



Patient education following vertebral fragility fracture: a scoping review

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Received: 10 September 2024 / Accepted: 17 May 2025 / Published online: 16 June 2025
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Abstract

Summary Vertebral fragility fracture (VFF) incidence is rising with significant associated patient and health service burden. Patient education is core to effective VFF management and thus the focus of this robust literature review. Eight studies met review inclusion criteria with the limited evidence and inconsistent approach to education post VFF illustrated.

Purpose The incidence of vertebral fragility fracture is rising, associated with osteoporosis among an ageing global population. Most VFFs are managed conservatively with patient education, a core element of conservative management. This review aims to identify and synthesise the available literature regarding healthcare professional (HCP)–led patient education post VFF.

Methods This review was registered on OSF [25] and conducted in accordance with the Joanna Briggs Institute methodology [21] for scoping reviews and guided by the Arksey and O'Malley Framework [22], using five key stages: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data and (5) charting, collecting and summarising the data. Six databases (Pubmed, ERIC, Embase, Cinahl, APA PsychINFO and Cochrane) were searched for papers published (in English) from January 2008 to November 2023, using a clearly defined search strategy. Predefined inclusion/exclusion criteria were used for screening papers using Covidence software [26] and a minimum of two independent reviewers. Data were extracted from full-text articles which met the inclusion criteria, with narrative synthesis of findings. Reporting of results adhered to the PRISMA-Scoping review checklist.

Results Title and abstract screening was conducted for the 7177 retrieved studies. Of the 34 papers identified for full text review, 8 studies (from Canada, Norway, Sweden, China and the UK) met the scoping review inclusion criteria. These included four randomised controlled trials, one pilot RCT, one non RCT one retrospective analysis of data from patients with fragility fractures and one pre-post interventional study. Where specified in the papers, education providers were a mix of healthcare professionals (Physiotherapists, Nurses, Doctors, Dietitians, Occupational Therapists). Education was delivered in a variety of settings using verbal, written and visual communication media. The most common education topics were exercise, osteoporosis, nutrition and falls management. A diversity of outcome measures captured patient knowledge, quality of life, falls efficacy, physical function, balance and pain.

Conclusion Findings of this review demonstrate the limited evidence and an inconsistent approach to education post VFF in terms of education topics, mode of delivery and outcome measures. A range of HCP disciplines deliver education. Research is critically needed to inform the development and delivery of effective, evidence-based education interventions for VFF management.

Keywords Fracture liaison services · Patient education · Patient education outcomes · Scoping review · Vertebral fragility fracture

Introduction

Vertebral fragility fractures (VFFs) are one of the most common fractures among individuals with osteoporosis [1], with approximately 20% of the older population

expected to sustain a VFF [2]. Reported VFF incidence varies, in part, reflecting that many individuals with VFF are asymptomatic and the fracture may go undetected [3]. Additionally, access to diagnostics varies across countries, VFFs may not be detected on radiology or ambiguous terminology is used in the radiology report, all leading to underdiagnosis of VFFs [4]. Yet, other individuals with VFF present clinically with severe back pain and may have associated changes in pulmonary function, increased falls risk and significant disability which necessitates hospitalisation [5, 6]. Increased risk of mortality and lasting effects on physical, social and psychological functioning are other known consequences of VFF [5, 6]. Additionally, initial VFF is associated with an increased risk of a further VFF, with reports of a two- [7] to fivefold increased risk [8] of subsequent VFF in women aged 65 years or older [9] and typically occurring within the first 12 months [10, 11]. Given this high incidence and associated burden on individuals and healthcare systems, effective and sustainable VFF prevention and management strategies are imperative.

Current conservative VFF management approaches include education, exercise and manual therapy to maintain and restore self-efficacy, mobility and physical function [11], while surgical interventions including kyphoplasty and vertebroplasty should be considered in cases with severe pain and a poor response to conservative management, even when potent analgesia is incorporated [12]. Fracture liaison services (FLS) are recognised as an effective form of secondary preventive care in fragility fracture patients, with an emphasis on initiation and adherence to pharmacotherapy [13, 14] and with education core to this approach. Additionally, the role of education in fragility fracture management has been the subject of two systematic reviews [15, 16], with education recognised for enhancing understanding of osteoporosis [17], improving patients' capacity for self-advocacy [18] and promoting utilization of other rehabilitation services [17]. However, the need for high-quality research trials which describe the characteristics and examine the mechanisms of osteoporosis patient education interventions persists as highlighted by a recent systematic review [19]. Furthermore, although many aspects of general osteoporosis education or education delivered as part of FLS for any fragility fracture will reasonably apply following VFF, defining what a VFF-specific education package should incorporate to be effective is warranted, especially given the high level of fear, loss of confidence and disability often associated with a VFF [20]. As a first step toward informing the development of effective VFF education interventions, a scoping review of the literature regarding healthcare professional (HCP)–led education interventions, for the adult population who have experienced a VFF was proposed with the following objectives:

1. To identify the nature and scope of the literature regarding education interventions for patients with a VFF
2. To describe the education interventions delivered
3. To identify outcome measures used to measure effectiveness of the education interventions.

Methods

This review was conducted in accordance with the Joanna Briggs Institute methodology for scoping reviews [21], and was guided by the Arksey and O'Malley Framework, using five key stages [22]: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data and (5) charting, collecting and summarising the data [23]. Reporting of results adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Review (PRISMA-ScR) checklist [24] (Appendix Table 4). The review was registered on Open Science Framework [25] in November 2023.

Population, Concept, Context (PCC) was employed to clarify the research question and establish the search strategy. Inclusion and exclusion criteria were defined (Appendix Table 5).

Inclusion Criteria: adults with a VFF (≥ 18 years), who have received an education intervention from a HCP or an intervention, which represents healthcare education as part of a clinical trial, English language papers and HCP education interventions in any setting.

Exclusion Criteria: Vertebral fractures due to causes other than osteoporosis.

The search strategy was developed in collaboration with a medical research librarian (DS), using keywords and MeSH terms (Appendix) to search PubMed, ERIC, Embase, Cinahl, APA, PSYCinfo and Cochrane databases. The search of these databases was conducted on 28 November 2023 with a historical time limit of January 2008. Only articles published in English were included (English filter applied). Three reviewers (FK, JD, PL) conducted an independent search of each database and results were compared to ensure reliability and accuracy of the search process. All identified citations were collated and uploaded into EndNote 20. Duplicates were identified and removed. The remaining results were exported to Covidence [26]. Initially, a series of Titles and Abstracts were screened by three independent reviewers (KH, EH, CC).

Once satisfied that criteria were clear for all (CC, KH, EH, PL, FK, JD) and with a high level of agreed understanding, all titles and abstracts were reviewed by a minimum of two independent reviewers. Any conflicts that arose between reviewers and detected via the Covidence review process were resolved through discussion and with an additional reviewer co-opted as required and with oversight provided

by first author (CC). The full text of selected studies was then reviewed in detail against the inclusion criteria by the two independent reviewers (KH, EH) and consultation with a third reviewer (CC) was sought as required to reach consensus. Reasons for exclusion of sources of evidence at full-text stage were recorded and reported (Fig. 1).

The TIDieR tool [27] was used to inform development of the data extraction template in Microsoft Excel and final data extraction headers are reflected in Table 1. Data were independently extracted by three reviewers (FK, JD, PL) and entered into the data extraction template. Final data for extraction were agreed via discussion and co-option of an additional reviewer (CC) as required to ensure accuracy of the data extraction process. A narrative summary of data accompanies the tabulated results and was undertaken to describe study designs, participants, education interventions,

outcome measures and settings in which patient education was delivered. Extracted data are synthesised in Table 1.

Results

A search of the databases yielded 8708 citations, with 1531 duplicates removed. A Prisma flowchart illustrates the paper selection process (Fig. 1). Based on title and abstract screening, 7143 studies were excluded and 34 papers were approved for full-text review. Following full text review, just eight papers remained which fulfilled the inclusion criteria of this scoping review.

Studies included in this review were conducted in Canada [28, 29], Norway [30], Sweden [31], China [32–34] and the UK [35].

Fig. 1 PRISMA flowchart for study selection indicating number of papers initially retrieved from databases and how many papers remained following title and abstract review and subsequent full text review

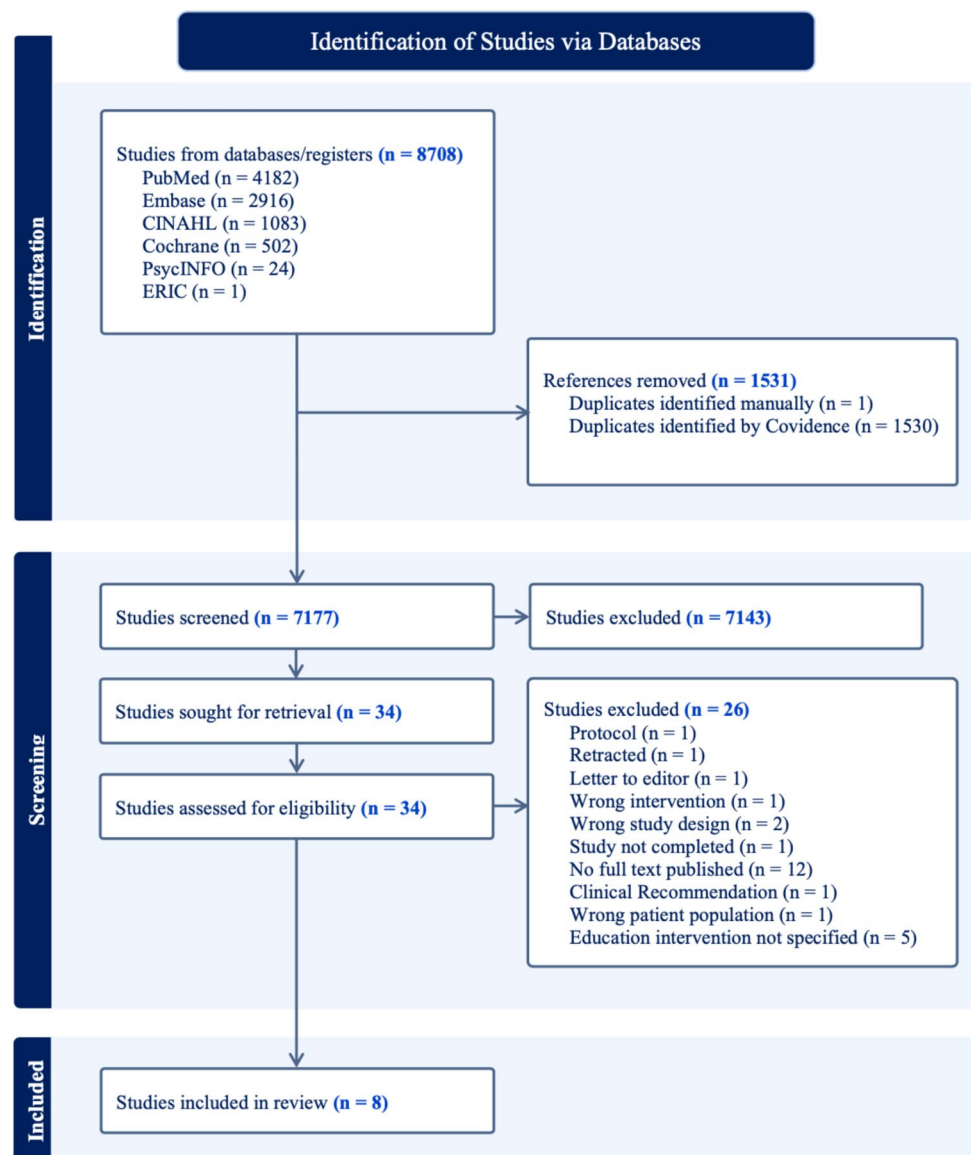


Table 1 Key data from included studies: patient education interventions post vertebral fragility fracture (VFF)

Author year Location	Study design	Participants' gender and mean age	Context	VFF case definition	Inclusion criteria	Education intervention	Education provider	Other trial arms	Follow up time points Primary outcome measures	Overview of findings
Barker K.L. et al. (2019) UK [35]	RCT (three-arm)	<i>n</i> = 613 Women 82 men 72.1 years	21 NHS outpatient physiotherapy departments	Diagnosed osteoporosis confirmed by radiograph or DEXA scan (≥ 2.5 SD below the norm at the lowest lumbar level) History of ≥ 1 symptomatic VFF	Patient able to walk at least 10 m, exercise and participate in physiotherapy safely and if female, be post-menopausal	Note: this arm represents 'usual care' Topics: Osteoporosis, vertebral fractures, strategies to reduce falls, lifestyle choices to promote bone health, diet, regular weight-bearing exercise and physical activity education consistent with Royal Osteoporosis Society information Mode: Verbal, written Duration: Single 1-h session	Physiotherapist	7 individual manual therapy or exercise sessions over 12 weeks	4 and 12 months QUAL-EFFO-41	At 12 months: No significant benefits of exercise/manual therapy over the education intervention At 4 months: Some benefits evident for manual/exercise therapy compared to education for TLS, balance and functional mobility

Table 1 (continued)

Author year Location	Study design	Participants' gender and mean age	Context	VFF case definition	Inclusion criteria	Education intervention	Education provider	Other trial arms	Follow up time points	Overview of findings
Liang R. et al. (2023) China [34]	Observational study	<i>n</i> = 72 58 women 14 men 76.24 years	Vascular Pain Hospital Department (June 2019–May 2022)	Osteoporotic compression fracture diagnosed by imaging evidence	Hospitalised patients ≥ 60 years treated with percutaneous vertebroplasty following osteoporotic vertebral compression fracture(s) ability to communicate independently	Topics: Osteoporosis, surgery including risks, positioning, postural health, spinal nerve function, diet, calcium intake, functional training precautions, timing and methods of rehabilitation exercises, drug treatments, falls prevention, waist circumference bracing, smoking, alcohol and sunlight exposure Mode: Verbal, written, pictures, video Duration: Unspecified	Head nurse, senior doctors and nurses led by department director	Usual care (Control)	<i>Follow-up time points unspecified</i> Health Education Awareness Survey (local Hefei Hospital Survey)	Significantly higher health education knowledge in intervention group compared to control group (88.89% vs 50.00%, <i>P</i> < 0.001) Patients receiving the education intervention were 'very satisfied' versus only 'satisfied' in the control group

Table 1 (continued)

Author year Location	Study design	Participants' gender and mean age	Context	VFF case definition	Inclusion criteria	Education intervention	Education provider	Other trial arms	Follow up time points	Overview of findings
Olsen C.F. et al. (2014) Norway [23]	RCT (Two-arm)	89 women 71.1 years	$n = 89$ Osteoporosis outpatient clinic in Ostfold Hospital, Sarpsborg	Osteoporosis diagnosed by DEXA scan using WHO criteria and a history of ≥ 1 vertebral fracture(s) verified by radiography	> 60 years living at home and ambulatory	Topics: Coping techniques, body awareness and ergonomic advice in specific, everyday situations Note: Education combined with a group circuit exercise program with a focus on reducing falls risk including practice getting down to and up from the floor Mode: Verbal Duration: Single 3-h session	Physiotherapist	Usual activities (control)	At baseline, 3 months and 12 months Falls Efficacy Scale-International (FES-I)	Intervention group had a statistically significant effect on fear of falling. The effect size was 0.4 at 3 months and 0.7 at 12 months

Table 1 (continued)

Author year Location	Study design	Participants' gender and mean age	Context	VFF case definition	Inclusion criteria	Education intervention	Education provider	Other trial arms	Follow up time points	Overview of findings
Spangeus et al. (2023) Sweden [31]	Pilot RCT (three-arm)	n = 21 20 women 1 man 72 years	Linköping University	Unspecified	≥ 1 vertebral fracture and osteoporosis diagnosis, most recent VF > 3 months ago, ≥ 60 years, ability to walk without an indoor walker, understand the Swedish language, follow the research protocol	Note: Same Education (Theory) included in all 3 trial arms T (theory only) group: Topics: Osteoporosis and physical activity, diagnosis of osteoporosis and pharmacological treatment, mindfulness and medical yoga, activating spinal orthosis and stable shoes, nutrition, balance, ergonomic aspects, physiology of pain (T group) Mode: Verbal Delivery: 1 h weekly for 10 weeks	Physiotherapist, Dietitian, Occupational Therapist, 2 representatives from the local patient osteoporosis organisation, members of pain rehabilitation interdisciplinary team	TMMY group: Education (Theory) + mindfulness/medical yoga TPH group: Education (Theory) and physical exercise	Baseline, post-intervention and 12 month follow-up EQ-5D-3L and RAND-36 TMMY group had no significant improvement in EQ-5D-3L and RAND-36 QUAL-EFFO-41 Theoretical Knowledge Assessment (TKA)	T group showed no significant improvement in EQ-5D-3L and RAND-36 TMMY group had no significant improvement in EQ-5D-3L 'Almost' significant improvement in the mental health score domain of QUAL-EFFO-41 in T group All groups scored significantly better on the TKA about osteoporosis post-intervention

Table 1 (continued)

Author year Location	Study design	Participants' gender and mean age	Context	VFF case definition	Inclusion criteria	Education intervention	Education provider	Other trial arms	Follow up time points	Overview of findings
Beaudoin C. et al. (2014) Canada [28]	RCT (Three-arm)	n = 1175 (no. of VFF unspecified) 1175 women 62.1 years	Home (recruited via Quebec Hospitals/Ministry of Health database, Canada)	Unspecified (undiagnosed and untreated for osteoporosis)	Women ≥ 50 years, not residing in a long-term care facility before fracture, ability to understand program information and consent form and willing and able to answer questions via telephone ≥ 1 fragility fracture(s) at: wrist, forearm, humerus, scapula, clavicle, sternum, thoracic or lumbar vertebrae, pelvis, sacrum, hip, femur, tibia, fibula or foot	Topics: Risk of a new fracture, importance of medical evaluation post fracture and non-pharmacological therapies Additional educational video on osteoporosis diagnosis, treatment and fragility fracture complication for videocassette and written materials Mode: Written only or Written plus Video (2 separate trial arms) Duration: 15-min educational video	Research team members	Usual care (Control)	Changes in the daily intake of calcium and vitamin D supplements Pre-intervention questionnaire adapted from the CaMOS questionnaire 6–8 months post-fracture 12-month follow-up for the CaMOS questionnaire	Interventions seem effective at increasing the amounts of calcium and vitamin D supplements, but ineffective at inciting more women to increase their consumption. Clinical significance of intervention impact is difficult to evaluate

Table 1 (continued)

Author year Location	Study design	Participants' gender and mean age	Context	VFF case definition	Inclusion criteria	Education intervention	Education provider	Other trial arms	Follow up time points	Overview of findings
Bessette L. et al. (2011) Canada [29]	RCT (Three-arm)	n = 1174 (no. of VFF unspecified) 1174 women 62.1 years	Home (recruited via Quebec Hospitals/Ministry of Health database, Canada)	Unspecified	Women ≥ 50 years, not residing in long-term care facility before fracture, able to understand program information, consent form and able to answer telephone interviews questions ≥ 1 Fracture(s) at: wrist, forearm, humerus, scapula, clavicle, sternum, thoracic or lumbar vertebrae, pelvis, sacrum, hip, femur, proximal and distal tibia, fibula or foot	Topics: New fracture risks, importance of a medical evaluation post fracture, non-pharmacological therapies + Additional educational video on osteoporosis diagnosis, treatment and fragility fracture complication for 'videocassette and written materials' group Mode: 'Written only' to women then women provided written to their primary care physicians or Written plus Video to women (2 separate trial arms)	Research team members	Usual care (Control)	Proportion of women that receive a diagnosis and treatment for osteoporosis following educational intervention Pre-intervention questionnaire adapted from the CaMos questionnaire 6–8 months post-fracture 12-month follow-up the CaMos questionnaire	Educational interventions assessed in this trial were not satisfactory to increase osteoporosis diagnosis or treatment in recently fractured women to a clinically meaningful degree

Table 1 (continued)

Author year Location	Study design	Participants' gender and mean age	Context	VFF case definition	Inclusion criteria	Education intervention	Education provider	Other trial arms	Follow up time points	Overview of findings
She P. et al. (2022) China [32]	Pre- and post-test	$n = 51$ (2 VFF) 38 women 13 men 63.4 years	Two orthopaedic departments in a tertiary hospital in Changsha, Hunan Province (October 2017 to April 2018)	Unspecified	≥ 1 Fracture(s) at pelvis, hip, acetabulum, femur, humerus, distal radius, or vertebrae, ≥ 50 years for females, ≥ 60 years for males, ability to understand the program, information, willingness to participate	Topics: Osteoporosis, fragility fractures, health problems, risk factors, treatment options, bone loss prevention measures, preventing further deterioration Mode: WeChat mobile messaging app (written and video) Duration: 3 sessions of 15 min	Nurse	Usual care	<i>Variable follow-up time points</i> OKAT within 24 h of admission and repeated on the day of discharge from hospital	<i>Post-intervention:</i> 12 items of the OKAT questionnaire showed significant improvement WeChat app proved to be a useful resource to improve patient's knowledge of osteoporosis among inpatients with fragility fractures during admission
Yang J. et al. (2023) China [33]	Retrospective data analysis	$n = 12999$ (8737 VFF) 8838 women 4161 men 68.83 years	8 fracture high-risk orthopaedic wards in Honghui Hospital (March 2021 to December 2022)	Unspecified	≥ 50 years, no or only slight trauma, fragility fractures diagnosis	Topics: Osteoporosis, diet, exercise, treatment suggestions, recommendation to see Osteoporosis Specialist Mode: Verbal Duration: Unspecified	Osteoporosis Specialist	Usual care	<i>Follow-up time points unspecified</i> Rate of visiting osteoporosis clinical specialists, BMD testing, BTM medication prescription	Rate of revisiting specialist clinics after discharge was significantly higher in the health education group

BMD bone mineral density; BTM bone turnover markers; CaMOS Clinically Adaptive Multidimensional Outcome Survey; EQ-5D-3L Euro Quality of Life Measure 5 Dimensions, 3 Levels; FES-1 Falls Efficacy Scale-International; OKAT The Osteoporosis Knowledge Assessment Tool; TKA Theoretical Knowledge Assessment; QUALEFFO-41 Quality of Life for Osteoporosis; RAND-36 Rand 36 Item Health Survey; RCT randomised controlled trial; TLS timed loaded standing; VFF vertebral fragility fracture

[†]based on information leaflets from Osteoporosis Canada and on the 2002 Clinical Practice Guidelines for the Diagnosis and Management of Osteoporosis in Canada

Study designs

Four randomised controlled trials (RCTs) [28–30, 35], one pilot RCT [31], one observational study [34], one retrospective analysis of fragility fracture patient data [33] and one pre-post intervention study design, were included. Of the five RCTs, four were three-arm trials [28, 29, 31, 35], and one was a single-blinded standard two-arm study [30] (Table 1).

Participants and settings

There were 16,194 participants in total across the eight studies (ranging from 21 to 12,999 participants), three of which focused on women only [28–30]. In the five remaining studies [32–36], both men and women were included, with women comprising just under 69% of study participants. The mean age of study participants was 68 (range 50–97) years. Four studies focused on participants diagnosed with a VFF only [30, 31, 34, 35]. In studies that included additional fragility fracture types, the participants with VFFs represented 3.9% [32] and 67.2% of the study population [33], or the VFF numbers were unspecified but the paper considered worthy of inclusion in this review [28, 29].

VFF case definition for study inclusion was based on DXA (Dual-energy X-ray Absorptiometry), X-ray or ‘imaging evidence’ in three studies [30, 34, 35]. Only two studies referred to a definition of osteoporosis and used the widely accepted definition of a bone mineral density (BMD) of 2.5 standard deviations below the mean peak mass (average of young healthy adults) as measured by dual-energy X-ray and reported as a T-score [23, 35].

VFF case definition detail was not specified in the remaining five studies [28, 29, 31–33]. Two studies utilised the Canadian Multicentre Osteoporosis Study (CaMOS) questionnaire [28, 29] to determine whether the fracture was primarily as a result of trauma or osteoporosis. Time since fracture was generally unspecified.

Three studies, from Norway [30], China [32] and the UK [35], conducted the education intervention in an outpatient hospital setting. One study was conducted in a fragility fracture high-risk ward [33] and another in an interventional Vascular Pain Department [34], with both of these studies from China. The education intervention was delivered in participants’ homes across Canada in two studies [28, 29] and with the education intervention delivered at a university in one Swedish study [31].

Education provider

The education intervention was delivered exclusively by physiotherapists in two studies [30, 35] and nurses in one study [37]. In one study [31], education was provided by

an interdisciplinary group, comprising physiotherapists, dietitians, occupational therapists, local patient osteoporosis organisation representatives and members of a pain rehabilitation team. A team, comprising head nurses, senior doctors and nurses, led by the department director, delivered the education in another study [34]. ‘Osteoporosis Specialists’ and research team members were the stated education providers in three studies though the professional disciplines involved were not specified [28, 29, 33].

Education topics

Exercise was the reported education topic in seven of the eight studies [28, 29, 31–35] (Table 2), primarily addressing the benefits, precautions and optimal timing of exercise. Nutrition was the education topic in six studies [28, 29, 31, 32, 34, 35]. Among these, four studies reported education specific to increasing calcium intake, smoking cessation and reducing alcohol consumption [28, 29, 32, 34] and three reported education specific to vitamin D intake [28, 29, 32].

Five study interventions included education regarding osteoporosis [31–34], with two of these addressing general bone health [32, 35]. ‘Seeking medical consultation post fragility fracture’ was an education topic in four study interventions [28, 29, 32, 33]. Education on implementing falls prevention strategies was outlined in five studies [28, 29, 31, 32, 35]. Three interventions focused on education regarding coping techniques [30, 32, 33]. Ergonomics and body awareness was an education topic in four studies [30–32, 34]. Osteoporosis drug treatment options were discussed in four studies [28, 29, 31, 34] and spinal orthosis was a topic in two studies [31, 34].

Education media

Face-to-face communication and written communication in the form of information leaflets emerged as the most common education delivery modes in the reviewed studies (Table 1). In three studies, the mode of delivery was exclusively verbal [30, 31, 33], while a further three utilised a combination of verbal and written techniques [32, 34, 35]. Four of the five studies which employed written communication also integrated visual communication in the form of video cassettes [28, 29], pictures [32, 34] and videos via WeChat [32], as well as videos regarding previous patients’ experience [34].

Frequency and duration of education intervention

Four studies carried out a single education session, with the duration of the session ranging from 15 min to 3 h [28–30, 32, 35]. The most extensive intervention comprised 1-h sessions held weekly over a period of 10 weeks [31]. One study

Table 2 Education topics included in education interventions post VFF

Education content	Barker K.L. et al. (2019) [35]	Liang R. et al. (2023) [34]	Olsen C.F. et al. (2014) [30]	Spangueus et al. (2023) [31]	Beaudoin C. et al. (2014) [28]	Besette L. et al. (2011) [29]	She P. et al (2022)[32]	Yang J. et al (2023)[33]
Exercise	✓	✓		✓	✓	✓	✓	✓
Nutrition	✓	✓		✓	✓	✓		✓
Falls management	✓			✓	✓	✓	✓	
Osteoporosis	✓	✓		✓			✓	✓
Calcium		✓			✓	✓	✓	
Vitamin D					✓	✓	✓	
Smoking		✓			✓	✓	✓	
Alcohol		✓			✓	✓	✓	
Caffeine intake					✓	✓	✓	
Ergonomics and body awareness		✓	✓	✓			✓	
Medical consultation post fragility fracture					✓	✓	✓	✓
Pharmacological approaches		✓		✓	✓	✓		
Coping techniques			✓				✓	✓
Complications of fragility fractures					✓	✓		
Bone health	✓						✓	
Surgical intervention		✓						

intervention comprised three education sessions, each 15 min in duration, with no overall time frame defined [32]. Two studies did not specify the duration of the education intervention [33, 34].

Outcome measures employed and summary findings

A variety of outcome measures was utilised across the studies (Table 3). Follow-up time points ranged from immediately post-intervention to 12 months, with two studies not specifying any follow-up time points [33, 34]. Measures of patient knowledge included the Osteoporosis Knowledge Assessment Tool (OKAT) [32] a local Health Education Awareness survey [34], and the Theoretical Knowledge Assessment [31]. Quality of Life measures used were the QUALEFO-41 [31, 35], EQ-5D-3L and RAND-36 [31]. Barker et al. (2020) also explored participants' mental health, social function and general health perception [35]. Outcome measures relating to falls included falls frequency in the past year [35] and the Falls Efficacy Scale International [30, 31]. The frequency of follow-up visits to 'Osteoporosis

Specialists' was employed as an outcome measure in the study where bedside education was conducted with elderly hospitalised VFF patients [33]. Besette et al. calculated the proportion of women who received an osteoporosis diagnosis and therapy [29]. Beaudoin et al. assessed the changes in the daily intake of calcium and vitamin D supplements [28]. Only one study explored participants' satisfaction with the education intervention [34]. Other outcome domains included physical performance and pain.

As establishing effectiveness or efficacy is not the purpose of a scoping review and in accordance with recommended scoping review methodology [21], a risk of bias assessment was not conducted for included studies. Therefore, caution should be taken when making any interpretations regarding effectiveness of the education interventions but an overview of findings is reported in Table 1 based on the range of outcome measures utilised. A greater understanding of osteoporosis was reported post education intervention in three studies [31, 32, 34]. One RCT did not demonstrate any intervention being preferable in impacting on the QoL measure [35], whereas another RCT exhibited a positive though non-significant improvement in the mental health

Table 3 Outcome measures utilised in VFF education intervention studies ($n = 8$)

Outcome domain	Outcome measure (study reference number)
Patient knowledge	Osteoporosis Knowledge Assessment Tool (OKAT) [32] Investigation Form for Health Education Awareness of the Second People's Hospital of Hefei [34] Theoretical Knowledge Assessment (TKA) [31]
Satisfaction with education intervention	Health Education Satisfaction Survey Form for Hefei City Second People's Hospital [34]
Quality of life (QoL)	QUALEFFO-41-Quality of Life for Osteoporosis [31, 35] EQ-5D-3L-Euro QOL[31] RAND-36-Rand 36 item Health Survey [31] Mental Health [35] General Health Perception [35] Social Function [35]
Pain	Japanese Orthopaedic Association (JOA) Low Back Pain Functional Assessment Form [34] Numeric Rating Scale (NRS)
Physical performance/balance	Functional Reach Test [35] Short Physical Performance Battery (SPPB) [35] 6 Minute Walk Test (6MWT) [35] Physical Activity Scale for Elderly (PASE) [35] Timed Loaded Standing (TLS) [35] Tandem walking [31] Single leg standing [31] Chair-stand tests [31] Grip strength [31] Back strengthening ability [31]
Falls related	No. falls in last year [35] Falls Efficacy Scale International (FES-I) [30]
Other	Recognizing Osteoporosis and its Consequences in Quebec (ROCQ) [28] Bone Mineral Density (BMD) [33] Bone Turnover Markers (BTM) [33] Rate of Visiting Osteoporosis Clinical Specialists [33]

score domain of QUALEFFO-41 [31]. Reduced fear of falling was demonstrated for the intervention group in the trial by Olsen et al. [30]. In the retrospective analysis, specialist clinic returns of patients after discharge were significantly higher in the health education group, regarded as a positive, with follow-up encouraged [33]. Two education interventions were deemed unsatisfactory in leading to meaningful clinical change as levels of osteoporosis diagnosis or treatment were not enhanced in ≥ 50 years of age after fragility fracture [29]. In the trial by Beaudoin et al., neither of the two education interventions proved to be more effective, than usual care, in increasing the amounts of calcium and vitamin D supplements consumed, suggesting a need to design more effective education strategies [28]. In the study that explored patient satisfaction, most patients receiving the education intervention reported being 'very satisfied' compared to patients in the control group reporting 'satisfied' only [34].

Discussion

This is the first scoping review conducted to identify and synthesise the published literature relating to health professional-led educational interventions following VFF and has highlighted the paucity of research in this area, with just eight studies included and these originating from only five countries. Although likely that VFF patients have unique education needs, extending beyond general fragility fracture and osteoporosis education, only four of the included studies focused solely on the VFF patient cohort [30, 31, 34, 35]. Significant variation existed in interventions from mode of delivery to education topics, with little to indicate a systematic, theory-based approach (e.g. incorporating behaviour change theory) to educational intervention development, which ideally would involve patients and consider literacy issues [38]. However, this criticism is not unique to VFF education interventions with several

meta-analyses showing that Therapeutic Patient Education (TPE) interventions are rarely described in detail [39].

VFF case definition was not standardised and was not specified in many of the included studies, although as previously highlighted this represents a key issue which affects management needs and approaches [40]. ‘Time since fracture’ was unclear in the majority of the studies, although this information should influence elements of the education content and knowing the optimal timing of education to enhance effectiveness is important for HCPs. Personnel providing the educational intervention differed from a single discipline, such as physiotherapists [30, 35], to a combination of professions [31, 34], unsurprising given all HCPs are likely to offer guidance but with a risk of mixed messaging between disciplines, especially given that consensus on core VFF education content, timing and mode of delivery has not been reached. Where an intervention was delivered by a team of education providers, only one study featured a specific coordinator [34], as is recommended for fracture liaison services (FLS) [41].

Exercise, nutrition, falls prevention and osteoporosis emerged as the most common education topics (Table 2). Other beneficial topics, previously identified by VFF patients, include movements to avoid, non-pharmacological strategies to help reduce pain, how to perform activities of daily living safely and performance of safe and effective exercises [9] with postural and ergonomic advice also recommended [42]. In addition, a more recently published qualitative study [5] exploring HCP experience of VFF management has also highlighted the need to educate patients on pain and how to have realistic expectations of pain and to offer guidance on movement and activities or recreational activities which may be unsafe or should be avoided. Studies included in our scoping review reported education being provided, using a range of media [28, 29, 32, 34, 35], with a combination of media previously shown to improve patient knowledge, self-care and health-related QoL in fracture patient cohorts [43]. As highlighted previously, digital health offers further potential solutions to support delivery of education for osteoporosis and post-fracture care, including post VFF care and this warrants further exploration [44].

A wide array of outcome measures was used across studies with many appearing non-sensitive to a response which could be attributed to the education intervention. Follow-up time points varied across studies or were not specified [33, 34]. In some trials [35], this reflects education being used as a comparator arm or simply as a co-intervention [30], whereas their main study focus was on testing the effectiveness of a non-education intervention. Additionally, any observations made on study findings in this review should be viewed with caution, as consistent

with recommended methodology for a scoping review study, quality of studies is not appraised, unlike a systematic review process.

Therapeutic patient education (TPE) delivered by healthcare professionals aims to empower patients to understand, be involved in the clinical decision-making process and effectively manage their conditions [45], with the need for comprehensive, evidence-based education following any fragility fracture well established [5]. Reported benefits of education interventions in the included studies were enhanced knowledge [32, 34] reduced fear of falling [23], mental health benefits [31] and increased amounts of calcium and vitamin D consumption [28] with a higher rate of revisiting specialist clinics also captured [33].

This scoping review has highlighted the need for focused research to develop and evaluate the impact of education interventions following VFF in order to generate evidence which will drive optimisation of education interventions in clinical practice. Research is needed to determine the optimal timing post VFF, duration, delivery mode, topics and key messaging of education interventions being delivered for VFF patients. Future research should focus on the effectiveness of education in specific VFF populations, as well as the use of outcome measures validated to capture the impact of education.

Grey literature, as well as expert consensus on optimal education strategies and leveraging studies written in languages other than English, should also be considered to enhance the evidence base and inform VFF management which includes education. The International Fragility Fracture Network’s (FFN) Clinical Toolkit [46] with four pillars (acute care, rehabilitation, secondary prevention, alliances to support implementation) and the International Osteoporosis Foundation’s Capture the Fracture initiative [47] provides key information on secondary fracture prevention and FLS models which has relevance to VFF patient education. However, there is very little reference to VFF under the acute care and rehabilitation pillars within these, with most of the focus on hip fracture.

To this end, the International Fragility Fracture Network, VFF Special Interest Group [48] is currently developing guidelines for VFF management with an international, interdisciplinary group of FFN members, including two of this paper’s authors (KB, CC). A VFF Care model is proposed, with three key pillars (Pain Management, Improved Physical Function and Falls and Fracture Prevention), with an associated project focusing on the development of education resources for both HCPs and patients to support evidence-based VFF management. Scoping review findings will inform the development of such VFF patient education resources.

Conclusion

Only eight studies regarding a patient education intervention post VFF were identified, three of which were large-scale RCTs. Inconsistencies were found regarding mode of delivery, education providers, educational content and outcome measures. The most common education topics

were exercise, nutrition, falls management and osteoporosis. This review has highlighted gaps in education post VFF and the critical need for research to inform the development and delivery of evidence-based education interventions in VFF management.

Appendices

Table 4 PRISMA-ScR Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE NO
TITLE			
Title	1	Identify the report as a scoping review	1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results and conclusions that relate to the review questions and objectives	See abstract
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach	1,2
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g. population or participants, concepts and context) or other relevant key elements used to conceptualize the review questions and/or objectives	3
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g. a Web address); and if available, provide registration information, including the registration number	3
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g. years considered, language and publication status), and provide a rationale	4,5
Information sources*	7	Describe all information sources in the search (e.g. databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed	5
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated	Appendix Table 5
Selection of sources of evidence [†]	9	State the process for selecting sources of evidence (i.e. screening and eligibility) included in the scoping review	5

Table 4 (continued)

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE NO
Data charting process	10	Describe the methods of charting data from the included sources of evidence (e.g. calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators	7
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made	7 + Tables 3, 4
Critical appraisal of individual sources of evidence	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate)	N/A
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted	7–10
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram	11
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations	Tables 3 & 4
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12)	N/A
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives	Tables 3,4
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives	7 to 10
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups	26
Limitations	20	Discuss the limitations of the scoping review process	26
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps	26
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review	None N/A

JB1 Joanna Briggs Institute, *PRISMA-ScR* Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews

*Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms and websites

†A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g. quantitative and/or qualitative research, expert opinion and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote)

‡The frameworks by Arksey and O'Malley [15] and Levac and colleagues [31] and the JBI guidance [32, 33] refer to the process of data extraction in a scoping review as data charting

§The process of systematically examining research evidence to assess its validity, results and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of 'risk of bias' (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g. quantitative and/or qualitative research, expert opinion and policy document)

Table 5 Inclusion and exclusion criteria

Inclusion	Exclusion
Individuals \geq 18 years with a VFF	Individuals < 18 years
Studies written in the English language	Non-English language studies
Education intervention delivered by a Health Care Professional or an intervention which represents healthcare education delivered as part of a clinical trial	Adults with a vertebral fracture due to a disease other than osteoporosis
Any healthcare/community/home/research setting	Adults with a vertebral fracture secondary to a treatment intervention (e.g. chemotherapy)
	Adults with a vertebral fracture as a result of acute trauma, not primarily due to underlying osteoporosis
	Intervention for osteoporosis, not specific to a VFF
	Education intervention not described
	Review papers

Search Strategy for Relevant Databases

- Databases searched: PubMed, ERIC, EMBASE, Cinahl, APA PSYCinfo and Cochrane.
- Date search was run: 28/11/23
- Filters applied: 01/01/08—28/11/23, *English language studies only*

PubMed Search

Population

#1 (Abstract/Title for all keywords in bold):

'VFF' OR 'vertebral compression fracture*' OR 'Osteoporotic compression fracture*' OR 'osteoporotic spinal compression fracture*' OR 'osteoporotic vertebral compression fracture*' OR 'Fractures, Compression'[Mesh]

#2 (Abstract/Title for all keywords in bold):

(osteoporos* OR fragility) AND ('spinal fracture*' OR 'spine fracture*' OR 'vertebral fracture*') OR 'Osteoporotic Fractures'[Mesh]

#3: NOT crash* OR collision* OR 'Road Traffic Accident*' OR 'Motor Vehicle Accident*' OR 'direct blow*' OR 'repetitive force*' OR tumor* OR tumour* OR cancer* OR 'Neoplasms'[Mesh] OR 'Accidents, Traffic'[Mesh]

#4:(#1 OR #2 NOT #3)

Concept

#5 (Abstract/Title for all keywords in bold):

(Patient* OR Health OR 'Health'[Mesh] OR 'Patients'[Mesh])

#6 (Abstract/Title for all keywords in bold):

Information OR Advice OR Educat* OR instruct* OR support* OR knowledge OR recommend* OR guid* OR teach* OR promotion* OR communication OR Counsel* OR literacy OR program* OR brochure* OR leaflet* OR handout* OR booklet* OR poster* OR pamphlet* OR video* OR radio* OR audio* OR podcast* OR 'social media' OR facebook OR instagram OR phone* OR website* OR webpage* OR online OR 'worldwide web' OR cyberspace OR internet* OR 'web based' OR web-based OR virtual OR telephon* OR videoconferenc* OR videoconferenc* OR 'mobile app*' OR 'text messag*' OR 'mobile technology' OR 'cell phone*' OR 'cellular phone*' OR blog* OR webinar* OR Teleconferenc* OR Tweet* OR twitter OR

'Guideline'[Publication Type] OR 'Counseling'[Mesh] OR 'Pamphlets'[Mesh] OR 'Communication'[Mesh] OR 'Teaching'[Mesh] OR 'Knowledge'[Mesh] OR 'Videotape Recording'[Mesh] OR 'Radio'[Mesh] OR 'Video-Audio Media'[Publication Type] OR 'Social Media'[Mesh] OR 'Cell Phone'[Mesh] OR 'Telephone'[Mesh] OR 'Internet'[Mesh] OR 'Videoconferencing'[Mesh] OR 'Mobile Applications'[Mesh] OR 'Text Messaging'[Mesh]

#7:

'Patient Education as Topic'[Mesh] OR 'Health Communication'[Mesh] OR 'Health Promotion'[Mesh] OR 'Health Education'[Mesh] OR 'Patient Education Handout'[Publication Type]

#8:(#5 AND #6) OR #7

9: ##4 AND #8

ERIC, EMBASE, Cinahl, APA PSYCinfo and Cochrane Search

The search strategies and filters applied for databases ERIC, Embase, Cinahl, APA PSYCinfo and Cochrane, Cinahl were identical to the PubMed search strategy. The MESH terms underlined above were replaced with relevant thesaurus terms identified from each individual database

The Thesaurus terms used for each database are detailed in the table below

	Population	Concept
PubMed	#1: 'Fractures, Compression'[Mesh] #2: 'Osteoporotic Fractures'[Mesh] #3: 'Neoplasms'[Mesh] OR 'Accidents, Traffic'[Mesh]	#5: 'Health'[Mesh] OR 'Patients'[Mesh] #6: 'Guideline'[Publication Type] OR 'Counseling'[Mesh] OR 'Pamphlets'[Mesh] OR 'Communication'[Mesh] OR 'Teaching'[Mesh] OR 'Knowledge'[Mesh] OR 'Videotape Recording'[Mesh] OR 'Radio'[Mesh] OR 'Video-Audio Media'[Publication Type] OR 'Social Media'[Mesh] OR 'Cell Phone'[Mesh] OR 'Telephone'[Mesh] OR 'Internet'[Mesh] OR 'Videoconferencing'[Mesh] OR 'Mobile Applications'[Mesh] OR 'Text Messaging'[Mesh] #7: 'Patient Education as Topic'[Mesh] OR 'Health Communication'[Mesh] OR 'Health Promotion'[Mesh] OR 'Health Education'[Mesh] OR 'Patient Education Handout'[Publication Type]
ERIC		#6: MAINSUBJECT. EXACT('Counseling') OR MAINSUBJECT. EXACT('Pamphlets') OR MAINSUBJECT.EXACT. EXPLODE('Social Media') OR #7: MAINSUBJECT. EXACT('Patient Education') OR MAINSUBJECT. EXACT('Health Promotion') OR MAINSUBJECT. EXACT('Health Education')
EMBASE	#1: 'vertebral compression fracture'/exp #2: 'osteoporotic vertebral fracture'/exp #3: 'traffic accident'/exp OR 'neoplasm'/exp	#5:'patient'/exp OR'health'/exp #6:'information'/exp OR'education'/exp OR'knowledge'/exp OR'counseling'/exp OR'literacy'/exp OR'videorecording'/exp OR'radio'/exp OR'podcast'/exp OR'social media'/exp OR'internet'/exp OR'telephone'/exp OR'videoconferencing'/exp OR'mobile application'/exp OR 'mobile phone'/exp OR'blogging'/exp OR'teleconference'/exp #7:'health education'/exp OR'health promotion'/exp OR 'Patient education'/exp OR 'patient guidance'/exp OR 'patient information'/exp
Cinahl	#1: (MM 'Fractures, Vertebral Compression') OR (MM 'Osteoporotic Fractures') #3: (MM 'Accidents, Traffic') OR (MM 'Neoplasms')	#5: (MM 'Patients') OR (MM 'Health') #6: (MM 'Education') OR (MM 'Knowledge') OR (MM 'Teaching') OR (MM 'Communication') OR (MM 'Counseling') OR (MM 'Counselors') OR (MM 'Literacy') OR (MM 'Posters') OR (MM 'Pamphlets') OR (MM 'Videorecording') OR (MM 'Radio') OR (MM 'Audiorecording') OR (MM 'Social Media') OR (MM 'Facebook') OR (MM 'World Wide Web') OR (MM 'Internet') OR (MM 'Telephone') OR (MM 'Videoconferencing') OR (MM 'Mobile Applications') OR (MM 'Text Messaging') OR (MM 'Cellular Phone') OR (MM 'Blogs') OR (MM 'Webinars') OR (MM 'Teleconferencing') OR (MM 'Twitter') #7: (MM 'Health Information') OR (MM 'Health Knowledge') OR (MM 'Health Literacy') OR (MM 'Patient Education') OR (MM 'Health Promotion') OR (MM 'Health Education')

	Population	Concept
APA PSY-Cinfo		#5: DE 'Health' #6: DE 'Information' OR DE 'Education' OR DE 'Knowledge (General)' OR DE 'Communication' OR DE 'Counselling' OR DE 'Literacy' DE 'Radio' OR DE 'Podcasts' OR DE 'Social Media' OR DE 'Internet' OR DE 'Text Messaging' OR DE 'Blog' OR DE 'Teleconferencing' #7: DE 'Health Information' OR DE 'Health Promotion' OR DE 'Health Knowledge' OR DE 'Health Literacy'
Cochrane	#2: (neoplasms) this term only	#10: [Patients] this term only #11: [Health] this term only #12: [Communication] this term only #13: [Literacy] this term only #14: [Counselling] this term only #15: [Poster] this term only #16: [Pamphlets] this term only #17: [Radio] this term only #18: [Social Media] explode all trees #19: [Telephone] this term only #20: [Mobile Applications] this term only #21: [Text Messaging] explode all trees #22: [Cell Phone] this term only

Funding Open Access funding provided by the IReL Consortium.

Declarations

Conflict of interest None.

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Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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