



Fracture liaison services in Ireland—how do we compare to international standards?

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Abstract

Summary In this first national survey of public hospitals in The Republic of Ireland, we found fracture liaison services (FLS) to be heterogeneous, limited in many cases and poorly supported. A national strategy is urgently needed to support the implementation and operation of an FLS, and thus help reduce the burden of fragility fractures for patients and the healthcare system.

Introduction Fragility/low-trauma fractures are a global concern, whose incidence is rising as the population ages. Many are preventable, and people with a prior fragility fracture are at particularly high risk of further fractures. This patient group is the target of the International Osteoporosis Foundation (IOF) Capture the Fracture campaign, advocating global adoption of fracture liaison services (FLS), with the aim of preventing secondary fragility fractures. We wished to determine the current availability and standards of an FLS in Ireland, ahead of the launch of a National FLS database.

Methods We devised a questionnaire encompassing the thirteen IOF standards for an FLS and asked all 16 public hospitals with an orthopaedic trauma unit in Ireland, to complete for the calendar year 2019 in patients aged ≥ 50 years.

Results All sites returned the questionnaire, i.e. 100% response rate. Nine hospitals stated that they have an FLS, additionally one non-trauma hospital running a FLS responded, and were included. These 10 FLS had identified and managed 3444 non-hip fractures in the year 2019. This figure represents 19% of the expected non-hip fragility fracture numbers occurring annually in Ireland. Implementation of the IOF standards was very variable. All sites reported being inadequately resourced to provide a high-quality service necessary to be effective.

Conclusion The existence and functioning of FLS in Ireland are heterogeneous and suboptimal. A national policy to support the implementation of this programme in line with international standards of patient care is urgently needed.

Keywords FLS · Fracture liaison service · Fractures osteoporosis

Introduction

Fractures as a result of low velocity or low energy falls are referred to as 'fragility' or osteoporotic fractures. These fractures are life-changing events for many, resulting in substantial morbidity and mortality as well as high economic

costs [1–4]. Recent European and global reports show the incidence is rising as the planet's population ages and people live longer lives; European data suggests there will be an almost 25% increase in number by 2030 [3, 4].

Despite a wealth of evidence of the effectiveness of osteoporosis drugs in reducing fracture risk, finding and treating

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those at the highest risk of fractures remains a challenge. In Ireland, similar to many countries worldwide, the billions of euros spent on fragility fracture care is almost all on the treatment of acute fracture rather than on fracture prevention [3]. This cost was estimated to be close to €400 million in Ireland over a decade ago, projected to be €1 billion today, and close to €2 billion by 2030 [5–7]. After an osteoporotic fracture in those aged over 60 years, a third of survivors will go on to have another fracture within 5 years, the risk being highest in the early post-fracture period [8, 9]. These are a key target group to capture therefore, namely those who have just suffered a first fragility fracture. International evidence shows the majority are neither diagnosed nor treated for their underlying osteoporosis following these sentinel events, and a significant gap remains between best evidence and current practice [10–12]. A recent survey of Orthopaedic staff in Ireland showed that while the majority agrees with treating the underlying osteoporosis, they also believe the responsibility rests with others [13]. Analysis of a large primary care dataset showed that only 1 in 5 patients deemed at high risk of fracture is initiated on osteoporosis medication [14].

Fracture liaison services (FLS) have emerged to address these gaps in care, which are evidence-based systems to case-find, assess, treat and monitor patients aged 50 years and over with incidence fragility fractures [15]. These programmes identify patients with recent fractures, address their falls risk and bone health and provide education and appropriate intervention. High-quality FLS are cost-effective and propose or initiate clinically effective interventions shown to reduce fracture numbers in these high-risk populations [15]. FLS exist in many countries today, and in 2012, the International Osteoporosis Foundation (IOF) launched a Best Practice Framework for FLS, entitled ‘Capture the Fracture’ [16]. This initiative outlines clearly in a step-wise manner how a service should operate and the necessary quality standards for efficacy in reducing fracture numbers in the population the FLS serves [17]. In 2020, a complementary set of Key Performance Indicators (KPIs) were launched by the IOF which measure performance at the patient level [18].

A number of FLS have been in existence in the Republic of Ireland (RoI) for some time but details are limited on the number, scope and process. Only six are listed on the IOF ‘Capture The Fracture’ website, the same number as Northern Ireland which has a population of around one-third that of RoI. There are few restrictions on the availability of osteoporosis medications in RoI; practitioners can prescribe all available licenced medications as per their clinical judgement, other than teriparatide and intravenous bisphosphonates which are initiated by hospital specialists only. As part of the establishment of a RoI National Fracture Liaison Service Database (FLSDB), there is a need to better understand existing services. We therefore conducted a facilities audit of all hospitals in Ireland, to enquire re-existence of an

FLS and to evaluate their performance against the 13 IOF best practice standards for FLS, similarly to other European countries [19–22].

Methods

A questionnaire (shown in supplement) was distributed to 16 public trauma hospitals in Ireland that receive acute fracture patients. The questionnaire was mailed to the hip fracture coordinator or fracture liaison service lead in each site, and for hospitals where this was not known, the chief executive officer was asked to delegate its completion to the most appropriate clinician locally.

Firstly, we asked about the existence of an FLS either on-site or in a linked hospital. Sites without an FLS were excluded from further analysis. Where such a service exists, a series of questions were included detailing their setup, staffing, case-finding strategy, treatment protocols and monitoring approaches for fragility fracture patients. We compared our results to the 13 standards of the IOF best practice framework as per Tables 1 and 2 [17]. We summarised data and calculated proportions as this was a descriptive study so no formal statistical analyses were deemed necessary. Agreement to anonymous publication of results was sought and received from each hospital site.

Results

Demographics

Of the 16 trauma hospitals, all 16 responded to the survey. Nine of these sites stated that they have an FLS in place. Four of these covered more than one hospital site. Of the remaining non-trauma acute hospitals in Ireland, there was one which had an established FLS whose patients were not included in their regional trauma hospital FLS, i.e. a standalone service for local fracture patients, so their results were included in the analysis, i.e. 9 FLS at trauma hospitals and 1 FLS within a non-trauma hospital.

Of the 10 sites with an FLS, 4 were established for more than a decade. All had a nursing staff of various grades running the service and regardless of service size; there was only one member of staff in most units, though the proportion of time spent on FLS was not captured in the survey. The consultant supervision for the service was by a geriatrician in 7/10 centres, a rheumatologist in 3, an orthopaedic surgeon in 3 and an endocrinologist in 2, so 5 centres had a combination of more than one specialist. One site had no consultant input or supervision, being entirely nurse-led. Four of 10 sites had some administrative support but none

Table 1 Performance of each FLS against IOF Best Practice Standards for an FLS

FLS centre	1	2	3	4	5	6	7	8	9	10
1. Patient identification	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
2. Patient evaluation	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
3. Post-fracture assessment timing	(1)	1	1	0	0	0	1	1	0	1
4. Vertebral fracture	(1)	0	0	0	0	1	0	(1)	(1)	0
5. Guidelines	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
6. Secondary causes of osteoporosis	1	(1)	0	1	1	1	(1)	1	1	1
7. Falls prevention services	1	1	0	(1)	(1)	(1)	1	1	1	1
8. Multifaceted health and lifestyle risk factor assessment	1	1	1	0	1	1	0	1	1	1
9. Medication initiation	1	1	(1)	1	1	1	1	1	1	1
10. Medication review	1	0	1	0	0	0	1	0	1	1
11. Communication strategy	1	1	1	1	1	1	1	1	1	1
12. Long-term management	1	0	0	0	0	1	1	1	0	1
13. Database	1	1	1	1	1	1	0	1	1	1

1 = yes, (1) = partial, 0 = no

Table 2 IOF capture the fracture: best practice framework for fracture liaison services

Data completeness	
1. Patient identification	Fracture patients within the scope of the institution (inpatient and/or outpatient facility or health care system) are identified to enable the delivery of secondary fracture prevention
2. Patient evaluation	Identified fracture patients within the scope of the institution are assessed for future fracture risk
3. Post-fracture assessment timing	Post-fracture assessment for secondary fracture prevention is conducted in a timely fashion after fracture presentation
4. Vertebral fracture	Institution has a system whereby patients with previously unrecognised vertebral fractures are identified and undergo secondary fracture prevention evaluation
5. Guidelines	The institution's secondary fracture prevention assessment, to determine the need for intervention, is consistent with local/regional/national guidelines
6. Secondary causes of osteoporosis	Institution can demonstrate what proportion of patients who require treatment for prevention of secondary fractures undergo further investigation (typically blood testing) to assess for underlying causes of low BMD)
7. Falls prevention services	Patients presenting with a fragility fracture, and who are perceived to be at risk of further falls, are evaluated to determine whether or not falls prevention intervention services are needed, and if so are subsequently referred to an established falls prevention service
8. Multifaceted health and lifestyle risk factor assessment	Patients presenting with fragility fractures undergo a multifaceted risk factor assessment as a preventative measure to identify any health and/or lifestyle changes that, if implemented, will reduce future fracture risk, and those patients in need are subsequently referred to the appropriate multidisciplinary practitioner for further evaluation and treatment
9. Medication initiation	All fracture patients over 50 years, not on treatment at the time of fracture presentation, are initiated or are referred to their primary care physician/provider for initiation, where required, on osteoporosis treatment in accordance with evidence-based local/regional/national guidelines
10. Medication review	For patients already receiving osteoporosis medications when they present with a fracture, reassessment is offered which includes a review of medication compliance, consideration of alternative osteoporosis medications and optimisation of non-pharmacological interventions
11. Communication strategy	Institution's FLS management plan is communicated to primary—and secondary—care clinicians and contains information required by and approved by local stakeholders
12. Long-term management	Institution has a protocol in place for long-term follow-up of evidence-based initial interventions and a long-term adherence plan
13. Database	All identified fragility fracture patients are recorded in a database which feeds into a central national database

included the task of data entry, which is carried out by the FLS nurse only.

Access to DXA scanning was available for all, 3 of these being on the same hospital site. Seven sites had a waiting time of over 4 months for a DXA, with average waiting times ranging from 4 to 76 weeks. The FLS nurse conducted the scans in 5 of these sites, a radiographer or nurse in the remaining. Seven sites used a fracture risk assessment tool, but only one site used it to determine the need for DXA scanning.

IOF standards

Standard 1: Patient identification

Identification processes varied across sites: 7 use hospital IT systems to identify all patients admitted with fractures or attending fracture clinics. Though we did not ask for technical details, none of these systems appears to be automated and required considerable time to run searches, as per free text comments received on the survey. For admitted fractures, 4 sites screen inpatient fractures on all wards, 3 sites do so only if they are on orthopaedic wards, the remaining 3 do not see patients during their admission with a fracture. One site does not employ a case-finding strategy and instead relies solely on referrals to the service. Insufficient time (5/10) and service still in development (7/10) were the primary reasons for service shortcomings.

Standard 2: Patient evaluation

The proportion and type of identified fracture patients who are evaluated by the FLS varied. All FLS exclude skull and digit fractures. rib, metatarsal and metacarpal fractures are excluded in 7 FLS; 6 FLS exclude patella and 3 exclude ankle fractures. Five FLS do not evaluate hip fractures; instead devolving this role to geriatricians who record their acute stay data on the IHFD (Irish Hip Fracture Database), as per Table 3 [23]. Time and lack of resources were again cited as the primary limitations for not assessing all fracture types.

The proportion of non-hip fractures seen by each FLS relative to the number of hip fractures at each centre is shown in Table 3. For the calendar year 2019, $n = 3444$ non-hip fractures were assessed in eight of the trauma hospital FLS (as one FLS was in development, no data was available for 2019). The number of hip fractures (as per IHFD) in 2019 in these eight sites was 1905 which represents 51% of all hip fractures in Ireland that year [23]. The UK FLS database estimate that for every 1 hip fracture, there are at least an additional 4 other fragility fracture types presenting clinically, though this varies widely in

Table 3 Non-hip fracture numbers per FLS vs. hip fracture numbers as recorded on IHFD in trauma hospitals with an FLS in operation in the calendar year 2019

Hospital	Hip fractures (source: IHFD)	Non-hip fractures (source: individual FLS)	Ratio of hip:non-hip fractures
1	246	280	1.1
2	244	300	1.2
3	121	437	3.6
4	141	499	3.5
5	323	357	1.1
6	210	373	1.8
7	428	648	1.5
8	192	550	2.9
<i>Total</i>	<i>1905</i>	<i>3444</i>	<i>1.8</i>

IHFD, Irish Hip Fracture Database

estimates from other countries [3, 22]; if we apply this denominator to an Irish population, these eight FLS sites currently capture about 45% of their target population of non-hip fractures, ranging from 25 to 90% or 1.1- to 3.6-fold the number of hip fractures per site (Table 3).

Standard 3: Timing of assessment

The IOF standard recommends performing the FLS assessment within 8 weeks of fracture occurrence. Five sites reported achieving this standard for the majority of those identified, 3 sites reported this as up to 52 weeks post-fracture, while 2 provided no information.

Standard 4: Vertebral fracture identification

Vertebral fracture (VF) ascertainment is an established step in the programme since they are common, often unrecognised or unreported. Three centres screen radiology reports for new VF, i.e. VF that present clinically, one centre also reviews all spine imaging for unreported VF. Two of these 4 centres also perform VFA (vertebral fracture assessment) screening during DXA scanning, to identify prevalent VF but it was not clear if this was on all patients having DXA or on select groups. Two additional services use VFA to capture VF (i.e. they capture prevalent VF, rather than acute, and only in those referred for DXA). Four other centres only see VF patients in their service if they are referred or if they appear in fracture clinic patient lists, i.e. no case finding of VF by the FLS takes place. As this IOF standard refers to screening for prevalent VF, 4/10 services were compliant with this standard.

Standard 5: Assessment guidelines

There is no current approved official national osteoporosis guideline, though the Irish Osteoporosis Society and the Health Service Executive (HSE) have previously published a strategy to prevent falls and fractures [24, 25]. Most FLS reported devising local guidelines drawn from European, US or UK guidelines, with some following a combination of these.

Standard 6: Secondary causes of osteoporosis

Seven sites performed investigations to exclude secondary causes of osteoporosis in all cases, 2 perform investigations only for those with low DXA T-scores, while 1 advises GPs to conduct these investigations as needed.

Standard 7: Falls prevention

Six services reported that they evaluate patients for falls risk, while 3 either refer to a falls service or ask GP to do this, and the remaining site neither assesses nor refers patients for this. The content of the falls risk assessment in the 6 performing sites varied (Table 4), with just 2 covering all elements of a standard multifactorial falls risk assessment [26]. Three refer patients directly for strength and balance exercise programmes, and an additional 5 either asked GPs to refer or patients to self-refer. The 2 remaining were not aware of the availability of such classes.

Standard 8: Health and lifestyle risk factor assessment

Eight sites provide general education and specific lifestyle advice for all patients as part of their patient assessment.

Standard 9: Medication initiation

A decision to start osteoporosis medication was made by the FLS with specialist consultant input in 90% of sites, while

the remaining site delegated this task to primary care. There were variations in the practice of prescribing medication with 7 directing patients to their GP for this, while the other 2 are the initial prescribers.

Standard 10: Medication review

New osteoporosis medication initiation includes reviewing the need for a change of existing medication, though this was not specifically addressed in our survey. Five sites conducted a medication review as part of the falls risk assessment for those medications known to increase falls risk.

Standard 11: Communication

All 10 sites send a copy of the assessment to the GP; 1 site also sends a copy to the managing orthopaedic surgeon as part of the communication standard. Only 2 send a copy to the patient. The content of this report varies but generally includes fracture risk factors, DXA results and treatment recommendations (8 sites), with fewer providing detail on falls risk (6 sites) and lifestyle factors (5 sites).

Standard 12: Long-term management

Five sites report monitoring patients to ensure those needing intervention are maintained on it, mostly by follow-up telephone clinics or by posting a questionnaire to patients. The timing of the first follow-up was at 4 months for 3 locations, at 12 months in 1 other, while the rest were either ad hoc or did not occur. All of these follow-up encounters addressed medication adherence, while just 1 FLS enquired about falls at the follow-up.

Standard 13: Database

One site has no database, while the remaining 9 maintain some information. The nurse coordinator performs all data entry as none had administrative staff support.

Table 4 Falls risk factors elicited, as reported by 5 of 10 FLS who screen for falls risk factors

Which of the following does your falls risk assessment cover	Frequency
A. Enquiry re blackouts or syncope	6
B. Medication review for drugs linked with falls risk	5
C. Gait and balance assessment	5
D. Vision assessment	3
E. Enquiry re continence	4
F. Lying and standing BP	3
G. Cognitive assessment	3

Discussion

This first facilities audit of trauma hospitals in The Republic of Ireland (RoI) evaluating fracture liaison services shows that there is marked heterogeneity in the present structure and functioning of these services. FLS services exist in just over half of public trauma hospitals, which are receiving hundreds or thousands of fracture patients each year. This falls short of the standard set by the Irish Trauma society in 2015 to extend this service to all 16 hospitals, and the IOF standard that all fracture patients should be assessed for secondary fracture prevention [17, 27]. While we found

that most FLS access hospital electronic data systems to identify fractures, many inpatient fractures are not screened and many fragility fracture types are excluded. Of those FLS in existence, 2 were established in the last year which is a promising development, yet 6 of 10 sites were established more than a decade ago and still cite lack of resources, including time and staff as primary reasons for failing to complete the standards outlined in The International Best Practice Framework [17, 18].

In the sites with an FLS, none are capturing all fracture patients but overall approximately 45% of their target fractures numbers are being captured. This target is based on extrapolation of the denominator figure used by the UK FLS database for case identification, which is an additional 4 non-hip fragility fractures per hip fracture or 5 times for total fractures [22]. This multiple resulted from an assessment of different methods of estimating fracture numbers from hospital coding in the UK, though has not been assessed in an Irish population. Such an approach is pragmatic because the incidence of fragility fractures varies substantially between studies, reflecting the difficulties in reliable ascertainment, whereas estimating hip fracture numbers is around 90% accurate as almost all are admitted to hospital and inpatient coding is more reliable [2, 6]. Though this case ascertainment figure for the 8 sites in Ireland is commendable at 45% vs. the UK FLS national database figure of 49% [28], it represents just 19% of expected fracture numbers in Ireland annually (there were 3701 hip fractures in 2019). This is a conservative estimate: national admitted patient data in Ireland suggests that hip fractures represent between 25 and 35% of inpatient fractures already [6]; adding those non-hip fragility fractures who are not admitted to hospital could give a hip: all fracture ratio of far higher than 1:5. Neither does this figure include patients managed at private facilities or patients managed solely at a primary care level. Further studies to better describe the true incidence of fragility fractures are required in Ireland and the forthcoming Irish FLSDB will help answer this.

FLS are both clinically and cost-effective systems of care for secondary fracture prevention [1, 15]. When fully implemented and the necessary quality standards are met, they will reduce fracture numbers locally and nationally, reducing the suffering for patients, and the illness burden for the healthcare system. In Ireland, fracture admissions to public hospitals increased by 30% from 2000 to 2014, and due to our ageing, demographics are expected to double over the next two decades [6]. International evidence and a national strategy for falls and fracture prevention have long established the urgent need for a national programme to systematically address this. The establishment of the IHFD resulted in annual audits of standards of care, which appears to have resulted in significant improvements in the care of patients aged 60 years and older with hip fractures [29]. A similar

rollout of standards of care for all fracture patients could have similar benefits and help reduce the inexorable rise in fracture numbers we have witnessed in the past decade.

Though all sites report being under-resourced, it is reassuring to see the great efforts of many to attain many elements of a high-quality FLS, including a multifactorial falls risk assessment. Some of the falls risk assessments are being carried out by FLS, and strength and balance classes are promoted in the majority of services. We do not know the proportions of patients nor fractures in which these elements are covered however, as this was not a patient-level audit, nor do we know how effective or satisfactory they are for patients and the service. Data from other registries such as the UK FLSDB and the RCP national falls audits show sometimes large mismatches in facilities and patient-level audit data [21, 28, 30].

Initiating FLS patients onto osteoporosis drug treatment in a timely manner is a fundamental standard. Concerningly while we found that most FLS either prescribe or request GPs to initiate, only 50% of sites were able to say that patients who receive a first prescription within 4 months of a fracture. Early treatment is extremely important because of the imminent fracture risk in the months following a first fracture, and the fact that it takes at least 12 months for treatment efficacy to be observed [8, 9, 31].

Osteoporosis is a chronic disease in which patient engagement for self-management can increase successful treatment rates. We found that lifestyle advice and patient education are given by nearly all FLS, but as only 2 centres send the patient a copy of the assessment/GP letter, this is an easy target to address that might improve treatment adherence rates.

Our study has important limitations. Firstly, the data are all self-reported and we are relying on colleagues countrywide to provide the most accurate data available. Since not all have a database and some have limited support it is likely that many key metrics are either incompletely captured, or not at all. Secondly, the data are around facilities and services, rather than patient-level data, which precludes inferences about the quality or outcomes of each service. Although the international evidence shows that fracture liaison services are both clinically and cost-effective, operationalising a national policy and the required resources will take time. Until all centres have an appropriate level of staffing, training and standards in place, the real and substantial benefits of FLS will not be realised. Despite the significant deficiencies at a local and national level, there are clearly pockets of expertise, goodwill and a strong professional culture to do the right thing, which can help guide the establishment of the national programme and support a national policy to implement best practice to benefit our citizens.

In summary, we have performed the first audit of FLS in Ireland ahead of the establishment of a national FLS database. Although there is a promising activity in this regard,

there are large and important deficiencies, which must be addressed in addition to establishing a national framework, policy and strategy. Considerable investment is needed to ensure that all individuals at high risk of fragility fracture are appropriately assessed and treated. Failure to implement the evidence base for FLS will result in an alarming rise in avoidable fractures ahead. The launch of a forthcoming national database is an important step towards addressing this gap.

Data availability All data was provided by each hospital from its own internal FLS database.

Hip fracture data are drawn from the publicly available Irish Hip Fracture Database.

Code availability Not applicable.

Declarations

Ethics approval Each hospital consented to complete the questionnaire and share results. As a service evaluation, research ethics committee approval was deemed not necessary.

Consent to participate As above.

Consent for publication As above.

Competing interests Frances Dockery, Aaron Glynn, Kenny Franks, John J Carey, Paddy Kenny, David Askin, Elaine Butler, Breeda Sweeney, Bernadette Conlon, Bruce McGregor, Rosie Lannon, Bridie Rooney, Isweri Pillai, Clare Fitzgerald declare that they have no conflict of interest. Donncha O'Gradaigh declares that he has a conflict of interest on being in receipt of educational grants from Amgen, UCB and Abbvie within the past 5 years.

References

- Compston J, McClung MR, Leslie WD (2019) Osteoporosis. *Lancet* 26(393):364–376. [https://doi.org/10.1016/S0140-6736\(18\)32112-3](https://doi.org/10.1016/S0140-6736(18)32112-3)
- Cauley JA, Wampler NS, Barnhart JM, Wu L, Allison M, Chen Z, Hendrix S, Robbins J, Jackson RD (2008) Women's Health Initiative Observational Study. Incidence of fractures compared to cardiovascular disease and breast cancer: the Women's Health Initiative Observational Study. *Osteopor International* ;19:1717–23. <https://doi.org/10.1007/s00198-008-0634-y>.
- Kanis JA, Norton N, Harvey NC, Jacobson T, Johansson H, Lorentzon M, McCloskey EV, Willers C (2021) Borgström F (2021) SCOPE: a new scorecard for osteoporosis in Europe. *Arch Osteoporosis* 16:82. <https://doi.org/10.1007/s11657-020-00871-9>
- Borgström F, Karlsson L, Ortsäter G, Norton N, Halbout P, Cooper C, Lorentzon M, McCloskey EV, Harvey NC, Javaid MK, Kanis JA (2020) Fragility fractures in Europe: burden, management and opportunities. *Int Osteoporosis Foundation Arch Osteoporos* 15:59. <https://doi.org/10.1007/s11657-020-0706-y>
- McGowan B, Bennett K, Barry M, Canny M (2008) The utilisation and expenditure of medicines for the prophylaxis and treatment of osteoporosis. *Ir Med J* 101(2):38–41
- Kelly MA, McGowan B, McKenna MJ, Bennett K, Carey JJ, Whelan B, Silke C (2018) Emerging trends in hospitalisation for fragility fractures in Ireland. *Ir J Med Sci* 20:351–359. <https://doi.org/10.1007/s11845-018-1743-z>
- HSE (2008) Strategy to Prevent Falls and Fractures in Ireland's Ageing Population. <https://www.hse.ie/eng/services/publications/olderpeople/strategy-to-prevent-falls-and-fractures-in-irelands-ageing-population.html>. Accessed May 2021
- Bliuc D, Nguyen ND, Nguyen TV, Eisman JA, Center JR (2013) Compound risk of high mortality following osteoporotic fracture and refracture in elderly women and men. *J Bone Miner Res* 28:2317–2324. <https://doi.org/10.1002/jbmr.1968>
- Balasubramanian A, Zhang J, Chen L, Wenkert D, Daigle SG, Grauer A, Curtis JR (2019) Risk of subsequent fracture after prior fracture among older women. *Osteoporos Int* 30:79–92. <https://doi.org/10.1007/s00198-018-4732-1>
- Klop C, Gibson-Smith D, Elders PJ, Welsing PM, Leufkens HG, Harvey NC, Bijlsma JW, van Staa TP, de Vries F (2015) Anti-osteoporosis drug prescribing after hip fracture in the UK: 2000–2010. *Osteoporos Int* 26:1919–1928. <https://doi.org/10.1007/s00198-015-3098-x>
- Solomon DH, Johnston SS, Boytsov NN, McMorro D, Lane JM, Krohn KD (2014) Osteoporosis medication use after hip fracture in U.S. patients between 2002 and 2011. *J Bone Miner Res* 29:1929–1937. <https://doi.org/10.1002/jbmr.2202>
- Curtis EM, Woolford S, Holmes C, Cooper C, Harvey NC (2020) General and specific considerations as to why osteoporosis-related care is often suboptimal. *Curr Osteoporosis Rep* 18:38–46. <https://doi.org/10.1007/s11914-020-00566-7>
- Caitriona C, Mark MG, Elaine H, Claire G, Michelle F, Persson UM, Sherrington C, Blake C (2020) Management of hospitalised osteoporotic vertebral fractures. *Arch Osteoporosis* 20(15):14. <https://doi.org/10.1007/s11657-020-0687-x>
- Walsh ME, Nerdrum M, Fahey T, Moriarty (2021) F. Factors associated with initiation of bone-health medication among older adults in primary care in Ireland. *Age Ageing*. DOI: <https://doi.org/10.1093/ageing/afab033>.
- Wu CH, Tu ST, Chang YF, Chan DC, Chien JT, Lin CH, Singh S, Dasari M, Chen JF, Tsai KS (2018) Fracture liaison services improve outcomes of patients with osteoporosis-related fractures: A systematic literature review and meta-analysis. *Bone* 111:92–100. <https://doi.org/10.1016/j.bone.2018.03.018>
- Akesson K, Marsh D, Mitchell PJ, McLellan A, Stenmark J, Pierroz DD, Kyer C, Cooper C, IOF Fracture Working Group (2013) Capture the fracture: a best practice framework and global campaign to break the fragility fracture cycle. *Osteoporosis Int* 24:2135–2152. <https://doi.org/10.1007/s00198-013-2348-z>
- IOF Capture the Fracture. Best Practice Framework for Fracture Liaison Services. http://worldosteoporosisday.org/CTF_website/BPF_framework/2017-bpf-framework-EN-WEB.pdf. Accessed May 2021.
- Javaid MK, Sami A, Lems W, Mitchell P, Thomas T, Singer A, Speerin R, Fujita M, Pierroz DD, Akesson K, Halbout P, Ferrari S, Cooper C (2020) A patient-level key performance indicator set to measure the effectiveness of fracture liaison services and guide quality improvement: a position paper of the IOF Capture the Fracture Working Group, National Osteoporosis Foundation and Fragility Fracture Network. *Osteoporos Int* 31:1193–1204. <https://doi.org/10.1007/s00198-020-05377-1>
- Van den Berg P, Schweitzer DH, van Haard PM, van den Bergh JP, Geusens PP (2015) Meeting international standards of secondary fracture prevention: a survey on Fracture Liaison Services in the Netherlands. *Osteoporos Int* 26:2257–2263. <https://doi.org/10.1007/s00198-015-3117-y>
- Javaid MK, Kyer C, Mitchell PJ, Chana J, Moss C, Edwards MH, McLellan AR, Stenmark J, Pierroz DD, Schneider MC, Kanis

- JA, Akesson K, Cooper C (2015) IOF Fracture Working Group; EXCO. Effective secondary fracture prevention: implementation of a global benchmarking of clinical quality using the IOF Capture the Fracture Best Practice Framework tool. *Osteoporos Int* 26:2573–2578. <https://doi.org/10.1007/s00198-015-3192-0>
21. Fracture Liaison Service Database (FLS-DB) facilities audit (2016) FLS breakpoint: opportunities for improving patient care following a fragility fracture <https://www.rcplondon.ac.uk/projects/outputs/fls-db-facilities-audit-fls-breakpoint-opportunities-improving-patient-care>. Accessed May 2021.
 22. Fracture Liaison Service Database, Feasibility Study Summary Report (2015) <https://www.rcplondon.ac.uk/projects/outputs/fls-db-feasibility-study>. Accessed May 2021.
 23. Irish Hip Fracture Database National Report (2019) http://s3-eu-west-1.amazonaws.com/noca-uploads/general/Irish_Hip_Fracture_Database_National_Report_2019_10.11.2020.pdf Accessed May 2021.
 24. Osteoporosis guideline for health professionals. <http://www.irishosteoporosis.ie/images/uploads/Osteoporosis-Guidelines.pdf>. Accessed March 2021.
 25. Strategy to Prevent Falls and Fractures in Ireland's Ageing Population. <https://www.hse.ie/eng/services/publications/olderpeople/strategy-to-prevent-falls-and-fractures-in-irelands-ageing-population---full-report.pdf>. Accessed March 2021.
 26. Hopewell S, Adedire O, Copsey BJ, Boniface GJ, Sherrington C, Clemson L, Close JC, Lamb SE (2018) Multifactorial and multiple component interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev* 7:CD012221. DOI: <https://doi.org/10.1002/14651858.CD012221.pub2>.
 27. A Trauma System for Ireland; Report of the Trauma Steering Group (2018) <https://www.hse.ie/eng/about/who/acute-hospitals-division/trauma-services/further-information-and-documentation/report-of-the-trauma-steering-group.pdf>. Accessed April 2021.
 28. Royal College of Physicians Fracture Liaison Service Database – 2020 Annual Report (2020) <https://www.hqip.org.uk/wp-content/uploads/2021/05/Ref-208-FLS-DB-2021-Annual-Report-FINAL.pdf>. Accessed May 2021.
 29. Walsh ME, Ferris H, Coughlan T, Hurson C, Ahern E, Sorensen J, Brent L (2021) Trends in hip fracture care in the Republic of Ireland from 2013 to 2018: results from the Irish Hip Fracture Database. *Osteoporos Int* 32:727–736. <https://doi.org/10.1007/s00198-020-05636-1>
 30. Falling standards, broken promises: report of the national audit of falls and bone health. Report of the national audit of falls and bone health in older people (2010) <https://www.rcplondon.ac.uk/projects/outputs/falling-standards-broken-promises-report-national-audit-falls-and-bone-health>. Accessed March 2021.
 31. Schnell AD, Curtis JR, Saag KG (2018) Importance of recent fracture as predictor of imminent fracture risk. *Curr Osteoporosis Rep* 16:738–745. <https://doi.org/10.1007/s11914-018-0487-z>

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