

# Evaluation of a Care Pathway in the Initiation of Calcium and Vitamin D Treatment of Patients after Hip Fracture

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## RÉSUMÉ

Les fractures de la hanche sont des fractures de fragilité, et la présence de ce type de fractures augmente les risques d'en subir d'autres. Bien que la manière de définir l'ostéoporose, qui requière des traitements antirésorption, chez les patients qui ont subi une fracture de la hanche n'est pas très claire, ces derniers devraient minimalement se faire prescrire du calcium et de la vitamine D. Lors d'un examen rétrospectif des dossiers, nous avons étudié l'efficacité d'inclure une recommandation (et non un règlement) sur la prise de calcium et de vitamine D au plan d'intervention concernant les fractures de la hanche, en comparant les unités où cette façon de faire a été implantée avec celles qui ne l'ont pas encore mise en place. Il résulte de ce plan d'intervention un nombre plus important de prescriptions de calcium et de vitamine D comparativement aux unités qui ne suivent pas ce plan (72% contre 13,5% ;  $p < 0,01$ ). Cependant, une étude prospective a démontré après quatre ans un déclin marqué dans la fréquence des prescriptions de calcium et de vitamine D. Cela suggère la nécessité d'un encouragement constant pour que les interventions continuent d'obtenir du succès.

## ABSTRACT

Hip fractures, fragility fractures, indicate an increased risk for further fragility fractures. Although the way to define osteoporosis, requiring antiresorptive therapy, is not clear, all patients who have had hip fractures should be prescribed calcium and vitamin D at a minimum. In a retrospective chart review, we have explored the effectiveness of incorporating a standing recommendation (but not a standing order) for calcium and vitamin D treatment in a hip fracture care pathway, comparing units where the pathway had been implemented with those where it had not yet been started. The pathway resulted in significantly more initiation of calcium and vitamin D compared to patients not on the pathway (72% vs. 13.5%,  $p < 0.01$ ). However, a follow-up study after four years showed a marked decline in the frequency of the initiation of calcium and vitamin D, suggesting the need for ongoing encouragement for the intervention to continue to be successful.

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## Introduction

In Canada, hip fractures account for nearly one fifth of fall-related fractures (Wilkins, 1999), and the cost of treating hip fractures in all Canadians over 60 years

of age was calculated to be CAN\$395 million dollars in 1994, excluding costs for long-term care, home care, and drugs (Lorrain et al., 2003). Not only is the monetary cost huge, but the functional decline resulting

from injury and hospitalization can also jeopardize the independence of an elderly person. The functional and mortality consequences of a second hip fracture are even more serious (Pearse, Redfern, Sinha, & Edge, 2003).

An opportunity exists to diagnose and treat osteoporosis during the time a patient is hospitalized for a fractured hip. However, the diagnosis and treatment of osteoporosis in men and women who have suffered any fracture remain sub-optimal and are particularly inadequate for hip fractures. A recent systematic review of observational studies examining post-fracture treatment of osteoporosis found that only 3 of 25 studies reported treatment with calcium and vitamin D in greater than 25 per cent of patients, with a median of 18 per cent (Elliot-Gibson, Bogoch, Jamal, & Beaton, 2004). There is clearly room for improvement. Focusing on in-hospital patients with fragility fractures represents an ideal opportunity for such an intervention. Various post-fracture initiatives are undergoing evaluation of their success in initiating assessment and treatment of such patients. These initiatives focus on obtaining bone density measurements and determining the need for bisphosphonate treatment.

Evidence suggests that hip fracture risk can be reduced by bisphosphonate treatment, but probably only if the individual has osteoporosis (McClung et al., 2001). Knowing that elderly people can break a "normal" hip if they fall heavily enough justifies the need for assessment. Presumably, although no data currently exist, osteoporosis treatment would not prevent the second hip fracture in the absence of osteoporosis, where falling with a significant impact might be the main problem. On the other hand, a simple intervention like calcium and vitamin D does reduce first hip fracture rate at the population level (Bischoff-Ferrari et al., 2005). Also, clinical practice guidelines recommend calcium and vitamin D supplementation as an adjunct therapy to the pharmacological interventions for osteoporosis (Avenell, Gillespie, Gillespie, & O'Connell, 2005; Brown & Josse, 2003). Vitamin D may also reduce falling, possibly through improving muscle function (Bischoff-Ferrari et al., 2004). Although we do not have evidence regarding the prevention of the second hip fracture with calcium and vitamin D treatment, there is evidence of greater risk of a second hip fracture in those who are vitamin D deficient (Chiu, Pun, Luk, & Chow, 1992).

Much evidence-based medicine is, in reality, evidence-by-extrapolation-based medicine where the population, patient, or circumstances under consideration differ from those used to generate the evidence. Under these circumstances, a test of reasonableness applies and the evidence is extrapolated if deemed appropriate. We suggest that initiating treatment with calcium

and vitamin D after the first hip fracture, in the hope of reducing the risk of a second hip fracture, is one such situation. Given the wide safety margin for the doses used, a recommendation that all hip fracture patients be started on calcium and vitamin D can be made and defended.

The purpose of this study was to evaluate the effectiveness of incorporating calcium and vitamin D treatment into an orthopedic care pathway as a means to facilitate consideration of calcium and vitamin D systematically for all patients. Under this intervention, all patients admitted with a hip fracture would be prescribed calcium and vitamin D if the physician ticked the appropriate box in the care pathway, thereby retaining an element of physician decision. This allows for the rare situation, such as hyperparathyroidism and sarcoidosis, where the use of calcium and vitamin D may be contraindicated. Within a busy surgical unit, where the primary concern is the management of the fracture and not the underlying bone disease, this is probably as much as can be expected.

The effectiveness of care pathways in changing practice and improving quality of care has been inconsistent. Both Roberts et al. (2004) and Olsson, Karlsson, and Ekman (2006) have reported on the effectiveness of a care pathway in managing hip fractures, and both have shown inconsistent results in the length of stay. Neither study examined medication use in the treatment of the underlying bone disease. In the present situation, where the implementation of osteoporosis treatment is rare, only improvement can be expected. Designing a process to capture and assess all post-fracture patients for osteoporosis has proven very challenging. One issue regarding hip fractures is that patients follow several different routes from acute care; some patients go to rehabilitation hospitals, some go to long-term care, and others go directly home. Follow-up for assessment and treatment can therefore be difficult. We reasoned that, as an initial step, we should attempt to ensure that all patients receive calcium and vitamin D, given extrapolated evidence of effectiveness coupled with safety and low cost.

## Methods

The care pathway was an orthopaedic initiative designed to streamline the management of hip fracture patients. The clinical pathway is a pre-typed order form entitled "Standardized Clinical Pathway for Hip Fracture Patients." In addition to approving other orders, the physician who completes the admission orders can tick off "Calcium 1000mg and Vitamin D 1000IU." However, this pathway item has to be so ordered and does not happen automatically.

A retrospective chart review of alternate admissions for the year April 1, 2002, to March 31, 2003, was undertaken. At the time, there were three orthopaedic units in the city situated at three different hospital sites. The care pathway was introduced in a staggered fashion within the study year, allowing its impact to be assessed by comparing the outcome in units where it had been implemented with those where normal care continued. The units serve a population of around 400,000 from the city of London and surrounding area. In the study year, excluding cases considered traumatic (e.g., motor vehicle collision), pathological (metastatic bone disease), or not within the age range (e.g., patients under the age of 60), there were a total of 444 eligible hip fractures, with 222 cases being reviewed in the audit. Of these, 207 had sufficient data for analysis. Data collected included evidence of a prior diagnosis of osteoporosis, evidence of prior treatment with osteoporosis medication or calcium or vitamin D, other recorded fractures, age and gender, circumstances of fracture (fall from standing height or otherwise), type of fracture, implementation of care pathway, and prescription of calcium, vitamin D, or other osteoporosis medications. Using a standardized chart abstraction tool, a trained research nurse (S.C.) abstracted all charts. Results were entered into an SPSS database for analysis.

A patient was considered to have a diagnosis of osteoporosis if it was recorded as one of the medical conditions on the medical history. Osteoporosis treatment was defined as any dose of any of the following: (1) calcium; (2) vitamin D, including that contained in multivitamin preparations; (3) Didrocal (etidronate/calcium combination); (4) Fosamax/alendronate; (5) Actonel/risedronate; (6) hormonal replacement therapy (HRT)/estrogen; or (7) Evista/raloxifene. Treatment was considered to occur before hospital admission if the nurse or physician recorded medication as part of the admission history. Treatment was considered to have been initiated during hospital admission if the medication was not recorded on the admission drug list but was listed as part of the medication administration record (MAR). Because it must list all medications that the pharmacy provides, the MAR is a valid measure of medication administration. In addition, if patients supply their own medication, the medication is listed on the MAR with the clause "patient supplies own." Treatment was considered to occur on discharge if the physician recorded the medication on the discharge summary or if the medication was included on the copy of the prescription given to the patient.

The Ethics Review Board of the University of Western Ontario approved the study.

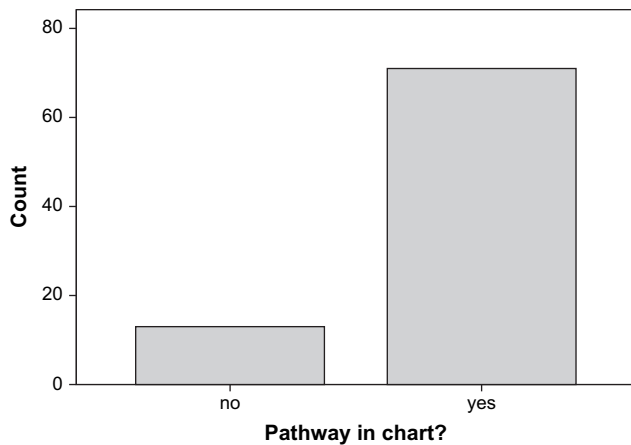
## Results

The analysis included a total of 207 cases, of which 100 were on the pathway. The mean patient age was  $82 \pm 8.7$  years, and 78 per cent were female. Prior to their hip fractures, 28 per cent of these patients lived alone, 9 per cent lived in a retirement home, and 22 per cent lived in a long-term care facility. Overall, 69 per cent lived within the city limits of London. Fifty-three per cent were admitted from their usual residence, 27 per cent from a community hospital outside of London, and 11 per cent from another London hospital. Eighteen patients (8%) were transferred from another location such as the home of another person or a public place. Upon discharge, 11 per cent went directly home after surgery, 31 per cent went to a rehabilitation facility within London, 24 per cent were discharged to a community hospital, and 27 per cent went to long-term care. Overall, 12 per cent had a change in living status upon discharge compared to what they indicated upon their admission. In total, 7 per cent ( $n = 16$ ) died during their hospital stay, 4 before surgery and 12 after surgery.

For comparison purposes and to ensure representativeness, the demographics of the study group were compared with those of all patients living within the city of London who suffered a hip fracture ( $n = 1,299$ ) and were admitted to London hospitals in the years 2002 to 2006, inclusive. In all respects, including age, gender distribution, and admission and discharge locations, the groups were essentially identical. Information regarding diagnosis of osteoporosis and the corresponding treatment was not available for the comparison group.

Osteoporosis had previously been diagnosed in 35 (16%) cases. Of these, 20 (57%) were taking an antiresorptive medication. Fifteen (43%) were on a bisphosphonate, (1 on risedronate, 1 on alendronate, and 13 on etidronate (Didrocal)), and 5 (14%) were on HRT (4) or raloxifene (1). Only 12 (35%) of those with a diagnosis of osteoporosis were on vitamin D, whereas 21 (60%) were on calcium, including those on Didrocal. In the patient population as a whole, only 34 (15%) were on vitamin D, either alone or as an ingredient of a multivitamin pill, and only 23 (10.4%) were on calcium alone (e.g., not including those on Didrocal).

No patient had bone mineral density testing while in the hospital. Calcium and vitamin D were prescribed in hospital in 41 per cent of patients overall and were included in the discharge medication list. Of those patients not on the care pathway, only 13.5 per cent had calcium and vitamin D prescribed in hospital, compared to 72 per cent for patients on the pathway ( $p < 0.01 \chi^2$ ). No previously untreated patient was ordered bisphosphonates or other specific osteoporosis treatment during the admission or upon discharge.



**Figure 1: The effect of being on the pathway on the initiation of calcium and vitamin D therapy**

For patients not on the pathway, 13.5% began treatment, whereas 72% of patients on the pathway started treatment.

Given that the prescribing of calcium and vitamin D was not automatic but required the physician's decision (to check the box on the care pathway), we investigated whether any patient characteristics were associated with who received the treatment and who did not. We found no influence of gender, no relationship to age, and no impact of the usual living quarters. In particular, patients from long-term care homes were as likely to be started on calcium and vitamin D as were those from the community.

Recently, four years after the original study, we reviewed the charts of 50 patients who were transferred to the rehabilitation program. Of these, only 13 (25%) had been started on calcium and vitamin D during their stay in the orthopaedic unit. In the original study, patients transferred to rehabilitation who had been on the pathway were prescribed calcium and vitamin D 80 per cent of the time. This suggests that the influence of having the calcium and vitamin D included in the pathway has waned and is now largely being ignored.

## Discussion

Hip fracture can have a devastating effect on the individual, in terms of mobility, institutionalization, and mortality (Eastell et al., 2001). The consequences of a second hip fracture are even worse (Pearse et al., 2003). The prevention of the first hip fracture in those with osteoporosis is important, and the aminobisphosphonates have been shown to be effective in this regard. There is no conclusive evidence regarding the prevention of the second hip fracture. The results of the studies of zoledronic acid in the prevention of the second hip fracture failed to show a statistically significant benefit, although the incidence of the second hip fracture was reduced by 30 per cent (Lyles et al., 2007).

There is evidence that calcium and vitamin D can reduce the (first) hip fracture rate (Bischoff-Ferrari et al., 2005). How this operates, whether through the effect on bone or an effect on muscle and hence fewer falls, or both, is not known; and, again, evidence that the second hip fracture can be prevented is lacking.

We have taken the view that further assessment of the patient's bone status is in order and have not advocated for the universal initiation of bisphosphonate therapy following hip fracture. Precisely how osteoporosis should be defined in this situation is not clear (Crilly, Kloseck, & Nassur, 2006). Calcium and vitamin D may, however, be of benefit to all and both are cheap and largely free of significant side effects. Although we have evidence that this approach may reduce first hip fracture, we do not have data regarding the second hip fracture. The extrapolation, however, seems reasonable. We believe that a case can be made for the provision of calcium and vitamin D to all hip fracture patients regardless of bone status when all may benefit in some way. Also, the osteoporotic patient, who frequently receives no treatment at all, may benefit at least to some extent. This should, however, be seen as the start of an assessment and treatment process. Some would recommend measurement of a serum calcium level prior to initiation of calcium and vitamin D treatment to identify the rare patient with hypercalcemia, such as might be due to malignancy, granulomatous disease, or hyperparathyroidism.

The pathway described here was successful in ensuring that 72 per cent of hip fracture patients left the hospital with prescriptions for calcium and vitamin D. This compares closely with the recently published results of Glowacki, LeBoff, Kolatker, Thornhill, and Harris (2008), using a similar methodology that started 74 per cent of the patients on vitamin D. On the other hand, the proportion of those started on treatment in our study, and who were not on the pathway, was very similar to the low value that Byszewski, Cranney, Man-Son-Hing, Azad, and Amos (2006) found. In their survey of usual practice, they found only 14 per cent of patients were started on vitamin D; only 15.6 per cent, on calcium. Other initiatives in this field have tended to focus on patient assessment for osteoporosis after discharge, entailing the use of dedicated staff such as coordinator or case manager (Majumdar et al., 2007; Sander, Elliot-Gibson, Beaton, Bogoch, & Maetzel, 2008).

Care pathways generally have had a variable success rate. Our experience is not unusual, and we have concluded that nothing continues indefinitely without constant input. It is well known that people on treatment for osteoporosis show limited persistence over time, with half stopping the treatment after a year

and about three-quarters after two years (Cramer, Amonkar, Hebborn, & Altman, 2005; Jones, Petrella, & Crilly, 2008; Rodan, Negri, & Gador, 2001). Adherence can be significantly improved by doing follow-ups on patients, reviewing them at yearly intervals, and providing feedback and encouragement (Clowes, Peel, & Eastell, 2004). The initial success of the care pathway in achieving our goals was largely the result of one individual's (SS) efforts to encourage implementation. The loss of this individual through transfer to other duties may have contributed to the loss of adherence with the directives in the care pathway. This observation shows that in the management of a chronic condition, a single intervention without supportive follow-up may not work for either the patient or the system.

Our study has some limitations. Chart reviews are always at the mercy of the reliability of the information recorded and, perhaps more importantly, of the information not recorded. Hence, the prior diagnosis of osteoporosis and prior treatment are very vulnerable to this phenomenon. The implementation of medications is, however, accurately recorded and should be a true reflection of the actions taken during admission. This is the basis of the study and should accurately reflect the impact of the pathway.

This study suggests that a care pathway can increase the treatment of hip fracture patients, at the most simple level, with calcium and vitamin D. We believe that, even with calcium and vitamin D, a physician should sign the order, rather than have the treatment started by standing order because there could be contraindications. A weakness of this approach, especially in a teaching hospital with transient trainees, is that ongoing involvement may be necessary to ensure that the recommendation is implemented, a concern evidenced by the drop-off in the implementation of calcium and vitamin D treatment after four years.

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