# Improving the quality of the fracture liaison service through the implementation of a structured health record

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## ABSTRACT

**Objective** According to the best practice framework for secondary fracture prevention, all patients aged ≥50 years with a fracture should be assessed for osteoporosis within the fracture liaison service (FLS). The framework includes an FLS quality registry database to ensure quality. The input of data into our FLS registry was time-consuming and required entering data twice: into both the journal record and the registry. A '3-in-1' solution was required: (1) developing a structured health record (SHR) to provide decision-support to FLS nurses during patient consultations; (2) making a structured journal record from the SHR and (3) exporting data to the quality registry database. The SHR needed to be web based, secure and available for use all over the world.

**Design** One provider at Stavanger University Hospital met all the criteria for further development of the record (CheckWare). An interdisciplinary working group was established, following the Plan–Do–Study–Act working model. Depending on the answers given, the FLS nurses were provided decision-making support. A significant loss of height (≥4 cm) was highlighted as one of the process quality indicators. All clinically relevant data were summarised in a report, which was exported to the health record software. Data were exported to the FLS quality registry.

**Results** All fracture patients in need of a dual-energy X-ray absorptiometry scan received an appointment at the FLS outpatient clinic and 96% attended. The minimum standard was met for the three quality indicators 1–3. In particular, the use of SHRs increased the number of patients investigated for vertebral fractures with a height loss ≥4 cm from 67% to 93%.

**Conclusion** The SHR was successful in regard to the '3-in-1' solution: providing decision support to FLS nurses, developing structured journal records and exporting data to the FLS quality registry. After implementation, all FLS registry quality indicators improved.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The fracture liaison service (FLS) uses a registry database to ensure quality. Entering data twice was time-consuming and inefficient at our clinic and no electronic health records were available to fulfil our need for structured health record (SHR) in Norway.

## WHAT THIS STUDY ADDS

⇒ The working group developed a web-based SHR, which included quality guidance to nurses and provided an electronic health record report. The SHR was tested and implemented in our FLS and provided efficient reports for health records, improved the quality indicators and increased the quality registry coverage rate to 98%.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The SHR contains all advantages an electronic health record should have: providing structured data, incorporating guidance for health workers and exporting data directly to the quality registry for continuous quality improvement in addition to the health record.

## BACKGROUND

The risk of breaking a bone quadruples after the age of 50 years and increases exponentially with age.[1 2] Osteoporosis is one of the most common diagnoses among people over the age of 50 years in Norway, which has one of the highest incidences and prevalences of hip fractures.[3–5] Without secondary fracture prevention, the later outcome may be more serious fractures, such as vertebral fractures or hip fractures (femoral neck fractures).[6 7] The consequences of serious fractures in old age are serious: one in four elderly individuals who suffer a hip fracture dies within a year, and one in four ends up permanently living in a nursing home, while the rest rarely return to the same functional level they had before the fracture.[8] It is a substantial cost, for both the individual and society.

Before the Capture The Fracture Initiative from the International Osteoporosis Foundation (IOF) and the Fragility Fracture Network was developed, the responsibility and initiative to diagnose and provide secondary

prevention to reduce the risk of a severe subsequent fracture were arbitrary, and the treatment gap was up to 85%–90%.[4] In 2015, the Norwegian Orthopaedic Society created nationwide fracture liaison service (FLS) guidelines for orthopaedic departments, inspired by similar routines, that is, those developed in Great Britain and by the IOF.[6 9 10] The guidelines were developed to begin providing treatment for patients with a fragility fracture and T score of −1.5 SD or lower. The Best Practice Framework (BPF) recommends capturing and detecting osteoporosis in the population aged ≥50 years with a fracture (index fracture), for example, in the wrist, and to begin secondary fracture prevention with antiosteoporosis drugs.[9] The BPF recommends keeping a quality registry to ensure best practice. For nearly two decades at Stavanger University Hospital (SUH), we have kept a local quality registry for all fracture treatments (the SUH Fracture Registry, further referred to as the 'fracture registry') to enable the exportation of a complete list of patients entitled to an FLS appointment. Recently, quality registries and patient-level key performance indicators have been tested and recommended.[11] Hospitals are now increasingly ensuring that every individual over 50 years of age with a fracture undergoes an assessment in which the risk of further fracture is assessed.[12 13] The process to determine whether the criteria in the BPF are fulfilled for an FLS quality registry is often time-consuming and requires additional human resources.

We are aware that the number of patients with low-energy fractures is high and likely to increase as this population increases throughout this decade.[14] Good, effective secondary prevention measures have been available for long time, but the healthcare system has lacked the routines to identify patients at risk.[15] This applies within both primary and specialist healthcare facilities.

Since 2016, the orthopaedic department at SUH has steadily implemented a procedure to detect and diagnose patients with bone fractures due to osteoporosis. In August 2020, we started the Orthopaedic Osteoporosis Outpatient Clinic for patients aged ≥50 years with fracture. This enabled us to capture all potential FLS patients and provide them with best-practice treatment at SUH. FLS nurses perform dual-energy X-ray absorptiometry (DXA) measurements in the FLS clinic, screen for other risk factors and start osteoporosis treatment, if necessary, in consultation with a medical doctor.

Implementing new workflows, new guidelines or both requires time and effort. Implementation requires thorough preparation and planning for all of the steps in the implementation process. The step-by-step model was developed by Capture the Fracture, a Worldwide Initiative to Prevent Second Fracture.[9] Several hospitals, including SUH, have introduced these quality indicator (QI) steps. One step requires a quality registry to maintain continuous quality control. Structured health records (SHRs) are needed to achieve a quality registry for a hectic outpatient FLS setting.

Today, most quality registries, including the FLS registry at SUH, require entering data twice: in both another programme and the unstructured health record (ie, an Excel sheet, Access database, RedCap).This is time-consuming and resource-consuming. The Norwegian Directorate of e-health recommends an SHR in their report 'design of a health technology scheme'.[16 17] The e-health strategy set by The Norwegian Directorate of e-health on behalf of the Ministry of Health and Care Services is to establish national standards, alleviate healthcare provider workflows in the electronic records and export data to medical quality registries, avoiding entering data two or three times.[16] The opportunities have been available since electronic health records (EHRs) were introduced in the 1990s. However, in today's EHRs, there are still problems regarding the importation and exportation of data to other medical systems, unstructured information (text/prose), and the exportation of data to quality controls or registries, and entering data twice is time-consuming.[18 19] Increasing advantages are seen from the use of structured patient medical information in EHRs regarding efficient medical resource and time use,that is, importing relevant data from the last health record or exporting data to patient safety projects or quality registries.[20–22]Thus, the '3-in-1 effect' should be within reach.

## MEASUREMENT

In August 2020, we started the FLS outpatient clinic together with a local quality FLS registry. We set QIs based on the International Society For Clinical Densitometry (ISCD) official position—for adults and the FLS framework.[9 11 23] The QIs for the local FLS registry were the following proportions:

1. At least 90% of patients receive treatment according to the national guidelines.
2. At least 80% of patients with a height loss ≥4 cm undergo vertebral fracture assessment (VFA).
3. At least 80% of patients undergo fall risk assessment, with the recommendation of antiosteoporosis medication and exercise (including strength and balance exercises).

The coverage of the registry should be ≥95%.

The FLS registry baseline data from 2021 showed the following demographics: a total of 23% of the patients were male, a median age of 68 years, and mainly wrist (27%), proximal humerus (15%), ankle (12%), spine (12%) and hip (11%) index fractures. All fracture patients living in the hospital population area (370 000 inhabitants) were offered an appointment at the FLS clinic, and approximately 92% attended. The waiting time was more than 52 weeks. Our registry revealed a treatment gap of 29% according to the guidelines provided in Norway. Thus, approximately 30% of patients with low bone density measurements (T score of −1.5≤SD) and at least one previous fracture were not started on treatment at the FLS. In addition, 58% of those with a height loss of ≥4 cm underwent VFA. Of these patients, 36% were

diagnosed with their first vertebral fracture. A total of 71% of patients aged ≥70 years did not undergo a VFA scan. According to the guidelines, 66% of the patients needed treatment: 83% of the vertebral fracture patients were treated with zoledronic acid or denosumab, 96% of the hip fracture patients were treated with either zoledronic acid or denosumab and 80% of patients were treated during hospital admission. The coverage of the registry was calculated to be 84%. Thus, our main issue in the quality assessment was to increase the coverage of the registry, improve the identification of patients in need of a VFA scan and reduce the waiting time from the index fracture to FLS assessment.

A pre-evaluation of the FLS nurses time schedules showed that much time was spent entering data into both health records and registry charts. The punching in the registry chart was time-consuming for nurses and reduced the time they spent providing treatment to patients. The overall registry coverage rate was 84%; however, coverage fell depending on the experience level of the staff, with a rate of 73% for new staff.

We developed an easy-input, structured patient record to guide healthcare professionals to make decisions tailored to each patient profile, following the guidelines from the BPF and The ISCD Official Position-Adult.[23] Links to updated information and guidelines in addition to indicators within the record (ie, colours, bold letters) may affect adherence to medical guidelines. A structured record makes it possible to export data to hospital quality registries and run checks on QIs set by the registry and international standards.

## DESIGN

To address 'the 3-in-1 effect', including a quality registry, QIs and a structured quality registry, a working group (WG) was developed. This group included the head of the FLS clinic and consultants, Information Technology (IT) consultants and FLS nurses, which reflected the clinical staff responsible for treatment, follow-up and the IT-software used in the department.

To be able to register all data input into the registry without the time-consuming need to enter data twice, a structured patient record was developed. The WG set up regular meetings to:

1. Identify appropriate and useful input variables, both for patient health records and exportation into the quality registry for quality improvement.
2. Run tests and develop a user-friendly interface for healthcare professionals (FLS nurses).
3. Make and remake the SHR output depending on different choices and help FLS nurses to make the correct decision in regard to fall prevention, treatment, follow-up and patient information.
4. Test the SHR.
5. Put the SHR into use in the FLS outpatient clinic.
6. Evaluate the records and the data exported to the FLS registry (BeinOP).

## STRATEGY

We used Plan–Do–Study–Act (PDSA) cycles to test the improvement provided by the interventions and assess the SHR. The project team continuously reviewed the SHR during the test period and made new improvements. This allowed for the continuous evaluation of the project and the final product.

### PDSA 1

The identification of fracture patient in the busy orthopaedic acute outpatient ward was a time-consuming task when looking at the baseline data from 2016. Only approximately 40% of patients were captured with an easy ID-patch referral to the secretary. It was obvious that a more effective method was needed. The development of a structured list extracted from the fracture registry was undertaken to identify all fracture patient following the criteria for a DXA scan. A secretary included the appointments from the list in the health record and sent out the FLS appointments. This enabled the use of an improved approach to identify more fracture patients, rather than manually searching through case notes and various clinical systems. The initial development of the FLS pathway required a number of changes in regard to the information needed to ensure that all patients were identified, informed and given an appointment. Fracture patients may not belong only to the orthopaedic department, that is, multiple trauma patients in the ER might be missed. A WG consisting of FLS nurses, a consultant orthopaedic and two Information Technology (IT) consultants was created to develop an SHR using CheckWare (CW). The SHR needed to be both a decision support tool for FLS nurses during consultations (like red indicators for extra attention/need for action) and a fully useful structured health report, in addition to providing important data for the quality registry. To develop a plan to test the changes (Plan), we used the QIs from the established FLS registry in addition to the registry coverage rate and number of the patients assessed compared to the number of patients captured in the orthopaedic department at SUH. The IT consultants, FLS nurses and orthopaedic consultant participated in carrying out the SHR tests (Do) and observed and learned from the consequences (Study). After 2–3 meetings, we tried a new test version (Act). We continued to review the content/variables in the SHR and tailor the data input into the SHR according to the FLS nurse workflow. Weekly meetings of the WG and with user participants were conducted in addition to evaluate the need for speeding up the process.

The WG also conducted weekly meetings with the staff to ensure the anchoring of all FLS clinic staff. The FLS staff and WG identified the need for the data input to be as close to the clinical workflow as possible. Anamnestic information (sex, age, height and medical history (known diseases, treatments/drugs, alcohol or smoking habits (Alcohol Use Disorders Identification Test C), family history of hip fracture or osteoporosis) was given in a digital report from the patients in advance and included

in the record. A height loss of at least 4 cm turned red and signalled the FLS nurse to perform an additional VFA scan during the DXA scan. This variable in the SHR was therefore crucial for the quality of the FLS.

The SHR contained a total of 164 possible input choices with dynamically adapted schemes depending on the answers. Pictures helping in the diagnosis of vertebral fracture (semiquantitative classification) and to identify an alcohol problem or the need for help to stop smoking. The Norwegian guidelines for activity and strength exercises for older adults were used in the variable choices to identify those in need of more exercise or activity.

### PDSA 2

The structured report from the SHR was developed. When the input to the SUH registry was completed, the WG focused on the generation of a text document to be exported to patient charts. The FLS nurses and orthopaedic consultant were highly involved together with the IT consultants to make the plan and carry out the tests of the generated text (Do), observe and learn from the consequences (Study) and make the necessary changes. The project manager and one IT consultant worked closely to improve the text and invited the rest of the WG to run the test with different scenarios and test patients. This allowed the WG to modify certain variables in response to themes/issues highlighted by the test data. These data were displayed in presentations to the department and in feedback for all individual staff provided via email. Errors in the SHR settings were identified, such as missing decimals in the laboratory results and missing text in the report when entering wrist-scan results. New drugs were added to the list of possible osteoporosis drugs after approval from the Norwegian Medical Agency. A new test version was launched for each change. After 217 test versions of the SHR text document, the document was ready for implementation.

### PDSA 3

The implementation of the structural health record into the daily routine of staff members required information from and training of outpatient clinic staff not included in the WG. The staff (mainly secretaries and FLS nurses) received adapted training in the workflow and setup of the CW chart. A user manual was provided with instructive illustrations. The data output parameters were set up in the same way as those in the existing quality registry and entered into the same secured database, which allowed for comparison between the two. This part included one senior IT consultant and the head of the quality registry, who both planned, performed, re-evaluated and put the exportation of data into action. Prior to the implementation of the SHR, a final report from the Excel sheet quality registry was analysed for comparison.

On 24 May 2022, the SHR was implemented in the FLS clinic at SUH.

PDSA 3: After 3 months of use, the WG planned to run a report of the collected data in the FLS-quality registry.

The data were exported from the SHR and analysed and evaluated by the WG (listed in the 'Measurement' section). In the initial analysis period of the project, a gap from the national guidelines was identified, especially in regard to adherence to VFA indications.[24]

All QIs were addressed and improved during the first 3 months of SHR use. The user interface helped the FLS nurses accomplish patient assessment, documentation in patient records and input into the quality registry. Thus, compliance with the number of completed SHRs was excellent.

A patient representative provided input regarding the final report exported to the GP and others in charge of the treatment of patients.

### PDSA 4

Staff engagement was achieved through staff meetings, handovers, teaching sessions, posters and email contact to keep staff informed and updated regarding the project and to highlight their hard work. Continued staff engagement throughout the project empowered staff members to commit to the project. Regular contact with staff through messenger groups, e-mails and meetings was integral to maintain staff ownership of the project. Feedback from FLS nurses and staff helped to guide the development of the SHR user interface and workflow from CW to the health record with specific tasks lists for each profession.

### RESULTS

The data input into the SHR (CW) by the FLS nurses from 24 May 2022 to 31 December 2022 were used as health record and quality registry data (figure 1). The number of datasets (n) was compared with the number of patients assessed at the FLS clinic in the same period in the EHR. The first 2 days had the most missing data and a coverage rate of 77%. After 3 days, the coverage rate increased to 100%.

After using the SHR for 6 months (excluding 1 month in which the clinic was closed for summer holiday), data from 1288 patients had been included in the FLS registry.
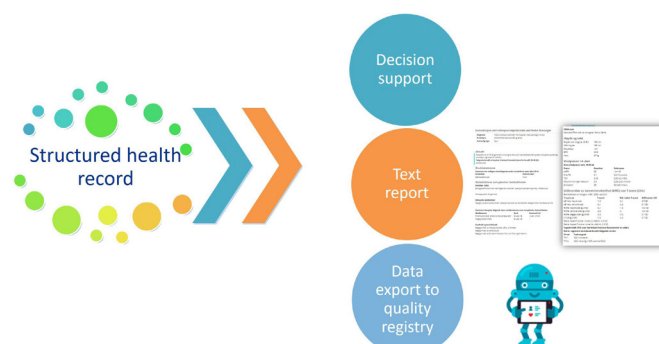


**Figure 1** A structured health record (SHR) in ChekWare including an '3-in-1' solution: providing decision support to FLS nurses, developing structured journal records and exporting data to the FLS quality registry. FLS, fracture liaison service.
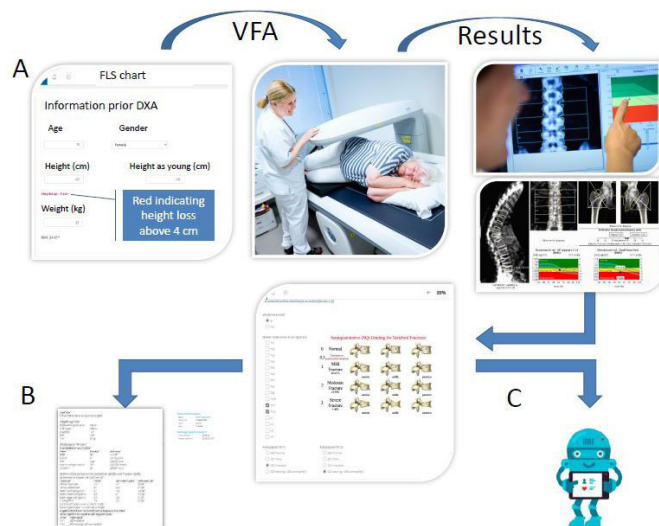
**Figure 2** Illustration of the process steps. The upper row illustrates the structured health record (SHR) guiding the FLS nurse to identify patient at risk with a height loss ≥4 cm (A). The lower row illustrates the data exported from the registration in the SHR providing a generated text document to the health record (B) and exporting data to the quality registry (C). DXA, dual-energy Xray absorptiometry; FLS, fracture liaison service; VFA, vertebral fracture assessment.

All our fracture patients aged ≥50 years at the orthopaedic outpatient trauma department received an invitation to have an appointment at the FLS outpatient clinic. A total of 96% of the patients attended.

The median age was 69 years and 76% of the patients were female. Wrist fractures (23%), vertebral fractures (16%) and hip fractures (14%) were the most common index fractures. The SHR increased the number of patients with a height loss ≥4 cm or an age ≥70 years who underwent a VFA, from 67% to 93% and 29% to 90%, respectively. A total of 55% of these patients had one or more vertebral fractures. Our structured chart had close to 100% completeness, discovered 24% more patients with vertebral fractures and was a success (figure 2).

The median waiting time was 138 days (20 weeks), with an IQR from 108 to 156 days. According to the QI 1, 'a total of >90% of patients should receive treatment according to the national guidelines', the T score limit was set to −1.5 SD or lower for starting treatment after a fracture.[24] From the registry, we identified 81% of the patients in need for treatment either were started on or changed drugs. The most common antiosteoporotic drugs given were zoledronic acid (43%), alendronate (33%) and denosumab (14%). A total of 95% of the patients with vertebral fractures, identified through the VFA, received either zoledronic acid, denosumab, teriparatide or romosozumab.

For the QI2, 93% of patients with a height loss ≥4 cm underwent a VFA according to the indicators in the SHR. In addition, the share of VFA scans performed due to an age ≥70 years increased to 79%.

For QI3, a total of 98% of patients underwent a fall risk assessment and 31% were at risk of another fall. A total of 21% were using walking aids; 8% of patients did not walk at least 30 min per day, and 77% performed activity for at least 30 min for a minimum of 3 days a week. A total of 18% of patients did exercise strength and balance training for at least 30 min, 3 days per week. A total of 68% of patients ate enough dairy products (3 units or more); 71% drank alcohol, but 90% drank less than 9 units per week. A total of 90% of those in need for further information, illustrations for home exercises and follow-up by the community service in regard to their nutrition or lifestyle received the information booklet.

The coverage rate of the FLS registry was 77% and increased rapidly to 100% after 3 months. The mean coverage rate was 98% compared with the health record appointment lists in our EHR software, DIPS Arena. There was one-half day in which we experienced problems entering the CW record during the 6-month period. The nurses had to use the 'old' way to register these patients by entering data into the Microsoft Excel sheet. They realised then how much easier and less time-consuming the new structured health record was.

## LESSONS AND LIMITATIONS

At the PDSA 1 stage, much energy was put into identifying the correct input variables and the record layout on the web interface. The FLS nurses and the project manager tested a total of 217 test versions before the record was complete and useful as an SHR. In addition, an output report to the quality registry had to be made, and the variable names were thoroughly kept in a codebook by the project manager to ensure correct interpretation of the variables. The structured data exported to the SPSS file was exported at chosen time intervals, tailored to own needs. After some time, a monthly data export was performed to run quality reports. This one-punch system ensured full coverage in the registry.

One limitation was the delay in the IKT development of software integrations (ie, Application Programming Interfaces). The EHR (DIPS Arena) could not import the SHR as expected. Thus, importing a pdf file or copying and pasting the SHR report was performed to be able to send the report electronically to the GP or the referral physician.

The FLS secretary played an important role in managing the list from the fracture registry from the emergency fracture outpatient clinic in addition to the in-hospitalised orthopaedic fracture patients. Our software developer at the fracture registry made checklists depending on the criteria: an age ≥50 or <95 years and having a recent fracture (except of toes, fingers or the skull). These lists enabled the FLS secretary to offer all patients an appointment at our FLS clinic. They also included the lists in CW to make sure the patients were ready in the SHR lists on a daily basis.

The WG consisted of FLS nurses, IT consultants and an orthopaedic consultant with interest in fragility fractures, in addition to patient representatives. The support of department leadership promoted the extra motivation to succeed. The money spent on development exceeded the amount granted by the SUH by approximately 13 000 EURO. The head of the FLS clinic and head of the FLS registry spent approximately 360 hours during development and testing. In addition, the IT consultants spent approximately 200 hours. The WG meetings were scheduled during the FLS nurses' lunch breaks and did not affect the patient schedule. The costs were estimated to €60 000 before taxes.

The WG had to modify the SHR several times because of missing data or incorrect data output. We had also some technical lags after a general upgrade affected our record.

The advantages of the WG included having IT consultants within the group, and the ability to make changes and interact through a high number of emails, phone calls and video meetings to move the project forward. The multidisciplinary team was of great importance regarding staff ownership of the SHR.

## CONCLUSION
The aim of this study was to develop an easy, efficient SHR to provide assistance to FLS nurses in decision-making and to develop a structured text health report in addition to exporting data to the quality registry.

Our (PDSA) cycles within the WG resulted in an excellent SHR, which was useful in the outpatient clinic to provide efficient and safer treatment for patients. It was crucial to invite the FLS nurses to participate in a weekly meeting in the project period to brief tests and provide feedback. The WG included several IT consultants with good access to include all the variables and functions into the SHR. Without interdisciplinary engagement, the product would perhaps not have been developed this fast or be supported by both FLS nurses and FLS doctors.

Our quality indices improved and our FLS registry coverage rate increased from 84% in 2021 to 98%. All our quality indices improved after SHR implementation. The SHR increased the number of patients with a height loss ≥4 cm who underwent VFA from 67% to 93% and a total of 24% more patients were diagnosed with vertebral fractures. The SHR was successful and is being further developed and made available across the country.

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