The purpose of this study was to assess whether physicians in practice inadequately diagnose osteoporosis in a high-risk population of postmenopausal women who have sustained hip fractures. Using the Texas Hospital Discharge Data–Public Use Data File (PUDF) provided through the Texas Health Care Information Council, the authors conducted a review of all postmenopausal women older than 55 years with fractured hips discharged from Texas hospitals during 1999. A total of 13,628 patients meeting these criteria were found using the PUDF. In their diagnoses, physicians for 2233 (16.3%) of these 13,628 women also specified the code for osteoporosis (P491.001) from the ninth revision of the International Classification of Diseases. It is estimated that between 40% and 50% of postmenopausal women have osteoporosis. Therefore, women with fragility fractures form an even more at-risk subset of the population—so much so that one would expect a majority of these women to carry diagnoses of osteoporosis. The age distribution in each group was comparable, implying that receiving a coded diagnosis for osteoporosis was not related to the age of the patient when she was admitted to the hospital. Further, when data was analyzed by race or ethnicity, percentages for each group (ie, diagnosed with hip fracture only versus diagnosed with hip fracture and osteoporosis) were comparable.

In conclusion, physicians practicing in Texas during calendar year 1999 inadequately diagnosed osteoporosis in a high-risk population of postmenopausal women who were admitted to hospitals with fractured hips. Future analysis of subsequent annual databases will identify whether continuing medical education efforts cause physicians to diagnosis osteoporosis in this high-risk population more frequently.

Osteoporosis is defined as a skeletal disorder characterized by diminished bone strength that predisposes patients to an above average risk of fractures. Bone strength consists of two main features: bone density and bone quality. Bone density in any given individual is determined by peak bone mass and by the amount of bone loss. Bone quality refers to the architecture and mineralization of bone. A fracture occurs when a force such as trauma is applied to osteoporotic bone. Osteoporosis has been called “the silent epidemic” because bone damage occurs over years or decades without symptoms. Eventually, bones become so weak that minor trauma and even normal movements like bending or turning can cause bone fractures (ie, fragility fractures).

Osteoporosis affects more than 28 million people in the United States. Women represent 80% of the affected population, and many of these women do not know that they have osteoporosis. The risk for osteoporosis-related morbidity is high. The lifetime risk for hip fractures among white women is 17%, which is an incidence rate higher than a woman’s combined risk for breast cancer, endometrial cancer, and ovarian cancer. In the United States, osteoporosis risks are highest in Asian and non-Hispanic white women, but African American women and Hispanic women are also at risk.

There are approximately 300,000 hip fractures per year in the United States. It is believed that 75% of fractures that occur in the elderly are related to osteoporosis. Virtually everyone who fractures a hip requires a hospital stay and surgery. Twenty-five percent of patients die within one year of suffering a hip fracture. A recent study showed that the total cost of caring for osteoporotic fractures in the United States approached $14 billion per year. Of this total, hip fractures alone accounted for annual medical costs of nearly $9 billion.

The purpose of this research study was to evaluate the adequacy of diagnoses of osteoporosis in postmenopausal women who presented to Texas hospitals in 1999 with hip fractures.
ORIGINAL CONTRIBUTION

Methods
This is a retrospective analysis, utilizing the Texas Hospital Discharge Data–Public Use Data File (PUDF) from January 1, 1999 to December 31, 1999 (see http://www.thcic.state.tx.us/PUDF.htm). The Texas Health Care Information Council (THCIC), which was created in 1995 by the 74th Texas Legislature to administer and compile the Texas Hospital Discharge Data–PUDF, operates within the Texas Health and Human Services Commission (see http://www.thcic.state.tx.us/ and http://www.hhsc.state.tx.us/). The THCIC’s primary purpose is to provide data that enables consumers and health plan purchasers in the state of Texas to make informed decisions on their health care choices. In the state of Texas, the THCIC is responsible for collecting data and reporting on (1) the performance and quality of health maintenance organizations operating within the state, and (2) inpatient and outpatient discharge data from all Texas hospitals.

The THCIC gathers data from hospitals using the UB92 Patient Discharge Billing Form, an administrative form for submitting patient charges to third-party payers. The information gathered from these forms ranges from patient diagnoses to costs incurred for available medical procedures. Four quarterly PUDFs containing patient-level information for inpatient hospital stays are provided annually by the THCIC for approximately 2 million discharged patients. Texas PUDF data, which contains 104 “data elements,” can be used to study and compare health care services, although any analysis of these records requires the use of computer software. Individual patient identities are protected in the PUDF and the THCIC will seek civil and criminal penalties against anyone trying to determine an individual’s identity based on the data they have compiled.

Study Population
The investigators selected female patients only as the study population for this retrospective analysis because women are much more likely than men to have osteoporosis. Additional exclusion criteria included a minimum age of 55 years because the average age of menopause is 50 years (range from 45 years to 55 years), with 98.5% of women having experienced menopause by age 55. Census data indicates that in the state of Texas in 1999, 70% of the female population over the age of 55 years, with 98.5% of women having experienced menopause by age 55. Census data indicates that in the state of Texas in 1999, 70% of the female population over the age of 55 years (range from 45 years to 55 years), with 98.5% of women having experienced menopause by age 55.6

Results
Investigators found that 13,628 women met the aforementioned study criteria for the period under review. All patients in the study population are women, have an ICD 9 code confirming Fracture of neck of femur during 1999 (Table 1), and are older than 55 years (Table 2).

The most frequent Fracture of neck of femur principal diagnostic codes used by physicians for their patients in the study population were:

- □ 820.21 indicating Pertrochanteric fracture, closed – Intertrochanteric section;
- □ 820.08, Unspecified part of neck of femur, closed (Hip, Not otherwise specified [NOS]; Neck of femur, NOS); and
- □ 820.09, Unspecified part of neck of femur, open.

This principal diagnostic code was further evaluated for each of the two groups (ie, osteoporosis diagnosed and osteoporosis not diagnosed). In both groups, ICD 9 code 820.21, Fracture of neck of femur – Pertrochanteric fracture, closed – Intertrochanteric section, was the most frequently used code, accounting for 5044 (44.3%) of the 11,395 patients who had a diagnosis of a hip fracture only and for 1109 (49.7%) of the 2233 patients who had a diagnosis of hip fracture and a concomitant diagnosis of osteoporosis.

The second most frequently used ICD 9 code is 820.8, Fracture of neck of femur – Unspecified part of neck of femur, closed (Hip, NOS; Neck of femur, NOS). This diagnostic code was used for 3333 (29.2%) of the 11,395 women diagnosed with a hip fracture only. This diagnostic code was also noted in 551 (24.7%) of the 2233 women diagnosed with a hip fracture and osteoporosis.
with osteoporosis (26.6%) was greater than the percentage of women who suffered a hip fracture but were not diagnosed as having osteoporosis (24.4%). This trend continued in the women older than 90 years. Of the women 90 years and older, 451 (20.2%) had been diagnosed with hip fractures and a diagnosis of osteoporosis, whereas only 1889 (16.6%) had diagnoses of hip fracture alone.

When the demographics of the study population are reviewed for race or ethnicity (Table 3), white, non-Hispanic women accounted for 8485 (74.5%) of the 11,395 documented cases in which hip fractures were not initially coded for osteoporosis. Of women who did not receive concurrent diagnoses with osteoporosis (26.6%) was greater than the percentage of women who suffered a hip fracture but were not diagnosed as having osteoporosis (24.4%). This trend continued in the women older than 90 years. Of the women 90 years and older, 451 (20.2%) had been diagnosed with hip fractures and a diagnosis of osteoporosis, whereas only 1889 (16.6%) had diagnoses of hip fracture alone.

### Table 1
Characteristics of Women Diagnosed with Hip Fractures and Discharged from Texas Hospitals in 1999 by Type of Principal Diagnostic Code* Assigned by Their Physicians†

<table>
<thead>
<tr>
<th>Principal Diagnostic Code</th>
<th>Fracture of Neck of Femur, Type</th>
<th>Fracture, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Osteoporosis Diagnosed</td>
</tr>
<tr>
<td>820.09</td>
<td>Other (Head of femur, Subcapital)</td>
<td>507 (22.7)</td>
</tr>
<tr>
<td>820.20</td>
<td>Pertrochanteric fracture, closed—Trochanteric section, unspecified (Trochanter: not otherwise specified [NOS], greater, lesser)</td>
<td>62 (2.8)</td>
</tr>
<tr>
<td>820.21</td>
<td>Pertrochanteric fracture, closed—Intertrochanteric section</td>
<td>1109 (49.7)</td>
</tr>
<tr>
<td>820.31</td>
<td>Pertrochanteric fracture, open—Intertrochanteric section</td>
<td>1 (&lt;.1)</td>
</tr>
<tr>
<td>820.8</td>
<td>Unspecified part of neck of femur, closed (Hip, NOS; Neck of femur, NOS)</td>
<td>551 (24.7)</td>
</tr>
<tr>
<td>820.9</td>
<td>Unspecified part of neck of femur, open</td>
<td>3 (.1)</td>
</tr>
<tr>
<td>Total‡</td>
<td></td>
<td>2233 (100)</td>
</tr>
</tbody>
</table>

* Diagnostic codes were assigned by the patients’ physicians and are based on the following source: American Medical Association. 
† Pearson’s χ² test, 27.989 (5, n = 13,628); P = .001.
‡ Percentages reported were rounded for each principal diagnostic code used for these patients. Therefore the sum of these percentages may not equal 100%.
Table 2
Characteristics of Women Diagnosed with Hip Fractures and Discharged from Texas Hospitals in 1999 by Age*

<table>
<thead>
<tr>
<th>Age, y</th>
<th>Osteoporosis Diagnosed</th>
<th>Osteoporosis Not Diagnosed</th>
<th>Total, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 to 59</td>
<td>25 (1.1)</td>
<td>188 (1.6)</td>
<td>213 (1.6)</td>
</tr>
<tr>
<td>60 to 64</td>
<td>40 (1.8)</td>
<td>303 (2.7)</td>
<td>343 (2.5)</td>
</tr>
<tr>
<td>65 to 69</td>
<td>92 (4.1)</td>
<td>619 (5.4)</td>
<td>711 (5.2)</td>
</tr>
<tr>
<td>70 to 74</td>
<td>174 (7.8)</td>
<td>1047 (9.2)</td>
<td>1221 (9.0)</td>
</tr>
<tr>
<td>75 to 79</td>
<td>348 (15.6)</td>
<td>1979 (17.4)</td>
<td>2327 (17.1)</td>
</tr>
<tr>
<td>80 to 84</td>
<td>508 (22.7)</td>
<td>2586 (22.7)</td>
<td>3094 (22.7)</td>
</tr>
<tr>
<td>85 to 89</td>
<td>595 (26.6)</td>
<td>2784 (24.4)</td>
<td>3379 (24.8)</td>
</tr>
<tr>
<td>90 and older</td>
<td>451 (20.2)</td>
<td>1889 (16.6)</td>
<td>2340 (17.2)</td>
</tr>
<tr>
<td>Total†</td>
<td>2233 (99.9)</td>
<td>11395 (100)</td>
<td>13628 (100.1)</td>
</tr>
</tbody>
</table>

* Pearson’s χ² test, 40.584 (7, n = 13,628); P = .001.
† Percentages reported were rounded for each demographic age group. Therefore the sum of these percentages may not equal 100%.

Discussion
In the United States alone, 1.5 million fractures, including 300,000 hip fractures, occur each year as a result of osteoporosis. These osteoporotic fractures, particularly hip fractures, result in substantial morbidity and mortality for postmenopausal women. Approximately 3% of women die during the acute period of treatment for hip fractures. Within one year, the death rate increases to 20% for women younger than 80 years. After the first year, 40% of patients with prior hip fractures remain unable to walk independently. Two-thirds require assistance with activities of daily living such as dressing, bathing, and cooking. Psychologically, patients become depressed and may fear further fractures. Freedman et al demonstrated that less than 25% of individuals who sustained osteoporotic fragility fractures had been placed on calcium and vitamin D.

Improved medical management of patients sustaining hip fractures should include (1) an increased recognition that fractures are due to osteoporosis, (2) documentation of the extent of osteoporosis, and, most importantly, (3) initiation of appropriate therapy—not only calcium and vitamin D supplementation but medical therapy as well.

Because fractures are clearly related to decreasing bone mass, recognition of low bone mass and treatment of it might decrease the risk of subsequent fractures. The following recommendations from the National Osteoporosis Foundation for treating patients with osteoporosis have been widely published in the medical literature:

- Physicians should perform evaluations for osteoporosis using bone-density testing to confirm the diagnosis and to determine the severity of the disease for all postmenopausal women who suffer fractures.
- Physicians should advise all patients at risk for calcium deficiency to ensure that they have an adequate intake of dietary calcium (at least 1200 mg daily, including supplements if necessary) and vitamin D (400 to 800 IU daily).
- Physicians should initiate therapy to reduce fracture risk in women with (1) low bone mass as indicated by bone mineral density test scores (ie, T-scores) of less than –2 standard deviation (SD) in the absence of risk factors, and (2) low bone mass as indicated by T-scores of less than –1.5 SD if other risk factors are present, including a history of adult fractures.
- Women older than 70 years with multiple risk factors (especially those with previous fractures involving either the hips or the spine) are at high enough risk for fracture to justify the initiation of treatment for osteoporosis without bone-density testing.

of hip fracture and osteoporosis, 1050 (9.2%) were Hispanic, and 500 (4.4%) were African American.

Of the 2233 patients whose physicians simultaneously assigned ICD 9 codes indicating a diagnosis of a hip fracture and a diagnosis of osteoporosis, 1740 (77.9%) were white, non-Hispanic women. There were 184 (8.2%) Hispanic women and 500 (4.4%) were African American.

Of the 13,628 patients meeting the study’s basic criteria, 9 have shown a significant decreasing rate in the diagnosis of osteoporosis diagnosed and osteoporosis not diagnosed by length of hospital stay (Table 4) had an average length of hospital stay between 1 day and 7 days. The length of stay (LOS) was seen in 1596 (71.5%) of the 2233 women who had a diagnosis of osteoporosis, 1740 (77.9%) were white, non-Hispanic women. There were 184 (8.2%) Hispanic women and 500 (4.4%) were African American.

The majority of women in each of the two groups (osteoporosis diagnosed and osteoporosis not diagnosed) by length of hospital stay (Table 4) had an average length of hospital stay between 1 day and 7 days. The length of stay (LOS) quartiles were arbitrarily chosen in weekly intervals of one, two, three, four or more weeks to determine whether diagnoses of osteoporosis increased complications and prolonged hospitalization. We found that 7701 (67.5%) women who were diagnosed with a hip fracture only had a LOS of 1 day to 7 days. The same average LOS of one week (ie, between 1 and 7 days) was seen in 1596 (71.5%) of the 2233 women who had concomitant diagnoses.

Of the 13,628 patients meeting the study’s basic criteria, 9 have shown a significant decreasing rate in the diagnosis of osteoporosis with increasing age. In our analysis, the data indicate a different trend, with a progressive increase in the percentage of women with fractured hips receiving concomitant diagnoses of osteoporosis.
Medical therapy should include the use of pharmacologic options approved by the US Department of Health and Human Services Food and Drug Administration for osteoporosis prevention and/or treatment: hormone replacement therapy (ie, HRT), alendronate sodium, calcitonin-salmon, raloxifene hydrochloride, and risedronate sodium.

Age is an independent risk factor for osteoporosis. The older an individual is, the greater the risk for osteoporosis. Only 15% of women between the ages of 50 and 59 have osteoporosis, while up to 70% of those older than 80 years show some evidence of this disease. Therefore, one would expect that the diagnoses of osteoporosis should increase as the population ages—particularly for the subset of the population that suffers hip fractures, which are a well-known consequence of long-standing osteoporosis.

While the diagnosis of osteoporosis can be made for patients of virtually any age, there are particular decision points at which the risks are higher and diagnoses of osteoporosis are more likely. Certainly the presence of a fragility fracture would be one of those major decision points. A fragility fracture occurs as a result of a patient falling with a force less than what would be present if one were to fall from a standing height. A fractured rib or perhaps a fractured vertebral body without major trauma would be examples of fragility fractures. Such fractures are often the first indication that bone mass has dropped to a low level, as is characteristic in patients who have osteoporosis. Fractures are usually identified by radiograph.

The National Osteoporosis Foundation’s current guidelines suggest that physicians should respond to fragility fractures by offering patients preventive and restorative treatment. Such treatment is important because the risk of future fractures is high in this patient group. For example, women who sustain any fracture prior to menopause (younger than 40 years) are at a 30% greater risk for repeat fracture after menopause (older than 60 years). Another study found that postmenopausal women who had prior vertebral fractures are at a fivefold risk for new vertebral fractures as they age. Patients with a history of hip fracture are at a greater risk of suffering another hip fracture than patients who have not displayed evidence of fragility fractures. Therefore, any history of fracture should raise the physician’s suspicions of osteoporosis.

Hip fracture was chosen as the topic for this study because hip fractures are an even more dramatic indicator for concomitant osteoporosis. Our analysis indicates that although there is a slight increase in the percentage of cases of women with hip fractures also being diagnosed with osteoporosis, it is always less than 30%, even in the most elderly population. Fragility risk is closely related to bone mass. One standard deviation of decreased bone mass increases the risk for a spinal fracture by a factor of two and a hip fracture by a factor of 2.5, compared with normal peers. Other major risk factors that lead to fragility fractures include low body weight, a personal or family history of such fractures, family history of osteoporosis, and smoking. These risk factors are independent of bone density.

Because a hip fracture in a patient similar to those in this study population may be the presenting event that prompts physicians to diagnose osteoporosis, it is critical that the attending physician recognize the possibility of underlying bone fragility (ie, osteoporosis) in such patients. Careful medical histories taken by physicians should identify whether patients have osteoporosis. Appropriate diagnostic measures and treatment should begin immediately thereafter. The medical management of osteoporosis can start at the time a fragility fracture is diagnosed.

A dual energy x-ray absorptiometry (DEXA) scan is recommended for all patients with fragility fractures. All of these patients should be assessed for their nutritional status and probably placed calcium and vitamin D, with doses of vitamin D depending on each patient’s age. Simply adding calcium and vitamin D may decrease the risk of future fracture, even if bone density measurements do not increase. In addition, pharmacologic treatment can be used to reestablish bone mass and could potentially decrease the risk of subsequent fracture. Kamel et al reviewed the medical records of 170 patients older than 65 years who were hospitalized for hip fractures, finding that less than 10% were treated with calcium, vitamin D, or alendronate sodium at discharge.
Physician awareness from continuing medical education efforts—which could emphasize and highlight the correlation between hip fracture and osteoporosis—should ensure an increase in the percentage of women older than 55 years who present with hip fracture and who are additionally diagnosed with osteoporosis. This trend can be followed as the Texas PUDF is extended over the next several years.

**Study Limitations**

There are several potential limitations to this study. Physicians may have inappropriately or incorrectly recorded diagnoses in the medical records we accessed through the PUDF. These errors would, of course, translate into inappropriate ICD 9 codes for patient diagnoses. Additionally, physicians could have written the correct diagnosis within patients' medical records, but medical records personnel could have either missed the diagnosis code or misinterpreted it, therefore coding the data in the PUDF incorrectly. This potential error would apply not only to the type of hip fractures patients suffered but may also apply to the diagnosis of osteoporosis.

Another potential source of bias could occur if patients were not covered by insurance. Using ICD 9 coding might be moot in that instance. While the correct surgical procedure might be coded, there would perhaps be little incentive to code for osteoporosis if there was no reason to think that a patient was going to be followed long-term because of a lack of insurance coverage. Additionally, if patients did not have health care insurance, they would not be covered for bone density testing, and therefore additional testing would not have been done during hospitalization to detect osteoporosis. The likelihood of these patients being followed up on an outpatient basis to be evaluated for osteoporosis would also be minimal.

If the only physicians providing care were orthopedic surgeons, rather than internists or family physicians, the coding might also be different.

In conclusion, certainly a key to the prevention of osteoporosis is the recognition of its existence. There is substantial in-hospital mortality in patients with hip fractures, ranging up to 8%. Many people who have suffered hip fractures are discharged to nursing homes rather than returned to their homes. Such patients may suffer subsequent fractures. Given this high degree of mortality and morbidity, it is shocking that such a small number of individuals hospitalized in Texas in 1999 with hip fractures had a concomitant diagnosis of osteoporosis. This discrepancy seems to indicate that physicians had poor knowledge of the underlying metabolic bone disease and hip fracture. If osteoporosis is not diagnosed for these patients and included in the discharge summary, patients will not be placed on medications to prevent further fractures. Subsequent fractures therefore cannot be prevented in these patients—nor can subsequent surgeries for osteoporotic fractures.

Osteoporosis is a disease of fracture risk, which physicians can assess through bone mineral density tests and any history of fractures. Failure to diagnose metabolic bone disease in someone who presents with a fracture, particularly a hip fracture, indicates a lack of physician awareness to known risk factors. Subsequent modification of lifestyle and diet and pharmacologic intervention are therefore minimized because of a poor understanding of the problem. It is hoped that the number

<table>
<thead>
<tr>
<th>Fracture, No. (%)</th>
<th>Osteoporosis Diagnosed</th>
<th>Osteoporosis Not Diagnosed</th>
<th>Total, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 7</td>
<td>1596 (71.5)</td>
<td>7701 (67.5)</td>
<td>9297 (68.2)</td>
</tr>
<tr>
<td>8 to 14</td>
<td>390 (17.5)</td>
<td>2294 (20.1)</td>
<td>2684 (19.7)</td>
</tr>
<tr>
<td>15 to 21</td>
<td>116 (5.2)</td>
<td>702 (6.2)</td>
<td>818 (6)</td>
</tr>
<tr>
<td>22 or more</td>
<td>131 (5.9)</td>
<td>697 (6.2)</td>
<td>828 (6.1)</td>
</tr>
<tr>
<td>Total*</td>
<td>2233 (100.1)</td>
<td>11394† (100)</td>
<td>13627† (100)</td>
</tr>
</tbody>
</table>

*Percentages reported were rounded for the number of days each patient spent in the hospital. Therefore the sum of these percentages may not equal 100%.
† The length of hospital stay in days was not available for one patient in the Osteoporosis Not Diagnosed group. Therefore the sum for this group and the grand total differ from the other totals in this study.
of concomitant diagnoses for hip fracture and osteoporosis among women older than 55 years presenting with hip fractures will increase with continuing medical education efforts and topic-specific workshops.

References


