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A Second Fragility Fracture Before Any Bone Health Assessment: A Narrative Review of Fracture Liaison Services and the Care Gap They Exist to Close

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Abstract

A fragility fracture is the clearest warning a skeleton can give. It is also, routinely, the one nobody acts on. Most patients who break a bone after a fall from standing height leave hospital with the fracture treated and the osteoporosis behind it neither investigated nor named.

Objectives: *To review the published evidence on secondary fracture prevention: how large the treatment gap is, why a first fracture so often passes without assessment, what fracture liaison services change, and what the evidence for them does and does not establish.*

Material and Methods: *Narrative review of meta-analyses, cohort studies, population registries, national audits, randomised trials of anti-osteoporosis therapy and society guidance indexed in PubMed and the major bone, rheumatology and orthopaedic journals. No new patient data were generated; every estimate quoted is one published by the original investigators.*

Results: *A prior fracture carried a relative risk of any subsequent fracture of 1.86 across 11 cohorts followed for 250,000 person-years, and the excess risk is concentrated in the first two years. Across 29 European countries in 2019, 71 per cent of women eligible for treatment received none, leaving 14.0 million untreated; the gap was 55 per cent in 2010, so it has widened. Pooled against usual care, fracture liaison services increased bone density testing by 24 percentage points, treatment initiation by 20 and adherence by 22, and reduced absolute re-fracture risk by 5 percentage points and mortality by 3.*

Conclusion: *The drugs work, the risk is quantified, and the patient is already in the building with a broken bone. What is missing is a person whose job it is to notice. Fracture liaison services supply exactly that, and the evidence for them is consistent in direction while resting almost entirely on before-and-after and cohort designs rather than randomised comparison.*

Abbreviations: *BMD – Bone Mineral Density, DXA – Dual-Energy X-Ray Absorptiometry, FLS – Fracture Liaison Service, FRAX – Fracture Risk Assessment Tool, IOF – International Osteoporosis Foundation, RR – Relative Risk.*

Keywords: *Osteoporosis; Fragility Fracture; Secondary Fracture Prevention; Fracture Liaison Service; Treatment Gap*

Introduction

Osteoporosis is silent until it is not. Its first clinical expression is usually a fracture sustained in a fall that would not have broken a healthy bone, and worldwide such fractures number in the millions each year [1,2]. In Europe alone, 4.3 million fragility fractures were recorded in 2019 at a cost exceeding 56 billion euros, of which only 3 per cent was spent on the drugs that prevent them [3,4].

What makes this a tractable problem rather than merely a large one is that the first fracture identifies the patients who will have the second. Prior fracture is among the strongest and best-quantified risk factors in clinical medicine [5,6], the risk is highest in the months immediately afterwards [7,8], and effective treatments exist [9,10,11,12]. Every element of a prevention strategy is therefore available at the moment a patient arrives in an emergency department with a broken wrist.

It is mostly not used. The dominant finding of two decades of audit is that the majority of patients presenting with a fragility fracture are never assessed for osteoporosis and never started on treatment [4,13]. This review sets out the size of that gap, what explains it, and what the evidence says about fracture liaison services, the organisational response designed to close it.

Material and Methods

Search strategy: PubMed and the archives of the major bone, rheumatology, orthopaedic and geriatric medicine journals were searched for studies of secondary fracture prevention. Search terms combined fragility fracture, osteoporosis and refracture with fracture liaison service, secondary prevention, treatment gap, care gap, coordinator, imminent risk and models of care. Reference lists of society guidance and best-practice frameworks [14,15,16] were screened by hand for primary sources.

Eligibility: Studies were included if they quantified subsequent fracture risk after an index fragility fracture, measured investigation or treatment rates after fracture, or evaluated a service model intended to improve them. Randomised trials of anti-osteoporosis drugs are cited to establish that effective treatment exists, not as evidence about service delivery, and are identified as such.

Data extraction and handling: Design, setting, sample size, comparator and the reported estimate were extracted as published. Whether a comparison was randomised, concurrently controlled or before-and-after is reported alongside every figure, because that distinction carries most of the uncertainty in this literature. No pooling or re-analysis was performed. Figures 1 to 4 and Tables 1 and 2 reproduce published values only. This is a narrative synthesis and was not registered as a systematic review.

Results

The risk a first fracture announces: An international meta-analysis of 11 cohorts comprising 15,259 men and 44,902 women, followed for 250,000 person-years, found that a previous fracture carried a relative risk of any subsequent fracture of 1.86 (95% CI 1.75 to 1.98) (Figure 4) [5]. A later analysis extended this to 64 cohorts in 32 countries and 19.5 million person-years for use in FRAX, confirming the association and its dependence on time since the index event [6]. That time dependence matters clinically: subsequent fractures cluster in the period immediately following the first [7,8,17], which is precisely the period in which the patient is under orthopaedic care and therefore reachable.

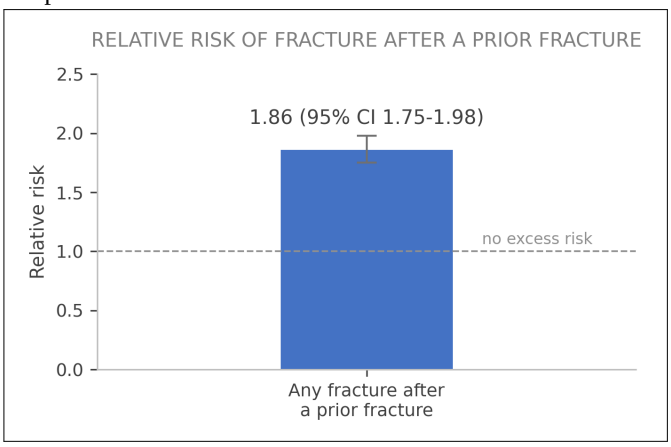

Figure 4: Relative risk of any subsequent fracture in patients with a previous fracture, pooled across 11 cohorts [5]

What a fracture costs beyond the bone: The consequences are not confined to the skeleton. Excess mortality following osteoporotic fracture is well documented [18], and a subsequent fracture carries further excess mortality on top of that of the index event [19]. The economic burden follows the clinical one, and its distribution is instructive: the overwhelming majority of the European spend goes on treating fractures rather than preventing them [3,20].

The size of the treatment gap: The most systematic European estimate comes from the SCOPE 2021 scorecard, covering the 27 European Union member states plus the United Kingdom and Switzerland. On average, 71 per cent of women who exceeded the intervention threshold received no osteoporosis treatment, leaving 14.0 million women untreated. The gap varied more than twofold between countries, from 32 per cent in Ireland to 87 per cent in Bulgaria (Figure 1) [4,13].

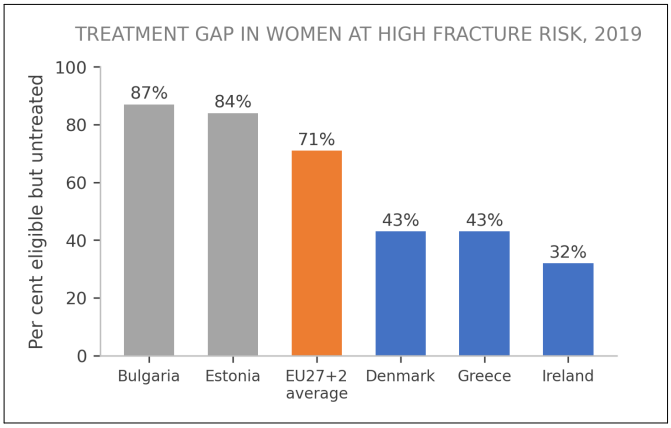

Figure 1: Proportion of women above the intervention threshold receiving no osteoporosis treatment, selected European countries and the EU27+2 average [4,13]

The gap is widening: The same exercise conducted in 2010 found an average treatment gap of 55 per cent, with 10.6 million women untreated. Nine years later the gap had risen to 71 per cent and the number untreated to 14.0 million (Figure 2) [13]. Some of this reflects a growing and ageing eligible population rather than deteriorating practice, but the direction is unambiguous, and it runs opposite to the direction of the evidence base. In the United States, osteoporosis medication use after hip fracture declined over roughly the same period [21].

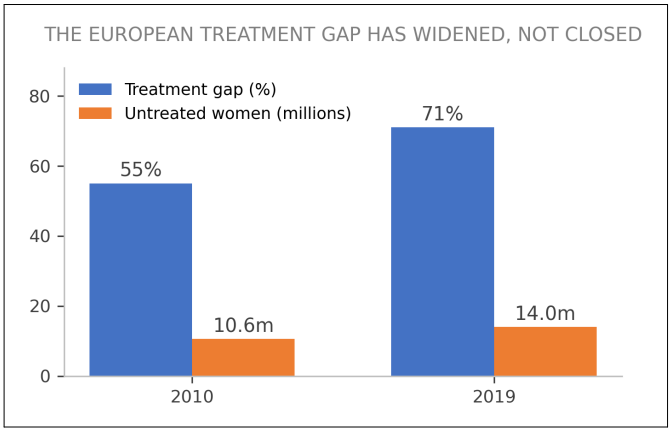

Figure 2: European treatment gap and the number of untreated women at high risk, 2010 against 2019 [13]

Study	Design and cohort	Principal reported finding
Kanis et al. 2004 [5]	Meta-analysis, 11 cohorts, 250,000 person-years	Prior fracture: RR 1.86 (95% CI 1.75-1.98) for any fracture
Kanis et al. 2023 [6]	Meta-analysis, 64 cohorts, 19.5m person-years	Confirms association; risk varies with time since index fracture
SCOPE 2021 [4,13]	Scorecard, EU27 plus UK and Switzerland	71% treatment gap in 2019; 14.0m women untreated; 55% in 2010
Ganda et al. 2013 [22]	Systematic review and meta-analysis of care models	Intensity of the model predicts investigation and treatment rates
Wu et al. 2018 [23]	Systematic review and meta-analysis of FLS	BMD testing +24pp, treatment +20pp, re-fracture -5pp, mortality -3pp
Li et al. 2021 [24]	Systematic review and meta-analysis, 16 studies	Lower subsequent fracture and mortality with FLS
Axelsson et al. 2020 [25]	Cohort, four Swedish hospitals	Recurrent fracture risk fell after FLS implementation

Table 1: Principal studies reviewed, with the finding as reported by the original investigators

Why the fracture passes unremarked: The explanation is structural rather than clinical. A fragility fracture presents to orthopaedics, whose task is the bone in front of them and whose follow-up ends when it has healed. Osteoporosis belongs to no single specialty, the assessment requires a separate investigation on a separate pathway, and responsibility for arranging it is diffuse enough that it frequently falls to nobody [15,16,26]. Even where treatment is started, persistence is poor, and poor adherence measurably erodes the fracture reduction achieved [27,28].

What a fracture liaison service is: The model originates in Glasgow, where a dedicated coordinator systematically identified patients presenting with fragility fracture, assessed them and arranged treatment [29]. The essential feature is a named person with responsibility for case-finding, not a new investigation. The approach was formalised as coordinator-based secondary prevention [15] and subsequently as the International Osteoporosis Foundation's Best Practice Framework, which sets out standards against which services can be benchmarked [16,30].

What the evidence shows: A systematic review and meta-analysis comparing services against no service found bone density testing increased by 24 percentage points (95% CI 18 to 29), treatment initiation by 20 (16 to 25) and adherence by 22 (13 to 31), with absolute re-fracture risk reduced by 5 percentage points (3 to 8) and mortality by 3 (1 to 5) (Figure 3) [23]. A later meta-analysis of 16 studies reached compatible conclusions on subsequent fracture and mortality [24]. Individual services report the same direction: reduced re-fracture in Australia [31,32], reduced subsequent non-vertebral fracture and mortality in the Netherlands [33], and reduced recurrent fracture risk across four Swedish hospitals [25]. Economic evaluations generally find the model cost-effective and often cost-saving [34].

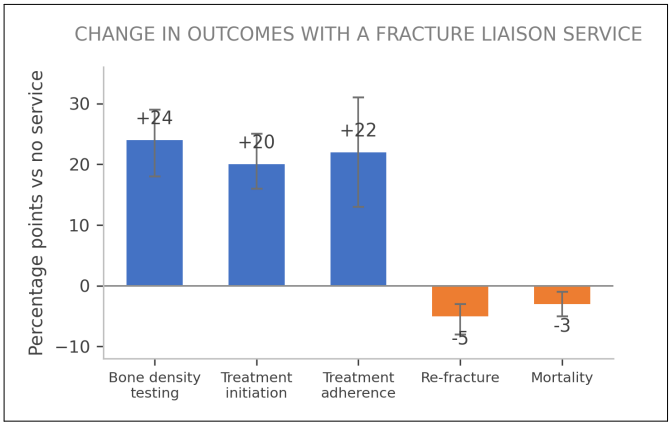

Figure 3: Change in outcomes with a fracture liaison service compared with no service, in percentage points with 95% confidence intervals [23]

Element	What it addresses	Evidence
Systematic case-finding	Patients never identified as having osteoporosis	Defining feature of the original model [29]
A named coordinator	Diffuse responsibility between specialties	Coordinator-based models outperform alerts alone [15,22]
Model intensity	Whether assessment is arranged or merely recommended	Higher-intensity models achieve higher rates [22]
Benchmarked standards	Wide variation in what a service does	IOF Best Practice Framework [16,30]
Adherence follow-up	Treatment started but not continued	Poor persistence erodes fracture reduction [27,28]
Cost-effectiveness	Whether services survive budget scrutiny	Generally cost-effective or cost-saving [34]

Table 2: Components of a fracture liaison service and the failure each is intended to correct

Discussion

The gap between what is known and what is done is unusually wide here, and unusually well documented. Prior fracture has been an established risk factor since 2004 [5], effective drugs have been licensed for longer [9,10,11,12], and yet the proportion of eligible European women left untreated rose from 55 to 71 per cent across the decade in which that evidence matured [13]. Whatever is failing is not the science.

What fracture liaison services do is supply an owner. The intervention is administrative in form and clinical only in consequence: someone reviews the fracture lists, contacts the patient, arranges the scan, starts the treatment and checks that it continues. The pooled effects are correspondingly modest in absolute terms, five percentage points off re-fracture and three off mortality, but they apply to a very large population who are currently receiving nothing [23,24].

The evidence deserves an honest description. Almost none of it is randomised. The pooled estimates combine before-and-after comparisons, concurrent cohorts and historical controls, designs in which secular improvement in fracture care is difficult to separate from the effect of the service itself [22,23,24]. Services that publish tend to be services that work, and the units that establish them are plausibly the units already interested in bone health. Both would inflate the apparent effect. The mortality finding in particular should be read with caution, since it is not obvious by what mechanism a coordinator reduces death within the follow-up periods reported [24].

Two things nonetheless favour the conclusion. The direction is consistent across countries, health systems and service designs [25,31,32,33]. And the intermediate outcomes, on which the evidence is strongest, are exactly the ones the model is designed to change: investigation, initiation and adherence [23]. A service that reliably moves those three, in a population whose risk is quantified and whose treatment is proven, does not require a separate trial to be worth having.

Study limitations

The limitations belong to the underlying literature. The absence of randomised comparison is the central one, and it will not be remedied, since withholding a service believed to work is not straightforwardly justifiable [22,23]. Definitions vary: services described as fracture liaison services range from a letter to a general practitioner to a fully staffed clinic with follow-up, and pooling them assumes an equivalence that does not exist [30,35]. Treatment gap estimates depend on the intervention threshold chosen and on the completeness of prescribing data, both of which differ between the countries compared [4,13]. Vertebral fractures, which are frequently asymptomatic, are systematically under-counted in every dataset cited here [1,17]. Follow-up in most service evaluations is one to three years, shorter than the horizon over which secondary prevention pays off [24,25]. And the evidence is drawn almost entirely from high-income settings [3,36].

Conclusion

A second fragility fracture in a patient who was never assessed after the first is a system failure with a known cause and a known remedy. The risk conferred by an index fracture has been quantified across millions of person-years, the treatments that reduce it are licensed and inexpensive, and the patient is physically present in a hospital at the moment the opportunity arises. Fracture liaison services close the gap by assigning responsibility for that moment to a named person, and every reported series points the same way even though the designs are weak. The finding that should provoke most discomfort is not any single effect estimate but the trajectory: across the decade in which this evidence accumulated, the proportion of eligible European women receiving no treatment went up.

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Conflict of Interest

The authors declare no competing interests.

Ethics Statement

This article reviews previously published studies only. No new patient data were collected and no participants were recruited, so ethical approval was not required.

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