Osteoporosis is a common and costly systemic disease that affects an estimated 26 million women in the United States [1]. A 50-year-old white woman has a 40% chance of suffering an osteoporotic hip, wrist, or spine fracture during her lifetime [1]. The consequences of an osteoporotic hip fracture may include extended disability or death. The economic costs of osteoporosis are significant: nearly $14 billion was spent in 1995 to treat complications of the disease [2].

Strategies to diagnose and treat osteoporosis are available [3–8]. Bone mineral density (BMD) measurement can be used to reliably identify patients at risk for fracture [9,10]. Lifestyle modification (eg, exercise, smoking cessation), hormone replacement therapy, and several classes of medications have been shown to improve BMD and reduce fracture risk [3]. Given the prevalence of osteoporosis and its potentially serious consequences, the appropriate diagnosis and management of this disease should be high on the list of priorities for health care providers.

In 1996, the Penn State Geisinger Health System (PSGHS) convened a multidisciplinary team consisting of representatives from rheumatology, endocrinology, general internal medicine, gynecology, orthopedics, radiology, nursing, pharmacy, biostatistics, and administration to develop a disease management program for osteoporosis. PSGHS is an integrated delivery system with 90 primary care sites serving 40 counties in central Pennsylvania. The Penn State Geisinger Health Plan (PSGHP) is one of the largest rural managed care plans in the country, with over 300,000 members and approximately 1000 employed or empanelled primary care physicians. A cost-benefit analysis based on prevalence data was undertaken that suggested that a comprehensive testing and treatment program for PSGHP enrollees could potentially result in a cost savings of $8 million over 5 years. This article will present the components of the program, the derived paradigms and projects, and program results to date.

Program Elements
Treatment Algorithms and Provider Education
Comprehensive treatment algorithms were developed between April 1996 and April 1997. Information and recommendations contained in the American Association of Clinical Endocrinologists (AACE) guidelines for the prevention and treatment of postmenopausal osteoporosis [4] and in the American College of Rheumatology (ACR) guidelines for prevention and treatment of steroid-induced osteoporosis [5] provided the foundation for the algorithms. While these society guidelines contained valuable review information, they did not define a clear pathway that a practitioner could refer to when an individual patient presented to the clinic. Thus, the team combined information from the guidelines with practical advice for the clinician and developed 4 algorithms: one for premenopausal women, one for postmenopausal women < 75 years, one for elderly women and men ≥ 75 years, and one for steroid-treated patients. The algorithm for premenopausal women is shown in Figure 1.

Several points about the algorithms are worth mentioning. In the algorithm for premenopausal women, patients at high-risk for osteoporosis are identified. These include patients with certain chronic diseases (eg, rheumatoid arthritis, chronic liver disease), who may be underrecognized by physicians as being at risk. In the postmenopausal algorithm, all women with no contraindications are offered hormone replacement therapy (HRT). Measurement of BMD is offered only if a woman refuses or cannot take long-term HRT; it is assumed that a woman compliant with HRT will receive bone protection, and testing early on would be unlikely to result in a change in therapy. In addition, the cost for testing in this...
Figure 1. Osteoporosis disease management algorithm for premenopausal women and for men younger than 75 years. BMD = bone mineral density.
population would be significant and results would not likely influence treatment. If a patient who will not or cannot take HRT has a BMD T-score of -1.5 or below, she is offered alendronate. In the algorithm for elderly patients, the threshold for offering a test of BMD is low. This group would in general have the highest prevalence of osteoporosis, making routine testing even more likely to yield a positive diagnosis. These 3 algorithms refer the user to the steroid algorithm if the patient is currently on or plans to be on long-term corticosteroids (prednisone ≥ 7.5 mg per day for > 3 months). The steroid algorithm focuses on appropriate calcium and vitamin D supplementation, education, exercise, and early BMD testing. Alendronate is considered the nonhormonal treatment of choice.

Dissemination of the algorithms and provider education began in April 1997. Booklets were assembled that contained the osteoporosis algorithms; information about diet, secondary causes of osteoporosis, BMD measurement, and medications; and excerpts from the AACE and ACR guidelines. These were distributed to all employed and empanelled primary care physicians plus selected specialists in PSGHS and PSGHP. A uniform slide set that discusses the epidemiology of osteoporosis and the algorithms and presents example patient scenarios was developed for health care provider education. A dedicated osteoporosis education faculty was formed and used this slide set to deliver more than 30 educational sessions to more than 500 providers over 2 years; sessions were pre-approved for CME credit. The guideline booklet was placed in electronic form on the system’s intranet. Almost 2000 laminated algorithm sets were distributed to primary care physicians for their examination rooms.

Community Education
Community pharmacists with ties to PSGHS were engaged to provide education to interested women in their respective communities. Approximately 80 pharmacists were trained in a day-long session with emphasis on prevention, diagnosis, and treatment of osteoporosis as outlined in the PSGHS guidelines. A lay-person education program (flip-chart and slides) was developed to be used by the pharmacists as a visual aid. The pharmacy classes were advertised in the local media by the individual pharmacist and held at the pharmacy or in a community hall. In addition to local advertising, all PSGHP women aged 50 and older (n = approximately 50,000) were mailed a letter inviting them to receive an osteoporosis informational packet and/or sign up for a community-based informational class to learn more about osteoporosis.

Classes were approximately 2 hours long and included a didactic session on osteoporosis and menopause followed by a question-and-answer session. Participants were asked to complete surveys that captured demographic and risk factor information. Participants were also asked to rate the class content using a satisfaction questionnaire. Following the program, participants received a postcard “reminder for action” thanking them for participating and urging them to consider making healthy lifestyle changes and to seek the counsel of their primary health care provider. Participants judged to be at high risk for osteoporosis (those with a score of 6 or greater on the Simple Calculated Osteoporosis Risk Estimation [SCORE] questionnaire) [11] were contacted by phone by a nurse who discussed with them their risk status and need for further evaluation; the primary care physicians of high-risk patients were sent a fax informing them of their patient’s status. A 4- to 6-month follow-up call was made to all pharmacy class participants to ask about actions taken since the program to improve bone health, such as use of exercise or medications, or whether they had contacted their primary care physician.

Peripheral Bone Mineral Density Measurement
To facilitate BMD testing among the enrolled population, 3 Sahara portable heel ultrasound bone mineral densitometers (Hologic, Bedford, MA) were purchased and rotated among 25 primary care sites on a monthly schedule, such that each site had a machine at least once per month. Use of the peripheral technology increased availability of BMD testing within the system, which was previously limited to 4 central DEXA sites (one in each of our 4 geographic regions). In addition to the primary care sites, heel ultrasounds were performed in several other locations, including work sites, community health fairs, and senior centers. Testing was offered only when the outcome of the test would influence clinical intervention; premenopausal women and post-menopausal women taking hormone therapy were not routinely offered BMD testing.

Results from ultrasound BMD measurement were used to risk-stratify and counsel patients. “Low-risk” patients had an ultrasound BMD T-score of > 0.0, “indeterminate-risk” patients had a T-score of 0.0 to –1.5, and “high-risk” patients had a score below –1.5. Results were reported on a form for the physician that provided uniform criteria for interpretation and recommendations. Patients received an easy-to-understand report of their results with suggestions for follow-up. High-risk patients received the recommendation to have a DEXA of the hip and spine, or to consider therapy (if score was below –2.0). For indeterminate-risk patients, follow-up was up to the discretion of the physician and patient based on additional osteoporosis risk factors and patient preferences. When testing occurred outside the primary care physician’s office (eg, a health fair), the same forms and reports were utilized and the physician results sheet was mailed to the patient’s primary care physician, along with a letter describing the program and thanking them for following through with any recommendations.
Program Results to Date

The percentage of female PSGHP enrollees 55 years of age or older who have been diagnosed with osteoporosis by their physician rose from 1.8% in fiscal year (FY) 1996 to 6.5% in FY1999. The total number of DEXA scans performed rose from 1916 in FY1996 to 5107 in FY1999. Consistent use of osteoporosis medication since program inception is shown in Figure 2. Consistent users were considered to be women who filled their prescriptions more than 50% of the time. HRT use rose early on and appears to have reached a plateau in most of the age groups. Approximately 28% of all women 50 years or older are now taking HRT. Alendronate use has risen steadily in all age-groups, such that 4% of all women 50 years or older, and 7% of women 65 years and older are now taking this medication. The use of calcitonin has also risen steadily in most age-groups, so that approximately 1.5% of women 50 or older are now using this medication.

Hip fracture rate estimation began 3 years ago, and rates appear to be remaining steady in the 55- to 64-year age-group (1.3 hip fractures per 1000 patient years) and the 65- to 74-year age-group (4.3 hip fractures per 1000 patient years). In the 75- to 84-year age-group, there was a decrease in hip fracture rate from 19 to 15 hip fractures per 1000 patient-years over the 3-year period.

As of September 1999, 336 women have attended the pharmacy classes. Survey data collected at the classes revealed that the mean (± SEM) age of participants was 54.2 ± 0.8 years. Fifty-two percent of the women had more than a high school education. Six percent had taken steroids for more than 3 months, and 15% had experienced a fracture during adulthood. Thirty-eight percent exercised more than twice per week, and 51% were taking calcium. Thirty-two percent were taking prescription hormone therapy, and 4% were taking alendronate. Eleven percent had previously received a test of bone density. Course content was rated excellent by 77% and very good by 23% of respondents. To date, 153 patients have passed their 6-month follow-up timepoint and were interviewed by phone.
Of these 153, 34% said they were exercising more; 5% exercising less. Fifty-five percent had seen their physician, and 28% had received a test of bone density. In women who had not previously taken preventive medication, 55% were taking calcium, 22% hormone therapy, and 9% alendronate therapy.

To date, over 1700 heel ultrasounds have been performed, the majority (64%) at primary care sites. The mean (± SEM) age of the women tested was 62.2 ± 0.4 years. T-score distribution analysis showed that 43% of women tested were at high risk, 33% were at indeterminate risk, and 24% were at low risk for osteoporotic fracture.

Discussion

Our program has been in place now for over 3 years, providing ample time to track outcome and process measures. Primary care physicians are now diagnosing osteoporosis more frequently. Diagnostic testing has risen markedly (as evidenced by the increased number of DEXA scans performed), as has the use of prescription osteoporosis medications. The community pharmacy program demonstrated improvement in self-reported osteoporosis-favorable behavior, including healthier lifestyles and rates of seeking appropriate consultation, testing, and medications. Hip fracture rates have declined in the older age-strata, but 1 to 2 more years of fracture rate monitoring will be necessary to have more confidence in this improvement.

There are a number of strengths to our program. It is multifaceted, addressing issues of professional education and community service and providing access to technology in a rural environment. Our program is novel in that we employ the use of pharmacists as members of the allied health care professional team. It is community-based, addressing issues of bone health in thousands of women in central Pennsylvania. Our guidelines are facilitatory, making it easier for clinicians to apply best practices. The program is transportable: other plans and systems can adopt pieces of this program for their use. Finally, it is plastic; we recognize the importance of upkeep and have just published an updated version of our guidelines booklet.

Our program also has several limitations. Since this is not a controlled research study, it could be argued that our results simply represent trends echoed elsewhere in the United States. There is no universal database: we do not follow an individual patient from diagnosis through therapy, and accordingly the outcome measures may reflect slightly different population groups. Finally, our ability to measure a decrease in hip fracture rate is constantly diluted. Patients who have received treatment may leave the plan before we can measure the benefit achieved, and others may enter the plan and form part of the measurement before we have had a chance to intervene.

In summary, the PSGHS osteoporosis disease management program employs a comprehensive approach to the prevention, diagnosis, and management of osteoporosis. Each individual piece of the program offers a distinctive feature that enhances the strength of the program as a whole. The health care provider piece employs the use of practical algorithms that provide a "user-friendly" framework for osteoporosis diagnosis and treatment. The patient piece employs the use of pharmacists to assist in education, testing, and encouraging women in the community to adopt healthier lifestyles. The testing piece employs the use of ultrasound technology, providing rural women access to bone density testing while simultaneously engaging the primary care provider/office in osteoporosis awareness. Future plans include an updated guideline, a focus on high-risk groups, and a study of the electronic record as a means of improving the diagnosis and treatment of osteoporosis.

The authors thank Drs. David Gutknecht, Sheryl Russ, David Brill, Dom Conca, David Bush, Ronald Monsaert, and Al Peters for their expertise and time; and Dr. Dennis Torretti for his original vision, which led us to where we are today.

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This program is supported by educational grants from Merck & Co., Wyeth-Ayerst Laboratories, Hoechst Marion Roussel, and Novartis Pharmaceuticals.