There were 20 Malays (7.8%), 200 Chinese (77.5%), 31 Indians (12.0%), and 7 other races (2.7%). There were 35 patients (12.6%) who were noted to have had a previous low-trauma fracture, of whom 4 received medication. Of these, 3 patients received a bisphosphonate with calcium (duration of treatment 1 month, 1 year, and 2 years) and the other patient received CaD alone (duration of treatment not known).

The number of patients who were treated or not treated in each year is shown in Table 1. Significantly more patients were treated in 2010 compared to the later years; however, there was no difference in the number of patients treated in the years 2011–2014 (chi-square, P > 0.05 for comparisons between all years 2011–2014 [data not shown]). Overall, 95 of 258 (36.8%) received treatment after their hip fracture, but out of these, 23 of 95 (24.2%) were prescribed calcium/vitamin D only, leaving 72 of 95 (75.8%) given active osteoporosis treatment. Thus overall, 72 of 258 (27.9%) of the total osteoporotic hip fracture population given active osteoporosis therapy.

Table 2 shows the various types of treatment given in each year of the study. Forty-seven of 95 patients (49.5%) received calcium/CaD/vitamin D together with active osteoporosis medication. The most commonly prescribed antosteoporosis medication was the bisphosphonates with 37 prescriptions (38.9%), both on its own or in combination. Of these, 17 patients were given intravenous (IV) zoledronate. Overall mean duration of treatment was 3.35 ± 4.44 months, median, 1.0 months (IQR, 2.5 months). Excluding those who had IV zoledronate, the mean duration of treatment was 1.26 ± 1.28 months, median, 1.0 months (IQR, 0.81 month). Table 3 shows the types of hip fracture, the operations performed and the outcome. Although the majority of hip fractures were at the femoral neck, there were 15 of 258 femoral shaft fractures (5.8%), which would have included any possible atypical fractures. However, none of these femoral shaft fractures were reported as atypical fractures by the radiologists. None of the patients with femoral shaft fractures had been on bisphosphonates. Median duration of hospital stay was 7 days (IQR, 4 days). At 3 months, only 26 patients (10.1%) returned for a follow-up visit, with consecutive reduction in patient follow-up at 6 months and 12 months with 9 (3.5%) and 3 patients (1.2%), respectively.

### 4. Discussion

This study was conducted at a private hospital with 393 beds in an urban area. The hospital has a busy Accident and Emergency Department and would be the main hospital for anyone seeking private medical care in the area. Furthermore, it also would receive patients from smaller private hospitals that may not have the facilities for more complicated cases. We studied 5 consecutive years from 2010 to 2014 so as to ensure that the results had validity and found that the numbers were broadly similar. Thus, we would suggest that the results are representative of the hospital admissions.

In general, studies have shown that there is a low rate of starting treatment after an osteoporotic hip fracture [7–10]. A large prospective, observational cohort of women from Canada, Australia, Europe, and United States showed that only 17% started antosteoporosis medication after an incident fracture [13]. Even within the same country, studies have shown different rates e.g., one Italian study showed treatment rates of 78% [6], but another had a treatment rate of only 33.9% [14]. Rates of treatment following low-trauma fractures in the United States have showed different results, but they have been generally lower than 30%. Kim et al. [8] found that 11% of US Medicare patients received after hip fracture treatment but a slightly higher rate of 13% from a US commercial health insurer. Gillespie and Morin [9] studying a private insurance medical and pharmacy claims database showed that only 7.2% received osteoporosis medication at 6 months after a hip fracture [9]. A study from a Pennsylvania Medicare medication database showed that between 2002 and 2004, 31% of patients received treatment after a hip fracture [15].

There have not been many studies in Asian populations. A Korean study examining their Health Insurance Review and Assessment Service database showed that 3 months after a hip fracture, 39% of patients had been prescribed antosteoporotic medication [8]. Kung et al. [12] looked at treatment received following a low-trauma hip fracture in 6 Asian countries—mainland China and Hong Kong, Singapore, South Korea, Malaysia, Taiwan, and Thailand. Rates of treatment varied from over 60% at 6 months in South Korea and Thailand to below 20% in mainland

### Table 1

| Year (n) | Treated | Not treated | P-value |
|---------|---------|-------------|---------|
| 2010 (n = 60) | 34 (56.7) | 26 (43.3) | — |
| 2011 (n = 58) | 17 (29.3) | 41 (70.7) | 0.003 |
| 2012 (n = 53) | 17 (32.1) | 36 (67.9) | 0.009 |
| 2013 (n = 44) | 14 (31.8) | 30 (68.2) | 0.012 |
| 2014 (n = 43) | 13 (30.2) | 30 (69.8) | 0.008 |

Values are presented as number (%).

*P < 0.05, statistically significant differences compared to 2010. Chi-square test.
China, Hong Kong, and Singapore. As part of that study, there were 72 patients from university/academic centres in Malaysia, where 44.4% were treated with antiosteoporosis treatment following a hip fracture at 6 months [12]. Comparatively, our study showed only slightly less patients (36.8%) being treated after a hip fracture in a private hospital. This is comparable to overall study result of Kung et al. [12] of 33.3% receiving treatment. Thus, our study confirms that treatment following an osteoporotic hip fracture remains low in Malaysia.

Our study showed that more patients were treated following a hip fracture in 2010 (56.7%) compared to the subsequent years 2011–2014 (approximately 30%). Similarly, a study looking at a commercial health insurance database covering people across the United States found a reduction in the number of people treated following a low-energy hip, vertebral or wrist fracture between 2000 and 2009 [16]. In women, 23.8% received treatment during 2001–2002 compared to 15.9% during 2007–2009. For men, over the same period, the numbers treated were 10.6% and 8.5%, respectively [16]. In contrast, a study looking at treatment after a hip fracture from a Pennsylvania Medicare medication database showed that treatment rates increased from 7% in 1995 to 31% in 2002 and remained stable until the end of the study in 2004 [15].

Table 2
Pharmacological treatment of post-low trauma hip fracture.

| Treatment & duration | Year          | 2010 (n = 60) | 2011 (n = 58) | 2012 (n = 53) | 2013 (n = 44) | 2014 (n = 43) |
|----------------------|---------------|--------------|--------------|--------------|--------------|--------------|
| No treatment         |               | 26 (43.3)    | 41 (70.7)    | 36 (67.9)    | 30 (68.2)    | 30 (69.8)    |
| Calcium only         |               | 4 (6.7)      | 2 (3.4)      | 1 (1.9)      | 3 (6.8)      | 1 (2.3)      |
| Calcium + vitamin D  |               | 4 (6.7)      | 0 (0)        | 0 (0)        | 2 (4.5)      | 5 (11.6)     |
| Vitamin D            |               | 1 (1.7)      | 0 (0)        | 0 (0)        | 0 (0)        | 0 (0)        |
| Calcium + bisphosphate|              | 1 (1.7)      | 1 (1.7)      | 0 (0)        | 1 (2.3)      | 0 (0)        |
| Calcium + strontium  |               | 3 (5.0)      | 0 (0)        | 0 (0)        | 0 (0)        | 0 (0)        |
| Calcium + denosumab  |               | 0 (0)        | 0 (0)        | 0 (0)        | 0 (0)        | 1 (2.3)      |
| Calcium + teriparatide|              | 0 (0)        | 2 (3.4)      | 0 (0)        | 1 (2.3)      | 0 (0)        |
| Calcium + vitamin D + bisphosphate | | 5 (8.3) | 4 (6.9) | 7 (13.2) | 3 (6.8) | 3 (7.0) |
| Calcium + vitamin D + strontium | | 5 (8.3) | 2 (3.4) | 0 (0) | 0 (0) | 0 (0) |
| Calcium + vitamin D + teriparatide | | 1 (1.7) | 1 (1.7) | 1 (1.9) | 1 (2.3) | 0 (0) |
| Calcium + vitamin D + bisphosphate + strontium | | 3 (5.0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Calcium + bisphosphate | | 0 (0) | 0 (0) | 1 (1.9) | 0 (0) | 0 (0) |
| Bisphosphonate | | 2 (3.3) | 1 (1.7) | 3 (5.7) | 1 (2.3) | 1 (2.3) |
| Strontium | | 2 (3.3) | 3 (5.2) | 4 (7.5) | 2 (4.5) | 0 (0) |
| Teriparatide | | 0 (0) | 1 (1.7) | 0 (0) | 0 (0) | 0 (0) |
| Not known | | 3 (5.0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Duration of treatment, mo | | 3.53 ± 4.62 | 2.37 ± 3.86 | 3.05 ± 4.30 | 4.30 ± 5.35 | 3.68 ± 4.30 |
| Median duration of treatment, mo | | 1.00 | 0.63 | 1.00 | 1.00 | 2.00 |
| Duration of treatment excluding IV zoledronate, mo | | 1.00 ± 1.16 | 1.00 ± 0.97 | 1.26 ± 1.38 | 0.88 ± 0.36 | 2.02 ± 2.02 |
| Median duration of treatment excluding IV zoledronate, mo | | 1.00 | 0.88 | 1.00 | 1.00 | 1.00 |

Values are presented as number (%) or mean ± 1 standard deviation unless otherwise indicated.

IV, intravenous.

Table 3
Hip fracture data and outcome.

| Variable                  | Year          | 2010 (n = 60) | 2011 (n = 58) | 2012 (n = 53) | 2013 (n = 44) | 2014 (n = 43) |
|---------------------------|---------------|--------------|--------------|--------------|--------------|--------------|
| Site of fracture          |               |              |              |              |              |              |
| Femoral neck              | 31 (51.7)     | 37 (63.8)    | 34 (64.2)    | 27 (61.4)    | 32 (74.4)    |              |
| Intertrochanteric         | 20 (33.3)     | 13 (22.4)    | 14 (26.4)    | 11 (25.0)    | 10 (23.5)    |              |
| Subtrochanteric           | 4 (6.7)       | 3 (5.2)      | 3 (5.7)      | 3 (6.8)      | 0 (0)        |              |
| Femoral shaft             | 5 (8.3)       | 4 (6.9)      | 2 (3.8)      | 3 (6.8)      | 1 (2.3)      |              |
| Not known                 | 0 (0)         | 1 (1.7)      | 0 (0)        | 0 (0)        | 0 (0)        |              |
| Operation performed       |               |              |              |              |              |              |
| THR                       | 12 (20.0)     | 12 (37.9)    | 22 (41.5)    | 9 (20.5)     | 12 (27.9)    |              |
| Hemi-arthroplasty         | 16 (26.7)     | 14 (24.1)    | 10 (18.9)    | 11 (25.0)    | 15 (34.9)    |              |
| Plate                     | 7 (11.7)      | 4 (6.9)      | 3 (5.7)      | 7 (15.9)     | 2 (3.8)      |              |
| Rod                       | 1 (1.7)       | 0 (0)        | 0 (0)        | 0 (0)        | 0 (0)        |              |
| Gamma nail                | 2 (3.3)       | 5 (8.6)      | 1 (1.9)      | 3 (6.8)      | 4 (9.3)      |              |
| DHS                       | 22 (36.7)     | 22 (37.9)    | 16 (30.2)    | 13 (29.5)    | 10 (23.5)    |              |
| Combination               | 0 (0)         | 1 (1.7)      | 0 (0)        | 1 (2.2)      | 0 (0)        |              |
| No operation              | 0 (0)         | 0 (0)        | 1 (1.9)      | 0 (0)        | 0 (0)        |              |
| Mobility on discharge     |               |              |              |              |              |              |
| Walking without aid       | 0 (0)         | 0 (0)        | 0 (0)        | 0 (0)        | 0 (0)        |              |
| Walking with stick        | 0 (0)         | 0 (0)        | 0 (0)        | 0 (0)        | 0 (0)        |              |
| Walking with frame        | 40 (66.7)     | 35 (60.3)    | 42 (79.2)    | 34 (77.3)    | 30 (69.8)    |              |
| Using wheelchair          | 16 (26.7)     | 22 (37.9)    | 11 (20.8)    | 10 (22.7)    | 12 (27.9)    |              |
| Bed-bound                 | 1 (1.7)       | 0 (0)        | 0 (0)        | 0 (0)        | 1 (2.3)      |              |
| Died                      | 1 (1.7)       | 0 (0)        | 0 (0)        | 0 (0)        | 0 (0)        |              |
| Data missing              | 2 (3.3)       | 1 (1.7)      | 0 (0)        | 0 (0)        | 0 (0)        |              |

Values are presented as number (%).

THR, total hip replacement; DHS, dynamic hip screw.
One other possible reason for a declining rate of treatment in 2010 compared to subsequent years could be due to the increasing reports of the association of atypical femoral fractures with bisphosphonate use. One of the initial case series came from Singapore, a neighbouring country to Malaysia, where the authors found that 9 out of 13 cases of low-energy subtrochanteric fractures had been on alendronate, an amino-bisphosphonate, for a median of 5 years prior to the fracture [17]. More reports followed until in 2010, the American Society of Bone and Mineral Research published its first task force report on atypical fractures which suggested that the risk of these fractures increased with increasing duration of bisphosphonate use [18]. Unfortunately, the effect of such reports was to reduce the use of antosteoporosis medication generally, with many doctors reluctant to even start medication. In Malaysia, the pharmaceutical industry sales tracking data showed that purchases of antosteoporotic drugs fell during that period with an estimated 34,000 patient-years treatment in 2012, reducing to approximately 30,000 patient-years treatment in 2015 (Data from IMS Health Malaysia (www.quintileIMS.com), personal communication). This would suggest that our data is just reflecting the trend throughout the country.

CaD supplementation is recommended as adjunctive therapy together with active antosteoporosis medication as the clinical trials for osteoporosis therapies have all included these 2 supplements [19]. CaD supplementation in the older population have been shown in meta-analyses to have a modest effect on the reduction of fracture risk [20,21] but it is not recommended as the sole treatment in patients with established osteoporosis [5]. Interestingly, it has been shown that CaD supplementation after a hip fracture has an effect in reducing mortality at 1 year, similar to that of taking antosteoporosis medication, and in combination (CaD and osteoporosis therapies), the reduction in mortality is greater. A study from Finland showed that the unadjusted 1-year mortality hazard ratio (HR) for those taking CaD supplementation was 0.74 (95% confidence interval [CI], 0.61–0.81), which was similar to the reduction in those taking antosteoporosis mediation HR 0.79 (95% CI, 0.67–0.93). In combination, the 1-year mortality HR was further significantly reduced to 0.62 (95% CI, 0.5–0.76) [22].

In our study, almost 50% of patients on antosteoporosis medication were on concomitant calcium/CaD/vitamin D but 24.2% were just given these supplements alone. Previous studies have shown similar treatment knowledge gaps. A study from 2 hospitals in Finland showed that 14% of their patients following a hip fracture received CaD only [11]. In a pharmacy and discharge database study after hip fracture from US, 6.6% of patients received CaD alone, 7.3% received antosteoporosis therapy and only 2% received both [23].

For the 36.8% of patients that started treatment in this study, the median duration of treatment was disappointing, only 1.0 months, because there would be no benefit from taking treatment for such a short period of time. This may be due to the low level of follow-up with only 10.1% returning for a 3-month follow-up appointment. Other studies have similarly shown that the persistence rate for taking osteoporosis medication at 1 year is low, varying from 34% [24] to 43% [25].

Subtrochanteric and femoral shaft fractures constitute 4%–10% of all femur fractures [26]. Within those fractures, a subset would be the atypical femoral fractures that have been associated with bisphosphate therapy. In our sample, we had 5.8% of femoral shaft fractures, which is not higher than the previously reported number. In addition, all those patients with femoral shaft fractures had not been exposed to bisphosphonates prior to their fracture. Thus, within this small sample, we did not observe bisphosphate-related femoral shaft fractures.

To improve the treatment of patients following a fracture, it had been shown 10 years ago that having a dedicated staff or “case manager” to counsel and follow-up patients improved the number of patients receiving treatment after a hip fracture; 6 months after the hip fracture, 51% of patients in the intervention group were receiving bisphosphonate therapy compared with 22% of patients in the control group (adjusted odds ratio, 4.7; 95% CI, 2.4–8.9; P < 0.001) [27]. More recently, both the International Osteoporosis Foundation [28] and the American Society of Bone Mineral Research [29] recommend a coordinator-based model of care known as a Fracture Liaison Service (FLS) as the model of choice to be adopted by all hospitals and outpatient facilities that are treating fragility fracture patients for prevention of secondary fractures following the first fracture. FLS programs have been shown to be cost-effective and cost-saving for the prevention of secondary fractures [30]. This study’s results would add to the evidence supporting the need to establish such a FLS program in the hospital to increase the treatment rate following an osteoporotic hip fracture.

There are some weaknesses in this study which may limit the interpretation of the results. Firstly, the numbers are small as it was single center review, as compared to previous other studies that looked at prescription database data. However, as there were very few data from Asian countries, we feel that these results are relevant in documenting suboptimal post osteoporotic hip fracture care. In addition, it was a retrospective case note review, which may have not fully documented the information required. Nevertheless, as the numbers were fairly similar throughout the 5 years of the study, the information should have some validity. There was also a preponderance of one ethnic group in our study, the Chinese, which is likely due to the fact that hospital is situated in an urban area that has more ethnic Chinese residents. Thus, these results may not be generalizable to the rest of the Malaysian population that has an ethnic Malay majority.

5. Conclusions

In conclusion, following a hip fracture, approximately 72% of patients were not prescribed active antosteoporosis therapy. Of those who were, the median duration of treatment was one month. There was a reduction in patients getting treated from 2011–2014 compared to 2010. Despite the availability of proven effective active antosteoporosis therapies, patients with osteoporotic hip fractures are not prescribed these medications, and even when initiated on such therapies, do not remain on therapy. This represents a missed opportunity for the prevention of future fractures.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

Acknowledgments

We would like to thank Ms S.B. Lim for her help in data extraction and entry, and the Department of Orthopaedics, Subang Jaya Medical Centre for their co-operation during this study.

References

[1] NIH Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy. Osteoporosis prevention, diagnosis, and therapy. JAMA 2001;285:785–95.
[2] Foster KW. Hip fractures in adults [Internet]. UpToDate; c2017 [cited 2015 Nov 4]. Available from: http://www.uptodate.com/content/hip-fractures-in-
[3] Klotzbuecher CM, Ross PD. Landsman PB, Abbott 3rd TA, Berger M. Patients with prior fractures have an increased risk of future fractures: a summary of the literature and statistical synthesis. J Bone Miner Res 2000;15:721–31.
[4] Watts NB, Bilezikian JP, Camacho PM, Greenspan SL, Harris ST, Hodgson SF,
et al. American association of clinical endocrinologists medical guidelines for clinical practice for the diagnosis and treatment of postmenopausal osteoporosis. Endocr Pract 2010;16(Suppl 2):1–37.

[5] Yeap SS, Hew FL, Lee JK, Goh EM, Chee W, MuntaZ M, et al. The Malaysian Clinical Guidance on the management of postmenopausal osteoporosis, 2012: a summary. Int J Rheum Dis 2013;16:30–40.

[6] Carnevale V, Nieddu L, Romagnoli E, Bona E, Piemonte S, Scilitani A, et al. Osteoporosis intervention in ambulatory patients with previous hip fracture: a multicentric, nationwide Italian survey. Osteoporos Int 2006;17:478–83.

[7] Rabenda V, Vanoverloop J, Fabri V, Mertens R, Sumkay F, Vannecke C, et al. Low incidence of anti-osteoporosis treatment after hip fracture. J Bone Joint Surg Am 2008;90:2142–8.

[8] Kim SC, Kim MS, Sanf...e of osteoporosis medications after hospitalization for hip fracture: a cross-national study. Am J Med 2015;128:519–26.

[9] Gillespie CW, Morin PE. Osteoporosis-related health services utilization following first hip fracture among a cohort of privately-insured women in the United States, 2008–2014: an observational study. J Bone Miner Res 2017;32:1052–61.

[10] Panneman MJ, Lips P, Sen SS, Herings RM. Undertreatment with anti-osteoporotic drugs after hospitalization for fracture. Osteoporos Int 2004;15:120–4.

[11] Lüthje P, Nurmi-Lüthje I, Kaukonen JP, Kuur...ate M. Undertreatment of osteoporosis following hip fracture in the elderly. Arch Gerontol Geriatr 2009;49:153–7.

[12] Kung AW, Fan T, Xu L, Xia WB, Park IH, Kim HS, et al. Factors influencing diagnosis and treatment of osteoporosis after a fragility fracture among postmenopausal women in Asian countries: a retrospective study. BMC Womens Health 2013;13:7.

[13] Greenspan SL, Wyman A, Hooven FH, Adami S, Gehlbach S, Anderson Jr FA, et al. Predictors of treatment with osteoporosis medications after recent fragility fractures in a multinational cohort of postmenopausal women. J Am Geriatr Soc 2012;60:455–61.

[14] Tan... branded ML. The costs and consequences of adherence to therapy in hip fracture patients. Results Longitud Anal Clin Cases Min Bone Metab 2011;37:57–62.

[15] Cadarete SM, Katz JN, Brookhart MA, Levin R, Stedman MR, Choudhry NK, et al. Trends in drug prescribing for osteoporosis after hip fracture, 1995-2004. J Rheumatol 2008;35:319–26.

[16] Balasubramanian A, Tosi LL, Lane JM, Dirschl DR, Ho PR, O'Malley CD, et al. Declining rates of osteoporosis management following fragility fractures in the U.S., 2000 through 2009. J Bone Joint Surg Am 2014;96:e52.

[17] Goh SK, Yang KY, Koh JS, Wong MK, Chua SY, Chua DT, et al. Subtrochanteric insufficiency fractures in patients on alendronate therapy: a caution. J Bone Joint Surg Br 2007;89:349–53.

[18] Shane E, Burr D, Ebeling PR, Abrahamsen B, Adler RA, Brown TD, et al. Atypical subtrochanteric and diaphyseal femoral fractures: report of a task force of the American Society for Bone and Mineral Research. J Bone Miner Res 2010;25:2267–94.

[19] Harvey NC, Biver E, Kaufman JM, Bauer J, Branco J, Brandi ML, et al. The role of calcium supplementation in healthy musculoskeletal ageing. Osteoporos Int 2017;28:447–62.

[20] Tang BM, Eslick GD, Nowson C, Smith C, Bensoussan A. Use of calcium or calcium in combination with vitamin D supplementation to prevent fractures and bone loss in people aged 50 years and older: a meta-analysis. Lancet 2007;370:657–66.

[21] Weaver CM, Alexander DD, Boushey CJ, Dawson-Hughes B, Lappe JM, LeRoy MS, et al. Calcium plus vitamin D supplementation and risk of fractures: an updated meta-analysis from the National Osteoporosis Foundation. Osteoporos Int 2016;27:367–76.

[22] Nurmi-Lüthje I, Sund R, Juntunen M, Lüthje P. Post-hip fracture use of prescribed calcium plus vitamin D or vitamin D supplements and anti-osteoporotic drugs is associated with lower mortality: a nationwide study in Finland. J Bone Miner Res 2011;26:1845–53.

[23] Jennings LA, Auerbach AD, Maselli J, Pekow PS, Lindemauer PK, Lee SJ. Missed opportunities for osteoporosis treatment in patients hospitalized for hip fracture. J Am Geriatr Soc 2010;58:650–7.

[24] Conflavreux CB, Canoui-Poitrine F, Schott AM, Ambrosi V, Tautturi V, Chapurlat RD. Persistence at 1 year of oral antosteoporotic drugs: a prospective study in a comprehensive health insurance database. Eur J Endocrinol 2012;166:735–41.

[25] Kothawa P, Badamgarav E, Ryu S, Miller RM, Halbert RJ. Systematic review and meta-analysis of real-world adherence to drug therapy for osteoporosis. Mayo Clin Proc 2007;82:1493–501.

[26] Shane E, Burr D, Abrahamsen B, Adler RA, Brown TD, Cheung AM, et al. Atypical subtrochanteric and diaphyseal femoral fractures: second report of a task force of the American Society for Bone and Mineral Research. J Bone Miner Res 2014;29:1–23.

[27] Majumdar SR, Beaupre LA, Harley CH, Hanley DA, Lier AE, Juby AG, et al. Use of a case manager to improve osteoporosis treatment after hip fracture: results of a randomized controlled trial. Arch Intern Med 2007;167:2110–5.

[28] Capture the fracture. Best practice framework for fracture liaison services [internet]. Nyon [Switzerland]: International Osteoporosis Foundation; c2017 [cited 2017 Mar 20]. Available from: http://capturethefracture.org/sites/default/files/2014-10-FCT-best_practice_framework.pdf.

[29] Eisman JA, Bogoch ER, Dell R, Harrington JT, McKinney Jr RE, McLellan A, et al. Making the first fracture the last fracture the last fracture: ASBMR task force report on secondary fracture prevention. J Bone Miner Res 2012;27:2039–46.

[30] Marsh D, Akesson K, Beaton DE, Bogoch ER, Boonen S, Brandi ML, et al. Coordinator-based systems for secondary prevention in fragility fracture patients. Osteoporos Int 2011;22:2051–65.