

Quality improvement initiative: implementing routine vertebral fracture assessments into an Australian Fracture Liaison Service

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To cite: Greene L, Shah D, Laver K, *et al*. Quality improvement initiative: implementing routine vertebral fracture assessments into an Australian Fracture Liaison Service. *BMJ Open Quality* 2023;**12**:e002303. doi:10.1136/bmjopen-2023-002303

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2023-002303>).

Received 3 February 2023
Accepted 7 July 2023



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ABSTRACT

Osteoporosis is a global health concern and a major contributor to worldwide mortality rates. Vertebral fractures due to osteoporosis are common and often undetected. Since vertebral fractures are often missed, evidence and guidelines suggest that vertebral fracture assessment (VFA) may optimise current approaches to bone density tests. We aimed to integrate VFA into an Australian Fracture Liaison Service (FLS) and measure the impact it had on osteoporosis treatment initiation.

A retrospective case note review was undertaken to determine the number of clinic patients receiving VFA before the change in practice. Proctor's seven domains of implementation strategy were used to facilitate quality improvement outcomes.

The percentage of eligible patients receiving a routine VFA at the FLS imaging centre increased from 0% to 90%. The remaining 10% of patients did not receive a scan due to the patient not being able to assume the correct position, skilled staff being unavailable to perform the scan, or the patient declining. Post implementation, almost half (41%) of patients who underwent a VFA displayed abnormalities and 16 (4%) of these recorded a normal bone measure density score but abnormal VFA. Despite the successful adoption of the new screening protocol, there was no statistically significant increase in treatment initiation rates for patients with normal bone mass density scores. The FLS successfully integrated routine VFA into the osteoporosis care pathway. However, the introduction of VFA did not significantly increase treatment initiation. It may be more effective to offer VFAs to a proportion of patients based on a tailored approach rather than offering them routinely to all patients who access the FLS.

PROBLEM

Osteoporosis is a serious global health concern¹ and is a major contributor to worldwide mortality rates.² It is estimated that cases of osteoporosis will continue to rise as the population grows and increases in age.³ Traditionally, osteoporosis diagnosis has been based on a minimal trauma fracture and/or a low bone mineral density (BMD) score, assessed via a dual-energy X-ray absorptiometry (DXA), in a person older than 50 years

of age.⁴ Vertebral fractures are common^{5 6} and are high-risk factors for future vertebral and non-vertebral fractures.^{7 8} Often these fractures are asymptomatic, and with conventional DXA scans not detecting vertebral fractures, estimates suggest up to 70% of cases may go undetected.⁹ These figures are alarming as vertebral fractures increase the risk of future fractures more than fourfold,⁹ lead to other serious health conditions,¹⁰ and significantly raise mortality rates.^{11 12} Since vertebral fractures are often missed, evidence^{13 14} and guidelines¹⁵ suggest that vertebral fracture assessment (VFA) may optimise current approaches to bone density assessments. Developments in technology now allow for VFA during routine DXA scans with low additional radiation exposure to the patient and minimal cost to the health-care system.¹⁶ Evidence suggests that identifying vertebral fractures using VFA can have a significant impact on secondary fracture probability, signifying that VFA may be an effective approach to improving fracture risk calculations.¹⁷ Furthermore, treatment initiation and medication continuation may be aided by the additional information provided by a VFA.⁸

The primary aim of this study was to evaluate the success of an Australian Fracture Liaison Service (FLS) in integrating VFA into their osteoporosis care pathway. The FLS where the evaluation took place is based at Flinders Medical Centre within the Southern Adelaide Local Health Network (SALHN). The service offers assessment for people aged 50 years or over who have attended the regional hospital and sustained a minimal trauma fracture. On referral, patients receive fracture risk assessment, fall risk assessment, dietetic-focused assessment, self-management education, investigations (pathology, bone density testing), and medication review and/



or the initiation of osteoporosis treatments (predominately antiresorptive therapy). There is a paucity of data reporting the number of patients receiving routine VFA in FLS, making it challenging to benchmark against other services. Schousboe and colleagues explored the relationship between a positive VFA and consequent treatment initiation within clinical practice.¹⁸ Using a prospective observational cohort design the researchers examined the Canadian Manitoba Bone Density Programme database between 24 February 2010 (when VFA testing was introduced) and 30 March 2016. In total, 47944 patients underwent a DXA scan, of which 10053 (21%) also received a VFA at the same time. A Dutch study evaluated the implementation of VFA in an FLS, reporting that VFA increased from 4.6% to 97.1%. Accounting for differences in international osteoporosis assessment frameworks and healthcare systems (e.g., differences in healthcare insurance), we aimed to increase VFAs from 0% to 50%. We were also interested in whether the VFA positively impacted early identification and treatment initiation for secondary osteoporotic fractures.

BACKGROUND

Osteoporosis is a skeletal disorder characterised by diminished BMD and bone microarchitecture, leading to an increased risk of fractures.¹⁹ Globally, it is estimated that up to 18.3% of the population is living with osteoporosis,¹ with this figure likely to rise with increasing life expectancy.^{3 20} The cost of the disease has significant social and economic burdens,^{21 22} yet, despite this, there are widening treatment gaps.^{23 24} The proportion of individuals with osteopenia or osteoporosis who require intervention but do not receive one is increasing for several reasons, including concerns about medication side effects, lack of awareness, and differences in national and international healthcare policies.^{25 26}

The most common osteoporotic fractures are vertebral fractures^{5 6} yet there is a worldwide underdiagnosis.²⁷ A large European study reported that up to 12% of females aged between 50 and 79 will experience a vertebral fracture, the majority being osteoporotic in nature.⁶ This figure is estimated to rise to 20% in females over 80 years of age.⁶ Currently, osteoporosis is diagnosed through a DXA scan that typically measures the density of the bones at the hip and lower spine, meaning that vertebral fractures are often missed. This oversight is further exacerbated by the asymptomatic nature of vertebral fractures, with prediction rates suggesting that between 50% and 70% of cases will not receive clinical attention.⁹ These statistics are concerning because spinal fractures can elevate the risk of subsequent fractures by⁹ over fourfold, and can increase other morbidities and even mortality.^{25 26} The identification of vertebral fractures offers healthcare systems a prime opportunity to reduce the frequency of secondary fractures. To achieve this, an additional scan, known as a VFA, can be undertaken, allowing clinicians

to acquire a lateral view of the thoracic and lumbar spine to determine if there are any fractures.

In Australia, VFAs are not routinely administered and, as such, many vertebral fractures are undetected, leaving individuals untreated and at high risk of subsequent fractures.⁴ An illustration of this comes from a large Australian community-based study (n=482) of postmenopausal women aged 70 and over who reported no previous knowledge of vertebral fractures.²⁸ VFA identified that 18.3% of the sample had experienced a vertebral fracture. Solely using BMD scores to diagnose osteoporosis resulted in a diagnosis range between 40% and 74%, suggesting that between 26% and 60% of osteoporotic women may not have received appropriate treatment. Knowledge of vertebral fractures, as well as BMD scores, significantly improves secondary fracture risk prediction¹⁵ and the evidence base is growing supporting the effectiveness of VFA as an additional clinical marker for osteoporosis.²⁸⁻³⁰

Routine VFAs for all patients who access an FLS may modify the patient's risk category and thus impact on the initiation and type of intervention offered.⁸ Furthermore, collecting a baseline for vertebral fractures allows clinicians to discriminate between old and new fractures and to monitor treatment plans.⁸

This study aimed to evaluate the success of an Australian FLS in introducing routine VFAs into their osteoporosis care pathway. We also wanted to assess whether VFA positively impacted early identification and treatment initiation for the detection of future osteoporotic fractures for patients with normal BMD. Research evaluating the use and effectiveness of VFA within public FLS is imperative for quantifying the diagnostic gap,³¹ influencing clinical guidelines, and informing funding decisions around osteoporosis care pathways.

Measurement

This study used routinely collected clinical data. A retrospective electronic medical record review was undertaken, and baseline indicators were collected from clinical data during the pre-implementation (i.e., before VFA was introduced) period from 1 September 2017 to 29 February 2020 and compared with post implementation data from 1 March 2020 to 30 October 2022. We aimed to measure how many patients received a VFA before and after the service had implemented the change in practice and whether this had an impact on treatment initiation. See online supplemental figure 1 for an illustration of the routine FLS care pathway before and after VFA was introduced.

Design

Before the implementation project proceeded, VFA in the FLS was only performed if a clinician specifically requested the scan. After implementation, VFAs were routinely offered to patients as part of their standardised osteoporosis assessment. The pre-implementation period occurred over 30 months and the study used a retrospective cohort design. Case notes for all patients

assessed during this time were audited by a primary reviewer (DS—FLS nurse) and checked by two secondary reviewers (BB—FLS non-physician clinician and LG—researcher). The primary outcome was the number of eligible patients who received a VFA after the change in practice was introduced. In terms of eligibility for the VFA, it should be noted that the publicly funded health-care insurance scheme in Australia, Medicare, only allows an individual to be rebated for one bone density test every 24 months. Therefore, if a patient has received imaging within another service, for example, prior to having surgery after a hip fracture, then they will not be eligible to receive a second scan with the FLS. The FLS will request scan results from the other service. We also wanted to explore the number of cases where the patient had normal BMD, demonstrated through a DXA scan, but the VFA identified vertebral fractures and treatment initiation was recommended.

An FLS quality improvement group was formed to implement the VFA into the osteoporosis care pathway. There was no hierarchical structure within the group, and we found that an inclusive team approach was effective for decision-making and promoted the onboarding of FLS staff. All FLS staff were consulted during the quality improvement process and were amenable to the changes. This positive engagement was primarily centred around the staffs' understanding that the service was aiming for a 'gold standard' of care, and this was the driving incentive for the team. To be successful, we had to gain the approval of the bone densitometry team who administer the FLS DXA scans. The bone densitometry team do not work exclusively with the FLS and accommodate other health-care services. The motivators for the bone densitometry team implementing the change were less explicit. To address this, we emphasised that the change was linked to a quality improvement which would offer patients a gold service of care. There was hesitation from the bone densitometry staff regarding the additional time needed to undertake the scan and interpret the results. A primary concern was the feasibility of administering a VFA with the FLS' patient population who are usually older, can be frail, and often present with painful fractures. Within our service, there is typically one unaided bone densitometry staff member on duty so there was apprehension about the time needed to position patients and manual handling for individuals who may need assistance. To mitigate this, the FLS staff, who are located next to the imaging facility, provided reassurance that they would be available to help with manual handling.

Strategy

We used the Expert Recommendations for Implementing Change³² discrete implementation strategies and Proctor's framework³³ to identify and measure outcomes related to the implementation of the VFA into the osteoporosis care pathway (table 1). The implementation required an integrated approach across the entire FLS including the diagnostic bone densitometry team and

consulting endocrinologists. We also used the Standards for Quality Improvement Reporting Excellence 2.0.³⁴

RESULTS

Table 2 outlines the pre-implementation and post implementation descriptive statistics. Before the implementation, 0% of patients were referred for a VFA. Post implementation, out of the total number of referrals to the FLS, 80% of patients were eligible to receive a VFA and 90% of these underwent a VFA at the FLS imaging centre. There were 10% of patients who underwent their DXA scan at the FLS imaging centre but did not receive a VFA. There were several reasons for this including the patient being unable to assume the position needed for the VFA, the bone densitometry staff being unable to perform the scan (i.e., lack of training or confidence), or the patient declining. It should be noted that out of 34 participants who underwent BMD assessments at another centre, only two of these received a VFA.

Post implementation, almost half (41%) of patients who underwent a VFA displayed abnormalities and 4% of these recorded a normal BMD score but abnormal VFA. Four per cent of patients received a normal BMD score but abnormal VFA. Inferential statistics found there was no significant difference in treatment initiation periods between the pre-VFA and post-VFA implementation periods $\chi^2(1, 134)=3.41, p=.065$.

Lessons and limitations

We proactively initiated a change in practice to try and optimise our approach to bone density assessments as part of our osteoporosis care pathway. Our FLS introduced routine VFAs for all eligible patients accessing the osteoporosis care pathway. The implementation has been successful with 90% of eligible patients receiving the additional VFA during their routine osteoporosis assessment. When compared with similar VFA implementation studies, for example, van der Velde and colleagues³⁵ who reported 97.1% of patients receiving VFA, our imaging rates are marginally lower, possibly relating to variations in patient populations or differences in staff capacity and training.

The proximity of the FLS offices to the imaging centre has been pivotal with the high number of VFAs performed. Informal conversations between the bone densitometry team and FLS have been invaluable and have had an implicit impact on the implementation, for example, informal debriefs after VFAs. Building rapport throughout the process has been important and we feel the face-to-face element has assisted compared with if we had taken a virtual approach. The bone densitometry staff can also access rapid support from FLS staff if they require assistance positioning a patient. Positioning frail, older patients for the VFA can be challenging and having two staff members on hand is often necessary. If this support was not available, the number of VFA performed would have likely been lower.

Table 1 Implementation strategies used in the current evaluation per the (ERIC)³² discrete implementation strategies and Proctor's framework³³

Proctor domain	Explanation	ERIC strategy
Actor	Who delivers the strategy? SALHN FLS clinical staff including those within the MDT FLS, the associated SALHN BDT team and the consulting endocrinologist	<ul style="list-style-type: none"> ▶ Build a coalition
Action	Steps to be taken to carry out the strategy? Organisational structure supports the implementation of routine VFA for every patient accessing the osteoporosis care pathway including discussions with Directors and Heads of Departments. It should be noted that the SALHN BDT already had the necessary imaging equipment to perform VFAs, so no new equipment was needed to implement the quality improvement. The FLS staff led the implementation in line with best practice guidelines. ³⁵ The BDT and consulting endocrinologist were consulted regarding the concept of the new pathway. This was achieved through departmental meetings and other channels which are in place to support the communication of change of practice directives. The positives and negatives of implementing VFA were discussed including logistics (e.g., ensuring we had the right equipment and prolonging scan time slots for room booking and staff/patient time (e.g., positioning the patient for the VFA can take some time). The FLS team committed to aiding the BDT throughout the project, which including aiding with patient positioning within the scanner. Staff were orientated to the evidence (e.g., CTF framework) supporting the change, particularly BDT and higher management who were less familiar with the CTF bronze, silver and gold rating system. Specific training was provided to ensure collaboration between staff for effective case-finding and management of patients with osteoporotic vertebral fractures. For example, it was critical to standardise the reporting system (e.g., terminology) in the BDT to clearly diagnose vertebral fractures for the FLS staff. On the service referral and results form, a tick box reminder system was available for the completion of a VFA	<ul style="list-style-type: none"> ▶ Involve executive boards ▶ Assess for readiness and identify barriers and facilitators ▶ Conduct educational meetings ▶ Develop and implement tools for quality monitoring ▶ Facilitation ▶ Remind clinicians ▶ Organise clinician implementation team meetings
Target of the action	Who/what the actors are attempting to impact, based on conceptual models of implementation? Change risk assessment for osteoporosis for all patients by introducing the VFA. Treatment initiation is to be recommended for patients who exhibit vertebral fractures, regardless of BMD score	
Temporality	When does the strategy take place; what is the order of the strategies? One-time rollout in March 2020 with ongoing monitoring. Clinical evaluation in October 2022	<ul style="list-style-type: none"> ▶ Audit and provide feedback
Dose	Frequency and intensity Ongoing practice	
Outcomes affected	What will the strategy change? The overall goal is to improve osteoporosis care quality and reduce the number of secondary fractures. The strategy will ensure every eligible FLS patient is offered a VFA as part of their routine care. The strategy also aims to increase the number of patients with normal BMD offered osteoporosis treatment initiation based on previous vertebral fractures. Furthermore, we have also made changes to the reporting system for vertebral fractures, ensuring results are clear and unambiguous for the FLS who are initiating treatment and talking to patients. We hope these changes will increase staff confidence for initiating treatment and increase patient confidence for accepting treatment	<ul style="list-style-type: none"> ▶ Promote adaptability
Justification	Basis for the strategy in research or practice? National and international clinical guidelines and standards advocate for the implementation of VFA	
	BDT, bone densitometry team; BMD, bone mineral density; CTF, Capture the Fracture; FLS, Fracture Liaison Service; MDT, multidisciplinary team; SALHN, Southern Adelaide Local Health Network; VFA, vertebral fracture assessment.	

Table 2 Data for number of referrals, tests and treatment initiation

Data	Pre-implementation of VFA	Post implementation of VFA
Dates	1 September 2017 to 29 February 2020	1 March 2020 to 30 October 2022
Number of months	30	30
Number of patients referred to FLS	400	574
Number of FLS patients eligible for bone density testing	366/400 (92%)	460/574 (80%)
Number of BMD scans undertaken at FLS imaging centre		
BMD normal	70	64
BMD indicated osteoporosis	118	139
BMD indicated osteopenia	166	213
Total	354/366 (97%)	416/460 (90%)
Number of BMD not undertaken		
BMD performed at another centre	12	34
Patient declined	0	8
Contraindicated	0	2
Total	12	44
Number of VFA performed at FLS imaging centre		
VFA normal	N/A	220
VFA abnormal	N/A	153
Total	0	373 (90%)
Number of VFA scans not undertaken at FLS imaging centre		
Patient unable to position for VFA	N/A	27
Staff unable to carry out scan	N/A	15
Patient declined	N/A	1
Total	0	43 (10%)
Number of VFA performed at other facilities		
VFA normal	N/A	1
VFA abnormal	N/A	1
Total	0	2
Normal BMD but abnormal VFA	N/A	16/375 (4%)
Osteopenia/osteoporosis diagnosis and abnormal VFA	N/A	72
Number of treatment initiation started for osteopenia/osteoporosis (abnormal VFA)*	159	170 (64)
Number of treatment initiation started for normal BMD (abnormal VFA)*	28	16 (8)

Bone mineral density was measured through dual X-ray absorptiometry (DXA) scan. Total VFA is calculated using those who received DXA scan in the FLS imaging centre.

*Antiresorptive therapy.

BDT, bone densitometry team ; BMD, bone mineral density ; CTF, Capture the Fracture ; FLS, Fragility Liaison Service ; MDT, Multidisciplinary team ; SALHN, Southern Adelaide Local Health Network ; VFA, vertebral fracture assessment.

The effectiveness of the VFA was mixed. On one hand, the assessment highlighted the high percentage of patients who displayed vertebral abnormalities (41%). Interestingly, 4% of patients received a normal BMD score but abnormal VFA, suggesting that some patients may not have been offered osteoporosis treatment if clinicians based their initiation decisions solely on BMD scores. However, it should be noted that our service offers

a tailored model of care and clinicians in the FLS base their treatment initiation decisions on multiple variables and would not use BMD scores in isolation.

Overall, there was no significant difference in treatment initiation between the pre-implementation and post implementation periods. It may be the case that treatment initiation did not increase post implementation because of our patient population. As our FLS



is a multidisciplinary programme designed to prevent secondary fractures in individuals who have already sustained a fracture, it is likely that treatment initiation would be offered based on this information alone. As well as fracture history, clinicians also use risk assessments which consider the demographics, medical history, and DXA scores of patients. Therefore, it may be the case that VFA provides little additional information that would impact treatment management for the population we serve. However, VFA may be beneficial when an individual without a known low trauma fracture has a DXA scan that indicates osteopenia and may not otherwise be started on treatment.^{10 13 14} Rather than implementing a routine VFA protocol for all FLS patients, it may be more appropriate to offer the additional scan to a proportion of patients based on a tailored approach that takes into consideration local guidance, available evidence, and the individual patient's needs.^{13 14} An innovative improvement would be for VFA to be offered to all patients who are referred for a DXA who do not have a fracture history.¹³ This remodelling may allow us to capture individuals who have not knowingly sustained a minimal trauma fracture yet but who have unidentified vertebral breaks and are at high risk of secondary fractures.

One of the limitations of this study was that we relied on case note data and did not collect data prospectively. For future evaluations, we will incorporate a short reflective process to capture this information in real-time. This lesson highlights the complementary nature of quantitative and qualitative evaluations and the necessity of both to be able to see the 'full picture'. On reflection, we acknowledge that the absence of a significant effect of VFA on treatment initiation may have been linked to inadequate investigation during the planning phase of the project. It is possible that we made an error by assuming that implementing guidelines would automatically enhance diagnosis or treatment initiation rates of the service we provide. As a competent and versatile multidisciplinary team offering a personalised approach to osteoporosis assessment, we may not have encountered any significant issues in the area that the guidelines are intended to address. It could have been advantageous for us to carry out a thorough baseline audit to gain a complete understanding of the number of patients who could potentially derive additional benefits from the implemented assessment. As a clinical team dedicated to enhancing our research skills, we now recognise the importance of choosing an appropriate conceptual framework during quality improvement projects. Looking back, a framework such as a Plan-Do-Study-Act cycle, which offers a more comprehensive approach to designing and evaluating quality improvements in health interventions, may have been more suitable. To optimise our future efforts, we aim to collaborate with an implementation researcher for any upcoming projects. This individual will provide us with the necessary guidance and support, including assisting us during the planning stage, to develop interventions that are both effective and sustainable in the

long term. Future research could formally investigate whether the implementation of VFA had an impact on other aspects of clinical practice or patient experience, such as the nuanced medication choices made by clinicians, or the treatment preferences expressed by patients.

CONCLUSION

Vertebral fractures are frequently undiagnosed as they can be asymptomatic, and routine osteoporosis assessment does not include spinal imaging.⁹ Current evidence^{13 14} and guidelines¹⁵ suggest that VFA may optimise current approaches to bone density assessments. This project aimed to integrate routine VFA into an Australian FLS and to measure their effect on treatment initiation. There is a dearth of research evaluating the success of implementing routine VFA into an osteoporosis assessment pathway, so this article aims to fill this knowledge gap. We achieved our objective as the percentage of eligible patients receiving a routine VFA increased from 0% to 90%. The introduction of VFA did not have a significant quantitative difference to treatment initiation suggesting that it may be more effective to offer the additional scan to a proportion of patients based on a tailored approach.

Acknowledgements We wish to extend our gratitude to the SALHN Bone Mineral Density Scanning Unit at GP Plus Marion for their help with the implementation of the project.

Contributors The concept for the evaluation was conceived by DS, KH, KM and BB. LG, DS and BB analysed the data. LG prepared the manuscript for publication with input from DS, KL, KH, KM and BB. All authors contributed to subsequent revisions and approved the manuscript prior to its submission. DS is the guarantor.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

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