

Bone Health and Osteoporosis

A Report of the Surgeon General



Department of Health and Human Services

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Message From Tommy G. Thompson

Secretary of the U.S. Department of Health and Human Services

This first-ever Surgeon General's Report on bone health and osteoporosis illustrates the large burden that bone disease places on our Nation and its citizens. Like other chronic diseases that disproportionately affect the elderly, the prevalence of bone disease and fractures is projected to increase markedly as the population ages. If these predictions come true, bone disease and fractures will have a tremendous negative impact on the future well-being of Americans. But as this report makes clear, they need not come true: by working together we can change the picture of aging in America. Osteoporosis, fractures, and other chronic diseases no longer should be thought of as an inevitable part of growing old. By focusing on prevention and lifestyle changes, including physical activity and nutrition, as well as early diagnosis and appropriate treatment, Americans can avoid much of the damaging impact of bone disease and other chronic diseases.

In recognition of the importance of promoting bone health and preventing fractures, President George W. Bush has declared 2002–2011 as the *Decade of the Bone and Joint*. With this designation, the United States has joined with other nations throughout the world in committing resources to accelerate progress in a variety of areas related to the musculoskeletal system, including bone disease and arthritis.

As a part of its *Healthy People 2010* initiative, the U.S. Department of Health and Human Services (HHS) has developed an important goal for Americans—to increase the quality and years of healthy life. Our hope is that Americans can *live long and live well*. Unfortunately, fractures—the most common and devastating consequence of bone disease—frequently make it difficult and sometimes impossible for people to realize this goal.

HHS is committed to developing a wide array of creative and innovative approaches that can help make the goal of living long and living well a reality for Americans. Several programs of particular relevance to bone health include:

- ***The National Institutes of Health's Osteoporosis and Related Bone Diseases ~ National Resource Center.*** The National Resource Center provides timely information for health professionals, patients, and the public on osteoporosis, Paget's disease of bone, osteogenesis imperfecta, and other metabolic bone diseases.
- ***The National Bone Health Campaign.*** Targeted at 9- to 12-year-old girls and their parents, this campaign uses Web sites and other activities to promote nutritional choices and physical activities that benefit bone health.

- ***Steps to a HealthierUS Initiative.*** HHS launched this initiative in 2003 to advance the President’s goal of helping Americans live longer, better, and healthier lives. At the heart of this program lies both personal responsibility for the choices Americans make and social responsibility to ensure that policymakers support programs that foster healthy behaviors and prevent disease.
- ***VERB_{TM} It’s what you do.*** This national, multicultural, social marketing campaign encourages young people ages 9–13 to be physically active every day as a means of promoting overall health, including bone health.

This Surgeon General’s Report brings together for the first time the scientific evidence related to the prevention, assessment, diagnosis, and treatment of bone disease. More importantly, it provides a framework for moving forward. The report will be another effective tool in educating Americans about how they can promote bone health throughout their lives. I appreciate the efforts of Surgeon General Richard H. Carmona and the many scientists and researchers who contributed to the development of this report.

Preface

**From the Surgeon General,
U.S. Department of Health and Human Services**

As Surgeon General, my primary role is to provide the American people with the best scientific information available on how to improve health and reduce the risk of illness and injury. This first-ever Surgeon General's Report on bone health and osteoporosis provides much needed information on bone health, an often overlooked aspect of physical health. This report follows in the tradition of previous Surgeon Generals' reports by identifying the relevant scientific data, rigorously evaluating and summarizing the evidence, and determining conclusions.

A healthy skeletal system with strong bones is essential to overall health and quality of life. Yet, today, far too many Americans suffer from bone disease and fractures, much of which could be prevented. An estimated 10 million Americans over age 50 have osteoporosis (the most common bone disease), while another 34 million are at risk. Each year an estimated 1.5 million people suffer an osteoporotic-related fracture, an event that often leads to a downward spiral in physical and mental health. In fact, 20 percent of senior citizens who suffer a hip fracture die within 1 year. One out of every two women over 50 will have an osteoporosis-related fracture in their lifetime, with risk of fracture increasing with age. Due primarily to the aging of the population and the previous lack of focus on bone health, the number of hip fractures in the United States could double or even triple by the year 2020.

However, the evidence in this report is clear: Hope is not lost. Over the past several decades, scientists have learned a significant amount about the prevention, diagnosis, and treatment of bone disease. Our next and most critical step is to transfer this knowledge from the research laboratories to the general population.

One of my priorities is to promote disease prevention by helping Americans take actions to make themselves and their families healthier. The good news is that regarding bone health, these steps are clear—with appropriate nutrition and physical activity throughout life, individuals can significantly reduce the risk of bone disease and fractures. Health professionals can also make significant improvements in our Nation's bone health by proactively assessing, diagnosing, and treating at-risk patients and then helping them apply this scientific knowledge in their everyday lives.

However, individuals and health professionals acting alone will not make a long-term difference. This brings us to the primary message of this report: A coordinated public health approach that brings together a variety of public and private sector stakeholders in a collaborative effort is the most promising strategy for improving the bone health of Americans. This report calls for the development of a national action plan to achieve improved bone health, and it highlights the unique and valuable perspectives that key stakeholders can bring to this effort. While government ought to be a part of the plan's development, leadership must be shared among the many public, private, nonprofit, academic, and scientific stakeholders.

Over the past 2 years, I have worked to improve the health literacy of Americans; that is, to ensure that individuals can access, understand, and use health-related information and services to make appropriate health decisions. To that end, a short, easy-to-read companion piece to this report has been developed. Available in English and Spanish, this *People's Piece* takes the best scientific information available in this report and provides Americans with important, practical information on how they can improve their own bone health.

I am encouraged by the participation of so many people and organizations in developing this report, and I would like to thank them for their willingness and eagerness to assist us in gathering the best scientific information available. I am confident that their passion will be a catalyst for action. Working together, we can take real steps to improve the bone health status of Americans. Our reward for this effort will be to prove the forecasters wrong—instead of seeing ever-increasing numbers of individuals suffering from the agony of bone disease and fractures, we will see the day when fewer and fewer Americans bear this burden.

Richard H. Carmona, M.D., M.P.H., FACS
Surgeon General

Summary

Executive Summary

This first report of the Surgeon General on bone health and osteoporosis, which was requested by Congress, comes at a critical time. Tremendous progress has been made in bone health in the last several decades, particularly in the past 15 years. Research has accelerated markedly, enabling the medical community to develop a much more detailed understanding of the factors that promote bone health and cause bone disease and fractures. This enhanced level of knowledge has led to significant advances in the ability to prevent, assess risk factors for, diagnose, and treat bone disease.

Physical activity and adequate calcium and vitamin D intake are now known to be major contributors to bone health for individuals of all ages. Even though bone disease often strikes late in life, the importance of beginning prevention at a very young age and continuing it throughout life is now well understood. Advances in knowledge about risk factors have allowed work to begin on tools that assess the potential for bone disease in an individual. These risk-factor assessment tools help to identify high-risk individuals in need of further evaluation. With respect to diagnosis, the development of noninvasive tools to measure bone density and bone mass has been one of the most significant advances in the last quarter century. As a result, it is now possible to detect bone disease early and to identify those at highest risk of fracture. Therapeutic advances in bone disease have equaled if not surpassed advances in the areas of prevention and diagnosis. Within the last 10–15

years new classes of drugs have been developed that, for the first time, have been shown in large-scale trials to significantly reduce the risk of fractures in individuals with bone disease. Large-scale trials have also confirmed the value of vitamin D and calcium supplementation in reducing bone loss and the risk of fractures in some populations.

Research has also led to a much better understanding of the role of secondary factors in the development of bone disease, including use of certain medications and the presence of certain diseases. For example, glucocorticoids are now known to be a significant contributor to osteoporosis. As a result, interventions are available that help minimize the risk of bone disease in those who need these drugs. Similarly, much more is now understood about a leading cause of fractures in the elderly—falls in those who have weakened bones. Enhanced knowledge about why people fall has led to interventions that target the risk factors for falls, such as avoiding or minimizing use of medications that cause dizziness, making environmental modifications in the home, and training to improve strength and balance.

In short, the last several decades represent an era of great excitement and progress in the field of bone health. Thirty years ago, relatively little was known or could be done about osteoporosis; both the disease and the fractures that go along with it were thought of as an inevitable part of old age. Today, however, advances in scientific knowledge have ushered

in a new era in bone health, one in which bone diseases can be prevented in the vast majority of individuals, and identified early and treated effectively in those who do get them.

However, the tremendous potential offered by this new era of bone health has yet to become a reality. In fact, the bone health status of Americans today appears to be in jeopardy. Osteoporosis and other bone diseases, such as Paget's disease, osteogenesis imperfecta, and hyperparathyroidism, represent a major public health problem in this country. They affect more than 10 million individuals today and cause approximately 1.5 million fractures annually, figures that will rise significantly in the decades ahead unless action is taken now. They impose tremendous physical and emotional costs, on both those with bone disease and their family members. They also represent a significant financial burden to both individuals and society at large.

A major message of this Surgeon General's report is that the bone health status of Americans can be improved. Many of the physical, emotional, and financial costs of bone disease and fractures can be avoided. However, much of what could be done to reduce this burden is not being done today, largely due to a lack of awareness of the problem and the failure to apply current knowledge. In fact, many in the public and even the medical community believe that osteoporosis, by far the most common bone disease, is a natural, unavoidable consequence of aging. This view must be changed. The intent of this Surgeon General's report is to serve as a catalyst for the development of a public health approach to promoting bone health. The central focus of this effort is to alert individuals and the medical community to the meaning and importance of bone health, including its impact on overall health and well-being, and of the need

to take action to prevent, assess, and treat bone disease throughout life.

This report comes at a very critical time. Like many nations, the United States faces the prospect of an aging population, and with it the expectation that the burden of chronic diseases, including osteoporosis, will increase. In fact, without concerted action to address this issue, it is estimated that in 2020 one in two Americans over the age of 50 will have, or be at high risk of developing, osteoporosis. If these predictions come true, they will have a devastating impact on the well-being of Americans as they age. Healthy bones provide the body with a frame that allows for mobility and for protection against injury. Bones also serve as a storehouse for minerals that are vital to the functioning of many other life-sustaining systems in the body. Unhealthy bones, however, perform poorly in executing these functions. Bone fragility also leads to fractures, which are by far the most important consequence of poor bone health, since they can result in disability, diminished function, loss of independence, and premature death.

In recognition of the importance of promoting bone health and preventing fractures, the President has declared 2002–2011 as the *Decade of the Bone and Joint*. With this designation, the United States has joined with other nations throughout the world in committing resources to accelerate progress in a variety of areas related to the musculoskeletal system, including bone disease and arthritis. As a part of its *Healthy People 2010* initiative, the U.S. Department of Health and Human Services (HHS) has developed two overarching goals that are highly relevant to bone health and osteoporosis. The first goal is increased quality and years of healthy life. In other words, the hope is that Americans can *live long and live well*. As

life expectancy has increased, attention has turned to living healthfully throughout life. Fractures, the most common and devastating consequence of bone disease, frequently make it difficult, if not impossible, for elderly individuals to continue to live well. The second goal is to eliminate health disparities across genders and racial and ethnic groups. In addition, the President has launched the *HealthierUS* initiative and, as a part of this effort, HHS has implemented *STEPS to a HealthierUS*, both of which emphasize the importance of physical activity and a nutritious diet. This Surgeon General's Report fits into these larger efforts to highlight the importance of the musculoskeletal system to the health status of Americans, and to provide individuals, clinicians, public health officials, policymakers, and other stakeholders with the information and tools they need to improve bone health.

The Magnitude of the Problem

Realizing the vision of a “bone-healthy” America will be challenging, given the magnitude of the problem. ***Fractures due to bone disease are common, costly, and often become a chronic burden on individuals and society.*** An estimated 1.5 million individuals suffer a bone disease-related fracture annually (Riggs and Melton 1995, Chrischilles 1991). A White woman over the age of 50 has more than a 40 percent chance of suffering a fracture sometime during the rest of her life (Cummings and Melton 2002). While the lifetime risk for men and non-White women is less across all fracture types, it is nonetheless substantial and may be rising in some groups, such as Hispanic women (Zingmond et al. 2004).

Fractures can have devastating consequences for both the individuals who suffer them and their family members. For example, hip fractures

are associated with increased risk of mortality. The risk of mortality is 2.8–4 times greater among hip fracture patients during the first 3 months after the fracture, as compared to the comparable risk among individuals of similar age who live in the community and do not suffer a fracture. Those who are in poor health or living in a nursing home at the time of fracture are particularly vulnerable (Leibson et al. 2002, Richmond et al. 2003). For those who do survive, these fractures often precipitate a downward spiral in physical and mental health that dramatically impairs quality of life. Nearly one in five hip fracture patients, for example, ends up in a nursing home (Salkeld et al. 2000). Many fracture victims become isolated and depressed, as the fear of falls and additional fractures paralyzes them. Spine fractures, which are not as easily diagnosed and treated as are fractures at other sites, can become a source of chronic pain as well as disfigurement.

Osteoporosis is the most important underlying cause of fractures in the elderly. Although osteoporosis can be defined as low bone mass leading to structural fragility, it is difficult to determine the extent of the condition described in these qualitative terms. Using the World Health Organization's quantitative definition based on bone density measurement, there are roughly 10 million Americans over the age of 50 with osteoporosis and an additional 34 million with low bone mass or “osteopenia” of the hip, which puts them at risk for osteoporosis, fractures, and their potential complications later in life (National Osteoporosis Foundation 2002).

Left unchecked, the bone health status of Americans is only going to get worse, due primarily to the aging of the population. The prevalence of osteoporosis and osteoporotic-related fractures will increase significantly unless the underlying bone health status of Americans

is significantly improved. By 2020, roughly 14 million individuals over the age of 50 are expected to have osteoporosis and another 47 million will likely have low bone mass (NOF 2002). Because of the aging of the population, the number of hip fractures in the United States could double or triple by 2040 (Schneider and Guralnik 1990).

While much less is known about the prevalence and treatment of other bone diseases, they too can have a severe impact on the health and well-being of those who suffer from them, especially if they are not diagnosed and treated in a timely manner. Many of the drugs that are used for osteoporosis are also effective as treatments for other bone diseases. While these other diseases often cannot be prevented, treatment can reduce levels of deformity and suffering. Further research on osteoporosis is likely to yield additional improvements in the treatment of these diseases, and may even yield insights into how they can be prevented.

Not surprisingly, bone disease takes a significant financial toll on society and individuals who suffer from it. The direct care expenditures for osteoporotic fractures alone range from \$12.2 to \$17.9 billion each year, measured in 2002 dollars (Tosteson and Hammond 2002). Adding in the direct costs of caring for other bone diseases as well as the indirect costs (e.g., lost productivity for patients and family members) would likely add billions of additional dollars to this total.

The Challenge

Much of this considerable burden can be prevented. There is no question that significant gaps in knowledge (and hence research needs) remain. ***However, real improvements in the bone health status of Americans can be made by applying what is already known about prevention, assessment of risk factors, diagnosis, and treatment.***

In fact, the evidence clearly suggests that individuals can do a great deal to promote their own bone health. Prevention of bone disease begins at birth and is a lifelong challenge. By choosing to engage in regular physical activity and to follow a bone-healthy diet, individuals can improve the health of their bones throughout life. Health care professionals can play a critical role in supporting these choices, and in identifying and treating those at risk for bone disease.

As noted earlier, the importance of achieving adequate levels of physical activity and appropriate intake of calcium and vitamin D is now known, as is the need to begin prevention at a very young age and continue it throughout life. It is never too late for prevention, as even older individuals with poor bone health can improve their bone health status through appropriate exercise and adequate calcium and vitamin D intake. Much is also known about how to ensure timely diagnosis of bone disease. Thanks to the development of bone mineral density (BMD) testing, fractures need not be the first sign of poor bone health. It is now possible to detect osteoporosis early and to intervene before a fracture occurs. Promising new approaches to assessment and screening will likely provide an even better understanding of the early warning signs of bone disease in the future. On the treatment front, a variety of drugs have been developed that improve bone health and reduce the incidence of fractures. New and potentially more effective drugs are currently under development. There are effective treatments not only for osteoporosis, but also for other bone diseases such as Paget's disease, hyperparathyroidism, rickets, and osteomalacia.

However, much of what we know from research about bone health is not always applied in practice. As a result, the bone health status of

Americans is poorer than it should be. Perhaps the biggest problem is a lack of awareness of bone disease among both the public and health care professionals, many of whom do not understand the magnitude of the problem or the ways in which bone disease can be prevented and treated.

Relatively few individuals follow the recommendations related to the amounts of physical activity, calcium, and vitamin D that are needed to maintain bone health. National surveys suggest that the average calcium intake of individuals is far below the levels recommended for optimal bone health (Wright et al. 2003). Measurements of vitamin D in nursing home residents, hospitalized patients, and adults with hip fractures suggest a high prevalence of insufficiency (Webb et al. 1990, LeBoff et al. 1999, Thomas et al. 1998). In addition, many Americans do not engage regularly in leisure-time physical activity. As shown in Chapter 6, the participation by both adult men and women declines with age, with women being consistently less active than men (Schiller et al. 2004). Only half of those 12-21 years old exercise vigorously on a regular basis and 25 percent report no exercise at all (Gordon-Larsen et al. 1999).

Health care professionals can do a better job as well. Studies show that physicians frequently fail to diagnose and treat osteoporosis, even in elderly patients who have suffered a fracture (Solomon et al. 2003, Andrade et al. 2003, Kiebzak et al. 2002, Kamel et al. 2000, Feldstein et al. 2003). For example, in a recent study of four well-established midwestern health systems, only one-eighth to a quarter of patients who had a hip fracture were tested for their bone density; fewer than a quarter were given calcium and vitamin D supplements; and fewer than one-tenth were treated with effective antiresorptive drugs (Harrington et al. 2002). Other studies

have found low usage rates for testing and treatment among the high-risk population, including BMD testing (which ranged from 3 percent to 23 percent), calcium and vitamin D supplementation (11 percent to 44 percent), and antiresorptive therapy (12 percent to 16 percent) (Morris et al. 2004, Smith et al. 2001). Most physicians do not discuss osteoporosis with their patients, even after a fracture (Pal 1999).

Even when physicians do suggest therapy, it often does not conform with evidence-based recommendations, such as those of the U.S. Preventive Services Task Force. For example, many patients with low BMD are not treated while others with high BMD are (Solomon et al. 2000).

Managed care organizations and other insurers that provide coverage to individuals under the age of 65 may not see the full impact of bone disease in their enrollees, since most will have moved on to Medicare by the time they suffer a fracture. Therefore, the commercial providers may not pay sufficient attention to bone health and to the preventive strategies available to and suitable for younger people.

In short, therefore, the gap between what we know and its application in the community remains large and needs to be closed. A particular concern relates to men, racial and ethnic minorities, the poor (especially the low-income elderly population), individuals with disabilities, and individuals living in rural areas. Some of the issues are not specific to bone health; rather, they relate to overall quality of care and general access to diagnostic and treatment services for these populations. However, another problem may stem from the fact that osteoporosis and fragility fractures are often mistakenly viewed by both the public and health care practitioners as only being a problem for older White women. This commonly held but incorrect view may delay

prevention and even treatment in men and minority women who are not seen as being at risk for osteoporosis. While a relatively small percentage of the total number of people affected, these populations still represent millions of Americans who are suffering the debilitating effects of bone disease.

The Opportunity

This Surgeon General's report looks upon the Nation's at-risk bone status as an opportunity to do better rather than as an intractable problem. A variety of factors make bone health an ideal candidate for a public health approach. These factors include: (a) the prospects of declining bone health status due to the aging of the population; b) the significant gap between what we know and what we apply; c) the need for early prevention of an often "silent" disease; d) the fact that the effects of most bone diseases do not manifest until people are on Medicare; and e) the lack of systematic evaluation of the prevalence and impact of bone disease. To that end, this Surgeon General's report is calling for Federal, State, and local governments (including State and local public health departments) to join forces with the private sector and community organizations in a coordinated effort to promote bone health and prevent disease. This type of approach can serve as the primary vehicle for improving the bone health status of Americans. To be successful it must involve all stakeholders—individual citizens, volunteer health organizations, medical and scientific societies, health care professionals, community organizations, private industry, and government—and must emphasize policies and programs that promote the dissemination of best practices for prevention, screening, and treatment for all Americans.

Some of the work on this public health approach has already begun. The aforementioned *Healthy People 2010* initiative has developed 467 specific objectives in 28 different areas of health that are to be achieved during the first decade of the 21st century. Included in these objectives are targets for reducing the number of individuals with osteoporosis and the number of hip fractures, along with increasing levels of calcium intake and physical activity.

One of the purposes of this Surgeon General's Report is to build support at many levels to include current *Healthy People 2010* objectives in health agendas and activities at the Federal, State, and local levels. Developing data systems to track progress on these objectives will be critical to achieving improvements in bone health status. Going forward, it is anticipated that the number of objectives related to osteoporosis and bone health will be modified when *Healthy People 2020* objectives are developed, and that existing measures will be refined as our understanding of the science and our data collection and measurement systems improve.

The Charge

Recognizing that bone health can have a significant impact on the overall health and well-being of Americans, Congress commissioned this report, instructing that it cover a range of important issues related to improving bone health, including: challenges in the diagnosis and treatment of osteoporosis and related bone diseases; the impact of these diseases on minority populations; promising prevention strategies; how to improve health provider education and promote public awareness; and ways to enhance access to key health services. (See Appendix A for more details.)

To initiate the development of the report, an interagency work group was convened by the Surgeon General with staff representatives from National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), the Health Resources and Services Administration (HRSA), the Agency for Healthcare Research and Quality (AHRQ), the Administration on Aging (AoA), the Centers for Medicare and Medicaid Services (CMS), the Office of Disease Prevention and Health Promotion, the Office on Women's Health, the Office on Minority Health, the President's Council on Physical Fitness and Sports, the Regional Health Administrators, and the U.S. Department of Agriculture (USDA).

As a second step, a Surgeon General's Workshop was convened in December 2002 that brought together a wide range of researchers, public health experts, and patient representatives to discuss key areas that should be addressed in the report. Prior to the workshop, public comments were solicited through the Surgeon General's Web site on what the priorities for the report should be. Following the workshop, a summary of its key findings was released by the Surgeon General (Report 2003).

This report includes contributions from more than 50 authors across the country, while over 100 experts provided valuable guidance and insights in their reviews of initial drafts.

Evidence Base for the Report

This report is based on a review of the published scientific literature. The scope of the review encompassed studies written in English from throughout the world. The quality of the evidence, based on study design and its rigor, was considered as a part of this review. All studies used in the report are referenced in the text, with full citations at the conclusion of the chapter.

This report does not offer any new standards or guidelines for the prevention, diagnosis, or treatment of bone disease. Rather, it summarizes knowledge that is already known and can be acted upon.

The clinical literature in bone disease includes the full range of studies, from randomized controlled trials to case studies. Comprehensive reviews of the literature are provided in Chapters 2 through 9, and Chapter 11. Chapter 10, which is an attempt to summarize key, actionable messages for busy health care professionals, contains few references, as it largely draws on findings cited elsewhere in the report. Chapter 12 draws on both published studies and case studies of population-based initiatives in bone health, which were selected in order to highlight particular lessons about such approaches.

Experts in their respective fields of bone health contributed to this report. Each chapter was prepared under the guidance of a coordinating author for that chapter. Independent, expert peer review was conducted for all chapters. The full manuscript was reviewed by a number of senior reviewers as well as the relevant Federal agencies. All who contributed are listed in the Acknowledgments section of the report.

Organization of the Report

This report attempts to answer five major questions for a wide variety of stakeholders, including policymakers; national, State, and local public health officials; health system leaders; health care professionals; community advocates; and individuals. The report is organized around each of these five questions. The first section strives to define bone health and bone disease in terms that the public can understand. The second section reviews

today's less-than-optimal bone health status and documents the magnitude of the problem facing the Nation. The third, fourth, and fifth sections of the report tackle the issue of what can be done to improve bone health—first from the perspective of the individual, then from that of the health care professional, and finally from that of the larger health system. The final section lays out a vision for the future.

Part One

What Is Bone Health?

This introductory part of the report defines bone health as a public health issue with an emphasis on prevention and early intervention to promote strong bones and prevent fractures and their consequences. Much of it should be considered as scientific background for the remainder of the report.

Chapter 1: A Public Health Approach to Promote Bone Health

Chapter 1 describes this public health approach along with the rationale for the report and the charge from Congress and from the Surgeon General.

Chapter 2: The Basics of Bone in Health and Disease

Chapter 2 provides a brief overview of the fundamentals of bone biology, helping the reader to understand the purpose of bones, how bones work, how bones change during life, what

keeps bones healthy, what causes bone disease, and the prospects for prevention and treatment of bone disease in the future. Key messages from Chapter 2 include the following:

- The bony skeleton is a remarkable organ that serves both a structural function, providing mobility, support, and protection for the body, and a reservoir function, as the storehouse for essential minerals.
- During childhood and adolescence bones are sculpted by a process called modeling, which allows for the formation of new bone at one site and the removal of old bone from another site within the same bone. This process allows individual bones to grow in size and to shift in space.
- Much of the cellular activity in a bone consists of removal and replacement at the same site, a process called *remodeling*. The remodeling process occurs throughout life and becomes dominant by the time that bone reaches its peak mass (typically by the early 20s). Remodeling continues throughout life so that most of the adult skeleton is replaced about every 10 years.

- Both genes and the environment contribute to bone health. Some elements of bone health are determined largely by genes, and errors in signaling by these genes can result in birth defects. External factors, such as diet and physical activity, are critically important to bone health throughout life, and these factors can be modified.
- The growth of the skeleton, its response to mechanical forces, and its role as a mineral storehouse are all dependent on the proper functioning of a number of systemic or circulating hormones that respond to changes in blood calcium and phosphorus. If calcium or phosphorus are in short supply, the regulating hormones take them out of the bone to serve vital functions in other systems of the body. Too many withdrawals can weaken the bone.
- Many things can interfere with the development and maintenance of a strong and healthy skeleton. *Genetic abnormalities* can produce weak, thin bones, or bones that are too dense. *Nutritional deficiencies* can result in the formation of weak, poorly mineralized bone. Many *hormonal disorders* can also affect the skeleton. Lack of exercise, immobilization, and smoking can also have negative effects on bone mass and strength.
- Osteoporosis, the most common bone disease, typically does not manifest until later in life, when bone loss begins due to bone breakdown and decreased levels of bone formation. Loss of bone mass leads to the development of structural abnormalities that make the skeleton more fragile.

Chapter 3: Diseases of Bone

Chapter 3 offers a summary review of the more common diseases, disorders, and conditions that both directly and indirectly affect bone. Key messages include the following:

- Osteoporosis affects millions of Americans. Individuals with osteoporosis are at high risk of suffering one or more fractures, which are often physically debilitating and can potentially lead to a downward spiral in physical and mental health.
- The most common form of osteoporosis is known as “primary osteoporosis.” It is the result of the cumulative impact of bone loss and deterioration of bone structure as people age. This bone loss can be minimized and osteoporosis prevented through adequate nutrition, physical activity, and, if necessary, appropriate treatment.
- There are a wide variety of diseases and certain medications and toxic agents that can cause or contribute to the development of osteoporosis. If recognized as a potential threat, this form of the disease—known as secondary osteoporosis—can often be prevented through proper nutrition and physical activity, along with appropriate therapy if needed.
- A number of childhood diseases cause rickets, a condition that results from a delay in depositing calcium phosphate mineral in growing bones. This delay leads to skeletal deformities, especially bowed legs. In adults, the equivalent disease is called osteomalacia. Both diseases can generally be prevented by ensuring adequate levels of vitamin D, but they can have devastating consequences for affected individuals.

- Patients with chronic renal disease are at risk of developing a complex bone disease known as renal osteodystrophy. While dialysis and transplantation have extended the life-expectancy of these patients, it may not prevent further progression of bone disease.
- Paget's disease of bone is a progressive, often crippling disorder of bone remodeling that commonly involves the spine, pelvis, legs, or skull (although any bone can be affected). If diagnosed early, its impact can be minimized.
- A large number of genetic and developmental disorders affect the skeleton. Among the more common of these is osteogenesis imperfecta (OI). Patients with this condition have bones that break easily.
- Some skeletal disorders tend to develop later in life. One of the most common of these acquired skeletal disorders is a malignancy of the bone. These malignancies can originate in the bone (primary tumors) or, much more commonly, result from the seeding of bone by tumors outside of the skeleton (metastatic tumors). Primary bone cancer also occurs in children. Both types of tumors can destroy bone.

Part Two

What Is the Status of Bone Health in America?

This part of the report describes the magnitude and scope of the problem from two perspectives. The first is the prevalence of bone disease within the population at large, and the second is the burden that bone diseases impose on society and those who suffer from them.

Chapter 4: The Frequency of Bone Disease

Chapter 4 provides detailed information on the incidence and prevalence of fractures, osteoporosis, and other bone diseases. Key messages are as follows:

- The biggest problem created by bone disease, especially osteoporosis, is fractures, which may be the first visible sign of disease in patients. Each year an estimated 1.5 million individuals suffer a fracture due to bone disease.
- The risk of a fracture increases with age and is greatest in women. Roughly 4 in 10 White women age 50 or older in the United States will experience a hip, spine, or wrist fracture sometime during the remainder of their lives. Looking ahead, the lifetime risk of fractures will increase for all ethnic groups as people live longer.
- Osteoporosis is the most common cause of fractures. Roughly 10 million individuals over the age of 50 in the United States have osteoporosis of the hip. An additional 33.6 million individuals over the age of 50 have low bone mass or "osteopenia" of the hip and thus are at risk of developing osteoporosis and its potential complications later in life.
- Due primarily to the aging of the population, the prevalence of osteoporosis and low bone mass is expected to increase. By 2020, one in two Americans over the age of 50 is expected

to have or be at risk of developing osteoporosis of the hip; even more will be at risk of developing osteoporosis at any site in the skeleton.

- Osteoporosis does not affect everyone to the same degree. Women, especially older women, are more likely to get the disease than are men. An estimated 35 percent of postmenopausal White women have osteoporosis of the hip, spine, or distal forearm. In addition, men, especially elderly men, can and do get osteoporosis.
- The age-adjusted prevalence of osteoporosis and the rate of hip fracture are lower in Black women than in White women in the United States. The prevalence of osteoporosis in Hispanic and Asian women is similar to that found in White women, and the incidence of hip fractures among Hispanic women in California appears to be on the rise. It is important to remember that osteoporosis is a real risk for *any* aging man or woman.
- Much less is known about the frequency of most other skeletal diseases, due in part to underdiagnosis and underreporting. Some data, however, are available. An estimated one million individuals in the United States have Paget's disease, while roughly 20,000 to 50,000 Americans may have OI.

Chapter 5: The Burden of Bone Disease

Chapter 5 examines the costs of bone diseases and their effects on well-being and quality of life, both from the point of view of the individual patient and society at large. It includes some real-life vignettes that highlight the terrible impact osteoporosis, Paget's disease, osteogenesis imperfecta, and other related bone diseases can

have on those who suffer from them and their family members. Key messages are as follows:

- Bone diseases have a major impact on the population as a whole and especially on affected individuals and their families. Although some bone diseases lead directly to pain and deformity, bone disease often is a "silent" disorder until it causes fractures.
- The 1.5 million osteoporotic fractures in the United States each year lead to more than half a million hospitalizations, over 800,000 emergency room encounters, more than 2,600,000 physician office visits, and the placement of nearly 180,000 individuals into nursing homes. Hip fractures are by far the most devastating type of fracture, accounting for about 300,000 hospitalizations each year.
- Caring for these fractures is expensive. Studies show that annual direct care expenditures for osteoporotic fractures range from \$12 to \$18 billion per year in 2002 dollars. Indirect costs (e.g., lost productivity) likely add billions of dollars to this figure. These costs could double or triple in the coming decades.
- From an individual's perspective, bone disease has a devastating impact on patients and their families. While few die directly from bone disease, for many individuals a fracture can lead to a downward spiral in physical and mental health that for some ultimately results in death. In fact, hip fractures are associated with a significantly increased risk of death, especially during the first year after the fracture.
- Bone diseases dramatically affect functional status. Many individuals who suffer fractures experience significant pain and height loss, and may lose the ability to dress themselves, stand up, and walk. These individuals are also at risk of com-

plications such as pressure sores, pneumonia, and urinary tract infections.

- Fractures can also have a negative impact on self-esteem, body image, and mood, which may lead to psychological consequences. Individuals who suffer fractures may be immobilized by a fear of falling and suffering

additional fractures. Not surprisingly, they may begin to feel isolated and helpless.

- Many bone disorders other than osteoporosis add greatly to the burden of bone disease in the population, although the impact varies enormously and is largely dependent upon the severity of the disease.

Three Part Three

What Can Individuals Do To Improve Their Bone Health?

This part of the report is the first of three sections that address the issue of what can be done to improve bone health.

This part examines factors that determine bone health and describes the many lifestyle choices that individuals can make to improve their personal bone health.

Chapter 6: Determinants of Bone Health

Chapter 6 provides a thorough review of the evidence on how nutrition, physical activity, and other factors influence bone health, including behaviors that promote it (e.g., physical activity, adequate calcium intake) and impair it (e.g., smoking). Key messages are as follows:

- While genetic factors play a significant role in determining bone mass, controllable lifestyle factors such as diet and physical activity can mean the difference between a frail and strong skeleton.
- Calcium has been singled out as a major public health concern today because it is critically important to bone health and the aver-

age American consumes levels of calcium that are far below the amount recommended for optimal bone health.

- Vitamin D is important for good bone health because it aids in the absorption and utilization of calcium. There is a high prevalence of vitamin D insufficiency in nursing home residents, hospitalized patients, and adults with hip fractures.
- Physical activity is important for bone health throughout life. It helps to increase or preserve bone mass and to reduce the risk of falling. All types of physical activity can contribute to bone health, albeit in different ways.
- Maintaining a healthy body weight is important for bone health throughout life. Being underweight raises the risk of fracture and bone loss. Weight loss is associated with bone loss as well, although adequate diet and physical activity may reduce this loss.
- Fractures are most commonly caused by falls, and thus fall prevention offers another opportunity to protect bones, particularly in those over the age of 60. Several specific approaches have demonstrated benefits, including muscle strengthening and balance re-

training, professional home hazard assessment and modification, and stopping or reducing psychotropic medications.

- Reproductive issues can affect bone health. Pregnancy and lactation generally do not harm the skeleton of healthy adult women. Amenorrhea (cessation of menstrual periods) after the onset of puberty and before menopause is a very serious threat to bone health and needs to be attended to by individuals and their health care providers.
- Several medical conditions and prescription medications can affect bone health through various mechanisms, and health care professionals should treat the presence of such conditions and the use of such medications as a potential “red flag” that signals the need for further assessment of bone health and other risk factors for bone disease.
- Smoking can reduce bone mass and increase fracture risk and should be avoided for a variety of health reasons. Heavy alcohol use is associated with reduced bone mass and increased fracture risk.
- Since many nutrients are important for bone health, it is important to eat a well-balanced diet containing a variety of foods, including grains, fruits and vegetables, nonfat or lowfat dairy products or other calcium-rich foods, and meat or beans each day.
- Most Americans do not consume recommended levels of calcium, but reaching these levels is a feasible goal. Approximately three 8-ounce glasses of low-fat milk each day, combined with the calcium from the rest of a normal diet, is enough to meet the recommended daily requirements for most individuals. Foods fortified with calcium and calcium supplements can assist those who do not consume an adequate amount of calcium-rich foods.
- For many, especially elderly individuals, getting enough vitamin D from sunshine is not practical. These individuals should look to boost their vitamin D levels through diet. Vitamin D is also available in supplements for those unable to get enough through sunshine and diet.
- In addition to meeting recommended guidelines for physical activity (at least 30 minutes a day for adults and 60 minutes for children), specific strength- and weight-bearing activities are critical to building and maintaining bone mass throughout life.
- Individuals should see a health care provider if they have a medical condition or use medications that can affect the skeleton. Women should also see their health care provider if menstrual periods stop for 3 months.

Chapter 7: Lifestyle Approaches To Promote Bone Health

Chapter 7 provides practical, real-world guidance on lifestyle approaches that individuals can take to improve their own bone health. Key messages include the following:

- There is much that individuals can do to promote their own bone health, beginning in childhood and continuing into old age. These activities contribute not only to bone health, but to overall health and vitality.

What Can Health Care Professionals Do To Promote Bone Health?

This part of the report describes what health care professionals can do with their patients to promote bone health.

Chapter 8: Assessing the Risk of Bone Disease and Fracture

Chapter 8 addresses the risk-factor assessment and the diagnosis of bone disease, both today and in the future. It includes real-life vignettes that highlight the need for the medical profession to become aware of the potential for severe osteoporosis to develop in younger men and women. Key messages include the following:

- Much of the burden of bone disease can potentially be avoided if at-risk individuals are identified and appropriate interventions (both preventive and therapeutic) are made in a timely manner. The evidence suggests that health care providers frequently fail to identify and treat individuals at high risk for future osteoporosis or other disorders of bone, even those who have already had a fracture.
- It is important to evaluate the risks for poor bone health at all ages. Therefore, assessment of calcium and vitamin D intake, physical activity, and adverse behaviors such as smoking should be a routine part of health care for all individuals.
- Those in greatest need should receive a full assessment of bone health. Diagnostic methods are available that can help to identify those in the population who are at highest risk of fracture.
- Both the public and health care professionals need to be aware of a number of known, easy-to-identify risk factors for osteoporosis and other bone diseases.
- Providers should be aware of a number of “red flags” that might signal potential problems with an individual’s bone health at different ages. One of the most important flags is a previous fragility-related fracture.
- While osteoporosis is clearly the most common bone disease, health care providers must also actively look for other bone diseases. Diseases such as hyperparathyroidism, rickets, osteomalacia, and Paget’s disease can often be identified by being aware of the warning signs and/or through simple biochemical measurements. Early identification of such diseases is critical, since treatment at an early stage can often be highly effective.
- Bone mineral density (BMD) testing should be performed on any patient for whom risk factor analysis indicates a strong potential for osteoporosis. Formal guidelines have been developed recommending BMD testing in certain populations, including postmenopausal women over age 65, younger women with multiple risk factors, and men and women with fragility fractures or who have other diseases or take medications that can greatly increase the risk of fracture.
- Individuals who are diagnosed with osteoporosis should be further assessed for secondary, treatable causes of the disease, particularly men and premenopausal women who suffer a fragility fracture.

Chapter 9: Prevention and Treatment for Those Who Have Bone Diseases

Chapter 9 focuses on current and future preventive and therapeutic measures for those who have or are at risk for bone disease, using a “pyramid” approach to treating bone diseases and preventing falls and fractures. It also reviews the treatment and rehabilitation of osteoporotic fractures. Key messages include the following:

- There have been important advances in the ability to prevent and treat fractures in the last 10 years, especially in those with skeletal fragility. Just as with the use of diagnostic measures, there has been a failure in the United States to apply appropriate preventive and treatment measures to many persons at risk for bone disease.
- Everyone should be informed of the basic elements of maintaining bone health and preventing bone disease. Paying attention to the basics—appropriate physical activity, nutrition, and smoking cessation—is critical for everyone, especially those who have, or who are at risk of developing, osteoporosis.
- Any individual who is diagnosed with osteoporosis should be evaluated for potential secondary causes of the disease, including the presence of other disorders or the use of medications that can cause harm to bone. If secondary causes are present, actions should be taken to minimize their impact.
- For the most common bone diseases, drugs that prevent bone breakdown (antiresorptives) have been shown to be effective in reducing the risk of future fractures. These drugs not only slow any further deterioration of the skeleton, but also allow for some repair and restoration of bone mass and strength.

- When antiresorptive therapy is not enough, anabolic therapy is available to help build new bone and further reduce the risk of fracture. While this approach has been developed for the prevention and treatment of osteoporotic fractures, it can also be applied to other bone diseases.
- For individuals who remain at high risk of fracture, an extensive fall prevention program should be developed. This program should aim to minimize the risk of falls in the home and community; avoid the use of drugs that increase the risk of bone disease or falls; and protect those who do fall through the use of hip protectors.
- Specific, effective treatments exist for a number of bone diseases other than osteoporosis, including hyperparathyroidism, rickets, and osteomalacia. Treatment is also available for some congenital bone disorders and for bone disease associated with kidney failure. For all of these conditions, early detection and treatment are critical to avoiding crippling deformities and fractures.

Chapter 10: Putting It All Together for the Busy Health Care Professional

Chapter 10 “puts it all together” for health care professionals by translating the research into practical advice for preventing, diagnosing, and treating bone disease in patients of all ages. Key messages include the following:

- Individuals have a critical role to play in promoting their own bone health through proper nutrition and physical activity. All health care professionals, especially primary care providers, have the opportunity and

responsibility to assist them in this task by promoting awareness of factors that influence bone health; identifying patients at risk of bone disease; and providing lifestyle and therapeutic interventions to prevent bone loss and fractures.

- Nurse practitioners, nurse midwives, and physician assistants can contribute significantly to the provision of bone health care. They all can educate patients on nutrition and physical activity recommendations, ensure proper screening, and monitor compliance with treatment. Physical therapists, occupational therapists, pharmacists, and dietitians can play valuable roles in helping patients achieve maximal physical function and bone accrual.
- Childhood is an excellent time to initiate counseling aimed at encouraging appropriate nutrition and physical activities and discouraging the adoption of behaviors that negatively affect bone health.
- All young and middle-aged adults should be encouraged to adopt lifestyles that help prevent bone loss and promote overall health and the prevention of chronic disease. Young and middle-aged adult patients who have medical conditions or who are taking medications associated with bone loss should be considered for bone density testing and drug therapy.
- For older adults and the elderly, recommended levels of both calcium and vitamin D increase. Older adults should engage in regular physical activity, and many can follow the recommendations for younger adults. Weight-supporting activities may be more appropriate in older adults with compromised bone health, although with proper supervision and training they can safely engage in resistance exercises as well.
- Risk factors for bone loss and fracture should be assessed in all older women. In addition, all women aged 65 and older should undergo bone density testing as recommended by the U.S. Preventive Services Task Force and the National Osteoporosis Foundation. Bone density testing should be considered in men with fragility fractures; those on therapies that may cause bone loss, notably glucocorticoids or androgen deprivation; and men with multiple risk factors.
- Drug therapy should be considered in individuals who have osteoporosis. Individuals with low bone mass and multiple risk factors should also be considered for therapy. Selection of a therapeutic agent can be tailored to the severity of the patient's bone loss and other co-morbid conditions.
- Fall prevention strategies should also be discussed with every osteoporosis patient, and hip protectors should be considered for the frail elderly and patients at high risk for falling.
- A person of any age (especially an elderly individual) who represents a challenging clinical situation may benefit from a referral to an endocrinologist, rheumatologist, or other specialist in osteoporosis management.

What Can Health Systems and Population-Based Approaches Do To Promote Bone Health?

This part of the report examines how health systems and population-based approaches can promote bone health.

Chapter 11: Systems-Based Approaches to Bone Health

Chapter 11 looks at the key systems-level issues and decisions that affect bone health care. Key messages include the following:

- Individual organizations—even very small ones—can apply a “systems-based” approach to clinical care and other services by putting into place any of a variety of formal policies and processes.
- There are four distinct systems-based activities that collectively encompass the overall goal of improving the bone health status of Americans:
 - ~ Identifying and developing intervention strategies for various risk levels of the population.
 - ~ Educating and raising awareness among clinicians and the public about bone disease.
 - ~ Ensuring that individuals receive appropriate preventive, diagnostic, and treatment services based upon their level of risk.
 - ~ Monitoring and evaluating bone health outcomes within populations and the community.
- The most important role for the clinicians in promoting a systems-based approach to bone health is to educate themselves and their patients about prevention, assessment of risk factors, diagnosis, and treatment.
- Medical groups have the opportunity to implement a systems-based approach as well. For example, they can dedicate staff to certain important tasks; use benchmarking data or academic detailing to promote quality improvement; or implement evidence-based care paths and computerized reminder systems that promote the provision of timely and appropriate care. Some groups may be able to develop specialized osteoporosis clinics or disease management programs.
- Hospitals and rehabilitation facilities can go beyond their traditional role of simply treating bone-related problems or symptoms by developing strategies for improving overall bone health and preventing future falls.
- Skilled nursing homes can institute measures to prevent falls and fractures; to assure that residents receive appropriate amounts of calcium and vitamin D; and to include activities that strengthen bones in their daily regimens. Health plans and insurers can get involved in managing bone health by assessing and monitoring provider performance; engaging in quality improvement programs; and/or implementing pay-for-performance initiatives.

- The public health system and other government agencies can play a vitally important role in promoting a systems-based approach to bone health, including:
 - ~ Promote awareness among consumers and clinicians of bone health and disease.
 - ~ Improve linkages between health care organizations, community-based organizations, and the public health system.
 - ~ Train health professionals to promote bone health and recognize and treat bone disease.
 - ~ Develop strategies to promote bone health and appropriate treatment.
 - ~ Monitor and evaluate activities within a community and the Nation as a whole.
- Other institutions, organizations, and agencies can facilitate a systems-based approach to bone health through research, education, and purchasing policies.

Chapter 12: Population-Based Approaches To Promote Bone Health

Chapter 12 describes the various potential components of population-based approaches at the local, State, and Federal levels to promote bone health and reviews the evidence supporting their use. This chapter also includes seven detailed profiles of innovative and/or effective population-based programs. Key messages include the following:

- Population-based interventions are targeted toward promoting the overall health status of the community by preventing disease, injury, disability, and premature death. A population-based health intervention should include the following: assessment, health promotion, disease prevention, monitoring of

services, and evaluation. Some methods include public education programs, community projects, and media interventions.

- Bone health is particularly amenable to population- and community-based interventions, for several reasons:
 - ~ Bone loss and fractures affect a large portion of the population and can be prevented during all stages of life.
 - ~ There is a widespread lack of knowledge about prevention among providers and the public.
 - ~ State and local governments have an incentive to promote this approach, since the costs of caring for bone disease are frequently borne by government and the benefits from population-based interventions extend to other areas of health.
 - ~ Well-crafted population-based interventions have been shown to be effective in improving bone health and other aspects of health, including increases in physical activity and decreases in smoking within a target population.
- Communication is an essential tool in many population-based health interventions. Public sector (social marketing, mass media campaigns) and private sector (direct-to-consumer advertising) approaches can be used to reach target populations.
- This chapter includes seven case examples of successful and/or innovative interventions that can serve as building blocks for future population-based approaches to bone health:
 - ~ Any campaign should be based upon credible evidence and be evaluated on a continuing basis to ensure that objectives are being met and/or that corrective action can be taken.
 - ~ A number of evidence-based tools are available for developing interventions.

- ~ Basic education about bone health is an important component.
- ~ Building local partnerships is critical to success. Health care providers; education, environmental, and housing agencies; organizations serving the aged; churches, synagogues, and other religious organizations; and other groups can help to build a comprehensive strategy for maximizing the bone health of community residents.
- ~ Useful prevention messages are available for every age group, although age should not be the only variable affecting the design of interventions.
- ~ Health policy and environmental changes are important tools in health promotion.

Part Six

Challenges and Opportunities: A Vision for the Future

Chapter 13: A Vision for the Future: A Framework for Action To Promote Bone Health

The final chapter of the report reviews its major messages and offers a vision for the future of bone health. The key elements of this vision are summarized below.

A Framework for Action

This Surgeon General's report looks upon the Nation's at-risk bone health status as an opportunity to do better. A **national action plan for bone health** can benefit all Americans. This plan can be aimed at improving overall health and quality of life by enhancing the underlying bone health status of the population, including men, racial and ethnic minorities, the uninsured, and the underinsured. Everyone has a role to play in improving and promoting bone health,

including families and individuals; health care professionals; hospitals and rehabilitation centers; academic medical centers; the research community; health systems; managed care organizations and insurance companies; public and private purchasers; private industry; community-based organizations; State and local public health departments; voluntary health organizations; professional associations; policymakers; and agencies at all levels of government. These stakeholders can work together to broaden the public's and providers' understanding of the importance of bone health and its relevance to general health and well-being, and to promote policies and programs to ensure that existing and future preventive, diagnostic, and treatment measures for bone diseases and disorders are made available on a timely basis to all Americans. This approach can serve as the primary vehicle for improving bone health in this country.

Key Action Steps

- Increase awareness of the impact of osteoporosis and related bone diseases, and how they can be prevented and treated throughout the life span.**

While much valuable work is already underway, more needs to be done to change the perception that osteoporosis is an inevitable part of aging. On the contrary, like heart disease, it needs to be thought of as a preventable chronic disease, the roots of which begin at a fairly young age even though symptoms may not manifest until later in life. Like heart disease and other chronic conditions, there needs to be a better understanding of how much can be done throughout life to prevent its eventual onset.

- Change the paradigm of preventing and treating fractures.**

Fractures, especially in the elderly, need to be thought of by both the public and practitioners as a sentinel event that probably signals the presence of a frail skeleton and an increased risk of future fractures. Much as a first heart attack is thought of as an opportunity to intervene to prevent future heart attacks, an individual's first fracture must be seized upon as an opportunity to intervene to prevent future fractures. Suffering one fracture is more than enough for any individual, and therefore treating fractures should go beyond the orthopedic aspect of setting and fixing the bone. Rather, fractures should be considered a "red flag" for the potential for bone disease, and therefore should be a catalyst for further assessment of risk factors, diagnosis, prevention, and treatment of bone disease. Patients who suffer non-spine fractures represent one of the easiest high-risk

groups to identify and target for intervention, since most fracture patients seek medical care for their injury. Health care practitioners and the public at large must recognize that fractures caused by weakened bones do not always manifest as broken arms, broken wrists, or other easy-to-recognize problems. Rather, they can occur "silently" in the spine with the collapse of spinal vertebrae. Individual patients may not recognize them as fractures, but rather may come into the office complaining of back pain or discomfort. Today these warning signs are too often dismissed by individuals and health professionals.

- Continue to build the science base on the prevention and treatment of bone diseases.**

Further work is needed in the area of basic research, clinical and epidemiological research, health system-based research, and population-based research, including community intervention trials. Specific research questions in each of these areas are discussed in relevant chapters of this report. A broad message of this report is that the Nation is not doing equally well in all areas of research and prevention. Extensive work is being done in the area of basic research, and clinical and epidemiological research enjoy significant support as well. More needs to be done, especially with respect to research related to men and racial and ethnic minorities and how best to translate basic and clinical research findings into everyday practice. Today this process takes far too long. More health system- and population-based research is needed to address bone health. One of the biggest voids is in the area of population-based research on behavior change, where little is known about how to get people to adopt bone-healthy behaviors. Fortunately, many of

the behaviors that promote bone health also promote other aspects of health, including cardiovascular health. The goal should be to integrate bone and musculoskeletal health into larger studies that are evaluating these behavioral issues in other disease areas. Within the area of health systems-based research, much more needs to be known about the most efficient and effective ways to use the various risk assessment, diagnostic, and therapeutic tools available in bone health today.

Support the integration of health messages and programs on physical activity and nutrition relating to other chronic diseases.

As noted earlier, many of the behaviors that prevent bone disease are also critical for preventing other diseases and chronic conditions, including asthma, diabetes, obesity, heart disease, and stroke. Thus, it is absolutely essential that information directed toward the public and physicians about the behaviors that optimize health be integrated. These integrated educational messages need to promote all aspects of health for individuals in various stages of life, including infants, children, adolescents, young adults, middle-aged adults, and the elderly. For the most part, the critical messages in each of these disease areas will be the same. The key is to maintain a healthy weight and diet, avoid smoking, and engage in regular physical activity. For example, the bone health community could join forces with other organizations promoting healthy lifestyles and the prevention of chronic diseases, such as the National Cancer Institute's 5 A Day campaign to advocate consumption of fruits and vegetables and the American Heart Association's efforts to promote cardiovascular health through physical activity, diet, and smoking cessation. The goal should be to ensure that their messages emphasize the bone-health

benefits of whatever is being promoted, be it following an appropriate diet, exercising on a regular basis, or other bone-healthy behaviors. These integrated messages will help both the public and practitioners to understand that there is not a different "recipe" for keeping different parts of the body healthy, and therefore it is not an all-consuming task to do what is needed to maintain one's health. Rather, the message will be a much more positive one: following healthy behaviors is relatively easy to do, and focusing on a few critical elements such as nutrition and physical activity can go a long way toward achieving overall health and well-being.

Act now, as we know more than enough.

While there will always be a need for more research and a greater understanding of bone health and bone disease, more than enough is known today to get started on any of a variety of critical actions that are needed to enhance the bone health status of Americans.

The Roles of Key Stakeholders

Many fruitful activities are already underway in the area of bone health. Advocacy groups, medical and science organizations, and others have been working diligently to promote better bone health for all Americans, including underserved populations. This Surgeon General's report can be a catalyst to build upon, broaden, and expand these efforts. To that end, this report calls for public and private stakeholders in the area of bone health to join forces in the development of a national action plan. The goals of this effort would be to forge consensus on the different action steps that are needed and to determine which stakeholders are best equipped to take responsibility for their execution. Because every stakeholder has an

important role to play, this comprehensive effort should include a wide variety of organizations, including those representing families and individuals; health care professionals; hospitals and rehabilitation centers; skilled nursing facilities; academic medical centers; the research community; health systems; managed care organizations and insurance companies; public and private purchasers; private industry; community-based organizations; State and local public health departments; voluntary health organizations; professional associations; policymakers; and agencies at all levels of government. Some of the most important action steps for the key stakeholders are highlighted below:

Individuals and Families

Because many individuals may not realize that they are at risk of bone disease and may not take action (e.g., begin engaging in physical activity) until they are motivated to do so, individuals and families need to:

- Educate themselves on the importance of bone health and to recognize that bone health is a lifelong issue and that osteoporosis is not just a women's disease.
- Set the stage during infancy, childhood, and adolescence for their children to have healthy bones throughout their lives.
- Encourage their middle-aged and elderly parents to take actions to maintain healthy bones and to prevent bone disease and fractures later in life.
- Recognize that, regardless of their age, gender, or racial and ethnic background, they are at risk of getting bone disease and therefore should consider making a lifelong commitment to doing what is necessary (e.g., getting adequate nutrition and physical activity) to maintain strong bones. Doctors cannot do this for their individual patients, although health care professionals clearly have

a role in encouraging their patients to adopt bone-healthy behaviors.

Health Care Professionals

All health care professionals—including physicians; nurses; nurse practitioners; physician assistants; dietitians/nutritionists; physical and occupational therapists; social workers; dentists; optometrists; and pharmacists—can play a critical role in promoting the bone health of their patients. They need to recognize the potential for bone disease in men and racial and ethnic minorities. While the underlying risk in these population groups may be lower than for White women, the potential for bone disease is still real, particularly in the elderly and the poor. Primary care providers have an especially critical role to play. They need to:

- Pay close attention to bone health issues when conducting wellness visits and treating people with other illnesses.
- Emphasize the basics of good bone health during their interactions with patients, including appropriate nutrition and levels of physical activity.
- Recognize “red flags” and risk factors that might signal the potential for osteoporosis and other bone diseases, and take necessary action or refer at-risk patients to other providers for the appropriate work-up.

Health care professionals working in emergency departments and orthopedic practices also have an important role. They must:

- Recognize that many bone fractures signal the potential for metabolic bone disease.
- Go beyond fixing patients' bones by referring them, when appropriate, to another health care professional for further assessment of the potential for bone disease.

Finally, regardless of the setting, consideration should be given to increasing the role of nurse practitioners and physician

assistants as a way of promoting bone health and minimizing the impact of bone diseases.

Health Systems

Health systems, including hospitals, organized delivery systems, and health plans and insurers can do much to promote bone health in the populations they serve, including:

- Help individuals practice bone-healthy behaviors.
- Assist health care professionals in promoting such behaviors in all patients and in identifying and treating bone disease in a timely manner. For example, these organizations can help practitioners to identify and implement tools that aid in the diagnosis and treatment of bone disease, and can point them to credible sources of information on prevention, assessment of risk factors, diagnosis, and treatment.
- Implement a comprehensive, systems-based approach to promoting bone health (assuming they have a large enough population of at-risk individuals to justify it). This approach may include: reminder systems that alert providers of the need for certain services in individual patients; systematic quality measurement and improvement; disease management programs focused on bone health; and/or the setting of appropriate financial incentives for providers and individuals.
- Consider adoption of coverage policies that provide payment for appropriate, evidence-based preventive, diagnostic, and therapeutic services within the area of bone health.

Health Care Purchasers

Health care purchasers, including public and private employers that buy health coverage on behalf of their employees, can use their power both individually and collectively to influence bone health. More specifically, they can do the following:

- Like health plans and insurers, consider adoption of coverage policies that allow for the appropriate provision of evidence-based preventive, diagnostic, and therapeutic services to all who need them.
- Use their purchasing clout to encourage providers to adopt policies and programs that promote bone health and overall health.
- Develop on-site physical activity and nutrition programs.

Communities and Community-Based Organizations

Communities consist of multiple components, including individuals, faith-based and other community organizations, employers, and government agencies. Working together these organizations can:

- Develop a forum in which the public can discuss bone health status and the burden of bone disease and fractures in their community.
- Assess the resources currently available for improving the bone health status of the community, including public education and treatment.
- Evaluate, and if necessary refine, current policies and programs for enhancing the bone health status of the community.
- Promote daily physical activity in schools at all grade levels.
- Make available user-friendly facilities for physical activity for all age groups, such as walking trails and gymnasiums.

Government

Governments at every level—local, State, and Federal—have a vital leadership role to play in promoting bone health. To play this role effectively, elected policymakers and other government leaders need to recognize the long-term financial and social costs of the status quo (less-than-optimal bone health status) and appreci-

ate the potential to reduce these costs and improve quality of life through prevention, early detection, and early treatment. Local public health departments and government agencies—especially those serving the elderly—have an especially important role to play in developing and implementing a public health approach to bone health promotion at the community level. Specific roles that government can play include:

- Promote public education, public awareness campaigns, and treatment services.
- Coordinate actions needed to improve bone health across the public and private sectors. These actions could include the formation of State or local task forces, steering committees, or advisory committees related to bone health and the development of strategic plans for improving the bone health status of the population and at-risk groups.
- Support the creation of an environment in which bone-healthy dietary and physical activity options are readily accessible and needed preventive, diagnostic, and therapeutic services are readily available and affordable to all who need them.
- Promote research on basic bone biology, new approaches to diagnosis and treatment of bone disease, and the translation of research findings into practice.
- Promote research on the effects of community- and population-based interventions on the community and at-risk populations, including their impact on: the prevalence of bone disease and fractures; diet and exercise; and access to and use of appropriate preventive, diagnostic, and treatment measures.
- Communicate with one another and coordinate activities to ensure that the actions and policies of various levels of government are complementary. The overall goal should be greater harmonization of government activi-

ties, thus ensuring more cost-effective and higher quality services to the public.

- Use the most current, credible evidence when making policy and program decisions related to bone health.

Voluntary Health Organizations

Voluntary health organizations play important roles in promoting bone health. They are often able to reach the public and providers with critical information quickly and with fewer constraints than can government organizations. More specifically, they can:

- Raise public awareness about specific health problems such as bone disease. By including individuals who have personally been touched by bone disease, these organizations are uniquely positioned to provide important guidance to other sectors of the health system regarding the real-life impact of bone disease on individuals, families, and communities.
- Work with residents in the local community to adopt the lifestyle changes necessary to prevent the onset or progression of bone and other diseases.
- Promote the availability of information and resources related to the prevention, diagnosis, and treatment of bone disease.

Professional Associations

Professional associations play a critical role in promoting bone health. They can:

- Facilitate the training of health professionals needed to address the prevention, diagnosis, and treatment of bone disease.
- Promote changes in the curricula of professional schools and provide continuing education to practicing bone health professionals.
- Develop evidence-based guidelines along with standards of care for bone health. These guidelines help to ensure that individuals

who have or are at risk of getting bone disease can benefit from the best practices related to prevention, assessment of risk factors, diagnosis, and treatment.

Academic Institutions

Academic institutions can be critical facilitators through their two core missions of education and research. With respect to osteoporosis and bone health, they can:

- Develop bone health-specific curricula for the education and training of physicians, nurses, nurse practitioners, physician assistants, dietitians/nutritionists, physical and occupational therapists, social workers, dentists, optometrists, and pharmacists.
- Develop the professional skills needed to become effective members of a health care team that focuses on improving bone health and preventing adverse outcomes. For example, trainees from different disciplines (e.g., medical students and residents, nurse practitioners, physician assistants) could be given the opportunity to rotate through osteoporosis clinics.
- Educate the general public by teaching lifestyles that promote bone health in primary and secondary schools and colleges. Schools can play a role in promoting and supporting good dietary habits and regular physical activity, beginning in childhood.
- Advance research on bone health. To date, such research has focused primarily on laboratory studies and clinical trials. Some academic institutions have active research programs on epidemiology, health care delivery, and outcomes as well. These should be expanded to include research on prevention strategies and on men and racial and ethnic minorities.

Industry

Industry also has an important role to play in promoting bone health. They can:

- Reduce the consequences of poor bone health through the development and promotion of drugs, devices, and other diagnostic and treatment technologies.
- Provide information to health care professionals and the public on the appropriate use of pharmaceutical agents to prevent and treat bone disease. This information needs to be part of a comprehensive approach to promoting bone health that includes education on appropriate diet and physical activity.
- Provide disease-management services that focus on managing osteoporosis and bone health in at-risk populations.

The Importance of Partnerships Among Stakeholders

While the roles and contributions of the individual stakeholders cited above are undoubtedly important, public-private partnerships will also be critical to the successful development and execution of a **national action plan for bone health**. These partnerships can build and strengthen cross-disciplinary, culturally competent, community-based efforts to promote bone-healthy behaviors and support the early identification and treatment of bone disease. There is no question that the collective and complementary talents of both public and private stakeholders will be vital to achieving the goal of improving the bone health status of all Americans.

Conclusion

Significant strides have been made in understanding bone health and bone disease over the last few decades. Much is known about how to keep bones healthy throughout life and how to prevent and treat bone disease and fractures in those whose bone health deteriorates. Yet too few people—individuals and health professionals alike—make use of this information. As a result, too many people have or are at risk of getting bone

disease. The time has come to address this problem, to “get the word out” about the importance of bone health and the serious consequences and significant costs of bone disease and fractures. The time has come for everyone—from individual citizens to solo practitioners to the heads of major public and private sector organizations to the leaders of government agencies—to do his or her part in promoting the bone health of all Americans.

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