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# EFFECTIVE INITIATION OF OSTEOPOROSIS DIAGNOSIS AND TREATMENT FOR PATIENTS WITH A FRAGILITY FRACTURE IN AN ORTHOPAEDIC ENVIRONMENT

BY EARL R. BOGOCH, MD, VICTORIA ELLIOT-GIBSON, MSc, DORCAS E. BEATON, PhD,  
SOPHIE A. JAMAL, MD, PhD, ROBERT G. JOSSE, MD, AND TIMOTHY M. MURRAY, MD

*Investigation performed at St. Michael's Hospital, Toronto, Ontario, Canada*

**Background:** Fragility fractures resulting from osteoporosis are common injuries. However, the identification and treatment of osteoporosis in these high-risk patients are widely reported to be inadequate. The goals of this study were to determine how many patients receiving inpatient or outpatient treatment for a fragility fracture could be identified and enrolled in a program for osteoporosis education, investigation, and treatment and receive appropriate osteoporosis care within the program.

**Methods:** An Osteoporosis Exemplary Care Program was implemented to identify, educate, evaluate, refer, and treat patients considered to be at risk for osteoporosis because of a typical fragility fracture. System modifications included coordination among the orthopaedic unit, Metabolic Bone Disease Clinic, and nuclear medicine unit to provide a continuum of care for these patients. Barriers were addressed through ongoing education of physicians, staff, and patients to increase knowledge and awareness of osteoporosis. The percentages of patients previously diagnosed and treated for osteoporosis, referred for investigation of osteoporosis, treated by the orthopaedic team, and receiving appropriate attention for osteoporosis were calculated. Risk factors for osteoporosis were also assessed.

**Results:** Three hundred and forty-nine patients with a fragility fracture (221 outpatients and 128 inpatients) who met the inclusion criteria and an additional eighty-one patients with a fracture (fifty-five outpatients and twenty-six inpatients) who did not meet the inclusion criteria but were suspected by their orthopaedic surgeons of having underlying osteoporosis were enrolled in the Osteoporosis Exemplary Care Program. More than 96% (414) of these 430 patients received appropriate attention for osteoporosis. Approximately one-third (146) of the 430 patients had been diagnosed and treated for osteoporosis before the time of recruitment. Two hundred and twenty-two of the remaining patients were referred to the Metabolic Bone Disease Clinic or to their family physician for further investigation and treatment for osteoporosis. Treatment was initiated by the orthopaedic team for another twenty-three patients. Many patients had risk factors for osteoporosis in addition to the fragility fracture; these included a previous fracture (forty-nine of 187; 26%), a mother who had had a fragility fracture (forty-two of 188; 22%), or a history of smoking (105 of 188; 56%).

**Conclusions:** In a coordinated post-fracture osteoporosis education and treatment program directed at patients with a fragility fracture and their caregivers, >95% of patients were appropriately diagnosed, treated, or referred for osteoporosis care. To accomplish this, a dedicated coordinator and the full cooperation of orthopaedic surgeons and residents, orthopaedic technologists, allied health-care professionals (nurses, physical and occupational therapists, and social workers), and administrative staff were required.

Up to 95% of fractures in patients older than seventy-five years of age who are hospitalized for a fracture and 80% to 90% of those in patients between sixty and seventy-four years of age can be attributed to osteoporosis<sup>1</sup>.

In this population, the risk of a future fracture increases 1.5 to 9.5-fold following a fragility fracture<sup>2-8</sup>. Treatment of osteoporosis with calcium, vitamin D, and a bisphosphonate can prevent future fractures in high-risk patients<sup>9-12</sup>, and such treatment may also lower the risk of mortality after fractures<sup>13</sup>. However, in a systematic review of thirty-seven articles on the diagnosis and treatment of osteoporosis following a fragility fracture<sup>14</sup>, our group found that patients with a fragility frac-



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ture assessed in fracture clinics and/or by orthopaedic surgeons usually do not receive appropriate investigation for and treatment of osteoporosis.

Barriers to initiating treatment of patients who have, or are at risk for, osteoporosis include a lack of knowledge and understanding by the patient and the family physician, a lack of awareness and use of current osteoporosis guidelines, a perception by the orthopaedic surgeon that investigation for and treatment of osteoporosis are not their responsibility, the cost of therapy, the time and cost of diagnosing osteoporosis, side effects of medications, confusion about medications available for osteoporosis or the perception that their effectiveness is unproven, complex medical conditions of elderly patients, a reluctance by elderly patients to add more medications to already long lists, a lack of access to bone mineral density tests, and a lack of the time required to address secondary prevention<sup>15-21</sup>.

The Division of Orthopaedic Surgery of a large urban university hospital, in collaboration with the Metabolic Bone Disease Clinic, initiated a program designed to identify, investigate, and appropriately treat all orthopaedic outpatients and inpatients who presented to the hospital with a fragility fracture of the wrist, shoulder, hip, or vertebra. The short-term goals of this Osteoporosis Exemplary Care Program were (1) to develop awareness by hospital staff regarding the importance of identifying patients with a fragility fracture and their need for referral, evaluation, and possible treatment; (2) to increase identification and referral rates of patients with a fragility fracture; (3) to develop awareness by patients that the fracture may have been caused by an underlying bone disease; and (4) to enhance patient knowledge regarding osteoporosis and its management. The goals of this study were to determine how many patients with a fragility fracture attending the fracture clinic or treated on the orthopaedic ward of our institution could be identified and enrolled in a program for osteoporosis education, investigation, and treatment as well as the proportion of these patients who could be appropriately managed for osteoporosis within the program.

### Materials and Methods

**A**t a large teaching hospital and regional trauma center, a program coordinator was hired in 2002 to develop, implement, and evaluate a collaborative Osteoporosis Exemplary Care Program to integrate the outpatient fracture clinic, the inpatient orthopaedic unit, the Metabolic Bone Disease Clinic, and the nuclear medicine unit for the evaluation and management of osteoporosis in patients with a fragility fracture. A program logic model was developed (see Appendix) to identify key components of the program. Our ultimate goal was to initiate appropriate osteoporosis education, investigation, and treatment for all patients with a fragility fracture.

In this program, patients with a fragility fracture were identified by the coordinator or sometimes by an orthopaedic surgeon or allied health-care professional. The coordinator instructed patients to take vitamin-D and calcium supplements

and educated them about osteoporosis and its management. Patients were referred for a bone mineral density test, referred to the Metabolic Bone Disease Clinic, and given a prescription for an antiresorptive medication when indicated by the orthopaedic staff, and these activities were facilitated by the coordinator. The bone mineral density test was ordered separately by a physician to facilitate the referral to the Metabolic Bone Disease Clinic, and the result of the test was assessed in the Metabolic Bone Disease Clinic; it was the responsibility of the coordinator to ensure that the bone mineral density test was performed. Numerous categories of staff, including orthopaedic technologists, administrative staff, nurses, therapists, and physicians, were encouraged to, and did, contribute to the identification of patients with a fragility fracture to the coordinator and raise the issue of a possible diagnosis of osteoporosis with the patients.

The Metabolic Bone Disease Clinic is an interdisciplinary clinic with osteoporosis specialists from the fields of rheumatology, endocrinology, and gynecology. Patients who attended the Metabolic Bone Disease Clinic received further diagnostic assessment; questions about diet, family history, and risk factors; blood tests as indicated; and treatment of any potential underlying bone disease. Treatment decisions conformed to published guidelines for osteoporosis care<sup>22,23</sup>. The intervention was customized to the specific needs of the patients. For example, for patients who had previously had a bone mineral density measurement, the focus was on treatment, not investigation, and those who could not or did not choose to attend the Metabolic Bone Disease Clinic were referred to their family physician. This clinical program and the collection of relevant data were approved by the hospital research ethics board.

### Patient Selection

All women forty years of age or older and men fifty years of age or older who were attending the fracture clinic as outpatients or who were inpatients admitted to the orthopaedic unit and had sustained a fragility fracture (from a fall from a standing height or less) of the wrist, hip, shoulder, or vertebra between December 1, 2002, and November 30, 2003, were recruited into the Osteoporosis Exemplary Care Program. Patients who did not meet all of the inclusion criteria but were referred by an orthopaedic surgeon who suspected osteoporosis were entered into the program as "atypical" patients. These patients had sustained a low-energy fracture involving the ankle, tibia and/or fibula, distal part of the femur, acetabulum, pelvis, pubic ramus, or clavicle; they had sustained a moderate or high-energy fracture but had radiographic findings typical of osteoporosis; or they were younger than the age threshold.

The Osteoporosis Exemplary Care Program coordinator screened all fracture clinic outpatients and orthopaedic inpatients daily (Monday through Friday), then consulted with the attending orthopaedic surgeon or resident, reviewed the patient's chart, and interviewed the patient directly, when possible, to confirm that the patient should be enrolled in the program.

### *Referral and Treatment*

#### **Outpatients**

The Osteoporosis Exemplary Care Program was designed to facilitate the transfer of patients from the care of the orthopaedic surgeon to the Metabolic Bone Disease Clinic. The program coordinator ensured that arrangements for a bone mineral density test were made (if one had not been performed in the previous twelve months) so that the results would be available for a future fracture clinic visit, booked patient appointments at the Metabolic Bone Disease Clinic, and sent each patient a letter with their appointment time. If the diagnosis of an osteoporosis-related fracture was made in the Metabolic Bone Disease Clinic, it was noted in the patient's chart and the patient was informed of the diagnosis, medications were prescribed, and a follow-up appointment for a new bone mineral density test and assessment of the effectiveness of treatment was scheduled at the Metabolic Bone Disease Clinic in one to two years. Copies of the consultation notes made at the Metabolic Bone Disease Clinic for the referring orthopaedic surgeon and copies of the clinic notes made by the orthopaedic surgeon were sent to the family physician. One of the coordinator's roles was to ensure that communications with the family physician were accomplished.

Patients who had an apparent fragility fracture but a normal result on the bone mineral density test were also assessed in the Metabolic Bone Disease Clinic. Usually, it was decided that such patients required only education, advice regarding risk reduction, calcium and vitamin-D supplementation, and follow-up for monitoring. On the basis of published guidelines for osteoporosis care<sup>22,23</sup>, this was considered to be appropriate management for the purposes of this study. Patients who declined a referral to the Metabolic Bone Disease Clinic were referred to their family physician or treating specialist, with an explanatory letter, for intervention.

#### **Inpatients**

The coordinator contacted the unit pharmacist, dietician, and orthopaedic resident to initiate vitamin-D (800 IU daily) and calcium (500 mg twice daily) supplements for each inpatient who had been identified. Additionally, some inpatients received antiresorptive therapy on the basis of an inpatient consultation with consultants at the Metabolic Bone Disease Clinic or through prescription by the attending orthopaedic surgeon or resident. Pharmacotherapy choices included alendronate (10 mg daily or, more recently, 70 mg weekly), risedronate (5 mg daily or, more recently, 35 mg weekly), and cyclical etidronate (400 mg daily for fourteen days). An etidronate and calcium preparation was sometimes prescribed to patients who were unable to pay for medication, as that preparation has been approved in Canada as a second-line treatment for osteoporosis and is provided free of charge as initial therapy by the Ontario Drug Benefit Formulary for patients over the age of sixty-five years, whereas the aminobisphosphonates require patient payment unless certain stringent criteria are met. Pharmacotherapy and supplements were not initiated if the medications were contraindicated or if the patient was judged to be unable to

comply with treatment. This was considered to be appropriate osteoporosis management for inpatients on the basis of published guidelines for osteoporosis care<sup>22,23</sup>. Inpatients over the age of seventy-five years who were admitted with a fragility fracture of the hip were considered to have osteoporosis; other inpatients with a fragility fracture underwent a bone mineral density test on an outpatient basis. Inpatients whose needs with regard to investigation and treatment of osteoporosis were incompletely addressed prior to discharge received a referral to the Metabolic Bone Disease Clinic within two to three months after discharge and received follow-up by the coordinator at their outpatient fracture clinic follow-up visit. The program protocol was modified after six months to permit the coordinator to notify the patient's family physician in writing regarding supplements and any pharmacotherapy that were initiated while the patient was in the hospital.

#### **Education**

Patients were provided with an information sheet with the recommendation to take vitamin-D and calcium supplements; a booklet on osteoporosis; and a pamphlet on osteoporosis, fall prevention, and the risk of hip fracture. Each patient also received individual counseling from the coordinator, who assessed their risk factors and responded to questions and concerns. When a patient had dementia or other mental or physical barriers to communication, efforts were made to speak with the patient's family and/or caregiver(s).

Orthopaedic residents received educational materials on osteoporosis during the first week of their rotation and were in regular contact with the program coordinator, who attended fracture clinics and visited the wards. All attending orthopaedic surgeons and staff also received literature on osteoporosis, regularly addressed osteoporosis issues during orthopaedic teaching rounds and clinical work, and were fully supportive of this program.

#### **Evaluation**

During the initial consultation with the patient to confirm the appropriateness of inclusion in the program, the coordinator recorded the gender and age of the patient, the mechanism and site of the fracture, the history regarding diagnosis and treatment of osteoporosis, and the referral pattern, diagnosis, and treatment of osteoporosis following recruitment into the program.

The coordinator offered baseline questionnaires to all outpatients and inpatients during the initial consultation and these were completed on a voluntary basis, either during the patient's hospital visit or stay or later at home, after which they mailed it in. The data collected with these questionnaires included the history regarding fractures and other risk factors for osteoporosis, sociodemographic characteristics, health beliefs relating to osteoporosis<sup>24</sup>, and responses to the Osteoporosis Self-Efficacy Scale, which was developed as a measure of self-efficacy, or confidence, regarding behaviors related to physical activity and calcium intake<sup>25</sup>. Consent was implied if the patient completed and returned the question-

**TABLE I Age and Gender of Patients with a Fragility Fracture and Sites of Fractures**

	Outpatients			Inpatients		
	Women (N = 172)	Men (N = 49)	Total (N = 221)	Women (N = 102)	Men (N = 26)	Total (N = 128)
Age (mean and stand. dev.) (yr)	69.4 ± 12.9	67.6 ± 10.4	69.0 ± 12.4	82.3 ± 9.0	75.4 ± 12.2	80.9 ± 10.0
Fracture site						
Hip	45	11	56	91	26	117
Wrist	87	18	105	2	0	2
Shoulder	37	17	54	9	0	9
Vertebra	3	3	6	0	0	0

naire. Questionnaires were not distributed to frail elderly patients with physical or mental barriers to communication; patients who did not speak English; those who did not wish to complete the form; and, obviously, those who had died.

A follow-up questionnaire was mailed at six months to all patients who had completed a baseline questionnaire and had agreed to participate in the follow-up study. The purpose of the follow-up questionnaire was to collect information on (1) rates of referral to and attendance at the Metabolic Bone Disease Clinic, (2) the patients' knowledge of the results of their bone mineral density test, (3) compliance with treatment, (4) new fragility fractures at any site, and (5) health beliefs and self-efficacy related to osteoporosis. Further intervention was initiated by the coordinator on the basis of the needs identified in the questionnaire. If the patient had not attended the appointment at the Metabolic Bone Disease Clinic or had not complied with treatment, the coordinator offered to reschedule the appointment at the Metabolic Bone Disease Clinic or encouraged the patient to pursue osteoporosis investigation and treatment with his or her family physician.

The proportions of the cohort that could be effectively managed with this focused program were calculated as percentages. A two-tailed Pearson chi-square test was used to compare groups of questionnaire respondents, with  $p < 0.05$  indicating significance.

## Results

From December 1, 2002, to November 30, 2003, 221 of 6890 individuals who had made a total of 10,638 visits to

an ambulatory orthopaedic outpatient fracture clinic supporting a level-I trauma unit met the criteria for enrollment in the Osteoporosis Exemplary Care Program. These patients represented 3.2% of all patients attending the clinic and 5.9% of the patients attending the clinic for treatment of a fracture. The latter percentage (i.e., relative to the total number treated for a fracture at the fracture clinic) was diluted by the large proportion of patient visits (46%) for consideration of, and follow-up for, elective procedures (such as joint replacement, rotator cuff surgery, and foot surgery) and for other non-fracture care (such as soft-tissue injury and diabetic ulcer). The age, gender, and fracture sites of the outpatients with a fragility fracture are presented in Table I. Sixty (27.1%) of these fractures had occurred prior to the implementation of the Osteoporosis Exemplary Care Program, and those patients were identified at a follow-up appointment.

Eighty patients (36.2%) had been previously diagnosed and treated for osteoporosis (Table II). One hundred and twenty-four (56.1%) of the 221 patients were referred to the Metabolic Bone Disease Clinic or to their family physician for osteoporosis treatment (Table III). Seven patients had a normal bone mineral density, and the orthopaedic surgeon determined that further investigation was not required. An additional three patients were not referred for osteoporosis treatment for reasons related to their physical health or mental capacity. In total, 214 (96.8%) of the 221 outpatients received appropriate osteoporosis care (Table III).

During the same period, 128 (7.2%) of 1775 inpatients admitted to the orthopaedic unit of our hospital met the fra-

**TABLE II Previous Diagnosis and Treatment of Osteoporosis at the Time of Inclusion in the Osteoporosis Exemplary Care Program**

	Outpatients (N = 221)	Inpatients (N = 128)	Atypical Patients (N = 81)	Total (N = 430)
Previously diagnosed and treated	80 (36.2%)	41 (32.0%)	25 (30.9%)	146 (34.0%)
Previously diagnosed but not treated	13 (5.9%)	10 (7.8%)	1 (1.2%)	24 (5.6%)
Not previously diagnosed or treated	128 (57.9%)	74 (57.8%)	55 (67.9%)	257 (59.8%)
Unknown*	0	3 (2.3%)	0	3 (0.7%)

\*Two patients died in the hospital before chart review by the Osteoporosis Exemplary Care Program coordinator, and one patient was missed and did not return for follow-up.

**TABLE III Type of Osteoporosis Attention Received (Referral, Diagnosis, and/or Treatment) by All Patients Identified and Included in the Osteoporosis Exemplary Care Program**

	Outpatients* (N = 221)	Inpatients (N = 128)	Atypical Patients (N = 81)	Total (N = 430)
Previously diagnosed and treated†	80	40	25	145
Not previously diagnosed and/or treated	141	84	56	281
Referred to Metabolic Bone Disease Clinic	97	28	36	161
Referred to general practitioner	27	15	4	46
Inpatient diagnosed and treated during Metabolic Bone Disease Clinic consultation	NA	12	3	15
Inpatient diagnosed and treated by orthopaedic surgeon, with information sent to general practitioner‡	NA	19	4	23
Normal bone mineral density (no treatment)	7	0	6	13
Physical or mental contraindications to treatment§	3	7	1	11
Total who received attention for osteoporosis	214 (96.8%)	121 (94.5%)	79 (97.5%)	414 (96.3%)
No referral, diagnosis, or treatment because of:				
Death (as inpatient)	NA	3	0	3
Language barrier	1	1	0	2
Patient refused	6	2	1	9
No follow-up#	0	1	1	2

\*NA = not applicable. †Of the patients who were previously diagnosed and treated for osteoporosis, eight outpatients, four inpatients, and six atypical patients were referred to the Metabolic Bone Disease Clinic for further osteoporosis treatment. The status with regard to previous diagnosis and treatment was unknown for three inpatients. ‡Four inpatients who were diagnosed and treated by an orthopaedic surgeon subsequently died in the hospital. Treatment included vitamin D and calcium and/or a bisphosphonate. §Three inpatients subsequently died in the hospital. #The inpatient, who was discharged before arrangement for consultation could be made, could not be seen by the Osteoporosis Exemplary Care Program coordinator at the time of follow-up as a result of hospital isolation protocols. The atypical patient did not return to the hospital for follow-up.

gility fracture criteria for inclusion in the Osteoporosis Exemplary Care Program; 91.4% of these patients had a hip fracture (Table I). Forty (31.3%) of the 128 inpatients had been previously diagnosed and treated for osteoporosis, which was similar to the rate of outpatients who had been previously diagnosed and treated (Table II). Treatment for osteoporosis was initiated, either by the orthopaedic surgeon or through a Metabolic Bone Disease Clinic consultation, for thirty-one inpatients (24.2%) (Table III). Another forty-three inpatients (33.6%) were referred to the Metabolic Bone Disease Clinic for post-discharge consultation, or to their family physician for osteoporosis treatment. Seven patients had contraindications, such as chronic renal failure, advanced dementia, a gastrointestinal disorder, or physical or mental barriers, that prevented pharmacological treatment of osteoporosis. Ultimately, 121 (94.5%) of the 128 inpatients were appropriately diagnosed and treated, or referred for diagnosis and treatment, for osteoporosis (Table III).

An additional fifty-five outpatients and twenty-six inpatients were designated as atypical because they did not meet the criteria for inclusion in the program but were entered into the program because their orthopaedic surgeon believed that they probably had osteoporosis. Table IV presents the age, gender, and fracture sites of these patients. Twenty-five (30.9%) of these eighty-one atypical patients had been previously diagnosed and

treated for osteoporosis (Table II). Seven patients (8.6%) had initiation of treatment for osteoporosis when they were inpatients and another forty (49.4%) were referred to the Metabolic Bone Disease Clinic or to their family physician for osteoporosis diagnosis and treatment (Table III). Six patients (7.4%) had a normal bone mineral density. One patient had a contraindication to osteoporosis treatment. Thus, seventy-nine (97.5%) of the eighty-one atypical patients received appropriate attention for osteoporosis.

Women (131 of 333; 39.3%) were more likely than men (fifteen of ninety-seven; 15.5%) to have been diagnosed and treated for osteoporosis prior to admission into the program ( $p < 0.0001$ ). Most of the 146 patients who had been previously treated for osteoporosis were taking calcium (95.2%) and/or vitamin D (90.4%) on admission. Seventy patients (47.9%) were taking aminobisphosphonates (alendronate or risedronate), fifty-three (36.3%) were taking etidronate, four (2.7%) were taking raloxifene, nine (6.2%) were taking calcitonin nasal spray, and five (3.4%) were undergoing hormone replacement therapy. Only two of these patients were not taking any medication, because of contraindications or financial reasons. The 146 patients who had been diagnosed and treated for osteoporosis prior to identification and inclusion in the Osteoporosis Exemplary Care Program were interviewed by the coordinator to explore potential improvements in treat-



ment, and eighteen of them (eight outpatients, four inpatients, and six atypical patients) were subsequently referred to the Metabolic Bone Disease Clinic for further assessment.

Risk factors for osteoporosis and patient perceptions regarding osteoporosis were determined with baseline questionnaires given to a subset of 195 patients in the Osteoporosis Exemplary Care Program, and the data are summarized in the Appendix. Many respondents had one or more risk factors for osteoporosis. Forty-nine respondents (26% of 187) had sustained a previous low-energy fracture of the hip, wrist, shoulder, or spine; forty-two (22% of 188) reported that their mother had had a fragility fracture; and 105 (56% of 188) smoked or had previously smoked. Although 174 respondents (91% of 191) had been aware of the subject of osteoporosis in general prior to the fracture, only fifty-five (30% of 182) perceived their current fracture to have been caused by osteoporosis. Respondents who had been previously diagnosed and treated for osteoporosis were more likely to believe that osteoporosis was the cause of the fracture sustained in the fall than were those who had not been previously diagnosed and treated or those who had been previously diagnosed but not treated (chi square = 28.939;  $p < 0.0001$ ). Respondents with a previous low-energy fracture were more likely to have been receiving treatment for osteoporosis prior to inclusion in the Osteoporosis Exemplary Care Program (twenty-three of forty-nine; 47.0%) than were those who had had no previous fracture (thirty-two of 138; 23.2%) ( $p = 0.006$ ). Of the 117 respondents who had not been diagnosed and treated for osteoporosis prior to identification for inclusion in the Osteoporosis Exemplary Care Program, 100 (85%) said that they would consider taking medication for osteoporosis, eight (7%) said that they would not consider taking medication, and nine (8%) were undecided.

## Discussion

The Osteoporosis Exemplary Care Program was developed to identify, educate, refer, treat, and evaluate patients with a fragility fracture presenting in either an inpatient or an out-

patient setting. This program was designed to overcome systemic and individual barriers to the identification and treatment of osteoporosis through coordination among the orthopaedic, endocrinology, and nuclear medicine units to provide a continuum of care for these patients with treatment decisions conforming to the published guidelines for osteoporosis care<sup>22,23</sup>.

The yield from screening in orthopaedic inpatient wards and outpatient fracture clinics for patients at increased risk for a future fracture is much higher than the yield from screening of the general population. In the first year of this program, 8.7% of orthopaedic inpatients (154 [128 typical and twenty-six atypical] of 1775) and 4% of outpatients seen at a fracture clinic (276 [221 typical and fifty-five atypical] of 6890) were identified as being at high risk for osteoporosis and were enrolled in the program.

Thirty-four percent of the patients who were identified for this program had previously been diagnosed and treated for osteoporosis; this rate was higher than we had expected. Published reports have indicated lower rates of treatment, even among patients who had had a previous fragility fracture. A systematic review of thirty-seven studies completed between 1994 and 2002<sup>14</sup> identified a treatment rate of >25% in only three of eleven studies focusing on osteoporosis treatment with a combination of vitamin D and calcium and a treatment rate of >10% in only six of twenty reports that listed the use of bisphosphonates. Furthermore, a study of three community hospitals in southern Ontario (the geographic region of the hospital in the current study) demonstrated that <18% of patients with a fragility fracture were diagnosed and treated for osteoporosis<sup>26</sup>. A subsequent intervention study of patients with a fragility fracture in five hospitals in the same geographic region demonstrated improved rates of osteoporosis investigation but similarly poor treatment rates of only 15.8% to 17.3%<sup>27</sup>. The higher rate of previous osteoporosis diagnosis and treatment in the patients in the current study could be an indication of a shift in practice, with an increased focus on osteoporosis investigation and treatment, in our region.

TABLE IV Age and Gender of Atypical Patients with a Fracture and Sites of Fractures\*

	Outpatients			Inpatients		
	Women (N = 38)	Men (N = 17)	Total (N = 55)	Women (N = 21)	Men (N = 5)	Total (N = 26)
Age (mean and stand. dev.) (yr)	60.1 ± 15.2	59.4 ± 12.3	59.9 ± 14.3	70.9 ± 15.5	58.0 ± 24.7	68.4 ± 17.7
Fracture site						
Hip	2	2	4	4	3	7
Wrist	10	8	18	0	0	0
Shoulder	5	2	7	2	0	2
Vertebra	0	1	1	0	1	1
Other site	21	4	25	15	1	16

\*These patients either sustained a moderate or high-energy fracture, were below the age threshold, and/or had an atypical fragility fracture site (the ankle, tibia and/or fibula, distal part of the femur, acetabulum, pelvis, pubic ramus, or clavicle).

Although one-third of the patients in this study were already receiving treatment for osteoporosis prior to admission to the program, some were receiving optimal first-line therapy (aminobisphosphonate with calcium and vitamin D) whereas others, such as those receiving only calcium and vitamin D, were probably being undertreated. However, even aminobisphosphonates, when taken with calcium and vitamin D for severe osteoporosis, prevent only approximately 40% to 60% of fractures in high-risk populations<sup>28-30</sup>.

Etidronate has been approved as a second-line treatment in Canada<sup>22</sup>, as it is known to be less effective than aminobisphosphonates for prevention of refracture in high-risk patients<sup>31</sup>. Etidronate, which is inexpensive, has been approved by provincial formularies and is provided free of charge to patients sixty-five years of age or older and to those receiving social assistance. Although osteoporosis opinion leaders in Canada have advocated the use of aminobisphosphonates over etidronate, the single-payer formularies have only partially funded their use (i.e., limited use criteria).

Thirty-nine percent (131) of the women and 15% (fifteen) of the men were diagnosed and treated for osteoporosis prior to identification in this program. The low rate of osteoporosis treatment in men is consistent with previously reported rates, which have ranged from 0% to 34%<sup>27,32-34</sup>.

The majority of patients (91%) who answered baseline questionnaires in the Osteoporosis Exemplary Care Program were aware of the subject of osteoporosis in general; in contrast, only 41%<sup>35</sup> to 79%<sup>36</sup> of patients were reported as being aware of osteoporosis in other published studies. However, most patients in our study (70%) did not suspect that their fracture could have been caused by brittle bones. Similarly, Burgener et al.<sup>37</sup> reported that, while the older adults who had volunteered to be interviewed for their study were aware of the term "osteoporosis," they had an incomplete understanding of the condition and did not perceive themselves to be at risk for its development. Furthermore, six of ten patients could not distinguish between osteoporosis and osteoarthritis. Regardless of their knowledge and beliefs concerning osteoporosis, very few patients in our program refused our offer to initiate intervention.

Previous authors reported that orthopaedic surgeons were unlikely to participate in osteoporosis care<sup>20,21</sup>. However, in a survey of Canadian orthopaedic surgeons in October 2003, 85% of the respondents indicated that they currently investigate and/or treat and/or refer patients with a fragility fracture for an assessment for osteoporosis<sup>38</sup>. Orthopaedic surgeons at our institution were fully engaged in the program and were willing to refer and sometimes initiate treatment of those at greatest risk for future fracture. Orthopaedic surgeons took the initiative by not only identifying patients with a low-energy fragility fracture but also by identifying for referral certain patients with a moderate or high-energy fracture as well as patients who were younger than the age criterion and referring those patients for investigation of osteoporosis.

Inpatients with fragility fractures, most of whom are elderly and have a hip fracture, frequently have complex medi-

cal histories and cognitive impairment and are socially isolated. Because of these barriers to appropriate follow-up care for this high-risk group, we developed a more intensive inpatient consultation process with links to the patients' downstream care providers. However, a decision was made to not treat some inpatients because of contraindications to medications, mental health issues, or a terminal illness.

Several modifications were made to the program during the first year to improve the continuum of patient care. First, inpatients with a hip fracture did not require confirmation of the diagnosis of osteoporosis by a bone mineral density test for inclusion in this program; they were immediately referred for treatment. However, the program coordinator advocated for evaluation of the bone mineral density of patients with a fracture who were younger than seventy-five years of age to confirm the diagnosis of osteoporosis, establish a baseline for follow-up comparisons, and provide data to qualify the patient for coverage of aminobisphosphonate therapy by the provincial pharmaceutical benefits program. Second, we provided consultation and osteoporosis treatment during the hospital stay for inpatients who were considered likely to have difficulty attending an outpatient appointment at the Metabolic Bone Disease Clinic. Third, at the beginning of the project, patients diagnosed with and treated for osteoporosis prior to their identification by the program coordinator were not asked to complete the baseline questionnaire, although they were referred by the coordinator for additional osteoporosis consultation and treatment modifications as appropriate. Four months after initiation of the study, the protocol was modified to ask patients who had been previously diagnosed and treated, as well as atypical patients, to complete the baseline questionnaire. Fourth, as some patients had insufficient time to complete the baseline questionnaire in the clinic, the protocol was modified to permit them to complete the questionnaire at home and submit it by mail.

Effective osteoporosis care after a patient has sustained a fragility fracture is a complex process involving several steps between recognition of the fracture and effective prevention of future fractures. The early phase of this process is under the control of the orthopaedic surgeon. The first essential step is for the fracture to be recognized as a fragility fracture that is potentially or probably related to osteoporosis. Then, appropriate investigations (e.g., measurement of bone mineral density) must be performed, followed by appropriate management (e.g., referral to the Metabolic Bone Disease Clinic) based on the results of the investigations. The Osteoporosis Exemplary Care Program was implemented to increase rates of identification and referral of patients with a fragility fracture and to enhance patient awareness and knowledge regarding osteoporosis and its management. The results of this study showed that the program was effective in the identification and referral of inpatients and outpatients with a fragility fracture and initiation of appropriate treatment for osteoporosis for those patients. Appropriate management, according to published guidelines for osteoporosis care<sup>22,23</sup>, was provided for >95% of the patients. Issues concerning patient compliance with therapy and the efficacy of therapy



are downstream in the fracture prevention process and must be addressed separately. The efficacy of all programs of post-fracture care ultimately depends on patient compliance.

One challenge of this program was to ensure that all patients with a fragility fracture were identified and subsequently enrolled in the Osteoporosis Exemplary Care Program. Several protocols were implemented to minimize the likelihood of missing a patient. To avoid missing outpatients, the coordinator reviewed the fracture clinic appointment schedule less than twenty-four hours prior to each clinical session as well as at the beginning of each clinical session to capture any last-minute additions. If the coordinator was absent from a clinic (because of a meeting, vacation, or illness), she screened the appointment lists on her return, at which time eligible patients were identified and were enrolled into the program at a follow-up visit. Most patients who have sustained a fracture have at least two, three, or four follow-up appointments, so it is probable that they will be identified and enrolled in the program at some point. Furthermore, since the coordinator was present during all clinics in the first three months of the program, the possibility of missing a patient who visited the fracture clinic for final follow-up was small. In addition, orthopaedic surgeons and the fracture clinic staff (technologists and nurses) were actively involved in the program, and they informed the coordinator about any outpatients, both typical and especially atypical, who might require osteoporosis care.

To avoid missing inpatients, the coordinator reviewed the clinical database of the orthopaedic service five days per week to identify all patients with a possible fragility fracture and/or diagnosis of osteoporosis and initiated their enrollment in the program. If the coordinator was absent, a staff member printed the daily inpatient lists and put them aside for review by the coordinator on her return. In the event that an inpatient was missed (for example, if he or she had been admitted and discharged over the weekend, if the coordinator had been denied access to the patient because the patient was in isolation, or if the coordinator had been absent), the coordinator made a note of the patient's follow-up appointment in the fracture clinic to ensure that he or she was enrolled in the program at that time. The orthopaedic residents were also actively involved in identifying inpatients with a fragility fracture and notifying the coordinator. On the basis of these initiatives, we are confident that few patients with a fragility fracture were overlooked. However, a patient who was treated only in other areas of the hospital (such as a patient undergoing renal dialysis who had had a previous fragility fracture that had been managed at another hospital) would not necessarily have been enrolled in this program. Some patients who were treated in another division, such as a cardiac patient who sustained a hip fracture in the hospital but remained on the cardiology ward, were subsequently identified on an outpatient basis in the fracture clinic.

Systematic identification and referral for treatment of patients with a fracture and suspected osteoporosis require the participation of all orthopaedic surgeons and residents, orthopaedic technologists, allied health-care professionals (nurses,

physical and occupational therapists, and social workers), and administrative staff as well as a dedicated osteoporosis coordinator for screening, education, and referral. Our review of the literature indicated low rates of osteoporosis investigation and treatment<sup>14</sup>. With the employment of a dedicated coordinator, we were able to initiate an osteoporosis care pathway for >95% of the patients who were identified as having a fragility fracture as well as for additional, atypical patients who did not meet all of the criteria for a fragility fracture but were still considered to be at increased risk for future fragility fractures. A recent four-part intervention study of patients with a fragility wrist fracture that was designed to improve patient education and to develop a system for alerting physicians demonstrated a high rate of investigations for the diagnosis of osteoporosis (performed for eleven of twelve subjects), but the rate of osteoporosis treatment was not evaluated<sup>39</sup>. We believe that a dedicated osteoporosis coordinator is necessary because public awareness, self-advocacy, and caregiver vigilance are not sufficient to consistently identify the majority of the patients who are at risk for future fractures.

The coordinator for this study had a Master of Science degree in Rehabilitation Science and did not have clinical training or other professional qualifications. She was chosen because she had skills relevant to program development, database management, and the reporting of the results of this study as well as communication skills. A clinical background, such as in nursing or physical therapy, should be considered useful but not essential when choosing a program coordinator. The coordinator should have the communication skills and sensitivity to provide a level of comfort for patients to discuss perimenopausal and other issues.

Financial support for a coordinator requires a new, and difficult to find, stream of funding at most institutions. We consider this to be an important barrier to the introduction of effective osteoporosis programs in orthopaedic practice in North America. The relative risk of a subsequent hip fracture in a patient with a fragility fracture ranges from 1.5 to 9.5, depending on the type of index fracture<sup>4,6,8</sup>. In a preliminary cost-effectiveness analysis based on the findings in our program, a one-year decision analysis model was developed that indicated that a full-time coordinator who manages 500 patients annually would prevent nine future hip fractures<sup>40</sup>. As the direct hospital cost of a hip fracture was \$21,800 (Canadian) in 2003, this results in a potential savings of more than \$100,000 for the payers after deduction of the salary and benefit costs for the coordinator. Thus, the cost-effectiveness analysis demonstrated that this management program is not only clinically beneficial but also cost-effective in a high-volume fracture clinic, even when there is no budget for a coordinator. The savings in fracture-care costs created by such a system are also relevant to various models of large health-care management organizations.

The model discussed in this study was designed for an environment in which a high volume of patients with fractures are treated, such as hospital-based fracture clinics in Ontario, Canada. There are other, less populated and less serviced environments that would not support the employment of an

osteoporosis coordinator. An integrated local-resource-based post-fracture model of care was developed for those types of environments and is currently being piloted in five demonstration communities in Ontario<sup>41</sup>. That model places responsibility for post-fracture care on both patients and health-care professionals, facilitates linkages between health-care professionals and community programs for integration of osteoporosis and fracture-prevention information, and complements existing initiatives and resources in communities.


Our model integrated multidisciplinary orthopaedic care and introduced direct initiation of treatment by the orthopaedic team and/or during the Metabolic Bone Disease Clinic consultation. Earlier intervention studies have focused primarily on educational and referral programs and have demonstrated limited success, as initiation of osteoporosis treatment ultimately remained low<sup>14</sup>. Kaufman et al.<sup>42</sup> detailed the barriers against osteoporosis care for patients with a fragility fracture, as well as some solutions, in a review of three American osteoporosis programs for patients admitted principally because of a hip fracture. In Groningen, The Netherlands, 74% of patients who had a fragility fracture and were fifty years of age or older were seen in a new fracture and osteoporosis outpatient clinic, and 87% of those patients were found to have osteoporosis or osteopenia<sup>43</sup>. In Glasgow, Scotland, nearly 75% of patients with a fracture who were identified by a novel Fracture Liaison Service were considered for bone mineral density testing, and >82% of patients who underwent testing were found to have osteoporosis or osteopenia<sup>44</sup>. Both studies are ongoing, and the investigators anticipate reporting treatment rates in the future. In Switzerland, an osteoporosis clinical pathway was developed to identify patients with a fragility fracture who were at high risk for osteoporosis and to recommend appropriate medical management<sup>36</sup>. Bone mineral density testing was performed for 63% of the patients in that study, and 86% of them had either osteoporosis or osteopenia. At a six-month follow-up visit, it was determined that 42% of the patients had followed the recommendations of the interactive educational program and 63% of the recommended treatments had been prescribed. Compliance was high: 86% of the patients for whom calcium and vitamin D had been prescribed and 75% of those for whom bisphosphonates had been prescribed were continuing treatment.

A limitation of the present study is the reliance on patient self-reporting of osteoporosis diagnosis and treatment, which may underestimate the rate of diagnosis of osteoporosis<sup>45</sup>.

In conclusion, a coordinated post-fracture osteoporosis education and treatment program directed at patients with a fragility fracture and their caregivers established a high standard of care for this patient group. In a group that has been demon-

strated to be difficult to treat, and is at high risk for subsequent fractures, >95% of inpatients and outpatients were appropriately diagnosed, treated, or referred for osteoporosis care. Accomplishment of this goal required the efforts of a dedicated coordinator and full cooperation of orthopaedic surgeons and residents, orthopaedic technologists, allied health-care professionals (nurses, physical and occupational therapists, and social workers), and administrative staff.

## Appendix

 Tables presenting the program logic model and describing the socioeconomic demographics, the perceptions regarding osteoporosis, and the risk factors for osteoporosis for both outpatients and inpatients are available with the electronic versions of this article, on our web site at [jbjs.org](http://jbjs.org) (go to the article citation and click on "Supplementary Material") and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM). ■

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Earl R. Bogoch, MD  
St. Michael's Hospital, University of Toronto, 55 Queen Street East, Suite 800, Toronto, ON M5C 1R6, Canada. E-mail address: [bogoch@smh.toronto.on.ca](mailto:bogoch@smh.toronto.on.ca)

Victoria Elliot-Gibson, MSc  
Dorcas E. Beaton, PhD  
Timothy M. Murray, MD  
St. Michael's Hospital, 30 Bond Street, Toronto, ON M5B 1W8, Canada

Sophie A. Jamal, MD, PhD  
St. Michael's Hospital, 61 Queen Street East, Suite 6113, Toronto, ON M5C 2T2, Canada

Robert G. Josse, MD  
St. Michael's Hospital, 61 Queen Street East, Suite 6122, Toronto, ON M5C 2T2, Canada

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