MILKEN INSTITUTE

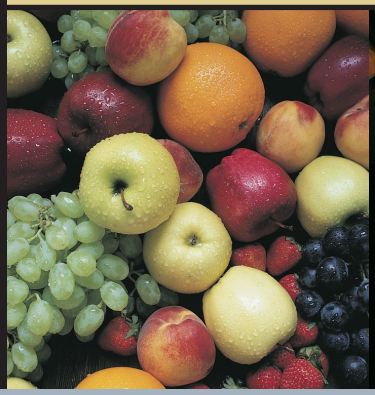
AN UNHEALTHY AMERICA:

The Economic Burden of Chronic Disease

Charting a New Course to Save Lives and Increase Productivity and Economic Growth

Executive Summary and Research Findings

October 2007



By Ross DeVol and Armen Bedroussian

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EXECUTIVE SUMMARY

More than half of Americans suffer from one or more chronic diseases. Each year millions of people are diagnosed with chronic disease, and millions more die from their condition. By our calculations, the most common chronic diseases are costing the economy more than $1 trillion annually—and that figure threatens to reach $6 trillion by the middle of the century. Yet much of this cost is avoidable. This failure to contain the containable is undermining prospects for extending health insurance coverage and for coping with the medical costs of an aging population. The rising rate of chronic disease is a crucial but frequently ignored contributor to growth in medical expenditures.

Of course, the personal and financial consequences of avoidable illness are greatest for those who become ill and their families. In this research, however, we focused on the narrower, more tangible costs of chronic illness: the medical resources used to treat avoidable illness; the impact on labor supply (primarily through lower productivity), and thus GDP; and the drag on long-term economic growth. Specifically, we analyzed the impact of seven of the most common chronic diseases—cancer (broken into several types), diabetes, hypertension, stroke, heart disease, pulmonary conditions, and mental disorders—and estimated the economic costs that could be avoided through more effective prevention and treatment. Even before considering the suffering of those with these diseases, the magnitude of these potential economic benefits would justify increased investment in preventive health measures.

The news about Americans' health is a mixed bag. Dramatic improvements in therapies and treatment have led to higher quality of life, less disability, and lower rates of mortality. Fatality rates for colon cancer began to drop in the early 1980s, while breast, prostate, and lung cancers followed similar patterns in the early 1990s. The most dramatic improvements in morbidity and longevity have come from advances in the treatment and prevention of heart disease: the likelihood of dying from heart ailments began waning in the mid-1960s.

But while treatment outcomes and mortality have been improving, the rates of chronic disease are steadily increasing and, if left to grow unchecked, threaten to cancel out these gains.

The past twenty years have seen dramatic growth in the percent of the population diagnosed with diabetes and cardiovascular disease, driven in large part by increased rates of obesity. The incidence of stroke is rising, in large part because more people are surviving to old age. Rates of pulmonary disease have also risen in recent decades. And reported cases of mental disorders, including depression, are growing, too.

Reducing the avoidable costs associated with these conditions is central to meeting the twin challenges of promoting affordable health care and fostering continued economic growth. We have a choice: continue on the current path or alter it by changing our behaviors and focusing on prevention and early intervention.

Current Treatment Costs and Productivity Losses

Federal survey data allow us to catalog the number of cases of chronic illness and the costs of treating them. The latest available information shows that in 2003, expenditures to treat the seven selected diseases totaled $277 billion for *non-institutionalized* Americans.[1] This is a conservative figure because it excludes the considerable health expenditures of the institutionalized population and because it excludes the spending associated with follow-on health consequences of the seven listed conditions. The latest available data at the

1. Analysis used the Medical Expenditure Panel Survey (MEPS) data from 2003, the most recent year available at the time of the analysis. The 2004 MEPS data have since been released.

time of the analysis show that the total number of cases of these conditions is 162 million, but the number of Americans afflicted with these chronic diseases is smaller (109 million) because many have more than one condition—for example, diabetes, hypertension, and heart disease. Differences in lifestyles (smoking, alcohol abuse, diet, exercise), along with demographics (age distribution, ethnicity) and urbanization, partly explain differences in disease rates.

The potential savings on treatment represents just the tip of the proverbial iceberg. Chronically ill workers take sick days, reducing the supply of labor—and, in the process, the GDP. When they do show up for work to avoid losing wages, they perform far below par—a circumstance known as "presenteeism," in contrast to absenteeism. Output loss (indirect impacts) due to presenteeism (lower productivity) is immense—several times greater than losses associated with absenteeism. Last (but hardly a footnote), avoidable illness diverts the productive capacity of caregivers, adding to the reduction in labor supply for other uses. Combined, the indirect impacts of these diseases totaled just over $1 trillion in 2003.

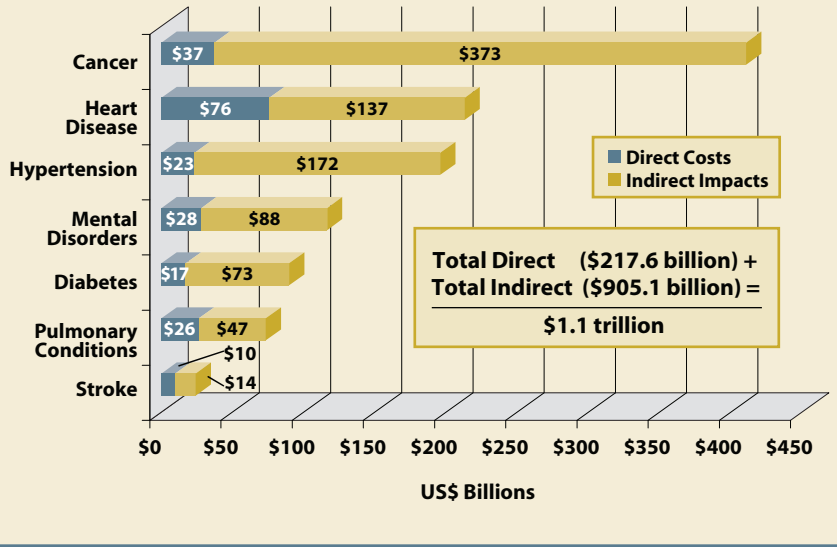
Avoiding Treatment Costs and Productivity Losses

To quantify the potential savings from healthier lifestyles and plausible but modest advances in treatment, we compared a "business-as-usual" baseline scenario with an optimistic scenario that assumes reasonable improvements in health-related behavior and treatment. The major changes contemplated here are weight control combined with improved nutrition, exercise, further reductions in smoking, more aggressive early disease detection, slightly faster adoption of improved therapies, and less-invasive treatments. The impacts of these factors vary widely by condition—gains against diabetes depend largely on reductions in obesity, while colon cancer advances depend heavily on wider early screening. A complete description of the assumptions on which these scenarios are based can be found in the full report.

Across the seven diseases, the optimistic scenario would cut treatment (direct) costs in 2023 by $217 billion (figure ES-1). And the cumulative avoidable treatment costs from now through 2023 would total a whopping $1.6 trillion. Note that this would be a gift that keeps on giving, saving hundreds of billions annually in the years beyond 2023.

For the broader impact on economic output, again we compared baseline and optimistic scenarios to estimate the potential gains (that is, avoided losses) associated with better prevention, detection, and treatment of chronic diseases. For all chronic diseases covered, the difference between the two scenarios in 2023 is a remarkable $905 billion (figure ES-1), while the cumulative difference in GDP over two decades is $6.9 trillion. Plainly, absenteeism and lower productivity on the job linked to chronic disease are major factors limiting economic growth and reducing living standards.

Figure ES-1 :: Avoidable Treatment Costs and Output Losses, 2023



Note: Treatment expenditures for individuals in nursing homes, prisons, or under other institutional care are not included. Treatment expenditures for comorbidities and secondary effects of listed disease are also excluded.
Sources: MEPS, NHIS, Milken Institute

Impacts of Major Behavioral Risk Factors

All told, our analysis implies that modest reductions in avoidable factors—unhealthy behavior, environmental risks, and the failure to make modest gains in early detection and innovative treatment—will lead to 40 million fewer cases of illness and a gain of over $1 trillion annually in labor supply and efficiency by 2023. Compared to the costs we project under the business-as-usual scenario, this represents a 27 percent reduction in total economic impact.

To get a clearer sense of the relative impact of the two most important behavior factors—obesity and smoking—we again compared alternate scenarios, holding all other factors at the baseline values. Lower obesity is projected to reduce cases of illness by 14.8 million in 2023, which cuts $60

billion from the national treatment bill and improves GDP by $254 billion. A parallel calculation for smoking alone suggests that lower tobacco use is responsible for 9.4 million fewer illnesses in 2023, along with $31 billion less in treatment costs and $79 billion in added productivity.

Impacts at the State Level

Differences in lifestyles (smoking, alcohol abuse, diet, exercise), along with demographics (age distribution, ethnicity) and urbanization, partly explain differences in disease rates among the states. States with the highest rates of chronic disease also tend to have the worst readings on behavioral risk factors, the highest percentage of elderly residents, and a demographic mix predisposed to one or more chronic diseases.

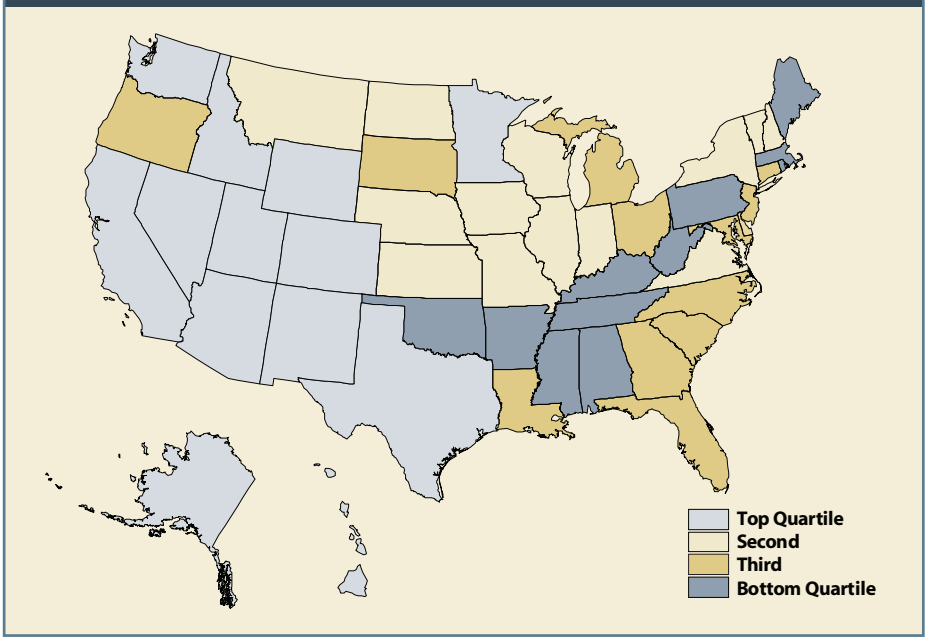
The map in figure ES-2 groups states according to their rankings on the Milken Institute State Chronic Disease Index, which measures the concentration of chronic diseases. As the map shows, the least healthy states lie in a belt of obesity and smoking that runs from the Northeast through Oklahoma. West Virginia, Tennessee, Arkansas, Kentucky, and Mississippi all fare poorly. The low scores for Massachusetts and Maine result from the high incidence of cancers and perhaps more complete reporting. Those with the healthiest populations are in the West, led by Utah, Alaska, Colorado, New Mexico, and Arizona.

We find that all states stand to gain in the optimistic scenario, with even the less-populous states, such as Alaska, avoiding 79,000 cases of chronic disease (a 16.4 percent reduction) and achieving benefits of $2.6 billion (27 percent) through lower treatment costs and higher productivity in 2023. Among the most populous states, California avoids 4.3 million (17.6 percent) cases of chronic disease and gains $117.1 billion through lower treatment costs and higher productivity in 2023.

Forgone Economic Growth Over the Long Term

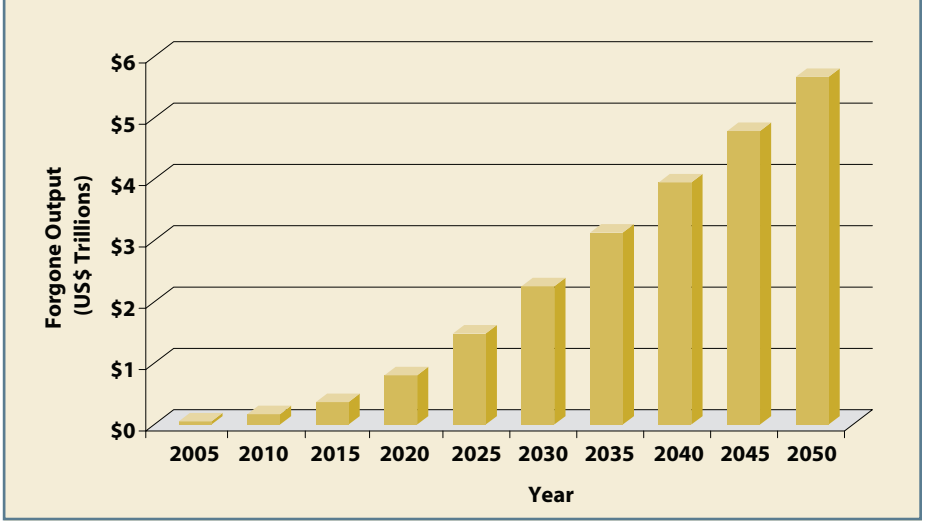
The long-term impact of chronic disease on economic growth—the consequence of less investment in human and physical capital—is likely to be of even greater magnitude than the impact of treatment costs and lost labor supply. This is because improvements in health today also yield increased investment in education and training a generation from now.

Figure ES-2 :: State Chronic Disease Index



Note: States in the top quartile have the lowest rates of seven common chronic diseases.
Source: Milken Institute

Figure ES-3 :: Long-Term Forgone Economic Output
Change in Real GDP Between Baseline and Optimistic Scenarios



Source: Milken Institute

Existing estimates of the economic impact of disease tend to ignore the productivity growth that results over the long term as returns on human capital investment accrue to subsequent generations.

We used a standard economic model of the relationship between inputs (capital, labor, skills) and output to simulate this impact, with health affecting the rate of investment and thus the rate of economic growth. Life expectancy at age 65 serves as a plausible proxy for this health variable, which affects decisions to invest both in human capital (education) and physical capital. An innovation from our research is the recognition of the dynamic feedback between health and human capital formation over time.

Comparing a baseline, business-as-usual scenario with an optimistic scenario assuming substantial (but plausible) reductions in chronic disease cases yields a gap of $1.2 trillion in real GDP terms in 2023, widening to $5.7 trillion in 2050 (a percentage difference of 17.6 percent). This represents a difference of about three-tenths of a percentage point in average annual economic growth resulting from lower rates of investment in education and physical capital. As a benchmark, over the past twenty years, real GDP growth has averaged 3.0 percent (see figure ES-3).

The Big Picture

While the avoidable treatment costs of less-than-optimal prevention and early intervention are large, the avoidable impact on GDP linked to reduced labor supply and lower rates of investment is gigantic. The good news implied is that the potential economic returns to initiatives that lead to a healthier population are enormous. To that end, we offer some guidelines for change.

Incentives in the health-care system should promote prevention and early intervention. Employers, insurers, governments, and communities need to work together to develop strong incentives for patients and health-care providers to prevent and treat chronic disease effectively. In many respects, we've gotten what we paid for: only a tiny fraction of health-care spending is devoted to the promotion of healthier behavior, despite the fact that preventable chronic diseases are linked to smoking, obesity, lack of exercise, and drug and alcohol use.

As a nation, we need to renew our commitment to achieving a "healthy body weight." Rising obesity rates threaten to send treatment costs for diabetes and related conditions, such as heart disease and stroke, soaring over the next twenty years. There needs to be a strong, long-term national commitment to promote health and wellness.

The rapid growth of chronic disease is costing us lives, quality of life, and prosperity. The current health-care debate rightly focuses on the extension of coverage to the uninsured and the design of a financing mechanism that is both fair and efficient. We suggest that the nature of services provided—the failure to invest in prevention and early intervention—deserves equal place in the debate. An increased emphasis on prevention would both improve the health of Americans and offset some of the costs of an aging population by increasing economic productivity.

This analysis should be seen as a contribution toward a sorely needed national discussion on health-care spending and chronic disease. Further research is necessary to bring additional precision and knowledge in measuring the economic, human, and social costs of preventable chronic disease and identifying opportunities to reduce or avoid them.

RESEARCH FINDINGS

More than half of all Americans suffer from one or more chronic diseases.[1] Each year millions of people are diagnosed with chronic disease, and millions more die from their condition. Despite dramatic improvements in therapies and treatment, disease rates have risen dramatically. Diabetes has become a new national epidemic, and rapidly rising rates of obesity and cardiovascular disease threaten to cancel out the gains we have made over the past decades.[2]

The rising rate of chronic disease is a crucial but frequently ignored contributor to rising medical expenditures.[3] The health of Americans and the economy depend on our ability to focus our efforts to reduce the burden of disease. In the absence of concerted efforts to prevent, diagnose, and better manage and treat chronic disease, we as a society will needlessly bear higher socioeconomic costs over time.

The human and economic toll of chronic disease on patients' families and society is enormous. Yet while a number of studies have sought to estimate the economic costs of illness, there has not been a significant focus on estimating the costs that could be avoided through efforts to reduce the prevalence and burden of chronic disease. The purpose of this study is to quantify the economic and *business costs* of chronic disease: the potential impact on employers, the government, and the nation's economy. This study documents what the country stands to lose in terms of economic growth—more than a trillion dollars within two decades—if we fail to make reasonable changes that improve the health status of Americans.

This study estimates current and future treatment costs and lost productivity for seven of the most common chronic diseases—cancer (broken into several types), diabetes, hypertension, stroke, heart disease, pulmonary conditions, and mental disorders. Each has been linked to behavioral and/or environmental risk factors that broad-based prevention programs could address. Reducing the avoidable costs associated with these conditions is central to meeting the twin challenges of promoting affordable health care and fostering continued economic growth.

While this study was designed to quantify the economic impacts of chronic disease, it differs from other studies of the cost of illness in several important respects. First, because our focus is not the impact of any one disease, but the aggregate impact on the economy, we do not attempt to estimate the full cost of the health consequences of each disease by taking into account the costs of other health problems caused by the underlying conditions. We also exclude costs associated with the institutionalized population, i.e., those in nursing homes, prisons, the military, or under other supervised care, as our focus is on the working population; and we do not quantify the costs to workers and their families of future lost wages due to premature deaths. As a result, our estimates of treatment costs and of lost productivity are likely to understate the true costs.

Our findings are organized to address the following questions.

1. WHAT DOES CHRONIC DISEASE CURRENTLY COST US? For each of the seven diseases, we calculate the number of people with a reported case, the treatment costs, and lost productivity and workdays.

- More than 109 million Americans report having at least one of the seven diseases, for a total of 162 million cases.
- The total impact of these diseases on the economy is $1.3 trillion annually.
- Of this amount, lost productivity totals $1.1 trillion per year, while another $277 billion is spent annually on treatment (not including costs to treat the follow-on health consequences of these diseases).

2. WHERE IS OUR CURRENT COURSE TAKING US? We project rates of disease, treatment costs, and lost economic output over a twenty-year period, assuming that current trends continue. On our current path, in 2023 we project:

- A 42 percent increase in cases of the seven chronic diseases, for a total of 230.7 million.
- $4.2 trillion in treatment costs and lost economic output.

3. WHAT COSTS ARE AVOIDABLE IF WE MAKE IMPROVEMENTS IN PREVENTION AND TREATMENT? We then project rates of disease and associated costs under a more optimistic scenario, assuming modest improvements in preventing and treating disease. We find that in 2023, compared with the baseline scenario:

- We could avoid 40 million cases of chronic disease.
- We could reduce the economic impact of disease by 27 percent, or $1.1 trillion annually; we could increase the nation's GDP by $905 billion linked to productivity gains; we could also decrease treatment costs by $218 billion per year.
- Lower obesity rates alone could produce productivity gains of $254 billion and avoid $60 billion in treatment expenditures per year.

4. WHAT ARE THE IMPACTS OF THESE SEVEN CHRONIC DISEASES AT THE STATE LEVEL? We quantify current and future avoidable costs for each state. We find that:

- Currently, the burden of disease varies widely: Utah has the lowest rates of chronic disease, followed by Alaska, Colorado, New Mexico, and Arizona. States with the highest rates include West Virginia, Tennessee, Arkansas, Kentucky, and Mississippi.
- All states stand to gain from a focus on prevention, with total avoided costs (from lower treatment costs and higher productivity) ranging from 26 percent to 28 percent of the baseline projected costs in 2023. We estimate the highest percentage savings in Washington, followed by Mississippi, Delaware, and North Dakota.

5. WHAT IS THE LONG-TERM IMPACT OF REDUCING THE DISEASE BURDEN? Building on the twenty-year projections, we assess the importance of investment in better health to human capital and national economic performance over a longer time horizon. We find that by 2050:

- Real GDP could increase by $5.7 trillion, 17.6 percent higher than the baseline projection.

6. WHAT ARE THE IMPLICATIONS OF OUR FINDINGS? We conclude that investment in good health is an investment in economic growth, and make two recommendations:

- Incentives in the health-care system should reward prevention.
- The nation should renew its commitment to achieving a "healthy body weight."

This study relies on the most recent and reliable public data available. For estimates of treatment expenditures, we use information from the Medical Expenditure Panel Survey (MEPS) to estimate the costs of treating each disease. The MEPS survey, launched in 1996 by the federal Agency for Healthcare Research and Quality (AHRQ), collects national and regional (census-based) data on specific services (for the non-institutionalized population), the frequency of service, and payment methods, and is the only consistent source of health spending data that allows for comparisons among states. We use data from 2003, the most recent year for which data were available at the time of this analysis.

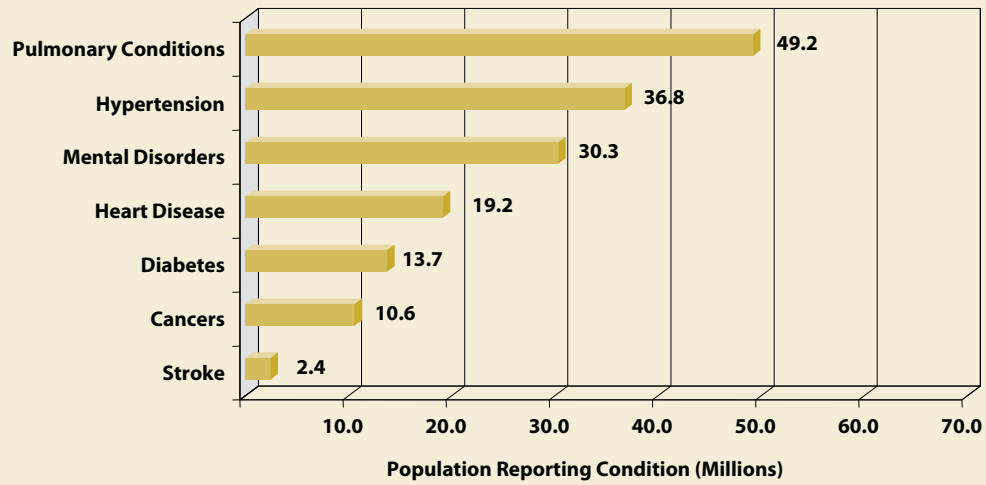
For our estimates on demographic and behavioral trends, as well as to estimate lost productivity, we rely on the U.S. Census Bureau, the Behavioral Risk Factor Surveillance System (BRFSS), and the National Health Interview Survey (NHIS).

I. Current Economic Impact of Chronic Disease

The combined cost of treatment expenditures and lost economic output for the U.S. was $1.3 trillion for these seven diseases in 2003.

The past twenty years have seen dramatically rising rates of diabetes and cardiovascular disease.[4] Many observers report that diabetes rates are reaching epidemic levels.[5] For example, it was recently reported that one in eight New Yorkers has diabetes, and that one in three Americans will develop diabetes over the course of his or her lifetime.[6] Cases of pulmonary conditions, including asthma and chronic obstructive pulmonary disorder (COPD), have also increased, tied in part to worsening air quality. And the nation has seen a rapid increase in the prevalence of depression, as well as other types of mental disorders.[7] Skyrocketing obesity levels may portend an epidemic of chronic diseases and related treatment costs that threaten to overwhelm the public and private sectors.

Figure 1 :: Number of People Reporting Selected Chronic Diseases, 2003

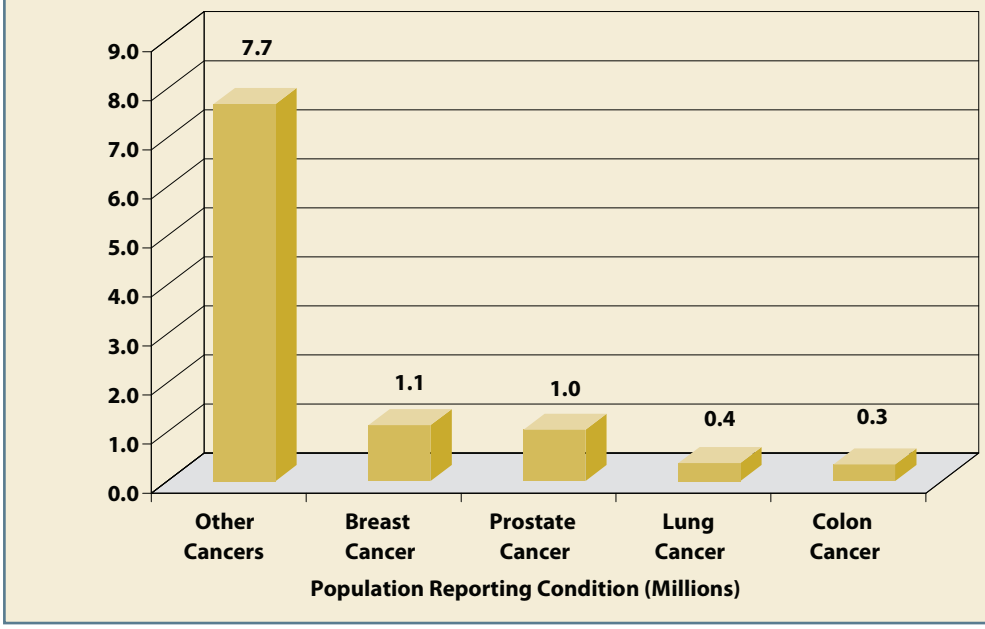


Sources: MEPS, Milken Institute

Nationwide, we find that more than one in three Americans report having one of the seven diseases we study here, with a total of 162.2 million cases in 2003, the most recent year for which comprehensive data were available at the time of this analysis (see figure 1). Of the diseases, pulmonary conditions were the most common, with 49.2 million cases recorded. Next in prevalence were hypertension, with 36.8 million recorded cases, and mental disorders, with 30.3 million; followed by heart disease at 19.2 million; diabetes at 13.7 million; cancer at 10.6 million; and stroke at 2.4 million.

The next figure illustrates the number of Americans with reported cases of cancer in 2003.

Figure 2 :: Number of People Reporting Selected Cancers, 2003



Sources: MEPS, Milken Institute

On a more positive note, dramatic improvements in therapies and treatment have led to higher quality of life, less disability, and lower rates of mortality. In recent years, most cancers have experienced a drop in incidence and death rates. The shift began with colon cancer death rates in the early 1980s; lung, breast, and prostate cancers followed similar patterns in the early 1990s. New cases of colon cancer fell after 1985; of lung cancer in 1993; breast cancer in 1999; and prostate cancer in 2003. Significant advances have also been made in treatment of cardiovascular disease.[8] Death rates related to heart disease began to diminish in the mid-1960s. Approximately half of the decrease in recent deaths in cardiovascular disease can be attributed to medical treatment.[9]

Next we discuss our estimates of current treatment expenditures and productivity losses associated with the current burden of disease.

Current Treatment Expenditures

In 2003, treatment expenditures for the diseases studied totaled $277.0 billion. Expenditures were highest for heart disease, at $64.7 billion. For the five cancers, expenditures totaled $48.1 billion. Mental disorders ranked third, at $45.8 billion, followed by pulmonary conditions at $45.2 billion; hypertension at $32.5 billion; diabetes at $27.1 billion; and stroke at $13.6 billion.

These estimates are conservative in two ways. First, we exclude costs for individuals in institutions—many of whom suffer from chronic disease. Second, because this study addresses a number of chronic diseases, we necessarily

Nationwide, expenditures totaled $277.0 billion, a conservative estimate that excludes the costs of related health conditions, as well as all costs for individuals in nursing homes, prisons, or other institutions.

focus only on the costs that can be attributed directly to the treatment of each disease and exclude the costs of comorbidities and secondary effects.[10] For example, diabetes is a risk factor in the development of circulatory and cardiovascular disease, and as a result, people with diabetes generally have health costs much higher than those without diabetes. The American Diabetes Association has estimated that the total treatment cost of diabetes, including comorbidities attributable to diabetes, was $91.8 billion in 2002.[11] The attribution of costs differs when there are one or more comorbidities, including those that can be a risk factor or main cause of the primary disease. Given our focus on the aggregate impacts, we did not seek to identify additional costs that could be attributed to comorbidities or to apportion costs between diseases (for example, to determine what share of cost of heart disease might be the consequence of diabetes).

As noted above, our estimates are based on MEPS data.[12] MEPS reports the numbers of population reporting condition (PRC).[13] In this summary, for simplicity, we refer to cases of a disease; however, it is important to note that this refers to "population reporting a condition" as used in the MEPS data files.

Current Productivity Losses

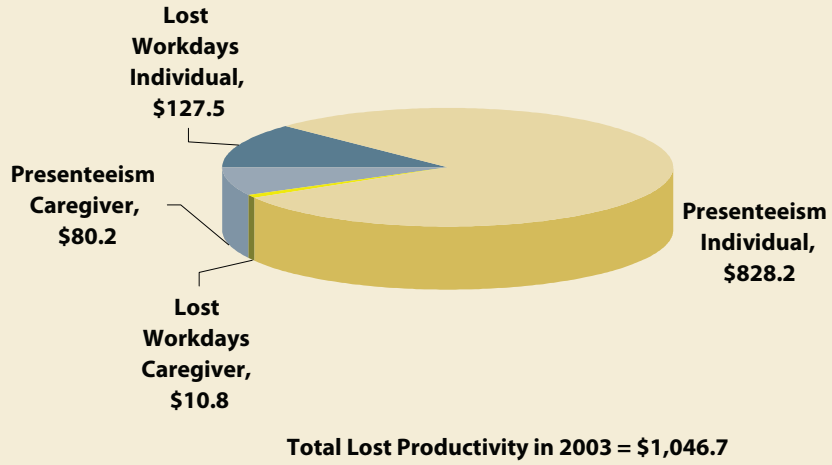
Good health is a vital component of individual well-being. But it also plays a large role in employee productivity. When individuals suffer from chronic disease, the result is often diminished productivity. An ill employee who shows up for work (to avoid sick days, for example) may not perform well, a circumstance known as "presenteeism." According to recent studies conducted by Nicholson et al., we cannot ignore the effect of presenteeism on output loss.[14] Other literature also suggests that output loss due to presenteeism is immense; some research suggests that for certain diseases, it can be up to fifteen times greater than for absenteeism, which is defined as work missed due to sick days.[15] For example, a study by Loeppke and colleagues in the *Journal of Occupational and Environmental Medicine* finds that the costs of productivity loss were four times as great as the direct medical costs of a chronic condition.[16] Caregivers also contribute to lost productivity through missed workdays and presenteeism.

To calculate the economic impact of lost workdays and presenteeism, we rely on representative data on lost work time from the National Health Interview Survey (NHIS). We then calculate the cost of lost work time using an approach that takes into account each worker's contribution to economic output (GDP).[17] Of course, being ill has many impacts for a worker, some of which are not easily quantifiable. For example, illness can lead to unwanted job changes, affect opportunities for promotion, and determine an employee's ability to take on additional job-related training. Our estimates do not attempt to capture all of these costs to the worker.

Overall, we find that individual presenteeism accounts for the greatest loss in output, at 79.1 percent of the total (see figure 3).

Figure 3 :: Lost Productivity by Source, 2003

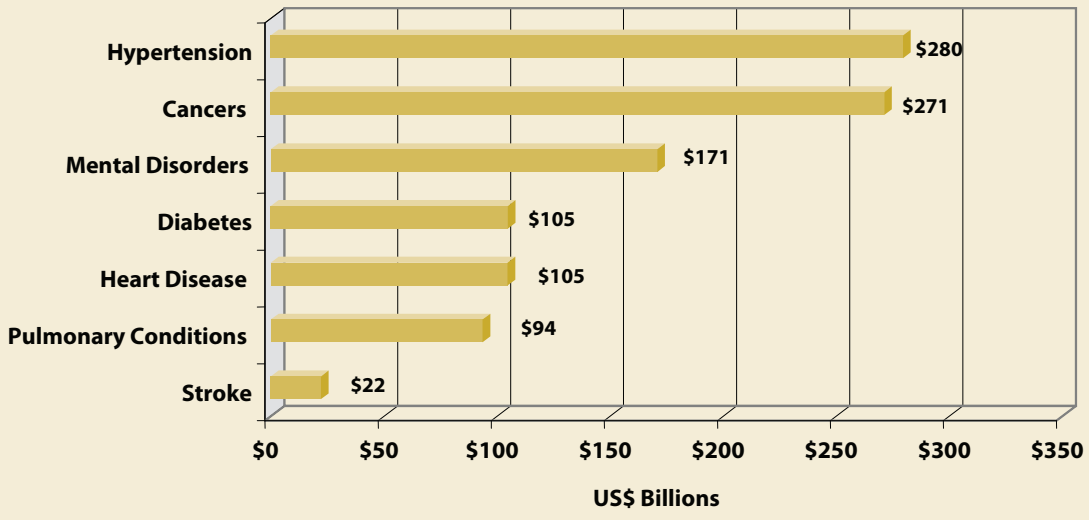
US$ Billions



Sources: NHIS, Milken Institute

Combined, the productivity losses associated with the seven diseases totaled $1.1 trillion in 2003. Among the diseases, lost workdays and lower employee productivity were highest for hypertension, at $279.5 billion, driven principally by the high proportion of the population that had hypertension. Cancer had a larger impact on business output than its prevalence would indicate, due to the higher-than-average productivity losses resulting from the effects of surgery and chemotherapy.[18]

Figure 4 :: Lost Productivity by Chronic Disease, 2003

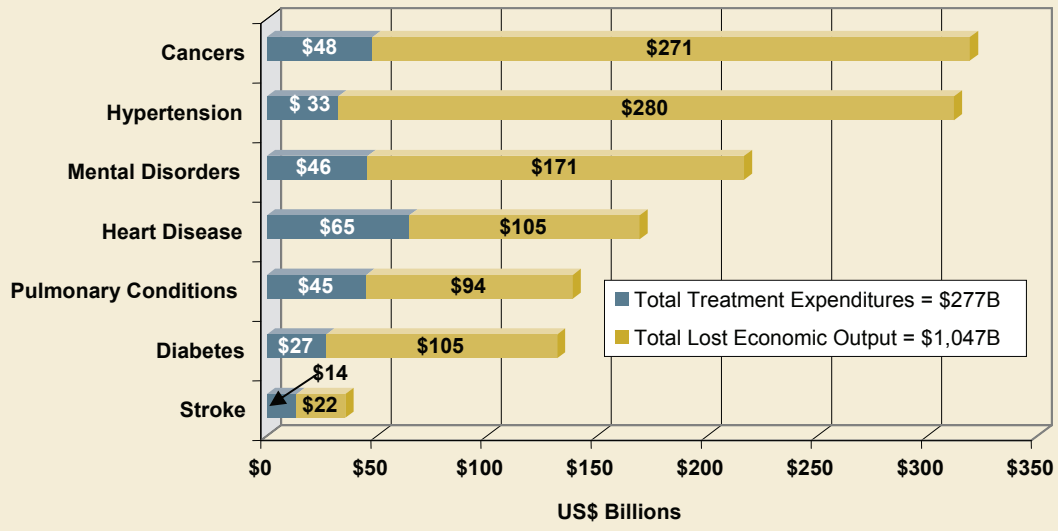


Sources: NHIS, Milken Institute

Summary: Combined Economic Impact

The economic costs of chronic disease include both direct treatment expenditures and the indirect impacts associated with lost workdays and reduced on-the-job productivity of both patients and employed caregivers. Generally, the value of these productivity losses greatly exceeds the cost of treatment. As shown in figure 5, we estimate that in 2003, the productivity losses associated with the seven diseases considered here totaled almost $1.1 trillion, while treatment expenditures totaled $277.0 billion. Together, the combined economic impact of these diseases amounted to $1.3 trillion.

Figure 5 :: Economic Impact of Chronic Disease, 2003



Sources: MEPS, NHIS, Milken Institute
Note: Treatment expenditures for individuals in nursing homes, prisons, or under other institutional care are not included. Treatment expenditures for comorbidities and secondary effects of listed diseases are also excluded.

II. Where We Are Headed: Two Potential Scenarios

Over the next twenty years, the choices we make as individuals and as a country about strategies to prevent and manage chronic disease will have an enormous impact on the nation's health and well-being. To appreciate the importance and value of acting now to prevent disease and continue to strive for health-care improvements in the most prevalent diseases, we construct two scenarios. The first is a "business-as-usual" baseline scenario that assumes current trends continue into the future. We then compare this with an optimistic scenario that assumes improvements in health due to more comprehensive prevention and lifestyle changes, as well as modest improvements in early intervention. The optimistic scenario assumes that while the population continues to age, the country takes some of the steps outlined by the Department of Health and Human Services, including improved nutrition, increased physical activity, maintenance of a healthy weight, and regular health screenings, and that there is a slight improvement in early detection, screening, and development of medical advances.[19]

Our Current Course: Baseline Projections to 2023

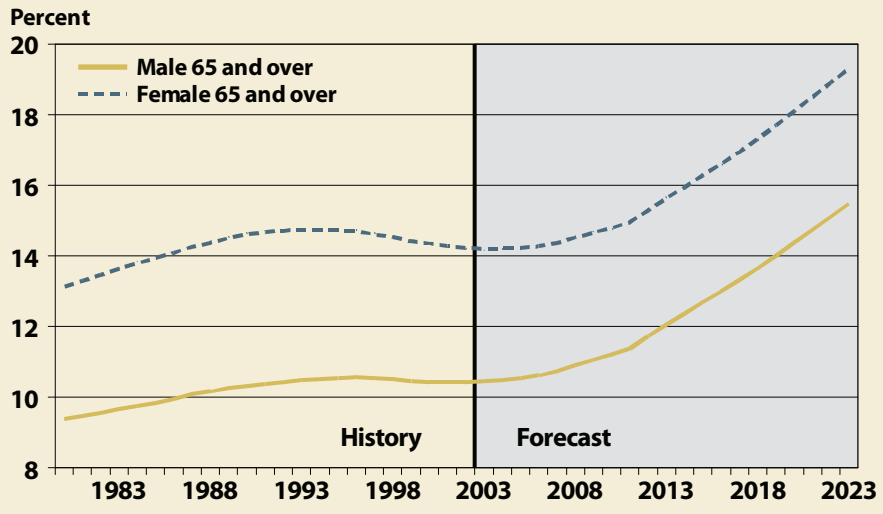
To construct our baseline projection for future rates of disease and associated treatment costs, we develop estimates assuming that current trends will continue to hold for:

- the aging population
- behavioral risk factors and other demographic influences
- improvement in early detection and medical innovation
- health-care cost changes.[20]

Because the risk of developing each of the seven diseases increases with age, the aging population is expected to drive a substantial increase in the number of cases of chronic disease over the next twenty years, even if other risk factors remain unchanged. For example, in the case of prostate cancer, the ratio of the incidence rate per 100,000 population in the 65–74 age group (936.1) to the 0–49 age group (5.6) is an astronomical 167.2, the highest of all cancers. This means that a man between 65 and 74 is 167.2 times more likely to develop prostate cancer than a male under 50. In short, prostate cancer is so common that men hope to die at an advanced age *with* the disease eventually, but not *because* of it. The U.S. Census Bureau projects a rise in the 65-and-over share of the population from 12.4 percent in 2003 to 17.4 percent by 2023 (figure 6).

Prostate cancer is so common that men hope to die at an advanced age *with* the disease eventually, but not *because* of it.

Figure 6 :: Population Projections: 65 and over



Source: U.S. Census Bureau

To estimate trends for future behavioral risk factors, we considered the observed trend and consulted the literature and relevant public and private experts, such as staff at the Centers for Disease Control and Prevention. Risk factors considered include overweight/obesity, smoking, alcohol consumption, physical activity, high cholesterol, air quality, and illicit drug use.

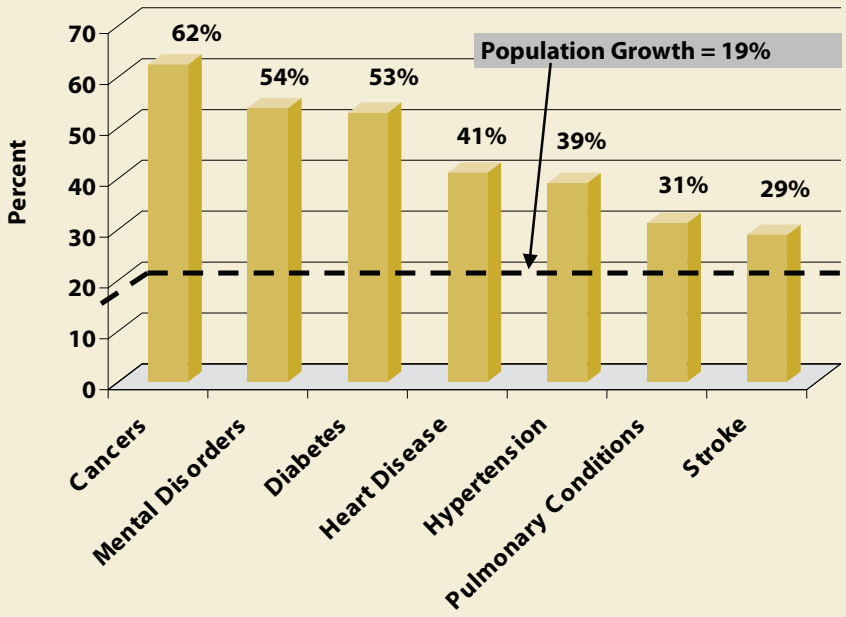
To estimate for the interplay of aging demographics and behavioral risk factors in our projections, we built pooled, cross-sectional state regression models. In these models, we explain variations in incidence and prevalence (depending on the disease statistics available) by utilizing data on demographic, behavioral, and other risk factors. In other words, we build assumptions about expected changes in such factors as race, air quality, weight, activity levels, smoking, and alcohol consumption. The statistical relationship allows an estimate of the relative importance of specific behavioral risk factors by disease.

We assume that current trends hold with regard to prevention and screening, as well as the rate of medical advances.

Rise in the Burden of Disease

Under the baseline scenario, we project a rise in the number of reported cases of the seven diseases to almost 231 million annually by 2023. As shown in figure 7, this represents an increase of 62 percent in the absolute number of cancer cases, a 54 percent increase in mental disorders, and a 53 percent increase in diabetes. The population is only projected to grow 19 percent over this twenty-year period; the excessive growth in chronic disease is caused by the aging of the population and increases in other risk factors.

Figure 7 :: Projected Rise in Cases of Chronic Diseases, 2003-2023



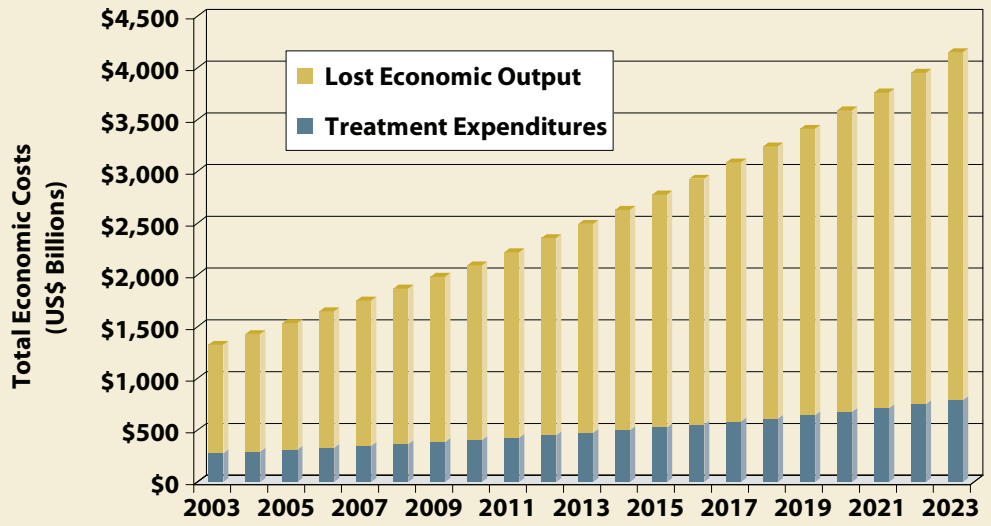
Sources: MEPS, Milken Institute

Rise in Total Costs, Including Productivity Losses and Expenditures to Treat Disease

In order to project productivity losses, we first calculate the future share of the employed adult population. Of this share, we determine the number of employed individuals reporting a particular condition. We also calculate the number of employed caregivers who suffer lost workdays and productivity for each condition. To calculate treatment costs, we multiply the number of projected cases by the estimated cost per case, projected forward by per capita medical spending growth trends developed by the Centers for Medicare and Medicaid Services.

We find that in 2023, the indirect impacts of the seven diseases total $3.4 trillion annually, more than four times the cost of treatment. As shown in figure 8, adding in the cost of expenditures to treat these diseases ($790 billion) brings the total annual economic burden associated with them to $4.2 trillion in 2023.

Figure 8 :: Current Path, Combined Value of Treatment Expenditures and Productivity Losses, 2003–2023



Source: Milken Institute

The Alternative Future: Improvements in Prevention, Behavioral Patterns, and Treatment in an Optimistic Scenario

To construct the optimistic scenario, we assume a range of reasonable improvements in prevention, behavioral patterns, and treatment relative to the baseline scenario. We develop these assumptions on the basis that the improvements are achievable. Most are modest but will require a focused, society-wide effort to be realized. The population continues to age consistent with the baseline assumptions. These assumptions include:

- **A reduction in number of obese persons.** The **baseline** obesity assumption calls for the rate of increase to moderate in relation to recent history and begin to plateau around 2015. For the **optimistic** case, we assume that obesity and overweight become a national health initiative, just as smoking cessation was a health priority in the 1970s, 1980s, and 1990s. We assume that the prevalence of overweight declines to 32.2 percent of the population by 2023, and that obesity declines to 19 percent of the population, roughly where it was in 1998.

- **A continued reduction in smoking.** Our **baseline** projects that smoking declines at the same rate it declined over the twenty years from 1985 to 2005, so that the adult smoking rate approaches 19 percent by 2023.[21] For the **optimistic** case, we assume that smoking declines at a faster rate, consistent with longer-term declines, reaching approximately 15 percent by 2023.

- **A decline in alcohol consumption.** In the **baseline** projection, we assume that the "at risk" percent of the population remains unchanged, at the 2003 percentage of 5.8 percent. In the **optimistic** scenario, we assume that the percentage of "at risk" drinking decreases steadily, to 4.2 percent.

- **Physical activity will increase.** We assume in the **baseline** projection that the percent share of the population engaged in physical activity will increase gradually, from 75.4 in 2003 to 77.9 by 2023. In the **optimistic** projection, the share of the population engaged in physical activity will have increased to 83.3 percent by 2023.

- **High cholesterol will return to 2000 levels.** We expect the percent of people with high cholesterol to stabilize around 42.2 percent by 2023 in the **baseline** projection. In the **optimistic** scenario, we assume the percentage of people with high cholesterol will decline to 31.5 by 2023, nearing 2000 levels.

- **An improvement in air quality.** In the **baseline** projection, we assume that as population growth rises, so does the demand for fuel. In the **optimistic** case, we assume that there is a net reduction in air pollution and other airborne allergens and irritants relative to underlying economic growth.

- **A gradual decline in illicit drug use.** In the **baseline** projection, we assume that illicit drug use, as a share of the total population, will plateau, due to increased awareness of the risks of drug use. In the **optimistic** projection, we assume that from 2010 onward it will embark on a downward trajectory.

- **A modest improvement in early intervention and treatment.** The **baseline** scenario assumes that historical trends in the improvement of early detection and screening continue to hold. The **optimistic** scenario assumes more uniform use of best practices in early detection and screening for the following conditions for which such mechanisms are most relevant today: colon and prostate cancer. It also assumes a very slight acceleration in the availability and use of new treatments for hypertension, heart disease, stroke, and mental disorders.

- **Lower health-care cost growth.** The **baseline** treatment spending projections assume medical inflation consistent with CMS projections. The **optimistic** scenario assumes growth rates of health-care cost that are 0.5 percentage point lower than baseline. This lower average cost reflects a host of factors that could potentially improve the efficiency of care, such as increased coordination of care for chronically ill patients, more widespread treatment to accepted guidelines, efforts to improve patient adherence to prescribed therapies, and faster adoption of health information technology. Our assumptions on improved and more widespread adoption of disease management practices act to reduce the rate of future growth of health-care costs. However, our optimistic scenario incorporates only moderate improvements in disease management practices. If greater advances in disease management practices are achieved, slower growth in health-care costs and treatment expenditures would be possible.

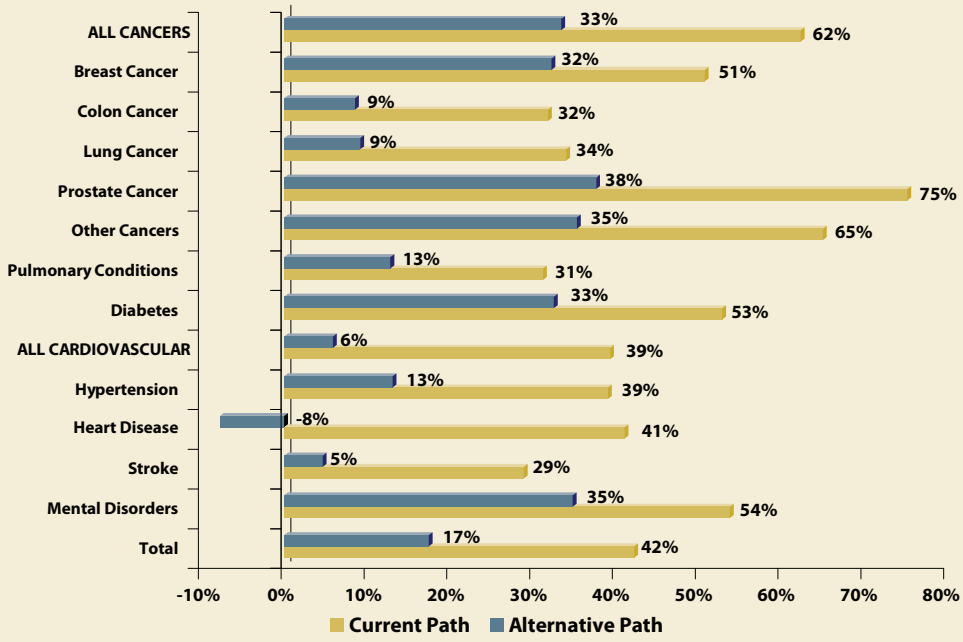
While these assumptions are optimistic, they are not beyond our reach. They address the most frequently cited behavioral risk factors and our own calculations of the statistical relationships between the risk factors and each condition. By mobilizing resources as a society, there is no reason why we cannot meet the challenge of bringing obesity levels down to where they were only a decade ago. We proved that smoking reduction was attainable and continue to educate our younger generation about its negative health-related impacts. Our underlying assumptions are based on reasonable frameworks explained in more detail in the main body of this study.

III. The Alternative Future: Avoidable Costs in the Optimistic Scenario

Avoidable Illness

Below we summarize projected rates of reported cases for each of the seven diseases, including specific types of cancer. We also compare projections based on current (baseline) trends and the optimistic scenarios. Across all seven diseases, we estimate that the number of cases can be reduced by more than 40 million (from 230.7 million to 190.5 million). This represents an increase of only 17 percent over twenty years, compared to the baseline projection of 42 percent. The largest difference is for the population reporting heart disease, where the absolute number of cases falls by 8 percent in the optimistic scenario, compared to a 41.1 percent increase in the baseline projection.

Figure 9 :: **Percent Growth in Number of People Reporting Chronic Diseases, 2003-2023: Current Path versus Alternative Path**



Sources: MEPS, Milken Institute

Brief descriptions follow of the key factors we expect will drive the trend in each disease. We focus mainly, although not exclusively, on *behavioral* risk factors because the scientific evidence shows that behavioral changes can yield predictable results that are relatively easy to quantify. For each condition, there may be a host of other factors in addition to those identified, including heredity, stress, and more environmental and behavioral factors. The risk factors identified were chosen according to a thorough review of the literature and availability of state-level data.

Breast Cancer

Current Path: The aging population and rising obesity rates will likely tip recent reductions in breast cancer incidence back to an upward trajectory. In the current path (*baseline scenario*), cases will increase by 50.8 percent between 2003 and 2023, 11.3 percentage points greater than the impact of aging alone.

Alternative Path: The principal source of variance between projections in the current and alternative path (*optimistic scenario*) is a lower projected trend for obesity. Cases grow by 32.2 percent from 2003 to 2023, resulting in 12.3 percent fewer breast cancer cases.

Colon Cancer

Current Path: Again, an aging population and obesity trends push colon cancer cases higher, but an expected decline in smoking and more widespread screening limit the increase. The projection calls for cases to increase to 447,000 (a 31.8 percent gain) between 2003 and 2023, or 19.4 percentage points below where aging alone would push the total.

Alternative Path: Increased screening, greater reductions in "at risk" smoking (defined as smoking at least 100 cigarettes over the course of a lifetime and still smoking), and obesity declines related to increased physical activity combine to produce 79,000 fewer cases (17.7 percent fewer) in 2023 in the *optimistic* scenario compared to the *baseline* trend.

Lung Cancer

Current Path: While the aging of the population will drive lung cancer rates up, expected continued declines in smoking will offset much of the impact of aging. The number of lung cancer cases is projected to increase 34 percent from 2003 to 2023, or 21.9 percentage points below the projection attributable to aging alone.

Alternative Path: While it is not the sole cause of lung cancer, smoking has a stronger statistical relationship with lung cancer than with any other cancer or chronic disease. We therefore focus on this behavioral risk factor as a key driver of cases of lung cancer. Lower smoking rates in the *optimistic* scenario result in 92,000 fewer cases of lung cancer (18.4 percent fewer) in 2023 than in the *baseline*.

Prostate Cancer

Current Path: Increased screening has led to earlier detection and improved survival rates in recent years, but aging demographics and higher obesity rates push incidence and cases higher over the next two decades. The projection calls for cases to increase by 75.4 percent (786,000).

Alternative Path: Increased physical activity, lower obesity rates, and an increase in early screening for prostate cancer together produce 393,000 fewer cases (21.5 percent) in 2023 in the *optimistic* scenario than in *baseline* projections in 2023.

Other Cancers

Current Path: Skin cancer is the most prevalent of "other cancers," but liver, kidney, brain, bladder, and uterine cancer, and leukemia are also significant. Obesity is expected to have a detrimental impact on future cases. To a lesser extent, high cholesterol will play a role. Reductions in smoking rates will partly offset rising obesity rates. Cases increase by 65.1 percent between 2003 and 2023, or 20.8 percentage points above where aging alone would send the total.

Alternative Path: Lower smoking, cholesterol, and obesity rates cut rates for other cancers in the *optimistic* scenario. Other cancer cases are reduced by 2.3 million (18 percent) due to these behavioral changes.

Pulmonary Conditions

Current Path: The net effects of an aging population, changing racial demographics, and worsening air quality lead to increased incidence of pulmonary conditions. Combined, these forces cause pulmonary conditions cases to increase by 31.3 percent, or 4.1 percentage points greater than where aging alone would push the total.

Alternative Path: The principal sources of variance between the current and alternative case scenarios are lower projections for smoking prevalence and average air quality. Cases grow by 12.8 percent between 2003 and 2023, resulting in 9.1 million fewer cases

Diabetes

Current Path: The obesity epidemic will have the greatest and most direct effect on diabetes cases. Diabetes cases are projected to increase 52.9 percent from 2003 to 2023, or 12.2 percentage points more than that solely attributable to aging.

Alternative Path: The major difference between the *optimistic* and *baseline* diabetes cases is the assumption of lower obesity rates. Diabetes cases would increase by 32.6 percent from 2003 to 2023. This results in 13.3 percent (2.8 million) fewer cases.

Hypertension

Current Path: Moderately higher exercise frequency will tend to counteract rising obesity rates. Exercise can mitigate hypertension to a significant extent. This projection calls for cases to increase by 39.1 percent between 2003 and 2023, just higher than where aging alone would push the total.

Alternative Path: Because hypertension is preventable, changes in obesity and exercise levels could prevent the rapid progression of prevalence. The *optimistic* scenario, based on these changes, as well as a slight improvement in treatment, results in 9.6 million fewer (18.7 percent) hypertension cases in 2023. In this scenario, we estimate that the prevalence rate will peak in 2010 and decline moderately thereafter.

Heart Disease

Current Path: Population aging and obesity are likely to cause an increase in heart disease cases in the absence of significant behavioral changes. Lower smoking mitigates some of the possible increase. The projection calls for cases to increase by 41.1 percent between 2003 and 2023, slightly above where aging alone would place the total. Heart disease cases reach 27.0 million.

Alternative Path: Fortunately, changes in behavioral risk factors could significantly alter the path of heart disease. We assume that a slight improvement in drug therapies will play a modest role, too. The *optimistic* scenario contains 9.4 million fewer (34.6 percent) cases in 2023. Here the prevalence rate falls during the projection period, in contrast to a steady increase in the baseline.

Stroke

Current Path: Of all behavioral risk factors, smoking has the strongest causal impact on stroke. The projection shows cases increasing by 28.9 percent between 2003 and 2023, slightly above where aging by itself would place it. Stroke cases increase to 3.1 million. (Note that these estimates do not include strokes among the institutionalized population).

Alternative Path: Lower smoking rates, changes in obesity and exercise levels, and an increase in early intervention to reduce stroke risk could prevent many strokes. The *optimistic* scenario has 589,000 fewer (18.8 percent) cases in 2023. It projects that the prevalence rate will decline slowly over the period.

Mental Disorders

Current Path: The term "mental disorders" encompasses a wide range and variety of conditions, including, for example, both major and mild depression, bipolar disorder, schizophrenia, and various anxiety disorders, such as panic, obsessive-compulsive disorder, and phobias. Approximately 26.2 percent of Americans over 18 suffer from one or more mental disorders during a given year. By 2023, we project roughly 46.7 million cases, or 53.8 percent more than in 2003.

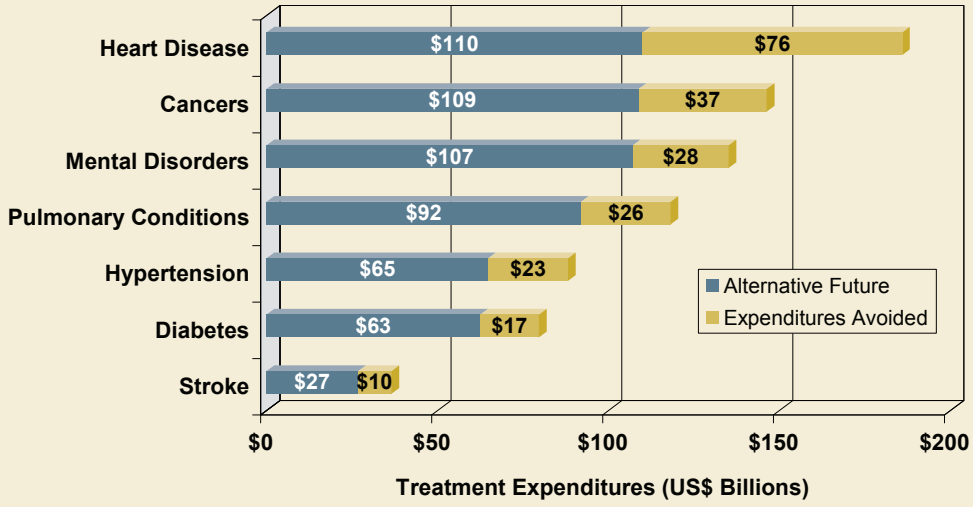
Alternative Path: While the origins of most mental disorders are complex and may have a hereditary or environmental component, behavioral factors can also affect the prevalence and severity of these conditions. We estimated the impact on the rate of mental disorders of two such factors—alcohol consumption and illicit drug use—for which data were rich and readily available. In the *optimistic* scenario, lower "at risk" alcohol consumption and illegal drug use helps reduce the prevalence by approximately 5.8 million cases by 2023 compared to *baseline*. Even so, the prevalence rate will follow an upward trend throughout the projection period.

Avoidable Treatment Expenditures

If fewer people suffered from chronic conditions, the country would spend far less on health care. To estimate the health-care spending that could be avoided by reducing the prevalence of chronic illness, we first project the 2003 expenditure per case out to 2023 (by applying growth rates in health-care costs). By applying this expenditure per case to the projected population with the condition, we can obtain total expenditure projections for the

twenty-year period. The baseline projection calls for an annual growth rate in the health-care cost index of 3.4 percent, while the optimistic projection uses a rate 0.5 percent lower. This optimistic path would still result in health-care cost index increasing nearly 1.0 percentage point faster than overall inflation.

Figure 10 :: Avoidable Treatment Expenditures, 2023



Source: Milken Institute

As discussed previously, our assumptions on the reduction in health-care cost growth attributable to improved disease management practices, early screening, and intervention in the optimistic scenario are modest. For example, more widespread breast self-examination or improved diagnostics would catch breast cancer at an earlier stage, when less-aggressive treatments are available, and reduce the growth in expenditures to treat patients. In the case of asthma (included in pulmonary conditions), improper management can lead to frequent hospitalizations and result in higher treatment expenditures. Improved disease management of diabetes can lessen the risk factors for developing cardiovascular disease and other conditions.

We estimate that more effective prevention and management of disease could save $218 billion in treatment expenditures annually in 2023 in the optimistic scenario. These avoidable treatment costs, $1.6 trillion over the period, can be attributed to changes in behavior, preventative measures, and innovation. To put this into perspective, such a savings—or a loss, depending on how we face the issue—is nearly double the size of India's economy. Or twenty-one times the Department of Education budget.

We find that breast cancer treatment expenditures drop 20.6 percent ($3.2 billion) in the optimistic scenario; colon cancer expenditures decline by 25.5 percent ($2.7 billion); prostate cancer expenditures fall 28.9 percent ($4.1 billion); lung cancer expenditures are down 26.2 percent ($4.2 billion); and expenditures for other cancers fall 25.8 percent ($23.1 billion). Treatment costs for all cancers are 25.6 percent ($37.4 billion) less in the optimistic scenario. The *cumulative* difference through 2023 between the optimistic and baseline scenarios is $22.3 billion for

breast cancer; $21.7 billion for colon cancer; $27.2 billion for prostate cancer; $32.4 billion for lung cancer; and $168.5 billion for other cancers. In the optimistic scenario, all cancers total $272.0 billion lower on a cumulative basis.

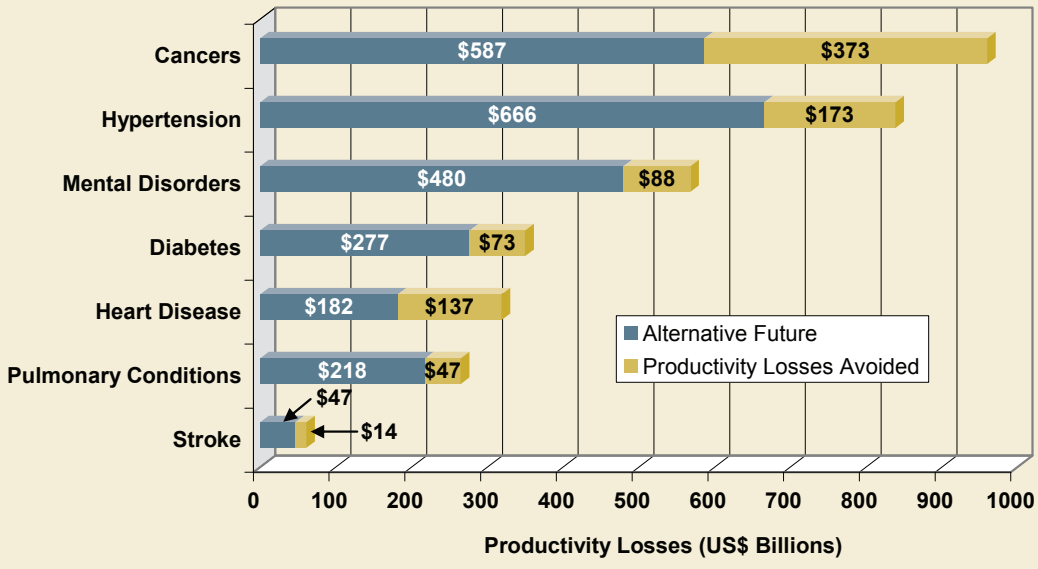
In 2023, treatment expenditures for pulmonary conditions are 22.2 percent ($26.2 billion) lower in the optimistic scenario. They drop 20.7 percent ($28.0 billion) for mental disorders; 21.5 percent ($17.1 billion) for diabetes; 40.8 percent ($75.8 billion) for heart disease; 26.4 percent ($23.3 billion) for hypertension; and 26.5 percent ($9.7 billion) for stroke. The *cumulative* difference over the projection interval for pulmonary conditions is $199.6 billion; $196.6 billion for mental disorders; $118.5 billion for diabetes; $561.7 billion for heart disease; $179.6 billion for hypertension; and $72.7 billion for stroke.

Potential to Avoid Lost Productivity

Baseline and optimistic scenarios help convey the forgone economic output attributable to lost workdays and productivity. As before, the estimate of future productivity losses will be the difference between the two scenarios.

National projections show a difference in the baseline and optimistic scenarios (based on GDP) of $905 billion (26.9 percent) in 2023. Figure 11 provides a comparison of the scenarios for *total* productivity losses. The productivity loss from cancer is $373 billion (38.9 percent) lower in the optimistic scenario. Similarly, the productivity loss for heart disease is $137 billion (43 percent) lower. The *cumulative* difference between the projections is $6.9 trillion (16.1 percent).[22]

Figure 11 :: **Avoidable Productivity Losses, 2023**



Source: Milken Institute

Summary: Combined Impact of Avoidable Treatment Expenditures and Productivity Losses (Economic Output)

Under the optimistic scenario, we estimate that the prevalence of chronic illness could be reduced substantially, leading to a dramatic reduction in treatment expenditures and avoiding a total loss of up to $1.1 trillion annually by 2023, a 27 percent difference (see figure 12).

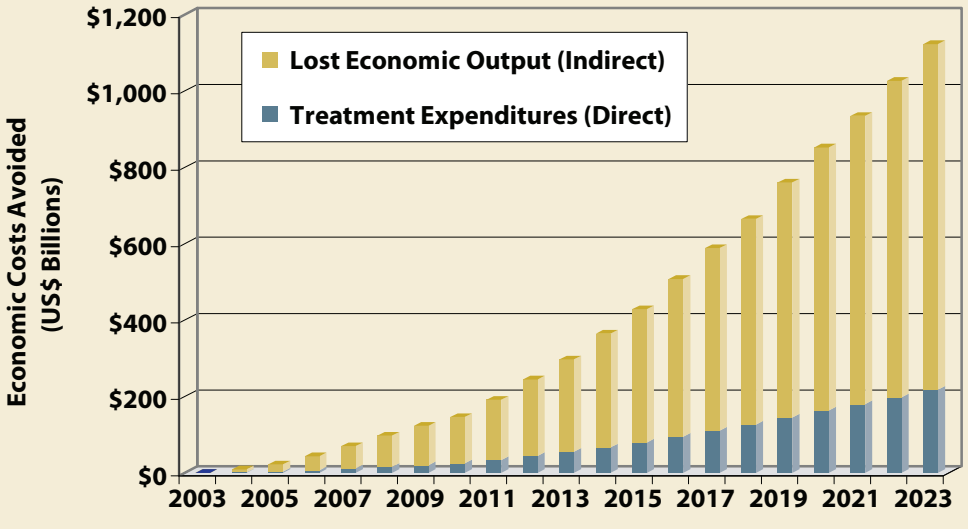
Figure 12 :: Projected Annual Costs of Chronic Diseases, 2023
US$ Trillions

	Current Path	Alternative Path	Avoided Costs	
			Amount	Percent
Treatment Expenditures	0.8	0.6	0.2	27.8
Lost Economic Output	3.4	2.5	0.9	26.8
Total	4.2	3.1	1.1	27.0

Source: Milken Institute

The following chart illustrates the total avoided costs over a twenty-year interval (from 2003 through 2023). The last bar in 2023 portrays the avoided costs (amount) figures from the table above.

Figure 13 :: Costs That Can Be Avoided, 2003-2023



Source: Milken Institute

Importance of Behavioral and Environmental Risk Factors: Spotlight on Obesity and Smoking

We find that the single most important way to reduce the burden of disease and reduce costs to society is to reduce obesity, closely followed by continuing to achieve reductions in smoking prevalence. Obesity is a key risk factor for many diseases and a key contributor to disability. For example, a RAND study finds that if obesity trends continue unchecked, disability rates will climb across all age groups, offsetting past reductions in disability.[23] RAND estimates that if current trends continue, one-fifth of health-care expenditures would be devoted to treating the consequences of obesity by 2020.

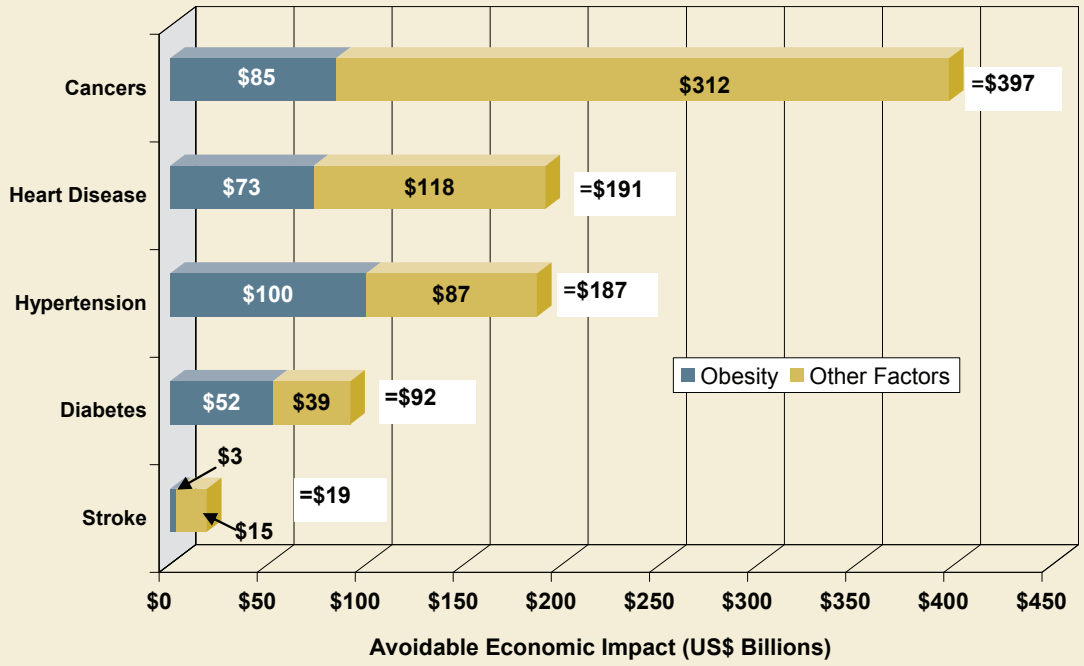
Based on our analysis, if the country could reverse the growth rate of obesity and return to 1998 levels in 2023, the impact would be close to 15 million fewer reported cases compared to baseline (a reduction of 14 percent) of the seven diseases studied. This would translate to a reduction in health-care spending of $60 billion and an increase in productivity of $254 billion, and account for a large proportion of the overall economic impact.

Lower obesity rates have the largest effect in reducing the total number of cases for hypertension (5.7 million, or 12 percent). They could reduce reported cases for heart disease by 4.4 million (20.4 percent) and for diabetes by 2.8 million (13.3 percent). Reducing obesity would result in the largest percent decline in the total number of prostate cancer cases (up to 22 percent).

Figure 14 displays the differences in total treatment costs and lost economic output between the two scenarios attributable to obesity versus other factors. (Note that the total avoidable costs reflected in figure 14 are lower than those described elsewhere in this report because they exclude avoidable-cost growth related to assumptions about differences in the growth of health-care costs.) We are showing the avoidable costs that are attributable to fewer cases of these chronic diseases so that they can linked back to their underlying causes.

The lowered obesity assumption in the optimistic scenario reduces treatment expenditures and improves productivity for hypertension by a combined $100.1 billion ($8.9 billion and $91.2 billion, respectively), the largest *absolute* impact. This is followed by cancer, at $84.6 billion (treatment expenditures of $12.4 and higher productivity of $72.2); heart disease at $73.2 billion ($27.6 billion for treatment expenditures and $45.6 billion for productivity); diabetes at $52.4 billion ($9.6 billion for treatment expenditures and $42.8 billion for productivity); and stroke at $3.3 billion ($1.2 billion for treatment expenditure and $2.1 billion for productivity).

Figure 14 :: Avoidable Economic Costs Attributable to Decline in Obesity, 2023



Source: Milken Institute

We perform a similar analysis for the risk factor smoking. The greatest *absolute* difference in cases in 2023 is seen for pulmonary conditions, at 7.3 million. However, the largest *percentage* difference is for lung cancer, at 18.4 percent. Heart disease cases ease by 1.35 million (7.1 percent), and cases for other cancers decline by 480,000 (4.4 percent) due to lower smoking. In total, cases are reduced by 9.6 million, or 9.0 percent, with the lower assumption.

Lower smoking in the optimistic scenario cuts expenditure on pulmonary conditions by $12.0 billion. Heart disease ranks second, at $8.4 billion; stroke is third, at $4.2 billion; other cancers come in fourth, at $3.0 billion; and all cancers see expenditures cut by $6.7 billion in 2023. In total, the optimistic assumption sees expenditures fall by $31.4 billion, or 9.0 percent, and accounts for nearly 23 percent of the overall difference attributable to behavioral, screening and medical innovation. The increase in productivity due to lower smoking is $79.0 billion.

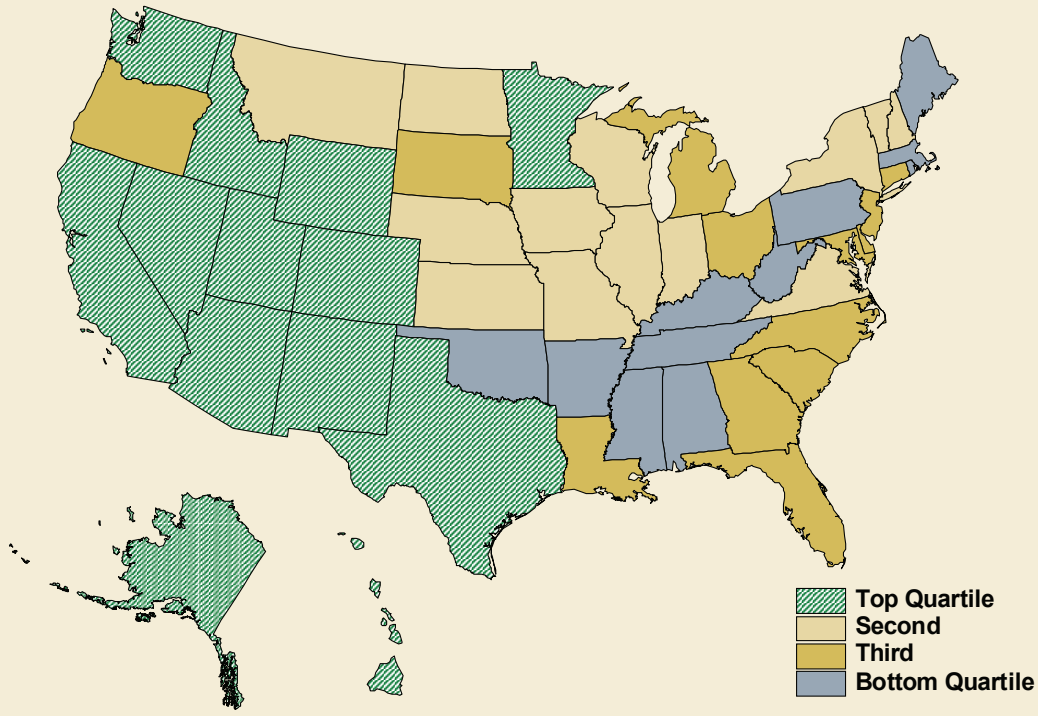
IV. Impact of Chronic Disease at the State Level

Chronic Disease Index

The prevalence of various chronic diseases and their economic impacts vary by state. To assess the burden of chronic disease across all states, we create a State Chronic Disease Index. We estimate the number of the state's population reporting each of the conditions on a per capita basis, and then benchmark each state to the state with the lowest rate. That state is assigned a composite value of 100. Thus, a state with a value of 70 means that the rate at which its population reports having one of these conditions is 30 percent worse off than the state with the healthiest population. The following map and table display the results.

The least healthy states lie in a belt of obesity and smoking that runs from the Northeast through Oklahoma.

Figure 15 :: State Chronic Disease Index



Note: States in the top quartile have the lowest rates of seven common chronic diseases.
Source: Milken Institute

Figure 16 :: State Chronic Disease Index*

State	Rank	Composite Score	State	Rank	Composite Score
Utah	1	100.00	Vermont	26	75.62
Alaska	2	96.58	Maryland	27	75.05
Colorado	3	95.29	Michigan	28	74.82
New Mexico	4	93.50	Ohio	29	74.71
Arizona	5	91.50	Oregon	30	74.48
California	6	89.83	Georgia	31	74.12
Hawaii	7	88.38	New Jersey	32	74.10
Idaho	8	87.68	North Carolina	33	74.08
Washington	9	86.43	Connecticut	34	73.28
Wyoming	10	83.13	Delaware	35	73.18
Minnesota	11	82.59	South Dakota	36	72.20
Texas	12	82.26	Louisiana	37	70.55
Nevada	13	80.80	Florida	38	70.15
North Dakota	14	80.64	South Carolina	39	68.76
Illinois	15	80.04	Massachusetts	40	68.65
Kansas	16	79.87	Alabama	41	68.59
Nebraska	17	79.61	Oklahoma	42	67.76
New Hampshire	18	79.29	Maine	43	67.60
Montana	19	79.05	Rhode Island	44	66.76
Virginia	20	77.68	Pennsylvania	45	66.37
Wisconsin	21	77.29	Mississippi	46	66.17
New York	22	77.26	Kentucky	47	65.98
Indiana	23	77.14	Arkansas	48	65.68
Iowa	24	76.91	Tennessee	49	65.31
Missouri	25	76.12	West Virginia	50	62.19

*Based upon national and regional totals from MEPS, proportioned to states, using NCI and CDC data.
Sources: MEPS, BRFSS (CDC), NCI, Milken Institute

This state-level data demonstrates linkages between risk factors and disease prevalence. Smoking, alcohol abuse, poor diet, and lack of exercise tend to be more common in states with high rates of certain diseases. State demographics and urbanization also influence disease rates; for example, urban pollution shows a statistically demonstrable impact on lung disorders. Ethnic composition plays a role, as do levels of record-keeping and reporting, and the rate at which people visit doctors. States that rank low tend to have the worst readings on behavioral risk factors, the highest percentage of elderly residents, and a demographic mix predisposed to one or more chronic diseases.

The least healthy states lie in a belt of obesity and smoking that runs from the Northeast through Oklahoma. West Virginia ranks as the least healthy state in the union. Tennessee (49th), Arkansas (48th), Kentucky (47th), and Mississippi (46th) also fare poorly. Western states score among the healthiest, led by Utah, Alaska, Colorado, New Mexico, and

Arizona. The low scores for Massachusetts and Maine result from the high incidence of cancers and, perhaps, better reporting rates. In June 2007, a study from the New England Healthcare Institute, *The Boston Paradox: Lots of Health Care, Not Enough Health,* concluded that despite having one of the leading health-care clusters in the world, Boston's residents have a surprisingly high prevalence of several types of cancers and other chronic diseases.[24]

We find that all states stand to gain in the 2023 optimistic scenario (see figure 17) , with even the less populous states, such as Alaska, avoiding 79,000 cases of chronic disease (a 16.4 percent reduction) and achieving benefits of $2.6 billion (27.0 percent) through lower treatment costs and higher productivity. Iowa avoids 351,000 cases and gains $9.9 billion in economic benefit. New Hampshire avoids 183,000 cases and gains $5.2 billion in lower treatment costs and higher levels of economic activity. Among more populous states, California avoids 4.3 million (17.6 percent) cases of chronic disease and gains $117.1 billion (27.1 percent) through lower treatment costs and higher productivity in 2023. Texas eliminates 3.2 million cases and gains $90.2 billion in economic benefit. New York benefits in a major way as well, avoiding 2.3 million cases and achieving economic benefits of $63.8 billion.

Figure 17 :: Avoidable Costs by State

Year	Number of Cases of Chronic Disease (Thousands)			Economic Burden of Chronic Disease (Direct + Indirect) (US$ Billions)		
	Total Cases, Current Path	Avoided Cases, Alternative Path	Percent Cases Avoided in 2023*	Total Burden, Current Path	Avoided Burden, Alternative Path	Percent of Economic Burden Avoided in 2023*
U.S. TOTAL**	230,724	-40,196	-17.4	4,153	-1,123	-27.0
Alabama	3,816	-681	-17.8	67	-18	-27.0
Alaska	482	-79	-16.4	10	-3	-27.0
Arizona	5,542	-944	-17.0	97	-26	-26.3
Arkansas	2,311	-410	-17.8	42	-12	-27.9
California	24,245	-4,258	-17.6	431	-117	-27.2
Colorado	2,972	-495	-16.6	55	-15	-26.9
Connecticut	2,531	-437	-17.3	44	-12	-26.6
Delaware	715	-127	-17.8	14	-4	-28.1
Florida	18,322	-3,247	-17.7	337	-91	-26.9
Georgia	7,791	-1,333	-17.1	138	-37	-26.9
Hawaii	785	-136	-17.3	15	-4	-26.4
Idaho	1,063	-183	-17.2	20	-5	-27.3
Illinois	8,407	-1,479	-17.6	150	-41	-27.1
Indiana	4,628	-808	-17.5	82	-22	-26.8
Iowa	1,967	-351	-17.9	36	-10	-27.3
Kansas	1,917	-335	-17.5	34	-9	-26.8
Kentucky	3,655	-638	-17.5	64	-18	-27.7
Louisiana	3,417	-612	-17.9	63	-17	-27.5
Maine	1,198	-204	-17.0	22	-6	-26.8
Maryland	4,584	-787	-17.2	81	-22	-27.4
Massachusetts	5,412	-893	-16.5	95	-25	-25.9
Michigan	7,984	-1,400	-17.5	135	-36	-26.9
Minnesota	3,944	-651	-16.5	74	-19	-26.2
Mississippi	2,458	-446	-18.2	46	-13	-28.1
Missouri	4,461	-794	-17.8	81	-22	-27.2
Montana	715	-123	-17.2	13	-4	-26.9
Nebraska	1,190	-206	-17.3	22	-6	-27.0
Nevada	2,222	-381	-17.1	44	-12	-27.4
New Hampshire	1,052	-183	-17.4	19	-5	-27.5
New Jersey	6,118	-1,087	-17.8	113	-31	-27.4
New Mexico	1,338	-232	-17.3	24	-6	-26.4
New York	12,697	-2,283	-18.0	232	-64	-27.5
North Carolina	7,786	-1,328	-17.1	140	-38	-26.8
North Dakota	399	-73	-18.3	8	-2	-27.9
Ohio	8,406	-1,473	-17.5	152	-40	-26.6
Oklahoma	2,763	-496	-17.9	48	-13	-27.7
Oregon	3,090	-506	-16.4	55	-14	-25.8
Pennsylvania	9,666	-1,690	-17.5	170	-45	-26.6
Rhode Island	914	-157	-17.2	16	-4	-26.5
South Carolina	3,797	-660	-17.4	71	-19	-27.1
South Dakota	575	-101	-17.6	11	-3	-27.6
Tennessee	5,394	-944	-17.5	99	-27	-27.5
Texas	18,641	-3,210	-17.2	332	-90	-27.2
Utah	1,723	-279	-16.2	30	-8	-26.0
Vermont	539	-92	-17.1	10	-3	-26.9
Virginia	6,224	-1,068	-17.2	109	-30	-27.3
Washington	4,231	-746	-17.6	80	-23	-28.2
West Virginia	1,591	-285	-17.9	28	-8	-27.2
Wisconsin	4,389	-752	-17.1	80	-21	-26.5
Wyoming	342	-61	-17.9	7	-2	-27.9

* Percentage differences in the baseline and optimistic state changes are small because the rate of change in projections for behavioral risk factors are similar.
** District of Columbia is included.

Source: Milken Institute

V. Long-Term Economic Impact: Forgone Growth

The preceding estimates of economic impact place a monetary value on the productivity losses associated with seven specific chronic disease categories and the share of these losses that could be prevented with improved health.

We now ask a different question: How much could we improve the nation's total economic output over the long term if we improve the health of the population? This analysis differs from the simpler estimates of lost productivity because it takes into account the intergenerational impacts of chronic disease and looks at these impacts in real (inflation-adjusted) terms.

Our goal is to assess the longer-term implications of poor health on the economy. Economic growth depends on the stock of human capital (a healthy and well-trained work force) and the flow of investments into education and work-based learning and training procedures. Economic Nobel Prize winner Gary Becker offers an insightful summation of the way knowledge drives innovation:

> "The continuing growth in per capita incomes of many countries during the nineteenth and twentieth centuries is partly due to the expansion of scientific and technical knowledge that raises the productivity of labor and other inputs in production. The increasing reliance of industry on sophisticated knowledge greatly enhances the value of education, technical schooling, on-the-job training, and other human capital."[25]

There has been little research to quantify the impact of poor health (chronic disease) on human and physical capital formation, or the restrictions this imposes on U.S. economic growth. Existing estimates of health's economic impact also tend to ignore the productivity growth that occurs in the long term, as returns on human capital investment accrue to subsequent generations.

Building on the twenty-year projections, we develop a multivariate analysis to assess the long-term impact on the U.S. GDP. We incorporate the intergenerational effects of health on workforce productivity. To do this, we take advantage of state-level data on economic output, chronic disease, and health status to establish the relationships between health, education, and economic growth. Using this data, we estimate how inputs—such as labor or capital—are converted to outputs of real, inflation-adjusted GDP. We account for differences among states through the use of fixed effects (factors unique to each state). This calculation, known as a production function, is able to explain more than 99 percent of the variations in real GDP growth between states, a high degree of explanatory power.

Our production function analysis incorporates the following factors as contributors to economic growth[26]:

- **Life expectancy:** Life expectancy at age 65 reflects the cumulative lifetime investment in health and is therefore particularly applicable to chronic diseases.[27] Greater investments in health and lifestyle result in greater sustained labor force numbers and higher workforce quality.
- **Education:** We look at the adult population with a bachelor's degree or greater. As noted, improvements to life expectancy increase future decisions to invest in education. This allows us to develop estimates of the intergenerational relationship between health, human capital, and economic growth.
- **Labor force size:** Those employed or actively seeking employment.
- **Capital stock:** The amount of equipment, machinery, and buildings in the economy.

We also ask how future generations would be affected by current decisions. An innovation from our research is the recognition of the dynamic feedback between health and multiple independent variables over time. The lag between improvements in health and its subsequent impact on investments in human and physical capital is more fully captured using intergenerational impacts than with the production function alone.

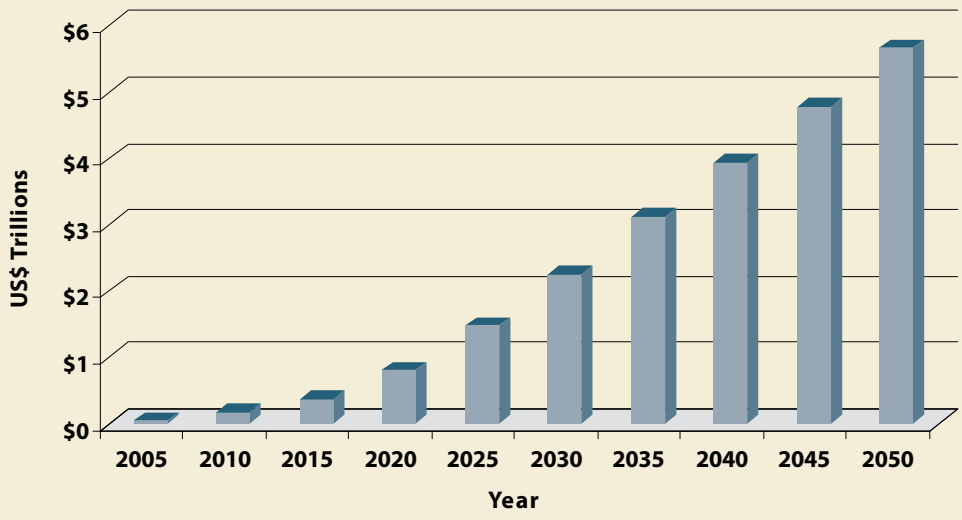
We estimate the long-term effects of investments in health and human capital by using state-level data to develop long-run elasticity estimates for labor, capital, and education that magnify the effects of improved health.[28] Please refer to the full study for a complete explanation.

Once more, we build two scenarios—baseline and optimistic—for each state, assuming in the former that current trends continue and, in the latter, that improvements take place in disease prevention, screening, and treatment. For the baseline scenario, we assume life expectancy trends consistent with the baseline chronic disease projections presented earlier. In the optimistic scenario, however, we find that the embedded investments in improved health in this generation pay off in higher real and nominal GDP levels in the middle of the century. Critically, the optimistic scenario finds that life expectancy at age 65 increases by about 0.7 year by 2023, and by 2050 it will increase 1.7 years above the baseline projection.

We then project U.S. GDP through 2050 under the baseline and optimistic scenarios. Using this method, we find that the optimistic scenario returns an impact even larger than the productivity impact estimates presented earlier. This analysis shows that potential increased economic output grows to $5.7 trillion in real terms in 2050, or a difference of 17.6 percent. Through 2050, this represents a difference slightly greater than 0.3 percent in the annual growth rate of the national economy (over the past twenty years, the annual growth rate of GDP has averaged 3.0 percent).

Figure 18 :: **Forgone Economic Output, 2005-2050**

Change in Real GDP Between Baseline and Optimistic Scenarios



Source: Milken Institute

Our findings suggest that unless projections of economic performance account for the interaction of health and other variables, they are likely to result in an underestimation of future GDP—by double-digit percentages. Further research on the dynamic interaction between health and human and physical capital is warranted.

VI. Implications

This report quantifies the staggering costs for the national economy, and to employers, of failing to address the rising costs of chronic disease. It differs from the majority of research, which generally addresses the costs of specific diseases for individuals, government programs, or society as a whole.

While our focus on aggregate economic impact dictates a different methodological approach, our results are generally consistent with other published estimates for treatment expenditures and productivity losses. Our findings on the long-term impacts of improvements in health are also consistent with the few published studies of this kind. A study by Murphy and Topel, for example,[29] found even more dramatic savings, concluding in 2003 that a 10 percent reduction in mortality from heart disease would have a value of $5.5 trillion to current and future generations, while a 10 percent reduction in mortality from cancer would be worth $4.4 trillion.

Good health is an investment in economic growth.

The clear implication of our findings is that good health is an investment in economic growth**.** The United States faces an increasingly competitive global economy, and our national economic performance is closely tied to our ability to maintain the best-educated, most highly trained, and healthiest work force. While it is well understood among policy-makers that economic growth is dependent on investments in human capital, the importance of good health in maintaining a competitive work force is frequently ignored. Better health leads to greater investments in education, resulting in higher levels of human capital—which in turn causes wealth to increase in a virtuous cycle of economic growth.

During the past twenty-five years, the United States has made remarkable progress in reducing death and disability attributable to many chronic diseases. Behavioral changes—especially the reduction in smoking—and early screening and innovations in medical technology and interventions are responsible for the improvement. Yet much remains to be accomplished to diminish the deleterious impacts on the quality and length of life. To that end, we offer two recommendations for change:

- **The incentives in the health-care system should promote prevention and early intervention.** Employers, insurers, governments, and communities need to work together to develop strong incentives for patients and health-care providers to prevent and treat chronic disease effectively. In many respects, we've received what we paid for: a tiny fraction of health-care spending is devoted to the promotion of healthier behavior, despite the fact that preventable chronic diseases are linked to smoking, obesity, lack of exercise, and drug and alcohol use.

- **As a nation, we need to renew our commitment to achieving a "healthy body weight."** Increasing obesity rates threaten to send treatment costs for diabetes and related conditions, such as heart disease and stroke, soaring over the next twenty years. There needs to be a strong, long-term national commitment to promote health, wellness, and healthy body weight.

The rise in chronic disease is costing us lives, quality of life, and prosperity. Our current health-care debates focus primarily on the extension of coverage and the design of efficient financing mechanisms. Equal attention should be paid to addressing the rising rates of chronic illness that will sap our productivity and drive our health-care costs needlessly higher. Our results show that even modest reductions in the burden of disease would yield dividends not just in lower health-care costs, but in higher productivity and economic output.

Our analysis should be seen as a contribution toward a sorely needed national discussion on health-care spending and chronic disease. The rise in chronic disease is an under-appreciated factor in pushing health-care costs higher. Further research will add additional precision and knowledge on the multiple personal, societal, and economic costs of chronic disease, as well as opportunities to reduce or avoid these costs.

Figure 19 :: Summary of Treatment Expenditures and Lost Economic Output

Selected Chronic Disease	2003				2023 -- Current Path				2023 -- Alternative Path				Avoidable in 2023			
	Population Reporting Condition (Millions)	Treatment Expenditures (US$ Billions)	Lost Economic Output (US$ Billions)	Total Economic Impact (US$ Billions)	Population Reporting Condition (Millions)	Treatment Expenditures (US$ Billions)	Lost Economic Output (US$ Billions)	Total Economic Impact (US$ Billions)	Population Reporting Condition (Millions)	Treatment Expenditures (US$ Billions)	Lost Economic Output (US$ Billions)	Total Economic Impact (US$ Billions)	Population Reporting Condition (Millions)	Treatment Expenditures (US$ Billions)	Lost Economic Output (US$ Billions)	Total Economic Impact (US$ Billions)
Cancers	10.6	48.1	271.2	319.3	17.2	146.3	959.6	1,105.9	14.1	108.9	586.5	695.4	3.1	37.4	373.1	410.4
Breast Cancer	1.1	5.5	30.8	36.3	1.7	15.6	102.3	117.8	1.5	12.4	66.6	79.0	0.2	3.2	35.6	38.8
Colon Cancer	0.3	3.9	21.9	25.8	0.4	10.6	70.4	81.0	0.4	7.9	42.7	50.6	0.1	2.7	27.7	30.4
Lung Cancer	0.4	6.3	35.3	41.6	0.5	16.1	105.9	122.0	0.4	11.9	63.9	75.8	0.1	4.2	42.0	46.2
Prostate Cancer	1.0	4.3	23.8	28.1	1.8	14.2	93.4	107.6	1.4	10.1	54.6	64.7	0.4	4.1	38.8	42.9
Other Cancers	7.7	28.0	159.4	187.4	12.7	89.7	587.7	677.4	10.4	66.6	358.7	425.3	2.3	23.1	228.9	252.0
Pulmonary Conditions	49.2	45.2	93.7	138.9	64.6	118.2	265.4	383.6	55.5	92.0	218.3	310.3	9.1	26.2	47.1	73.3
Diabetes	13.7	27.1	104.7	131.8	21.0	79.7	350.1	429.9	18.2	62.6	277.5	340.0	2.8	17.1	72.7	89.8
Cardiovascular Diseases	58.3	110.8	406.3	517.1	81.3	310.7	1,219.0	1,529.7	61.8	201.8	895.1	1,096.9	19.5	108.9	323.9	432.8
Hypertension	36.8	32.5	279.5	312.0	51.1	88.1	838.7	926.9	41.6	64.9	666.3	731.2	9.6	23.3	172.4	195.7
Heart Disease	19.1	64.7	104.6	169.3	27.0	186.0	318.9	504.8	17.7	110.1	181.7	291.8	9.4	75.9	137.1	213.0
Stroke	2.4	13.6	22.1	35.7	3.1	36.6	61.4	98.0	2.5	26.9	47.1	73.9	0.6	9.7	14.3	24.0
Mental Disorders	30.3	45.8	170.9	216.7	46.7	135.2	568.5	703.7	40.9	107.2	480.2	587.3	5.8	28.0	88.3	116.3
Total	162.2	277.0	1,046.7	1,323.7	230.7	790.0	3,362.6	4,152.6	190.5	572.4	2,457.6	3,030.0	40.2	217.6	905.0	1,122.6

Sources: Milken Institute, MEPS, NHIS

Endnotes

1. *Chronic Conditions: Making the Case for Ongoing Care*, ed. Johns Hopkins University Partnership for Solutions (Baltimore: September 2004 update).
2. Earl S. Ford et al., "Explaining the Decrease in U.S. Deaths from Coronary Disease, 1980–2000," *The New England Journal of Medicine* 356 (2007).
3. See Kenneth E. Thorpe, Curtis S. Florence, and Peter Joski, "Which Medical Conditions Account for the Rise in Health Care Spending? The Fifteen Most Costly Medical Conditions Accounted for Half of the Overall Growth in Health Care Spending between 1987 and 2000," *Health Affairs* (2004). See also Kenneth E. Thorpe et al., "The Impact of Obesity on Rising Medical Spending: Higher Spending for Obese Patients Is Mainly Attributable to Treatment for Diabetes and Hypertension," *Health Affairs* (2004).
4. Diabetes prevalence has nearly doubled, rising from a low of 3.91 per 100,000 people in 1990 to a rate of 7.72 per 100,000 people in 2003. This rate suggests a strong causal relationship with the risk factor of obesity. During the period from 1990 to 2003, the percentage of the U.S. population classified as obese—rather than simply overweight—rose from 12.81 percent to 22.81 percent. Based on Behavioral Risk Factor Surveillance System (BRFSS) self-reported rates, which under-report actual rates.
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6. K. M. Venkat Narayan et al., "Lifetime Risk for Diabetes Mellitus in the United States," *Journal of the American Medical Association* 290, no. 14 (2003).
7. We use the category in the MEPS database called mental disorders. This category includes anxiety disorders, schizophrenia, senility, other psychoses, and substance-related disorders. It excludes Alzheimer's and other hereditary and degenerative neurological disorders.
8. McGinnis and Foege, "Actual Causes of Death in the United States."
9. Ford et al., "Explaining the Decrease in U.S. Deaths from Coronary Disease, 1980–2000." *Journal of the American Medical Association*.
10. In aggregate, the analysis includes the costs of secondary effects if they occur in one of the seven diseases studied. For example, if a patient with diabetes later develops heart disease as a consequence, those costs are captured in the heart disease costs and in our totals, but not shown as related to diabetes.
11. American Diabetes Association. "Economic Costs of Diabetes in the U.S. in 2002." *Diabetes Care*, March, 2003; 26(3): 917–932. Note that if comorbidity costs are removed, the ADA study produces a direct cost of $23.2 billion, the MEPS total for the same year.
12. Five diseases—breast, colon, lung, prostate, and "other" cancers—are not included in the MEPS summary tables, but we use MEPS data files for numbers of Population Reporting a Condition (PRC) by site of services to estimate expenditures and PRC for these diseases.
13. PRC is population reporting condition as used by Cohen and Krause at AHRQ and other researchers, but stems from the total number of people accounting for expenditures by site of service in MEPS.
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15. "The Hidden Competitive Edge: Employee Health and Productivity," (Newton, Massachusetts: Employers Health Coalition, 2000).
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17. Calculations were also performed using a wage-based approach; when measured in wages, as opposed to GDP, the productivity loss totaled $464.0 billion for the year. Most analyses of the indirect impacts of chronic disease base their estimates on average wages. Wages are the most accurate measure for evaluating the value of lost work hours or productivity at the margin to an individual employee. But GDP per employee is more accurate for evaluating the marginal loss to the firm or to the economy overall.
18. National Cancer Institute, "Cancer Trends Progress Report," (2005).
19. Department of Health and Human Services, "Diseases and Conditions." See: http://www.hhs.gov/diseases/index.html (accessed September 13, 2007).
20. Changes in the price level, or inflation.
21. "Smoking 101 Fact Sheet," American Lung Association. See: http://www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=39853 (accessed May 3, 2007).
22. The cumulative difference in lost productivity, using a wage-based method rather than a GDP-based method, totals $3.0 trillion.
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27. Some statistical projections use life expectancy at birth, but this is generally used to proxy a country's health and poverty, and seems less appropriate for a leading economy.
28. We see from separate state cross-sectional regressions that a 1.0 percent increase in life expectancy at age 65 is associated with a 1.8 percent increase in the percent of the adult population with a bachelor's degree or above.
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Ross DeVol is Director of Regional Economics and the Center for Health Economics at the Milken Institute. He oversees the Institute's research on the dynamics of comparative regional growth performance, and technology and its impact on regional and national economies. DeVol authored the ground-breaking study *America's High-Tech Economy: Growth, Development, and Risks for Metropolitan Areas*, an examination of how clusters of high-tech industries across the country affect economic growth in those regions. He also created the *Best Performing Cities Index*, an annual ranking of U.S. metropolitan areas that shows where jobs are being created and economies are growing. His most recent work involves the study of biotechnology and other life science clusters, and the impact these industries have on regional economies. He was the lead author of *Mind-to-Market: A Global Analysis of University Biotechnology Transfer and Commercialization,* released in September 2006, which looked at the commercialization of university-developed intellectual property on a global basis, with particular focus on the field of biotechnology. Prior to joining the Institute, DeVol was senior vice president of Global Insight Inc. (formerly Wharton Econometric Forecasting), where he supervised the Regional Economic Services group. He was the firm's chief spokesman on international trade. He also served as the head of Global Insight's U.S. Long-Term Macro Service and authored numerous special reports on behalf of the U.S. Macro Group. He has been ranked among the "Super Stars" of Think Tank Scholars by *International Economy* magazine.

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