Comprehensive osteoporosis management with easy access to bone mineral density measurements

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Abstract

Background The majority of people with osteoporosis are never evaluated even though effective treatments are available. The County Council of Värmland in Sweden has implemented an osteoporosis management model that has been shown to be effective in promoting awareness and providing care for osteoporosis patients. Discussions among a prevention group on osteoporosis in the county council were opened in 1997. The county of Värmland covers a large area, and the distances from the peripheral parts to the main city are approximately 300 km and cumbersome for the inhabitants. The importance of having an osteoporosis service that could reach the county inhabitants in a convenient way was therefore recognized. **Methods** Three thousand four hundred patients were evaluated between March 2001 and December 2003. Guidelines for patient selection for bone density testing and treatment guidelines were formulated. Promoting awareness was an important prerequisite for the model to function. This was accomplished by having the measurement devices where the patients showed up and by regular education of the primary care doctors. **Results and conclusions** A multidisciplinary team was established and consisted of primary care doctors, orthopaedic surgeons, internists, physiotherapists, a patient organization member, a county health care representative and nurses. Team members met every third month and agreed upon clinical guidelines for implementing the system. The presented osteoporosis management system is not a screening approach as all patients had risk factors for osteoporosis before they were suggested for bone density testing. This study shows that providing a comprehensive package of measures makes it possible to establish an effective osteoporosis management system with limited economical resources.

Introduction

Osteoporosis-related fractures causes immense personal suffering and places a huge economic burden on society. Despite this, most patients with the disease go undiagnosed and receive no assistance (Siris *et al*. 2001).

Osteoporosis diagnosis and treatment are mainly provided at large osteoporosis clinics at the main hospitals despite the fact that most of these patients show up at general practitioners and at fracture clinics. This means that the patients often have to travel long distances to get access to bone densitometry. In 1997, the County Council of Värmland in Sweden

started a project about osteoporosis, the aim of which was to overcome these problems and lessen the burden of osteoporosis to individuals and society. The main obstacle was finding a way to bring diagnosis and care to the patients, rather than the other way around. To solve this problem, the osteoporosis project group decided to buy three portable Dual X-ray Absorptiometry (DXA) devices for measurements of the heel bone instead of one axial DXA system.

Several studies have shown that the use of clinical risk factors and selective addition of bone mineral density (BMD) is effective in finding patients for assessment of osteoporosis (Kanis 2002; Johansson *et al*. 2004; Kanis & Johnell 2005). It has been estimated that the efficient use of BMD for assessment of osteoporosis could save up to a quarter of all fractures (Kanis & Johnell 2005).

Low bone mineral density is an important risk factor among other risk factors for future fractures. About 80% of the variance in bone strength is dependent on the bone mineral content (Cummings & Black 1995). Although axial DXA applied at the hip and spine is the most commonly used technique among osteoporosis specialists, the cheaper and more rapid application of DXA technology at the heel bone could serve as an alternative at general practitioner clinics and orthopaedic wards. The heel bone is weight bearing and consists of more than 90% trabecular bone. The proximal femur consists of about 43% (Bohr & Schaadt 1985) and lumbar spine about 42% (Nottestad *et al*. 1987) trabecular bone. The turnover rate for trabecular bone is about 6–8 times faster than for cortical bone in, for example, the long bones and the spinal processes. Effects of therapeutic interventions, nutrition and exercise may therefore show up fast in the trabecular bone.

The aim of this study is to report the experiences found for this osteoporosis management model and to describe some of the results.

Materials and methods

The county of Värmland in Sweden has a total population of 273 000 and covers 155 square kilometres. The main county town, Karlstad, has about 82 000 inhabitants, while the remaining residents (75%) live in the rural areas. Karlstad is situated in the southern part of the county and the distances from the northern parts to Karlstad are long and cumbersome for the inhabitants.

By 1997, both clinicians and county officials recognized that the osteoporosis care in the county was of unsatisfactory quality, and an expert group was set up. There was a rapidly growing need for osteoporosis diagnosis and treatment.

The number of patients an axial DXA device could handle daily was estimated at a maximum of 15–20. The machine would be located in the central hospital in the county town, and many patients would still be required to travel long distances to get to the machine. Owing to the relatively small potential benefits of this system for preventing fractures on a large scale, we searched for other possible solutions that would cost less but which also might have a more profound effect on the total problem of fractures in the region. The solution was a peripheral device, DXL Calscan (Fig. 1). This device had accuracy, mobility, WHO guideline compatibility and speed (70–80 patients per day, per machine or maximum 210–240 patients per day with three machines) for implementing an effective system for fracture prevention in the county. The osteoporosis management

Figure 1 The DXL Calscan device used in the osteoporosis management system. The measurement time is 55 s and the absorbed dose to the patient less than 0.2 µSv.

system was based on four machines, one was located at a private clinic that could be effectively rotated between offices to cover nine primary care facilities, two region hospitals and the physiotherapy sessions for fracture patients at the central hospital as well. As the DXL Calscan device did not require a technician and could be operated by any nurse or physiotherapist, it would not take much additional time or resources to implement a comprehensive fracture prevention plan for the county. Each personal handling the equipment got adequate training before using it, and the software was easy to use. The purchase cost for the three systems was less than 60% of the proposed cost of the axial DXA system with a technician. The system was implemented successively and the last device installed in 2001.

The portable heel DXA devices (DXL Calscan, Demetech, Stockholm, Sweden) were distributed to four parts of the county. One unit was placed at the orthopaedic ward at the main hospital to assess low-trauma fracture patients, and the remaining units were shared between general practitioners at nine locations (Fig. 2) at regular intervals, one week each fourth to sixth week.

One advantage of the peripheral DXA device is that it is easy to use and can be operated by a physiotherapist or a nurse. The DXL technique uses X-rays at two different energy levels in combination with laser measurement of the object thickness in order to determine three tissue components. Conventional DXA has an inherent limitation in that fatty tissues cause errors in accuracy (Bolotin & Sievänen 2001). The DXL technology eliminates these errors (Hakulinen *et al*. 2003). As the total thickness of the object being measured is a sum of the individual thickness of bone mineral, lean soft tissue and fat, it is possible to combine the thickness measurement with the two X-ray measurements and get a unique estimate of the three different components at the measurement site. It has been shown that DXL measurement at the heel bone, using a *T*-score threshold of –2.5 for classification of osteoporosis, is in concordance with the World Health Organization (WHO) definition of osteoporosis (Kullenberg & Falch 2003). As the devices were located at primary care facilities, they served to promote awareness among the doctors, and the patients that showed up could easily be identified and treated. The patients did not have to travel to the device for measurements and could be managed at site.

Figure 2 The County of Värmland. The nine locations participating in the osteoporosis management system are indicated on the map as well as the central hospital in Karlstad.

Patients taking part in the osteoporosis management programme were selected based on clinical risk factors for osteoporosis. The programme did not include population screening. The osteoporosis programme included taking BMD measurements, providing the general practitioners with osteoporosis education, a risk factor questionnaire, home visits to assess the patient's risk of falling, an osteoporosis school for the patients, and a package of other measures. The osteoporosis school was set up at three different locations in the county. It was a locally set-up network consisting of a doctor, a nurse and a physiotherapist. The patients were offered education at 7–8 different occasions.

Between March 2001 to December 2003, approximately 3400 patients were enrolled in the programme.

Results

A multidisciplinary team was established and met every third month. The team consisted of primary care doctors, orthopaedic surgeons, internists, physiotherapists, a patient organization member, a county health care representative and nurses. Team members agreed upon clinical guidelines for implementing the system, who to scan with DXL Calscan, and which patients needed to still be referred to an osteoporosis specialist.

The team developed criteria for bone density testing, based on risk factors (Table 1). These were in concordance with the recommendations from the Swedish Osteoporosis Society (http://www.sos-osteoporos.com/) and The Swedish Medical Products Agency (in Swedish). Screening of healthy individuals, including post-menopausal women, was not allowed.

The criteria for bone density testing are summarized in Table 2.

Treatment indication guidelines were developed by the team and are summarized in Table 3.

Osteoporosis treatment recommendations were developed in collaboration with the county drug therapeutic committee. Treatment alternatives included basic preventive measures such as giving calcium and vitamin D, as well as pharmacotherapy in accordance with the recommendations of the Swedish Osteoporosis Society.

Examples of other recommended low-cost alternatives are:

- Fall prevention checklist – the patient completes a questionnaire about domestic conditions that might precipitate a fall – loose carpets, sleep disturbances, prescribed drugs that could cause dizziness, etc.
- Daylight exposure – too little time spent out of doors could signal a need for vitamin D supplements.
- Skeletal exercise – is the patient getting the equivalent of a 30-minute walk per day?
- The osteoporosis school.

The patient flow model for the devices situated in the primary care facility is presented in Fig. 3.

The distribution of measured *T*-scores among the patients is presented in Fig. 4. Approximately 80% of the patients had a *T*-score of less than –1 and were osteopenic or osteoporotic.

The team organized educational meetings for all primary care doctors in the region to teach them the

Table 1 Clinical risk factors used to stratify fracture risk

Osteoporosis-related low trauma fracture
Family history of fracture
Age < 70 years old**:** More than 3 cm height loss
Age ≥ 70 years old**:** More than 5 cm height loss
Glucocorticoid treatment for more than 3 months
Disease or treatment that may cause secondary osteoporosis
Early menopausal onset (before 45 years of age)
Low BMI < 20 or weight loss of more than 10 kg since age 25 years
High risk of falling
Little physical activity, corresponding to < $^1/_2$ hour daily walk

Table 2 Bone-density testing guidelines

All osteoporosis-related low trauma fracture patients
Patients without a fracture if:
• <70 years old and 2 or more risk factors are present
• >70 years old and 1 or more risk factors are present

Table 3 Indication guidelines for intervention

T-score less than –1.0 and vertebrae compression and/or an oral cortisone treatment lasting more than 3 months
T-score less than –2.0 and a suspected fragility fracture
T-score of less than –2.5
T-score less than –2.0 and the existence of 2 or more risk factors

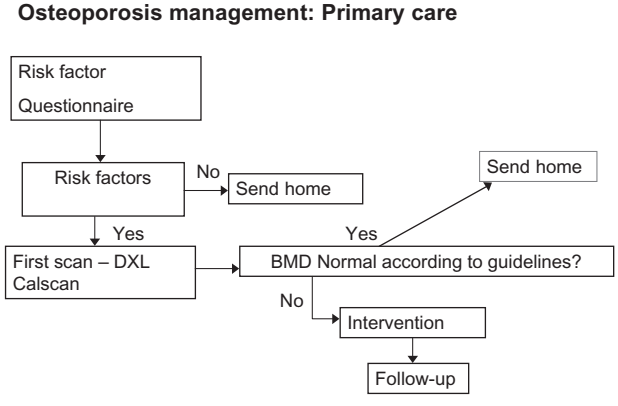

Figure 3 Patient flow for osteoporosis management in primary care.

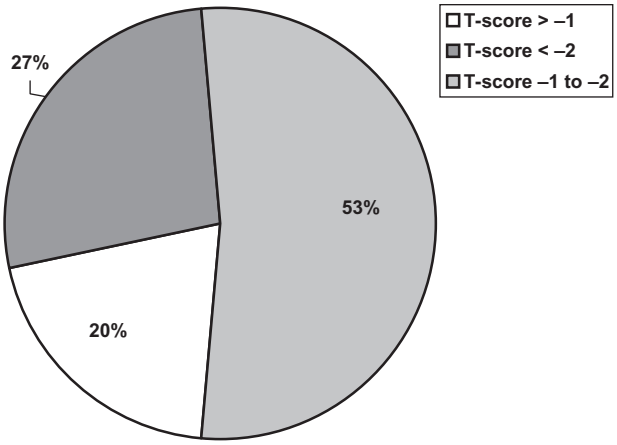

Figure 4 Distribution of T-scores among the 3400 patients with BMD measurements by DXL Calscan in the heel bone.

guidelines and provide periodic patient education on osteoporosis. They also promoted nurse visits to elderly homes and distributed risk factor questionnaires to identify people needing to be scanned. Informative brochures on osteoporosis were already available at Swedish pharmacies, and these were also distributed.

The team also agreed upon where and how they could best find and scan patients. For example, a physiotherapy group of fracture patients meets once a week at the main hospital in the county. The team decided to have a DXL Calscan available there for scanning those patients who were already known to have a fragility fracture after they had been treated (cast applied). During the other 4 days of the week this unit is at the main primary care facility, scanning 'at-risk' patients.

Their primary care doctor prescribed the patients bone-protecting treatment according to the guidelines in the programme. However, some patients present special challenges that the team did not feel experienced enough to start treating in primary care. These patients were referred to a specialist endocrinologist in the region, who then decided whether to treat the patient directly, or to refer them to the neighbouring county for an axial DXA scan. About 20% of the patients fell into this category. These include cases of:

- Male osteoporosis;
- Secondary osteoporosis;
- Osteoporosis in young patients (i.e. under 50 years old);
- Cancer-treated or severely ill patients.

Children were referred directly to a local paediatrician.

Discussion

The present model for osteoporosis assessment is not intended to represent guidelines for the management of osteoporosis, but rather to demonstrate the possibility to improve the management of this disease in the general population.

This type of osteoporosis management system can be implemented with 1, 2, 3 or more peripheral devices. The size of the local population to be protected against fractures should be considered when setting up any system, as should the number of primary care clinics servicing this population. The personal time needed for the measurements could easily be incorporated in the daily routines as the measurements could be scheduled in advance.

The current most widely accepted standard for osteoporosis diagnosis is based on DXA measurements of bone mineral density in the spine and hip. However, DXA equipment is expensive compared with peripheral devices, which are not portable, inaccurate in relation to soft tissue composition, and in many geographical areas usually restricted to secondary-care hospitals, because specialized, trained staff is required. Furthermore, the spine is not an appropriate site for bone density measurements for patients older than about 60 years of age owing to degenerative changes and fractures of the spine (von der Recke *et al*. 1996; Haczyńsk & Jakimiuk 2001). Given the considerable health problem posed by post-menopausal osteoporosis, a need exists for low-cost methods able to identify women at risk for future fracture. The DXL Calscan device used in this osteoporosis management model is a relatively inexpensive technique, which could be used by general practitioners in primary care and in ambulatory settings.

Prospective studies have shown that bone mineral density measurements of the heel bone have a high predictive value for identifying patients who are at risk of sustaining fragility fractures. This high predictive value is valid for both hip fractures and fractures

at other sites (Marshall *et al*. 1996). Several studies show that the Calcaneus bone is the most effective site for predicting lumbar spine fractures (Vogel *et al*. 1988; Black *et al*. 1992). There may also be large side-to-side differences in bone mineral density between the left and right proximal femur (Faulkner *et al*. 1995). Hence, the heel bone might instead serve as an overall sensitive site, without artefacts, for assessing the patient's risk of sustaining fragility fractures. The heel bone is also easily accessible, and patients do not have to be prepared in any special way.

No lower age limit for bone-density testing was applied in the guidelines. However, patients below the age of 50 and found to have low bone-density values were referred to a specialist endocrinologist in the region. The presented osteoporosis management system is not a screening approach as all patients had risk factors for osteoporosis before they were suggested for bone-density testing. This approach has been shown to be cost-effective in fracture prevention (LaCroix *et al*. 2005).

The intervention thresholds for osteoporosis should not solely be based on the *T*-score values, as this approach will give diagnostic misclassification. Other risk factors for future fractures should also be considered in making clinical decisions. The combination of risk fractures and bone density gives a better estimate of the risk of fracture (Cummings *et al*. 1995) than either of these indicators alone. This approach has therefore been applied in the described osteoporosis management model. There is a useful analogy with hypertension as blood pressure is used to diagnose hypertension, which is in turn a major risk factor for stroke.

The challenge for the health care system in managing osteoporosis and its consequences lies in delivering a service that has the ability to identify at-risk patients in a timely fashion. There is a need to address the low level of awareness among laymen and health care professionals alike.

The validity of this management system needs to be evaluated in terms of decrease in fractures. As records of fractures are recorded in the county, a follow-up study is planned.

We also plan to make further studies of this model in terms of economical consequences for the health care system.

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