JBM J Bone Metab 2020;27(3):187-199
https://doi.org/10.11005/jbm.2020.27.3.187
pISSN 2287-6375 eISSN 2287-7029

Original Article

What is the Role of Coordinators in the Secondary Fracture Prevention Program?

Yong Han Cha[1,*], Yong-Chan Ha[2,*], Ki-Soo Park[3], Jun-Il Yoo[4]

[1]*Department of Orthopaedic Surgery, Eulji University Hospital, Daejeon;*
[2]*Department of Orthopaedic Surgery, Chung-Ang University College of Medicine, Seoul;*
[3]*Department of Preventive Medicine and Institute of Health Sciences, Gyeongsang National University Hospital, Jinju;*
[4]*Department of Orthopaedic Surgery, Gyeongsang National University Hospital, Jinju, Korea*

Corresponding author
Jun-Il Yoo
Department of Orthopaedic Surgery,
Gyeongsang National University Hospital,
79 Gangnam-ro, Jinju 52727, Korea
Tel: +82-55-750-8688
Fax: +82-55-754-0477
E-mail: furim@hanmail.net

Received: May 25, 2020
Revised: July 3, 2020
Accepted: July 8, 2020

*Yong Han Cha and Yong-Chan Ha contributed equally to this work and should be considered co-first authors.

Background: The purpose of this study is to search for reports on the clinical effectiveness of FLS being implemented worldwide through the systematic review, analyze the roles of coordinators in each study, and provide basic data for the development of future coordinator education programs. **Methods:** A systematic search of the literature using the Medline, PubMed, and EMBASE databases and the Cochrane Library was conducted for using the following keywords: 'osteoporosis' AND 'fractures' AND 'secondary prevention'. Finally, 65 studies are included in this study. **Results:** At the coordinator-based fracture liaison service (FLS) center, the coordinator (often a nurse) acts as a central player in the establishing of patient connections, orthopedic surgeons, radiologists, and attending physicians. Coordinators help bridge the nursing gap by supporting identification, investigation, initiation of treatment, and patient follow-up. Medics has opened the way to effectively manage patients at high risk of developing another fracture. In addition, nurses are in a unique and important role as nurses responsible for enhancing their daily lives by building relationships with patients and families. **Conclusions:** The coordinator in the FLS program plays an important role in the multidisciplinary management of vulnerable fractures, as well as in the diagnosis and treatment of osteoporosis and in maintaining continuity of treatment. In the future, the broader role of coordinators should be systematically organized and developed into accredited educational programs.

Key Words: Nurses · Osteoporotic fractures · Secondary prevention

INTRODUCTION

Secondary fracture preventions (fracture liaison service [FLS]) including anti-osteoporotic medication and patient education are important for fragility fractured patients because of the high rates of re-fracture after the first fracture.[1] Among fragility fractures including spine, hip, wrist, and proximal humerus, hip fractures are notorious to high mortality, morbidity, and a socioeconomic burden in an aging society. According to recent studies, numbers of fragility fractures are expected to increase trends in the future.[2,3] Secondary fracture prevention programs can be configured in a variety of forms depending on the country's medical system and hospital capacity, and are currently operating in 35 countries around the world.[4] Reported secondary fracture prevention programs can be divided into

Copyright © 2020 The Korean Society for Bone and Mineral Research

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (https://creativecommons.org/licenses/by-nc/4.0/) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

two main categories. The first is to report the clinical outcomes such as changes in the rate of evaluation and management of osteoporosis or changes in the re-fracture rate after the second fracture prevention program.[3,5-7] The second is proven the economic effect of the second fracture prevention program.[8] Those programs have the same purpose of operation but vary in the way they operate and their members.

Although the management of the secondary fracture prevention program is performed in various ways, the coordinator is important for multidisciplinary management.[2] The role of the coordinator is considering assessment of the past medical history of patients, arrangement of the necessary examinations for osteoporosis, engagement in communication with the primary physician after discharge, and communication among the medical staff in the hospital. They can also help patients to understand the need for osteoporosis evaluation and anti-osteoporotic medication use and to maintain the continuity of patient care. However, there are only a few reports of what role coordinators perform in these secondary fracture prevention programs, and there is no globally recognized training program for them. The hypothesis of this study is that the role and assignment of the coordinator will vary among FLS studies.

Therefore, the purpose of this study is to search for reports on the clinical effectiveness of FLS being implemented worldwide through the systematic review, analyze the roles of coordinators in each study, and provide basic data for the development of future coordinator education programs.

METHODS

A systematic search of the literature using the Medline, PubMed, and EMBASE databases and the Cochrane Library was conducted for publications (January 2000–October 2019 inclusive) using the following keywords: 'osteoporosis' AND 'fractures' AND 'secondary prevention'. The detailed search method is shown in the Supplementary Appendix 1. Relevant papers have also been searched for other local repositories, blogs, and gray literature outlets. The systematic reviews adhere to the Cochrane Collaboration approach.

Inclusion criteria for the trials were: performed in patients ≥50 years of age with all forms of osteoporosis-related fractures; randomized or non-randomized stage 1 to 4 studies; retrospective or prospective observational studies. Excluded are research relating to the prevention of primary fractures or other bone-associated diseases, forms of narrative analyses, systematic reviews, meta-analysis, opinion articles, editorials, case reports, letters, and publications in languages other than English. Two independent reviewers selected the studies by first screening the title and abstract followed by full-text articles. The discrepancy between the 2 reviewers was resolved by consensus or by a third independent reviewer, if necessary. Data analysis used the parameters Population, Procedure, Contrast, Outcomes, Environment (PICOS) and included general information about the article (e.g., authors, publication year), study characteristics (e.g., design, sample size), patient characteristics (e.g., fracture type, osteoporosis duration), and outcomes (bone mineral density testing, treatment initiation, adherence, persistence, rates of re-fracture, and mortality).

Data synthesis and findings were reported in the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement. Quality assessments of eligible study methodologies were conducted using the Newcastle – Ottawa scale for non-randomized studies. These 2 authors independently assessed the quality of all studies.

RESULTS

1. Searched Studies of FLS in Various Countries

The initial search identified 755 references from the selected databases. The 681 references were excluded by screening the abstracts and titles for duplicates, unrelated articles, case reports, systematic reviews, and non-comparative studies. The remaining 74 studies underwent full-text reviews, and subsequently, nine studies were excluded. Finally, 65 studies are included in this study. The details of the identification of relevant studies are shown in the flow chart of the study selection process (Fig. 1). Seventeen randomized controlled studies, 26 comparative studies, and 22 cohort observation studies were selected for further investigation.[1-3,5-7,9-66] The main characteristics and outcomes of the studies included in this systematic review are presented in Table 1.

Reported studies for second fracture prevention programs were performed in the USA, Canada, and Australia et al. from 2002 to 2017. The most common type of fracture in included studies was hip (57 studies), followed by wrist (43

https://doi.org/10.11005/jbm.2020.27.3.187

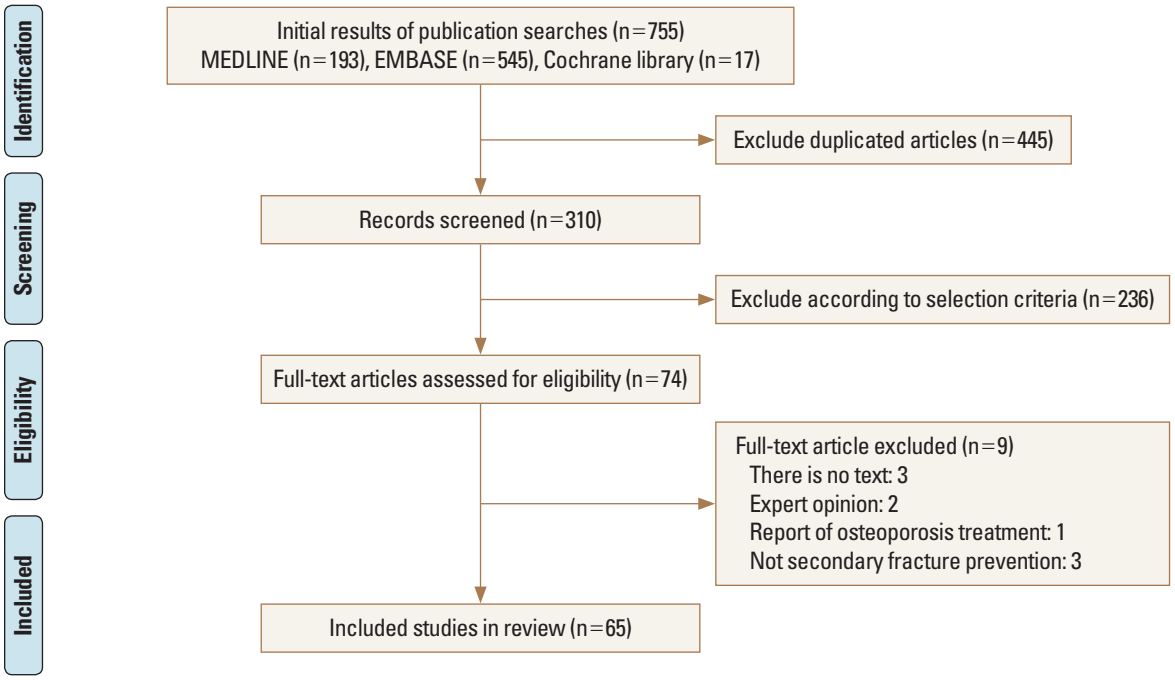

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram details the process of relevant clinical study selection.

studies) and humerus (38 studies) fracture.

The most used name of the program was FLS in 18 studies (Table 2). There were also 16 programs containing "intervention". There were 9 studies involving the expression "integrated" or "multidisciplinary" or "multifaceted". There were also 5 studies that included the expression "fracture prevention" or "secondary prevention".

2. Naming and Roles of Coordinators in FLS

Coordinator is mentioned in various ways in each study (Table 2). Expression including "nurse" is observed in 20 studies and 11 studies include "coordinator". In the 6 studies, they were called "manager", and there were 26 studies that did not mention them. Three studies have also mentioned their real names directly.

There were 31 studies describing the role of the coordinator directly, but 34 studies did not describe the role of the coordinator directly. The described roles of coordinator in included studies can be categorized into 9 roles (Table 3). The most common description is "explaining to the patient the need for osteoporosis evaluation and management" and "identifying the patients to be included in the secondary fracture prevention program" was described in 18 studies. "Casual link with patients" and "patient assessment" are also described as coordinator roles.

3. Results of Quality Assessment

The quality assessment for retrospective observational comparison studies using the modified Newcastle-Ottawa Score Tool is measured. All of the included studies were described as observational studies. Sample size calculations were not performed in all studies. The representation of the selected samples was considered appropriate in all included studies. The ascertainment of the assessment tool for sarcopenia was considered as adequate in all observational studies. The response rate, consideration of important confounding factors, ascertainment of assessment tool, and statistical evaluation were reported in all studies. Overall, all of the included individual studies were considered to have a low risk of bias.

DISCUSSION

In this systematic review, the program of FLS was found to be reported in various forms. There was a model in which patients were screened by pharmacists and evaluated for osteoporosis while a consultation program was provided to the hospitalist or rheumatologist for evaluation and treat-

Table 1. Demographic data of included studies

Reference	Year	Country	Study design	Age limitation	Included fracture					Number of patients
					Hip	Vertebra	Wrist	Humerus	Others	
Chevalley et al. [49]	2002	Switzerland	Cohort observational study	No age limit	Yes	Yes	Yes	Yes	Low trauma fracture	385
Hawker et al. [33]	2003	Canada	Comparative study	>40	Yes	Yes	Yes	Yes	Ankle	278
Jachna et al. [20]	2003	USA	Comparative study	-	Yes	No	No	No	No	82
Majumdar et al. [14]	2004	Canada	RCT	>50	No	No	Yes	No	No	102
Cuddihy et al. [57]	2004	USA	Cohort observational study	>45	No	No	Yes	No	No	59
Murray et al. [52]	2005	UK	Comparative study	>50	Yes	No	No	Yes	No	271
Gardner et al. [42]	2005	USA	RCT	>65	Yes	No	No	No	No	72
Harrington et al. [58]	2005	USA	Comparative study	>50	Yes	Yes	Yes	Yes	Rib, pelvis, long bone	92
Johnson et al. [38]	2005	USA	Comparative study	-	Yes	Yes	Yes	Yes	Patients with history of a fracture	262
Jones et al. [19]	2005	Australia	Comparative study	>70	Yes	No	No	No	No	254
Vidán et al. [22]	2005	Spain	RCT	>65	Yes	No	No	No	No	319
Feldstein et al. [23]	2006	USA	RCT	50-89	Yes	Yes	Yes	Yes	No	327
Streeten et al. [40]	2006	USA	Comparative study	-	Yes	No	No	No	No	78
Fisher et al. [54]	2006	Australia	Comparative study	>60	Yes	No	No	No	No	951
Laslett et al. [37]	2007	Australia	Comparative study	>45	Yes	Yes	Yes	Yes	Low trauma fracture	121
Davis et al. [31]	2007	Canada	RCT	>60	Yes	No	No	No	No	48
Majumdar et al. [55]	2007	Canada	Comparative study	>50	No	No	Yes	No	No	102
Quintos-Macasa et al. [35]	2007	USA	Cohort observational study	>54	Yes	No	No	No	No	78
Kuo et al. [64]	2007	Australia	Cohort observational study	>20	Yes	Yes	Yes	Yes	Low trauma fracture (no fingers, toes, skull)	155
Harrington and Lease [50]	2007	USA	Cohort observational study	>50	Yes	Yes	Yes	Yes	Rib, pelvis, long bone	1,019
Majumdar et al. [55]	2007	Canada	RCT	>50	Yes	No	No	No	No	220
Cranney et al. [45]	2008	Canada	RCT	Postmenopausal women	No	No	Yes	No	No	261
Majumdar et al. [44]	2008	Canada	RCT	>50	No	No	Yes	No	No	272
Miki et al. [48]	2008	USA	RCT	-	Yes	No	No	No	No	62
Tosi et al. [9]	2008	USA	Comparative study	-	Yes	Yes	Yes	Yes	Low trauma fracture	635
Collinge et al. [51]	2008	USA	Cohort observational study	>18	Yes	Yes	Yes	Yes	All fracture	238
Morrish et al. [28]	2009	Canada	RCT	>50	Yes	No	No	No	No	220
Haaland et al. [12]	2009	Canada	Cohort observational study	>50	Yes	No	No	No	No	342
Jaglal et al. [17]	2009	Canada	Comparative study	>40	Yes	Yes	Yes	Yes	No	274
Carpintero et al. [41]	2009	Spain	Comparative study	>50	Yes	Yes	Yes	Yes	Low trauma fracture (no facial bone, skull)	82
Bessette et al. [7]	2011	Canada	RCT	>50	Yes	Yes	Yes	Yes	Scapula, clavicle, sternum, pelvis, sacrum, proximal and distal tibia, fibula (including ankle), or foot	1,174
Wallace et al. [25]	2011	UK	Comparative study	>75	Yes	No	No	No	No	88
Roy et al. [47]	2011	USA	Comparative study	-	Yes	No	No	No	No	140
Lih et al. [65]	2011	Australia	RCT	>45	Yes	No	Yes	Yes	No	403
Boudou et al. [43]	2011	France	Cohort observational study	>50	Yes	No	Yes	Yes	No	155
Ojeda-Bruno et al. [63]	2011	Spain	Cohort observational study	>50	Yes	Yes	Yes	Yes	Fragility fracture (no facial bones, skull, ribs, hand, foot)	380

(*Continued to the next page*)

https://doi.org/10.11005/jbm.2020.27.3.187

https://doi.org/10.11005/jbm.2020.27.3.187

Table 1. Continued

Reference	Year	Country	Study design	Age limitation	Included fracture					Number of patients
					Hip	Vertebra	Wrist	Humerus	Others	
Huntjens et al. [34]	2011	Netherlands	Comparative study	>55	Yes	No	Yes	Yes	No skull	3,255
Jaglal et al. [32]	2012	Canada	RCT	>40	Yes	Yes	Yes	Yes	Rib, sternum, pelvis, lower leg, ankle	267
Leslie et al. [11]	2012	Canada	RCT	>50	Yes	Yes	Yes	Yes	No	4,264
Heilmann et al. [6]	2012	USA	Comparative study	>67	Yes	Yes	Yes	Yes	Low trauma fracture (no facial bone, skull, fingers, toes)	1,129
Astrand et al. [60]	2012	Sweden	Comparative study	50-75	Yes	Yes	Yes	Yes	No	458
Roux et al. [56]	2013	Canada	RCT	>50	Yes	Yes	Yes	Yes	No	881
Queally et al. [39]	2013	Ireland	Comparative study	Women: >40/ Men: >50	Yes	Yes	Yes	Yes	Any fracture of osteoporosis on plain radiographs	61
Chandran et al. [62]	2013	Singapore	Cohort observational study	>50	Yes	Yes	Yes	Yes	No	287
Goltz et al. [24]	2013	Germany	Comparative study	-	-	-	-	-	Osteoporosis fracture	4,910
Sarfani et al. [10]	2014	USA	Cohort observational study	>50	No	No	Yes	No	No	151
Van Der Kallen et al. [3]	2014	Australia	Comparative study	>50	Yes	Yes	Yes	Yes	Low trauma fracture	460
Lee et al. [53]	2014	USA	Cohort observational study	>50	Yes	Yes	Yes	Yes	ICD-9 codes 733.93–733.95, 767.3, 800–829; V54.13	444
Ganda et al. [13]	2014	Australia	RCT	>45	Yes	Yes	Yes	Yes	Low trauma fracture	102
Dehamchia-Rehailia et al. [61]	2014	France	Cohort observational study	No age limit	Yes	Yes	Yes	Yes	Low trauma fracture	335
Huntjens et al. [5]	2014	Netherlands	RCT	>50	Yes	No	Yes	Yes	No	3,322
Eekman et al. [46]	2014	Netherlands	Cohort observational study	>50	Yes	Yes	Yes	Yes	Low trauma fracture (no facial bone, skull, foot, hand)	2,207
Ruggiero et al. [29]	2015	Italy	Comparative study	>65	Yes	No	No	No	No	382
Olenginski et al. [30]	2015	USA	Cohort observational study	>50	Yes	Yes	No	No	No	1,241
Naranjo et al. [66]	2015	Spain	Cohort observational study	>50	Yes	Yes	Yes	Yes	Low trauma fracture (no facial bone, skull, ribs, hand, foot)	759
Axelsson et al. [21]	2016	Sweden	Comparative study	>50	Yes	Yes	Yes	Yes	pelvis	5,329
Amphansap et al. [26]	2016	Thailand	Cohort observational study	>50	Yes	No	No	No	No	75
Kim et al. [36]	2016	New Zealand	Cohort observational study	>50	Yes	Yes	Yes	Yes	No rib, sternum, clavicle, skull, hand, foot	301
Shipman et al. [16]	2016	UK	Cohort observational study	>50	Yes	No	Yes	Yes	No	1,773
Chandran et al. [18]	2016	Singapore	Cohort observational study	>50	Yes	Yes	Yes	Yes	No	938
Nakayama et al. [27]	2016	Australia	Comparative study	>50	Yes	Yes	Yes	Yes	Low trauma fracture	931
Beaton et al. [2]	2017	Canada	Comparative study	>50	Yes	Yes	Yes	Yes	Low trauma fracture (pelvis, ankle, other)	1,130
Cosman et al. [59]	2017	USA	Comparative study	>50	Yes	No	No	No	No	135
Fraser and Wong [1]	2017	Australia	Cohort observational study	>50	Yes	Yes	Yes	Yes	Low trauma fracture	166
Henderson et al. [15]	2017	Ireland	Cohort observational study	44-96	Yes	No	No	No	No	248

RCT, randomized clinical trials; ICD-9, International Classification of Diseases 9th revision.

Table 2. Name of fracture liaison services and roles of coordinators in included studies

Reference	Year	FLS name	Coordinator name	Explaining to need osteoporosis evaluation and management	Encouraging to follow-up with primary physician	Patients identification	Data collection	Patients assessment	Study consent obtain	Casual link or regular follow-up	Discuss with physician or transfer information to physician	Arrangement test	Text about coordinator education
Chevalley et al. [49]	2002	Osteoporosis clinical pathway	Coordinator nurse	Yes	No	No	No	No	No	No	No	No	-
Hawker et al. [33]	2003	Fracture clinic intervention	Coordinator	Yes	Yes	Yes	Yes	Yes	No	No	No	No	-
Jachna et al. [20]	2003	Hospitalist consultation	-	No	No	No	No	No	No	No	No	No	-
Majumdar et al. [14]	2004	Intervention	-	No	No	No	No	No	No	No	No	No	-
Cuddihy et al. [57]	2004	Secondary prevention	Coordinator	Yes	Yes	Yes	No	No	No	Yes	No	Yes	-
Murray et al. [52]	2005	FLS	Specialist nurse	No	No	No	No	No	No	No	No	No	-
Gardner et al. [42]	2005	Intervention	Coordinator	No	No	No	No	No	No	No	No	No	Trained regarding the discussion of the role of osteoporosis in hip fractures, the importance of preventing future fractures, and the effectiveness of currently available therapies
Harrington et al. [58]	2005	Osteoporosis care	Rheumatology nurse manager	No	No	No	No	Yes	No	Yes	No	No	-
Johnson et al. [38]	2005	Intervention	Recruiter	Yes	No	Yes	No	No	Yes	No	No	No	-
Jones et al. [19]	2005	Fracture protocol	- (person name)	No	No	No	Yes	Yes	No	No	No	No	-
Vidán et al. [22]	2005	Comprehensive geriatric intervention	Orthopedic nurses	-	No	No	No	No	No	No	No	No	-
Feldstein et al. [23]	2006	Electronic medical record reminder	-	No	No	No	No	No	No	No	No	No	-
Streeten et al. [40]	2006	Inpatient consultation	-	No	No	No	No	No	No	No	No	No	-
Fisher et al. [54]	2006	Geriatric medicine cocare	Orthogeriatric geriatric medicine registrar	No	No	Yes	No	No	No	No	No	No	-
Laslett et al. [37]	2007	Intervention	-	No	No	No	No	No	No	No	No	No	-
Davis et al. [31]	2007	Patient empowerment and physician alert intervention	-	No	No	No	No	No	No	No	No	No	-
Majumdar et al. [55]	2007	Multifaceted intervention	-	No	No	No	No	No	No	No	No	No	-
Quintos-Macasa et al. [35]	2007	Mandatory rheumatology osteoporosis consultation	-	No	No	No	No	No	No	No	No	No	-
Kuo et al. [64]	2007	Intervention	-	No	No	No	No	No	No	No	No	No	-
Harrington and Lease [50]	2007	Osteoporosis care service	Nurse manager	Yes	Yes	No	Yes	No	No	Yes	No	No	-

(*Continued to the next page*)

https://doi.org/10.11005/jbm.2020.27.3.187

https://doi.org/10.11005/jbm.2020.27.3.187

Table 2. Continued

Reference	Year	FLS name	Coordinator name	Explaining to need osteoporosis evaluation and management	Encouraging to follow-up with primary physician	Patients identification	Data collection	Patients assessment	Study consent obtain	Casual link or regular follow-up	Discuss with physician or transfer information to physician	Arrangement test	Text about coordinator education
Majumdar et al. [55]	2007	Case manager intervention	Osteoporosis case manager	Yes	No	No	No	No	No	No	No	No	-
Cranney et al. [45]	2008	Multifaceted intervention	Coordinator	No	No	No	No	No	No	No	No	No	-
Majumdar et al. [44]	2008	Multifaceted intervention	Experienced registered nurse (person name)	Yes	Yes	No	No	No	Yes	No	No	No	Experienced registered nurse who had additional training and expertise in the diagnosis and treatment of osteoporosis
Miki et al. [48]	2008	Inpatient osteoporosis evaluation	-	No	No	No	No	No	No	No	No	No	-
Tosi et al. [9]	2008	FLS	Nurse practitioner	No	No	No	No	No	No	No	No	No	-
Collinge et al. [51]	2008	Osteoporosis Protocol	Nurse clinician	Yes	No	Yes	No	No	No	Yes	No	No	-
Morrish et al. [28]	2009	Case manager intervention	Case manager	No	No	No	No	No	No	No	No	Yes	-
Haaland et al. [12]	2009	Fracture think osteoporosis program	-	No	No	No	No	No	No	No	No	No	-
Jaglal et al. [17]	2009	Educational intervention	Coordinator	Yes	Yes	No	No	No	No	Yes	Yes	No	Trained to carry out the educational outreach visits according to the principles outlined
Carpintero et al. [41]	2009	Prevent project	-	No	No	No	No	No	No	No	No	No	-
Bessette et al. [7]	2011	Educational interventions	-	No	No	No	No	No	No	No	No	No	-
Wallace et al. [25]	2011	FLS	Fracture liaison nurse	No	No	No	No	Yes	No	No	Yes	Yes	-
Roy et al. [47]	2011	Hospitalist-orthopaedic surgeon integrated model of care	-	No	No	No	No	No	No	No	No	No	-
Lih et al. [65]	2011	Targeted intervention	Investigator	No	No	No	Yes	Yes	No	No	No	No	-
Boudou et al. [43]	2011	FLS	Nurse	No	No	Yes	No	No	No	No	No	No	-
Ojeda-Bruno et al. [63]	2011	Secondary prevention program	-	No	No	No	No	No	No	No	No	No	-
Huntjens et al. [34]	2011	FLS	Fracture nurse	Yes	Yes	No	No	Yes	No	No	No	No	Trained in osteoporosis management and fall risk-assessment
Jaglal et al. [32]	2012	Multidisciplinary osteoporosis program	Coordinator	Yes	Yes	No	Yes	Yes	Yes	No	No	No	-
Leslie et al. [11]	2012	Intervention	-	No	No	No	No	No	No	No	No	No	-
Heilmann et al. [6]	2012	Clinical-pharmacy-based osteoporosis management service	Primary care clinical pharmacy specialist	No	No	No	No	No	No	Yes	Yes	No	-

(*Continued to the next page*)

Table 2. Continued

Reference	Year	FLS name	Coordinator name	Explaining to need osteoporosis evaluation and management	Encouraging to follow-up with primary physician	Patients identification	Data collection	Patients assessment	Study consent obtain	Casual link or regular follow-up	Discuss with physician or transfer information to physician	Arrangement test	Text about coordinator education
Astrand et al. [60]	2012	Osteoporosis screening program	Nurse and secretary	No	No	No	No	No	No	No	No	No	-
Roux et al. [56]	2013	Integrated multidisciplinary approach	Coordinator	Yes	Yes	No	No	No	No	Yes	No	No	-
Queally et al. [39]	2013	Screening for osteoporosis in a community fracture clinic setting	-	No	No	No	No	No	No	No	No	No	-
Chandran et al. [62]	2013	FLS	Case manager (specialist nurse)	No	No	Yes	No	No	No	No	No	No	-
Goltz et al. [24]	2013	Program of integrated care	-	No	No	No	No	No	No	No	No	No	-
Sarfani et al. [10]	2014	Integrated model of care	Patient educator	Yes	No	Yes	No	No	Yes	No	No	No	-
Van Der Kallen et al. [3]	2014	Fracture prevention service	Fracture prevention nurse	Yes	No	No	No	Yes	No	Yes	No	No	-
Lee et al. [53]	2014	Osteoporosis electronic consult service	-	No	No	No	No	No	No	No	No	No	-
Ganda et al. [13]	2014	FLS	-	No	No	No	No	No	No	No	No	No	-
Dehamchia-Rehailia et al. [61]	2014	FLS	FLS nurse	No	No	Yes	No	No	No	No	No	No	-
Huntjens et al. [5]	2014	FLS	Fracture nurse	Yes	No	Yes	No	No	No	No	No	No	-
Eekman et al. [46]	2014	FLS	Fracture nurse	Yes	No	Yes	No	Yes	No	No	No	No	-
Ruggiero et al. [29]	2015	Fracture prevention service (multidisciplinary integrated model of care)	-	Yes	No	No	No	No	No	Yes	No	No	-
Olenginski et al. [30]	2015	High-risk osteoporosis clinic: improving osteoporosis and post-fracture care with an organized, programmatic approach	Clinical nurse specialists or nurse manager	No	No	No	No	No	No	No	No	No	-
Naranjo et al. [66]	2015	FLS	Nurse	No	No	No	No	Yes	No	No	No	No	Trained nurse
Axelsson et al. [21]	2016	FLS	Coordinator	No	No	No	No	No	No	No	No	No	-
Amphansap et al. [26]	2016	FLS	-	No	No	No	No	No	No	No	No	No	-
Kim et al. [36]	2016	FLS	FLS coordinator	Yes	No	Yes	No	No	No	No	No	No	-

(*Continued to the next page*)

https://doi.org/10.11005/jbm.2020.27.3.187

Table 2. Continued

Reference	Year	FLS name	Coordinator name	Explaining to need osteoporosis evaluation and management	Encouraging to follow-up with primary physician	Patients identification	Data collection	Patients assessment	Study consent obtain	Casual link or regular follow-up	Discuss with physician or transfer information to physician	Arrangement test	Text about coordinator education
Shipman et al. [16]	2016	FLS	-	No	No	No	No	No	No	No	No	No	-
Chandran et al. [18]	2016	FLS	-	No	No	No	No	No	No	No	No	No	-
Nakayama et al. [27]	2016	FLS	-	No	No	No	No	No	No	No	No	No	-
Beaton et al. [2]	2017	Fragility fracture screening program	Coordinator	No	No	Yes	No	No	No	No	No	No	-
Cosman et al. [59]	2017	FLS	Geriatric NP (person name)	No	No	No	No	No	No	No	No	No	Well-trained geriatric NP
Fraser and Wong [1]	2017	Secondary fracture prevention	Fracture liaison coordinator	No	No	Yes	No	No	No	No	No	No	-
Henderson et al. [15]	2017	Orthogeriatric service	-	No	No	No	No	No	No	No	No	No	-

FLS, fracture liaison service; NP, nurse practitioners.

Table 3. Roles of coordinator in included studies

Role of coordinator	Number of reports
Explain to need osteoporosis evaluation and management	18
Find the patients	14
Casual link with patients	9
Patients assessment	9
Encouraged to follow-up with their primary physician	8
Data collection	5
Study consent obtain	4
Discuss with health care provider or transfer information	4
Arrange the test	3

ment of osteoporosis.[20,35,67] There was also an electronic medical record reminder to increase osteoporosis management in fragility fracture patients.[23] Most of the patients with fractures under the program were older than 50 years of age, but there were programs with inclusion of lower age limits of 40 or 45 years old, and one study had no age limitation.[33,51,61,65]

At the coordinator-based FLS center, the coordinator (often a nurse) acts as a central player in the establishing of patient connections, orthopedic surgeons, radiologists, and attending physicians. Coordinators help bridge the nursing gap by supporting identification, investigation, initiation of treatment, and patient follow-up. Medics has opened the way to effectively manage patients at high risk of developing another fracture. In addition, nurses are in a unique and important role as nurses responsible for enhancing their daily lives by building relationships with patients and families.

Based on the results of this systematic review, the role of the FLS coordinator are summarized by explaining the need for osteoporosis evaluation and management, promoting follow-up with primary physicians, recognizing patients, collecting data, evaluating patients, obtaining research approval, casual or daily follow-up, consulting with physicians or transferring information to physicians, coordinating the test. Yuksel et al. [67] reported that osteoporosis assessment was increased, but there were many patients who did not receive appropriate care. For this reason, the authors of these studies attempted to explain the lack of knowledge of the patient and general practitioner, a lack of awareness of current treatment guidelines by both family physicians and orthopedic surgeons, and a perception by orthopedic

surgeons. practitioners, poor compliance with prescribed medications and a general lack of communication between all health care providers involved in managing a patient with a fragility fracture. There is a lack of understanding and communication between the patient and the medical staff about this condition, and continuous management of the patient is needed, and this can be done by the coordinator. So, as the results of our study, the most commonly mentioned and important role of the coordinator may be explaining the need for osteoporosis evaluation and management to patients and their families.

Mentions of Coordinator training were observed in 6 studies.[17,34,42,44,59,66] A study by Gardner et al. [42] mentioned that coordinators trained regarding the discussion of the role of osteoporosis in hip fractures, the importance of preventing future fractures, and the effectiveness of currently available therapies. Majumdar et al. [55] stated that the experienced nurse had additional training and expertise in the diagnosis and treatment of osteoporosis. Huntjens et al. [34] described that fracture nurse trained in osteoporosis management and fall risk-assessment.[17,34, 42,44] Mentioned only trained nurses and did not give specific details.[59,66]

Although the exact career is not described in many studies, the most commonly mentioned career is a nurse. In terms of medical experience, a nurse may be very suitable for the coordinator and may not require much additional training. Depending on the names of specialist nurses, rheumatology nurse managers, orthopedic nurses, and fracture liaison nurses, you can estimate the major department of nurse affiliation or program operation.[22,25,52,58]

In the included studies, the types of fractures for the prevention program also varied. In the study of Kuo et al. [64], all minimal trauma fractures were included, but fractures of finger, toe, and skull were excluded. The subjects of Eekman et al. [46] were similar to that of Kuo's study, but were excluded facial bone fractures. Because the study of Collinge et al. [51] covers all fracture patients over the age of 18, all fractures in addition to low energy trauma were included in the study. Surely, hip was the most frequently mentioned fracture sites managed by the FLS program. In some studies, vertebral fractures were excluded because they did not increase mortality.[5,34] Hurrington and Lease [50] and Beaton et al. [2] included pelvic fractures in the subjects.

This study has several limitations. First, only limited information could be extracted from these selected papers. Although included studies have reported the role of the FLS coordinator, most studies do not mention detailed protocols of an education program for FLS coordinator. Therefore, it is important to share information on the role of FLS coordinator, and actual educational programs of the FLS coordinator through consensus meetings and academic meeting on different continents. Second, we only included papers that were found after a systematic search against scientific databases. Thus, grey literature on this topic, including abstracts of presentations at meetings on FLS, was not included in this systematic review. Third, we have included retrospective studies, and it may make some biases for data analysis. But, we didn't perform statistical analysis and just collected for the descriptions of the role of coordination in FLS. Thus, we believe that there are a few possibility for risk of bias by including retrospective studies in our study.

The importance of FLS has been proven in many studies. In addition, it is also reasonable to say that the coordinator is a member who plays a key role in the successful progress of the fracture prevention program between doctors and patients. However, it seems showed that the roles of coordinators and educational programs were not unified worldwide. In our best knowledge, this is the first study for analysis about the roles of coordinator and their education. Based on the results of this study, it is considered that the role of the coordinator should be clearly defined, and efforts should be made to activate the educational program for coordinator training.

CONCLUSIONS

In conclusion, the coordinator in the FLS program plays an important role in multidisciplinary management of vulnerable fractures, as well as in the diagnosis and treatment of osteoporosis and in maintaining continuity of treatment. In the future, the broader role of coordinators should be systematically organized and developed into accredited educational programs.

DECLARATIONS

Ethics approval and consent to participate

Not applicable.

https://doi.org/10.11005/jbm.2020.27.3.187

Conflict of interest

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

ORCID

Yong Han Cha *https://orcid.org/0000-0002-7616-6694*
Yong-Chan Ha *https://orcid.org/0000-0002-6249-0581*
Ki-Soo Park *https://orcid.org/0000-0001-5571-3639*
Jun-Il Yoo *https://orcid.org/0000-0002-3575-4123*

REFERENCES

1. Fraser S, Wong PK. Secondary fracture prevention needs to happen in the country too: the first two and a half years of the Coffs Fracture Prevention Clinic. Aust J Rural Health 2017;25:28-33.
2. Beaton DE, Vidmar M, Pitzul KB, et al. Addition of a fracture risk assessment to a coordinator's role improved treatment rates within 6 months of screening in a fragility fracture screening program. Osteoporos Int 2017;28:863-9.
3. Van der Kallen J, Giles M, Cooper K, et al. A fracture prevention service reduces further fractures two years after incident minimal trauma fracture. Int J Rheum Dis 2014;17:195-203.
4. International Osteoporosis Foundation. FLS around the world apply for Capture the Fracture® recognition. 2020 [cited by 2020 Apr 1]. Available from: https://www.capturethefracture.org/fls-around-world-apply-capture-fracture%C2%AE-recognition
5. Huntjens KM, van Geel TA, van den Bergh JP, et al. Fracture liaison service: impact on subsequent nonvertebral fracture incidence and mortality. J Bone Joint Surg Am 2014;96:e29.
6. Heilmann RM, Friesleben CR, Billups SJ. Impact of a pharmacist-directed intervention in postmenopausal women after fracture. Am J Health Syst Pharm 2012;69:504-9.
7. Bessette L, Davison KS, Jean S, et al. The impact of two educational interventions on osteoporosis diagnosis and treatment after fragility fracture: a population-based randomized controlled trial. Osteoporos Int 2011;22:2963-72.
8. Major G, Ling R, Searles A, et al. The costs of confronting osteoporosis: Cost study of an Australian fracture liaison service. JBMR Plus 2019;3:56-63.
9. Tosi LL, Gliklich R, Kannan K, et al. The American Orthopaedic Association's "own the bone" initiative to prevent secondary fractures. J Bone Joint Surg Am 2008;90:163-73.
10. Sarfani S, Scrabeck T, Kearns AE, et al. Clinical efficacy of a fragility care program in distal radius fracture patients. J Hand Surg Am 2014;39:664-9.
11. Leslie WD, LaBine L, Klassen P, et al. Closing the gap in post-fracture care at the population level: a randomized controlled trial. CMAJ 2012;184:290-6.
12. Haaland DA, Cohen DR, Kennedy CC, et al. Closing the osteoporosis care gap: increased osteoporosis awareness among geriatrics and rehabilitation teams. BMC Geriatr 2009;9:28.
13. Ganda K, Schaffer A, Pearson S, et al. Compliance and persistence to oral bisphosphonate therapy following initiation within a secondary fracture prevention program: a randomised controlled trial of specialist vs. non-specialist management. Osteoporos Int 2014;25:1345-55.
14. Majumdar SR, Rowe BH, Folk D, et al. A controlled trial to increase detection and treatment of osteoporosis in older patients with a wrist fracture. Ann Intern Med 2004;141:366-73.
15. Henderson CY, Shanahan E, Butler A, et al. Dedicated orthogeriatric service reduces hip fracture mortality. Ir J Med Sci 2017;186:179-84.
16. Shipman KE, Stammers J, Doyle A, et al. Delivering a quality-assured fracture liaison service in a UK teaching hospital-is it achievable? Osteoporos Int 2016;27:3049-56.
17. Jaglal SB, Hawker G, Bansod V, et al. A demonstration project of a multi-component educational intervention to improve integrated post-fracture osteoporosis care in five rural communities in Ontario, Canada. Osteoporos Int 2009;20:265-74.
18. Chandran M, Cheen M, Ying H, et al. Dropping the ball and falling off the care wagon. Factors correlating with nonadherence to secondary fracture prevention programs. J Clin Densitom 2016;19:117-24.
19. Jones G, Warr S, Francis E, et al. The effect of a fracture protocol on hospital prescriptions after minimal trauma fractured neck of the femur: a retrospective audit. Osteoporos Int 2005;16:1277-80.
20. Jachna CM, Whittle J, Lukert B, et al. Effect of hospitalist consultation on treatment of osteoporosis in hip fracture patients. Osteoporos Int 2003;14:665-71.
21. Axelsson KF, Jacobsson R, Lund D, et al. Effectiveness of a minimal resource fracture liaison service. Osteoporos Int

2016;27:3165-75.
22. Vidán M, Serra JA, Moreno C, et al. Efficacy of a comprehensive geriatric intervention in older patients hospitalized for hip fracture: a randomized, controlled trial. J Am Geriatr Soc 2005;53:1476-82.
23. Feldstein A, Elmer PJ, Smith DH, et al. Electronic medical record reminder improves osteoporosis management after a fracture: a randomized, controlled trial. J Am Geriatr Soc 2006;54:450-7.
24. Goltz L, Degenhardt G, Maywald U, et al. Evaluation of a program of integrated care to reduce recurrent osteoporotic fractures. Pharmacoepidemiol Drug Saf 2013;22:263-70.
25. Wallace I, Callachand F, Elliott J, et al. An evaluation of an enhanced fracture liaison service as the optimal model for secondary prevention of osteoporosis. JRSM Short Rep 2011;2:8.
26. Amphansap T, Stitkitti N, Dumrongwanich P. Evaluation of police general hospital's fracture liaison service (PGH's FLS): the first study of a fracture liaison service in Thailand. Osteoporos Sarcopenia 2016;2:238-43.
27. Nakayama A, Major G, Holliday E, et al. Evidence of effectiveness of a fracture liaison service to reduce the re-fracture rate. Osteoporos Int 2016;27:873-9.
28. Morrish DW, Beaupre LA, Bell NR, et al. Facilitated bone mineral density testing versus hospital-based case management to improve osteoporosis treatment for hip fracture patients: additional results from a randomized trial. Arthritis Rheum 2009;61:209-15.
29. Ruggiero C, Zampi E, Rinonapoli G, et al. Fracture prevention service to bridge the osteoporosis care gap. Clin Interv Aging 2015;10:1035-42.
30. Olenginski TP, Maloney-Saxon G, Matzko CK, et al. High-risk osteoporosis clinic (HiROC): improving osteoporosis and postfracture care with an organized, programmatic approach. Osteoporos Int 2015;26:801-10.
31. Davis JC, Guy P, Ashe MC, et al. HipWatch: osteoporosis investigation and treatment after a hip fracture: a 6-month randomized controlled trial. J Gerontol A Biol Sci Med Sci 2007;62:888-91.
32. Jaglal SB, Donescu OS, Bansod V, et al. Impact of a centralized osteoporosis coordinator on post-fracture osteoporosis management: a cluster randomized trial. Osteoporos Int 2012;23:87-95.
33. Hawker G, Ridout R, Ricupero M, et al. The impact of a simple fracture clinic intervention in improving the diagnosis and treatment of osteoporosis in fragility fracture patients. Osteoporos Int 2003;14:171-8.
34. Huntjens KM, van Geel TC, Geusens PP, et al. Impact of guideline implementation by a fracture nurse on subsequent fractures and mortality in patients presenting with non-vertebral fractures. Injury 2011;42 Suppl 4:S39-43.
35. Quintos-Macasa AM, Quinet R, Spady M, et al. Implementation of a mandatory rheumatology osteoporosis consultation in patients with low-impact hip fracture. J Clin Rheumatol 2007;13:70-2.
36. Kim D, Mackenzie D, Cutfield R. Implementation of fracture liaison service in a New Zealand public hospital: Waitemata district health board experience. N Z Med J 2016;129:50-5.
37. Laslett LL, Whitham JN, Gibb C, et al. Improving diagnosis and treatment of osteoporosis: evaluation of a clinical pathway for low trauma fractures. Arch Osteoporos 2007;2:1-6.
38. Johnson SL, Petkov VI, Williams MI, et al. Improving osteoporosis management in patients with fractures. Osteoporos Int 2005;16:1079-85.
39. Queally JM, Kiernan C, Shaikh M, et al. Initiation of osteoporosis assessment in the fracture clinic results in improved osteoporosis management: a randomised controlled trial. Osteoporos Int 2013;24:1089-94.
40. Streeten EA, Mohamed A, Gandhi A, et al. The inpatient consultation approach to osteoporosis treatment in patients with a fracture. Is automatic consultation needed? J Bone Joint Surg Am 2006;88:1968-74.
41. Carpintero P, Gil-Garay E, Hernández-Vaquero D, et al. Interventions to improve inpatient osteoporosis management following first osteoporotic fracture: the PREVENT project. Arch Orthop Trauma Surg 2009;129:245-50.
42. Gardner MJ, Brophy RH, Demetrakopoulos D, et al. Interventions to improve osteoporosis treatment following hip fracture. A prospective, randomized trial. J Bone Joint Surg Am 2005;87:3-7.
43. Boudou L, Gerbay B, Chopin F, et al. Management of osteoporosis in fracture liaison service associated with long-term adherence to treatment. Osteoporos Int 2011;22:2099-106.
44. Majumdar SR, Johnson JA, McAlister FA, et al. Multifaceted intervention to improve diagnosis and treatment of osteoporosis in patients with recent wrist fracture: a randomized controlled trial. CMAJ 2008;178:569-75.

https://doi.org/10.11005/jbm.2020.27.3.187

45. Cranney A, Lam M, Ruhland L, et al. A multifaceted intervention to improve treatment of osteoporosis in postmenopausal women with wrist fractures: a cluster randomized trial. Osteoporos Int 2008;19:1733-40.
46. Eekman DA, van Helden SH, Huisman AM, et al. Optimizing fracture prevention: the fracture liaison service, an observational study. Osteoporos Int 2014;25:701-9.
47. Roy A, Heckman MG, O'Connor MI. Optimizing screening for osteoporosis in patients with fragility hip fracture. Clin Orthop Relat Res 2011;469:1925-30.
48. Miki RA, Oetgen ME, Kirk J, et al. Orthopaedic management improves the rate of early osteoporosis treatment after hip fracture. A randomized clinical trial. J Bone Joint Surg Am 2008;90:2346-53.
49. Chevalley T, Hoffmeyer P, Bonjour JP, et al. An osteoporosis clinical pathway for the medical management of patients with low-trauma fracture. Osteoporos Int 2002;13:450-5.
50. Harrington JT, Lease J. Osteoporosis disease management for fragility fracture patients: new understandings based on three years' experience with an osteoporosis care service. Arthritis Rheum 2007;57:1502-6.
51. Collinge C, LeBus G, Gardner MJ, et al. Osteoporosis in orthopaedic trauma patients: a diagnosis and treatment protocol. J Orthop Trauma 2008;22:541-7.
52. Murray AW, McQuillan C, Kennon B, et al. Osteoporosis risk assessment and treatment intervention after hip or shoulder fracture. A comparison of two centres in the United Kingdom. Injury 2005;36:1080-4.
53. Lee RH, Lyles KW, Pearson M, et al. Osteoporosis screening and treatment among veterans with recent fracture after implementation of an electronic consult service. Calcif Tissue Int 2014;94:659-64.
54. Fisher AA, Davis MW, Rubenach SE, et al. Outcomes for older patients with hip fractures: the impact of orthopedic and geriatric medicine cocare. J Orthop Trauma 2006; 20:172-8.
55. Majumdar SR, Johnson JA, Lier DA, et al. Persistence, reproducibility, and cost-effectiveness of an intervention to improve the quality of osteoporosis care after a fracture of the wrist: results of a controlled trial. Osteoporos Int 2007; 18:261-70.
56. Roux S, Beaulieu M, Beaulieu MC, et al. Priming primary care physicians to treat osteoporosis after a fragility fracture: an integrated multidisciplinary approach. J Rheumatol 2013;40:703-11.
57. Cuddihy MT, Amadio PC, Gabriel SE, et al. A prospective clinical practice intervention to improve osteoporosis management following distal forearm fracture. Osteoporos Int 2004;15:695-700.
58. Harrington JT, Barash HL, Day S, et al. Redesigning the care of fragility fracture patients to improve osteoporosis management: a health care improvement project. Arthritis Rheum 2005;53:198-204.
59. Cosman F, Nicpon K, Nieves JW. Results of a fracture liaison service on hip fracture patients in an open healthcare system. Aging Clin Exp Res 2017;29:331-4.
60. Astrand J, Nilsson J, Thorngren KG. Screening for osteoporosis reduced new fracture incidence by almost half: a 6-year follow-up of 592 fracture patients from an osteoporosis screening program. Acta Orthop 2012;83:661-5.
61. Dehamchia-Rehailia N, Ursu D, Henry-Desailly I, et al. Secondary prevention of osteoporotic fractures: evaluation of the Amiens University Hospital's fracture liaison service between January 2010 and December 2011. Osteoporos Int 2014;25:2409-16.
62. Chandran M, Tan MZ, Cheen M, et al. Secondary prevention of osteoporotic fractures--an "OPTIMAL" model of care from Singapore. Osteoporos Int 2013;24:2809-17.
63. Ojeda-Bruno S, Naranjo A, Francisco-Hernández F, et al. Secondary prevention program for osteoporotic fractures and long-term adherence to bisphosphonates. Osteoporos Int 2011;22:1821-8.
64. Kuo I, Ong C, Simmons L, et al. Successful direct intervention for osteoporosis in patients with minimal trauma fractures. Osteoporos Int 2007;18:1633-9.
65. Lih A, Nandapalan H, Kim M, et al. Targeted intervention reduces refracture rates in patients with incident non-vertebral osteoporotic fractures: a 4-year prospective controlled study. Osteoporos Int 2011;22:849-58.
66. Naranjo A, Ojeda-Bruno S, Bilbao-Cantarero A, et al. Two-year adherence to treatment and associated factors in a fracture liaison service in Spain. Osteoporos Int 2015;26: 2579-85.
67. Yuksel N, Majumdar SR, Biggs C, et al. Community pharmacist-initiated screening program for osteoporosis: randomized controlled trial. Osteoporos Int 2010;21:391-8.

Supplementary Appendix 1. Detailed search strategies for each database. MeSH terms, search terms, and combinations of the 2 were used for each database search

Database	Detailed search strategies	Records founded
MEDLINE/PubMed	("osteoporosis, postmenopausal"[MeSH Terms] OR ("osteoporosis"[All Fields] AND "postmenopausal"[All Fields]) OR "postmenopausal osteoporosis"[All Fields] OR "osteoporosis"[All Fields] OR "osteoporosis"[MeSH Terms]) AND ("fractures, bone"[MeSH Terms] OR ("fractures"[All Fields] AND "bone"[All Fields]) OR "bone fractures"[All Fields] OR "fractures"[All Fields]) AND liaison[All Fields] AND service[All Fields]	193
EMBASE	('osteoporosis'/exp OR 'osteoporosis') AND ('fractures'/exp OR 'fractures') AND ('liaison'/exp OR 'liaison') AND 'service'	545
Cochrane Central Register of Controlled Trials	('osteoporosis'/exp OR 'osteoporosis') AND ('fractures'/exp OR 'fractures') AND ('liaison'/exp OR 'liaison') AND 'service'	17

Ultimately, 755 records were found, 193 from MEDLINE/PubMed, 545 from EMBASE, and 17 from the Cochrane Library. Studies were further selected according to the inclusion criteria listed in the material and methods (Fig. 1).

https://doi.org/10.11005/jbm.2020.27.3.187