

THE DIABETES EPIDEMIC: The Case for Changing Diabetes

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Barriers to Chronic Disease Care in the United States of America: The Case of Diabetes and its Consequences

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EXECUTIVE SUMMARY

Purpose of This Report

This report highlights the impact of chronic diseases on the health of Americans and the economy. Diabetes is shown in this report to be a powerful indicator of the country's systemic failures of chronic disease prevention and treatment. The principle barriers to optimal chronic disease management are identified with a view to stimulating action to address them.

Chronic Diseases in the United States

Despite steady improvements to the overall health of Americans during the last several decades, the burden of chronic diseases continues to grow. Chronic diseases and their risk factors currently account for the greatest share of premature death and disability in the United States and throughout the world. Without proper and ongoing medical management, these long-term conditions can impose considerable hardships on the health and economic status of sick individuals, their families, communities and the nation.

Fortunately, several low-cost and efficacious treatments have emerged within the past decade that can help prevent and delay the onset of many of these harmful diseases. Yet today, many of the 100 million patients with chronic diseases in the United States reportedly receive inadequate treatment, and preventive measures are not adequately implemented. Considerable gaps exist between clinically recommended care and the actual patterns of health care use.

Diabetes, a serious and costly chronic disease, is an indicator of the failure of the United States health care system to adequately prevent and treat chronic disease. Within the last five years, the number of people with diabetes has increased 22 percent to 20.8 million. If the system remains unchanged, in 2025:

- an estimated 50 million people (15 percent of the population) will suffer from diabetes, more than double the current number;
- more people will die from a diabetes-associated death (622,000) than died in 2002 from the top six killers combined;
- three times more people every year will lose their sight, lose a limb or lose function of their kidneys because of diabetes (70,000, 239,000 and 119,000 respectively); and
- diabetes will cost America \$351 billion (calculated in 2002 dollars) in direct medical and indirect societal costs, more than double the amount we are currently spending.

Only a very small fraction of existing diabetes patients receive care that meets the guidelines of the American Diabetes Association.



What are the economic costs associated with the failure to adequately treat chronic diseases? What do the shortcomings in diabetes care reveal about the chronic disease care system as a whole? Are there unrealized opportunities to augment the effectiveness and efficiency of chronic disease management? What are the major barriers to improving chronic care and prevention while containing costs?

This report summarizes and analyzes these critical questions and addresses three focal areas:

- Health and economic burdens of chronic disease
- United States health system failures to manage chronic diseases
- Barriers to improvement of chronic care and prevention

Health and Economic Burdens of Chronic Disease

Conclusion #1. Diabetes growth will dramatically increase in the next 20 years, and diabetes will likely be the No. 1 killer in America.

Conclusion #2. Obesity is to Type 2 diabetes what tobacco is to lung cancer.

Conclusion #3. The rise of diabetes threatens past progress on cardiovascular and other diseases.

Conclusion #4. Chronic diseases negatively impact the labor supply and productivity of the United States, with total costs estimated to account for 6.8 percent of gross domestic product.

Conclusion #5. Curtailing the growth of obesity and, as a result, diabetes will require a new generation of integrated structural interventions focused on environmental changes.

United States Health System Fails to Manage Chronic Diseases

Conclusion #1. There is growing evidence that patients with a wide range of chronic diseases fail to receive adequate treatment.

Conclusion #2. Current approaches to health promotion and the prevention of cardiovascular disease, cancer, and diabetes do not draw on the preventive potential of the existing state of knowledge.

Conclusion #3. Systems of chronic care management or disease management may not directly address the important challenges of patients with chronic diseases who need sustained, coordinated care.

Barriers to Improvement of Chronic Care and Prevention

We have identified six systemic barriers to the improvement of chronic care in the United States: the orientation of the health care system towards providing



acute care, the orientation of the health care system towards physicians providing health care, insufficient quality measures for chronic care, the direction and focus of research related to chronic diseases, current reimbursement patterns, and the undervaluation of preventive approaches.

Barrier #1. The orientation of the U.S. health system favors acute care, not chronic care. Historically, the U.S. health system has been structurally oriented toward reactionary, tertiary, acute, institution-based care. This focus does not correspond to chronic disease patients' central needs for long-term coordinated care.

Barrier #2. The health system primarily delivers care through on-site, acute, episodic physician visits. In general, the focus of care for the chronically ill needs to shift away from high-intensity, acute and episodic interventions to a patient-primary care provider (PCP) partnership where PCPs coordinate a team of non-physician health professionals and specialists, when appropriate, to assist the patient in consistent self-management.

Barrier #3. The health system lacks adequate chronic disease care quality benchmarks and best practices. Current quality benchmarks do not adequately reflect the complexity of chronic diseases, particularly interventions in the home and community and the permutations associated with multiple chronic disease. Quality measures for patients with chronic disease must reflect the patients' long-term goals, which include reducing disability, improving quality of life and reducing mortality. Validated processes to achieve quality benchmarks (i.e., best practices) are also needed.

Barrier #4. Health services research is anemic—undervalued and underfunded. The American research infrastructure is world class in innovation when it comes to new drugs and devices. While this component of an overall research strategy is undeniably important, an equivalent investment in better health systems, improved adherence to therapy and innovative use of information technology is needed.

Barrier #5. Cost-reimbursement arrangements do not create sufficient incentives for prevention, long-term chronic disease management, or continuity of coverage and care. Reimbursement patterns are a central part of an acute care bias in two ways. First, most insurance plans prioritize the physician-patient office encounter in reimbursement systems, rather than allowing for multiple interventions by a range of health professionals. Second, higher reimbursement levels that inadvertently encourage high-cost procedural interventions and higher compensation levels encourage doctors to specialize.

Barrier #6. Health promotion and the prevention of chronic diseases and their risk factors are undervalued. System-wide changes that build on multi-stakeholder approaches to tackling the barriers described above are urgently needed and would lead to better health for Americans and a more



productive society. The many well-intentioned initiatives by government, industry and civil society to address specific chronic diseases or their totality would be more effective if brought under a common vision and action plan. Diabetes offers a rallying call and a strategic starting point for such action. Progress in reducing the incidence of diabetes, its complications and its death rate would have widespread implications for chronic health systems well beyond the disease itself.



PREFACE

This report was prepared in response to a request by Novo Nordisk, USA. Derek Yach was responsible for the overall design and content of the report. William R. Rowley and Clement Bezold from the Institute for Alternative Futures offered vital analysis on the diabetes trends that influenced many of the fundamental conclusions. Stephen S. Cha, Joseph S. Ross, Elizabeth H. Bradley and Harlan M. Krumholz played major roles in the development and conceptualization of the barriers to improved chronic diseases in general, while David Stuckler reviewed the current economic and epidemiologic evidence and Erica Fagnan completed analyses related to comorbidity and the position of the United States relative to other countries. The team drew upon a diverse range of available research and consulted with several experts who are knowledgeable and active in the field of chronic disease prevention and control, including Ed Wagner, Karen Pollitz, Sheri Pruit and Joanne Epping-Jordan. Their inputs are acknowledged and appreciated.



1. Introduction: Overview of Chronic Disease Care in the United States

Chronic diseases, among them cardiovascular disease, cancer and diabetes, are the leading causes of premature death and disability in the United States. Every year these illnesses claim the lives of more than 1.7 million Americans. It is estimated that chronic diseases cost the United States nearly 18.8 million years of life lost.¹ The total economic cost for medical care and lost productivity is \$700 billion, or 6.8 percent of the 2003 gross domestic product.²

Although the United States has made tremendous strides within the past decade in improving its citizens' health, progress toward reducing the burden of chronic diseases has been limited. While mortality rates for some chronic diseases, such as cardiovascular disease, have been slowly falling as a result of prevention efforts and improvements in medical treatments, the mortality rate for other chronic diseases, such as diabetes and chronic obstructive pulmonary disease (COPD) have been dramatically increasing.³ Despite sizeable mortality rate declines of 7.2 percent and 17.0 percent for cancer and cardiovascular diseases from 1991 to 2000, the total number of deaths rose by 22.5 percent and 7.4 percent, respectively.^{4, 5}

As the occurrence of chronic diseases continues to rise with upward demographic shifts, the accompanying health and economic burdens can be expected to rise as well. In the past three decades, the number of cardiovascular operations performed has increased by 470 percent.⁶ The American Diabetes Association estimates that the direct medical costs due to diabetes have more than doubled, from \$44 billion in 1997 to \$92 billion in 2002. Indirect and direct medical costs due to diabetes totaled \$132 billion in 2002.⁷

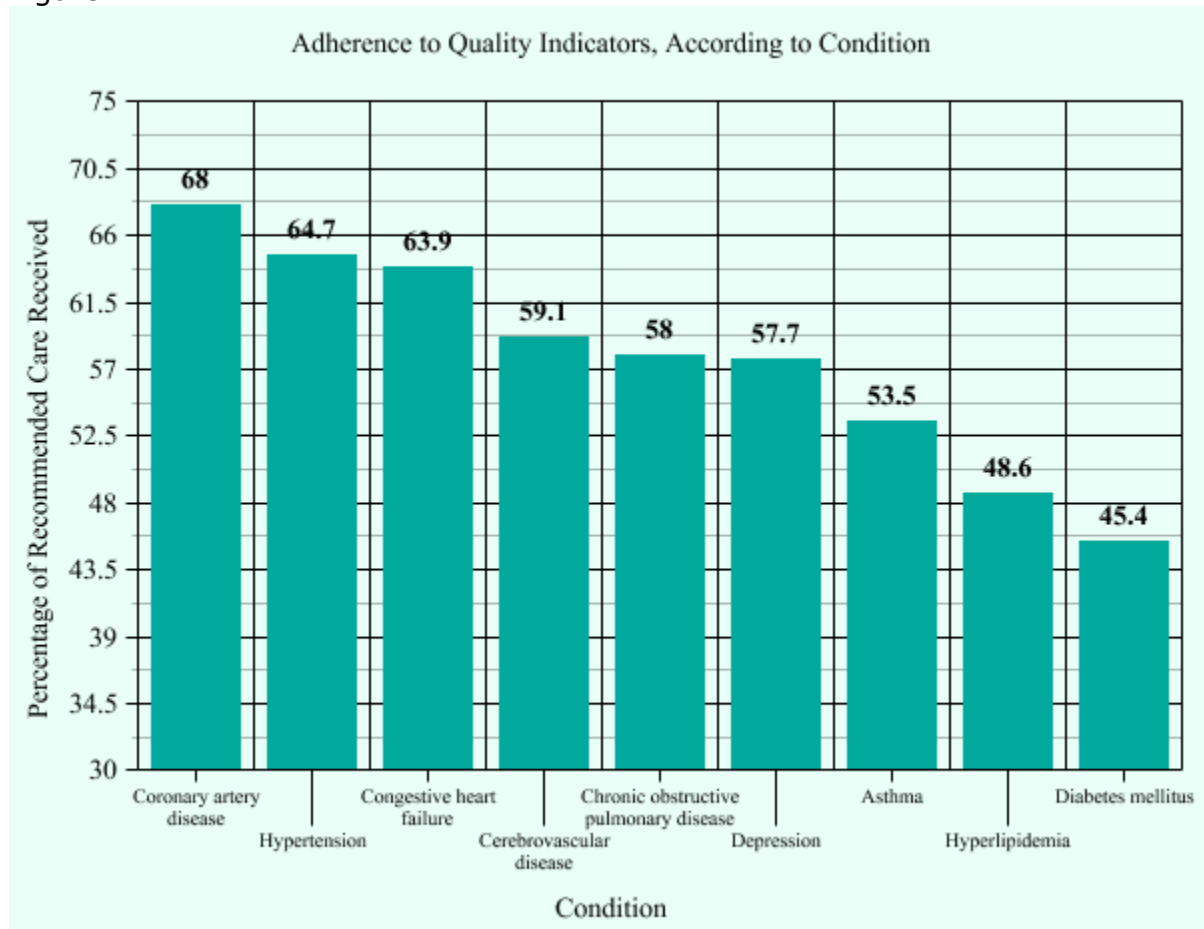
In order to curtail the explosive growth of medical care costs in the United States, several influential bodies, such as the Institute of Medicine, have recently emphasized the importance of developing strategies to improve quality of care while containing costs.⁸ Such challenging initiatives arrive in the midst of a crisis in chronic disease care in the United States. A 2004 joint-venture report written on behalf of the American Cancer Society, American Heart Association and American Diabetes Association indicates that current chronic disease control efforts are "underfunded and fragmented."² The majority of individuals with chronic diseases report difficulties accessing the health care that they need: 38 percent are unable to afford a necessary service, 19 percent report that needed services are unavailable, 15 percent lack transport to the site of care provision, and 13 percent consider the quality of a service too poor to make its use worthwhile.^{9,10}

Moreover, adults in the United States are estimated to receive only 55 percent of recommended preventive care and 56 percent of recommended



chronic disease care. In the case of diabetes and hyperlipidemia, patients received recommended care less than half the time.¹¹ (Figure 1)

Figure 1



Source: 11. McGlynn, E.A., Asch, S.M., Adams, J., Keesey, J., Hicks, J., et al. "The quality of healthcare delivered to adults in the United States." *New England Journal of Medicine*. 348:2635-2645. 2003.

Not surprisingly, there is an accumulating body of evidence that the United States is falling short of responding to the challenge of chronic disease control. Many patients with chronic diseases fail to receive adequate treatment that can prevent and reduce costly morbidity and mortality.^{12, 13, 14, 15, 16, 17, 18, 19, 20} Several researchers stress the need to identify mechanisms at the patient, provider and health care system levels to improve the quality of chronic disease care, as well as identify integrative ways of delivering care that meet recommended standards and balance the cost requirements.^{9, 19, 21}

Diabetes, a serious and costly chronic disease,²² is an exemplary case of the failure of the current health care system to detect, treat and prevent



complicated chronic diseases. Within the last decade, the incidence of diabetes increased by 60 percent, with an incidence of approximately 1.5 million new cases each year. Today, an estimated 20.8 million people are living with diabetes in America. Over 6 million of those people do not know they have diabetes.⁷ By 2025, America may realistically have as many as 50 million people living with diabetes.²³ Researchers colorfully portray the overall quality of diabetes care in the United States as “varied,”^{9, 24} “sub-optimal”²⁰ and even “poor.”¹⁹ And despite the emergence of several promising, efficacious and cost-effective treatments, a considerable implementation gap remains between the patterns of care use and the practices recommended for optimal care.¹⁹

What do the above shortcomings reveal about the opportunities for improving the chronic health system as a whole? Are there unrealized opportunities to improve the effectiveness of chronic disease management while containing costs? Better understanding of the factors that are limiting progress in diabetes care may help enhance care for chronic diseases overall. To date, there has been very little evaluation done of the quality of diabetes care in the United States.¹⁹

The main purpose of this report is to examine the current state of knowledge about the care for those with chronic diseases, with an emphasis on diabetes. Section 2 reviews the current health and economic burdens associated with diabetes in the context of chronic diseases. In Section 3, we highlight the key treatment failures impeding effective and efficient chronic disease care, and in Section 4 we explore the major barriers facing chronic disease care.



SECTION 2. HEALTH AND ECONOMIC BURDENS OF CHRONIC DISEASES

I. Health Impact of Chronic Disease

Chronic diseases are harmful conditions that require comprehensive health services and extensive medical management to effectively reduce the burden of morbidity and mortality. Within the next three decades, the number of people in the United States with at least one chronic condition is projected to rise from 100 million to over 150 million, based almost entirely on the graying of the population and not on the other barriers outlined in this paper.²⁵

Chronic disease causes death. Table 1 presents the trends in death rates for the six leading causes of death in the United States, adjusted for the effects of aging. Of the top six killers in America, four are chronic diseases.³

Change in the mortality rate is a good metric of progress toward combating disease. Within the past 30 years, there have been sustained declines in the death rate from heart disease and many cancers— 52 percent and 2.7 percent respectively. These gains can likely be attributed to steady declines in tobacco use, changes in the levels of saturated fat and salt in the diet, and improved access to effective health care for many. Although these gains appear promising, the progress made toward reducing the burden of chronic diseases threatens to mask other very disturbing statistics, such as the growing rates of chronic obstructive pulmonary disease and diabetes.³ The rate of COPD has increased by almost 103 percent since 1970, and the diabetes rate has increased by 3.2 percent. The rise of COPD is almost entirely attributable to the high smoking rates of the 1960s and 1970s. Since tobacco use in the United States has declined precipitously since that time, these death rates are expected to be on a downward trajectory.²⁶ In the case of diabetes, however, the actual number of cases is likely to be much higher, as studies have found only about 35 percent to 40 percent of descendants with diabetes have it listed on their death certificate, and only about 10 percent to 15 percent have it listed as the underlying cause of death.⁷



Table 1. Trends in Age-Standardized Death Rates for the Six Leading Causes of Death in the United States

	Death Rate		
	1970	2002	% Change
All Causes	1242.2	844.6	-32.0
Heart Disease	502.6	240.5	-52.1
Cancer	198.8	193.5	-2.7
Stroke	151.9	56.1	-63.1
COPD	21.4	43.4	102.8
Accidents	62.5	36.9	-41.0
Diabetes Mellitus	24.6	25.4	3.2

Source: Jemal, A., Ward, E., Hao, Y., Thun, M. "Trends in the Leading Causes of Death in the United States, 1970-2002." *JAMA*. 294(10): 1255-1259. 2005.

The era of population growth and longevity that America is experiencing naturally increases the total number of deaths for each of the leading six causes. Mortality rates are considered to be the best metric of progress against diseases.

The increase in diabetes mortality embodies a more challenging and concerning phenomenon. The key population determinants of diabetes—overweight/obesity and aging—are likely to persist into the future. To date, there is not a single country that has successfully curtailed the rise of obesity, and the unremitting upward demographic shifts in the United States will continue for decades.

In addition, the risk factors for chronic disease are increasingly being observed in children, which leads to an increase in chronic diseases among adults.²⁷ The impact of the growth in risk factors and chronic diseases in America's youth has been so pronounced that scientists are now predicting that children today may not achieve the life expectancy of their parents due to the escalating risks for chronic diseases as a result of unhealthy lifestyles. If this occurs, it will be the first time in American history that the life expectancy rate will have declined.

II. Scope of Prevention and Treatment for Chronic Diseases

Chronic diseases strongly relate to behavioral risk factors such as smoking, physical inactivity and unhealthy dietary patterns that tend to precede and exacerbate traditional risk factors such as raised blood pressure, cholesterol and blood glucose levels. Since the accumulation of damage from behavioral risk factors to the point of clinical relevance (such as the path from tobacco



use to lung cancer) often requires decades, most chronic diseases tend to first manifest in people toward middle and later stages of life.

Once the clinical stage of the disease progression has been reached, chronic diseases are less or no longer amenable to curative intervention, and instead require careful “maintenance management” to suppress the disability associated with the co-symptoms and morbidities that accompany them. These palliative treatments have been shown to considerably reduce the risk for costly disease complications and acute events such as stroke or myocardial infarction. In this regard, the successful reduction of risk factors for chronic diseases is equivalent to prevention of disease, and the treatment of clinical disease is equivalent to the prevention of acute episodes.

Since the uptake of chronic disease exacerbates the risk for other long-term diseases, diseases tend to occur in multiples. For example, diabetes patients are two to four times more likely than non-diabetics to have heart disease.²⁸ In 2001, it was estimated that one-third of all middle-aged and two-thirds of all elderly Americans had two or more chronic conditions.²⁹ The complications and comorbidities associated with chronic diseases are often protracted illnesses that necessitate and complicate treatment. In such scenarios where a chronic disease state is an etiological factor of other forms of disease, the patient has a combination of developing diseases that require individualized treatment regimens to be coordinated by health care providers. The intertwined networks of symptoms and sicknesses impose substantial costs on the health care system as patients are ping-ponged from one specialist to another. Box 1 summarizes the most frequently occurring patterns of coexisting chronic conditions in the United States.



Diabetes Forecasts to 2025 and Beyond: The Looming Crisis Demands Change

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INTRODUCTION

If recent trends in obesity and diabetes continue, we face a very challenging and tragic future. This report considers how bad the growth of obesity and diabetes might get. We look at the best recent data and forecasts for the long-term future. Then we provide a range of extrapolative Diabetes Crisis Forecasts for 2050. Finally, we calculate the comorbidities and costs associated with the growth of diabetes.

The Diabetes Crisis Forecasts describe the course we are on if we do not change. To repeat—these forecasts will only prove right if we do not change. The Diabetes Crisis Forecasts will be part of a larger set of diabetes scenarios that the Institute for Alternative Futures will release in 2006. The full set of diabetes scenarios will explore more positive developments and more hopeful paths that identify how diabetes can be prevented and controlled.

OVERVIEW OF 2025

In 2025, America will be struggling with the serious consequences of the twin epidemics of obesity and diabetes. Unfortunately, individuals and institutions will have changed their behaviors little in the past 20 years, and will have missed several opportunities to address the root causes of obesity and diabetes. They will have failed to lessen the impact of these twin epidemics on their health, their lives and their communities. The following bullets tell the key elements of the story if we do not change, leaving to the reader the task of filling in the details of the personal pain and societal suffering caused by these twin disasters. Given current conditions and recent trends in obesity and diabetes, our forecasts for the U.S. suggest the following:

- In 2025, 50 million people will suffer from diabetes, of which 35 million will be diagnosed and another 15 million will be undiagnosed. This is more than double the 2005 figure of 20.8 million people with diabetes. Almost 15 percent of Americans will have the disease in 2025.
- In 2025, diabetes will contribute to 622,000 deaths—triple the number of deaths attributed to diabetes than in 2000.
- In 2025, 70,000 people with diabetes will develop blindness, 119,000 will experience renal failure, and 239,000 will have lower extremity amputations. These numbers are three times higher than in 2000.
- In 2025, diabetes will cost America \$351 billion (calculated in 2002 dollars) in direct medical and indirect societal costs, more than double the amount we are currently spending.

- In 2025, up to 80 percent of Americans will be overweight (body mass index (BMI) of 26 or greater—meaning at least 26 percent of body weight is fat) and 50 percent will have progressed to obesity (BMI of 30 or greater). The lifetime risk of being overweight or obese is higher for minorities.
- Given the increase in obesity by 2025, the lifetime risk of getting diabetes for those Americans born in the year 2000 will be over 40 percent, ranging from 30 percent for white males to 60 percent for Hispanic females.
- In 2025, the average person with diabetes will die 15 years prematurely and suffer a disease burden of over 20 quality-adjusted life years (QALYs) lost. Black females with early onset of diabetes in their 20s will lose 19 years of life and about 30 QALYs.
- Huge socioeconomic and ethnic disparities will remain in 2025 and result in much higher morbidity and early mortality rates for blacks and Hispanics.
- Due to a complacent society, with all segments avoiding responsibility in an increasingly “obesogenic” environment, the economy in 2025 will be crippled and the well-being of all citizens will be severely degraded—a situation that did not have to happen.

These Diabetes Crisis Forecasts are more severe than previously projected by earlier studies, as explained in the next section.

DETAILED DIABETES CRISIS FORECASTS FOR 2025 AND 2050: CURRENT CONDITIONS EXTENDED

Dramatic Growth in Diabetes

Diabetes is an epidemic in America, with over 1.5 million new cases occurring in 2005.ⁱ In a recent New England Journal of Medicine article, KMV Narayan and his colleagues note that a male born in 2000 has almost a one in three chance of developing diabetes during his lifetime, and females fare worse, with a two in five chance. The chances are even worse for minorities: one out of two blacks and Hispanics born in the year 2000 will get diabetes.ⁱⁱ Management of the disease is made more difficult by many serious complications, and life expectancy is often shortened by 10 to 20 years. In some cases, life expectancy is shortened even more.ⁱⁱⁱ

The epidemic of diabetes is directly tied to the explosion of obesity in America. Currently, two-thirds of adults are overweight and almost one-third are obese. (A person is defined as obese when more than 30 percent of their body weight is fat.)^{iv} A recently published report from the ongoing Framingham heart study, which has been carefully monitoring adults in a community for over 30 years, concluded that eight out of 10 Americans will become overweight and one in two can expect to advance to obesity during their lifetime.^v It will be even worse for minorities. These trends imply that the diabetes epidemic will become much more severe over time unless Americans take dramatic action now. If our attitudes, behaviors and systems remain unchanged, what will be the impact of diabetes in 2025 and 2050? We will explore that below.

The Centers for Disease Control and Prevention (CDC) estimates there were 14.6 million Americans with diagnosed diabetes in 2005 based on national interview surveys.^{vi} This is a significant increase from the 5.8 million in 1980, 10.5 million in 1998 and 13 million in 2002.^{vii viii} Another 6.2 million are estimated to have undiagnosed diabetes in 2005, for a total of 20.8 million with the disease.

The best recent study of the long-term trend in diabetes prevalence to 2050 is by Amanda Honeycutt, et al., which uses sophisticated modeling weighing changes in population, age, sex and ethnic groups over time.^{ix} The study projects an increase in diagnosed diabetes from 12 million in 2000 to 39 million in 2050. However, recent increases in the prevalence rate and the number of persons with diabetes have been about 5 percent per year for the past few years, much higher than the earlier trends Honeycutt, et al. used developing their model. It is likely that the Honeycutt forecasts, which assume a 3 percent annual growth in diabetes prevalence from 2000 to 2010, underestimate the number of people with diabetes in 2025 and 2050. Therefore, a model was created with 5 percent annual growth in prevalence rates between 2000 and 2010, followed by a gradually declining increase thereafter, in parallel with Honeycutt et al. but 0.75 percent higher. This is

referred to as the Diabetes Crisis Forecasts. A detailed explanation of both methodologies is included in Appendix A.

There Will Likely Be 50 Million People with Diabetes in 2025 and 86 Million in 2050

The number of diagnosed, undiagnosed and total cases of diabetes in 2025 and 2050 according to the Honeycutt paper and the Diabetes Crisis Forecasts are presented in Table 1.

Table 1. Total Number of People with Diabetes in 2025 and 2050 According to Honeycutt et al. and the Diabetes Crisis Forecasts

Prevalence Assumption	# Diagnosed	# Undiagnosed (30% of total)	Total # with Diabetes
Honeycutt			
2025	27,190,000	11,650,000	38,840,000
2050	39,040,000	16,730,000	55,770,000
Diabetes Crisis Forecasts			
2025	35,000,000	15,000,000	50,000,000
2050	60,250,000	25,820,000	86,070,000

In 2025 70,000 People with Diabetes Will Develop Blindness, 119,000 Will Experience Renal Failure, and 239,000 Will Receive Lower Extremity Amputations

Elevated blood sugar and associated comorbidities of hypertension and abnormal cholesterol and triglycerides take a severe toll on blood vessels and nerves, with resulting blindness, renal failure, amputations and cardiovascular events.

Table 2 extrapolates current incidence rates of major complications out to 2025 and 2050 using the Diabetes Crisis Forecasts model.^x It shows the huge burden on Americans and their health care system if current trends continue.

Table 2. Projections of the Annual Incidence of Major Diabetic Complications

Annual New Complications	Blindness	Renal Failure	Amputation
2000	24,000	41,046	82,000
Honeycutt et al.			
2025	54,471	93,159	186,109
2050	78,759	133,759	267,219
Diabetes Crisis Forecasts			
2025	70,117	119,000	239,566
2050	120,701	206,429	412,396

Diabetes Will Contribute to 622,000 Deaths in 2025, and between 694,000 and 1 million deaths in 2050

In 2000, diabetes contributed to an estimated 213,062 deaths.^{xi} Assuming the same relationship between prevalence of diabetes and death, diabetes will contribute to 622,000 deaths in 2025, and between 694,000 and 1 million deaths in 2050, as shown in Table 3.

Table 3. Projected Deaths Attributable to Diabetes in the U.S.

Year	Deaths Based on Honeycutt et al. Forecasts	Deaths Based on Diabetes Crisis Forecasts
2000 (Base Year)	213,062	213,062
2025	483,569	622,468
2050	694,319	1,071,535

In 2025, America Will Spend \$350 Billion on the Direct and Indirect Costs of Diabetes, Rising to Over \$600 Billion in 2050 (Calculated in 2002 Dollars)

Diabetes is an extremely expensive disease to treat due to its frequent blood sugar testing, medications, multiple comorbidities, severe complications and the long-term involvement of multiple medical professionals. A comprehensive analysis commissioned by the American Diabetes Association estimated that the total societal cost of America's 12.1 million people diagnosed with diabetes in 2002 was \$132 billion. Of this, \$92 billion went to direct medical costs and the other \$40 billion went to indirect costs, including disability, lost work days and premature mortality. There were 88 million disability days due to diabetes that year.^{xii} Table 4 applies these costs to the

Honeycutt, et al. study and the Diabetes Crisis Forecasts, showing the dramatic increase in expense with either set of assumptions.

Table 4. Projected Total Direct and Indirect Costs of Diabetes in 2025 and 2050, in Billions

<i>Constant 2002 Dollars</i>	2002	2025	2050
	\$ in Billions		
Honeycutt et al.	\$132	\$272	\$391
Diabetes Crisis Forecasts	\$132	\$351	\$604

2002 was the base year, with 2025 and 2050 extrapolated based on the expected population with diabetes as compared to 2002.

THE PAIN OF DIABETES FOR INDIVIDUALS

The Lifetime Risk of Getting Diabetes Will Approach 50 Percent in 2050

Dr. Narayan and his colleagues estimated that the lifetime risk of getting diabetes for a person born in 2000 is 32.8 percent for males and 38.5 percent for females. The likelihood is even higher for minorities, as shown in Table 5.^{xiii} These risks were derived from National Health Interview Surveys conducted between 1984 and 2000 and do not reflect the dramatic increase in the prevalence rate since 2000. **It is likely that the lifetime risk will be 30 percent for white males born after 2025, 35 percent for white females, 45 percent for black males, 50 percent for Hispanic males, 55 percent for black females and as high as 60 percent for Hispanic females.**

Table 5. Lifetime Risk for a Diagnosis of Diabetes for Those Born in 2000

	White	Black	Hispanic	Other	Total
Male	26.7%	40.2%	45.4%	36.9%	32.8%
Female	31.2%	49.0%	52.5%	43.3%	38.5%

Narayan, *JAMA* 2003;290:1884-1890

Diabetes Will Be Common in Children in 2050

In 2002, over 15 percent of 6- to 19-year-olds were overweight. Among blacks and Hispanics, 23 percent were overweight.^{xiv} These numbers have been rising steadily, with a significant impact on diabetes. Until the late 1980s, Type 2 diabetes was almost unheard of in children. Now 50 percent of children with diabetes have the Type 2 disease.^{xv} Children as young as 4 years old already have abnormally high insulin levels, and 13 percent of all children have elevated cholesterol levels.^{xvi} Growing rates of obesity will likely cause the average age of onset of diabetes to drop significantly from the mid 40s into the 30s by 2050, and, unfortunately, it will be common for

adolescents to be diagnosed with Type 2 diabetes. This will increase the risk of lifetime complications, associated loss of quality-adjusted life years and earlier premature deaths.

The Average Diabetic Person Will Die 15 Years Prematurely in 2050

Narayan's 2003 article carefully lays out the number of life years lost due to premature death from diabetes depending upon the age of onset of the disease, sex and race. At present, people tend to develop diabetes in their mid-40s, but with the growth of childhood obesity, more are getting the disease in their 30s, 20s and even teens. Looking at Table 6, it is clear that a loss of between 10 and 20 life years will be common unless current trends, particularly in obesity, change.

Table 6. Life Years Lost to Diabetes Depending upon Age at Onset, Sex and Ethnicity

Age at Onset:	20 y/o	30 y/o	40 y/o	60 y/o
MALE				
White	15.3 years	13.2 years	10.9 years	7.1 years
Black	20.5 years	17.1 years	13.4 years	7.9 years
Hispanic	17.8 years	14.8 years	11.5 years	7.7 years
FEMALE				
White	16.9 years	15.6 years	13.8 years	9.3 years
Black	22.0 years	19.9 years	16.8 years	10.5 years
Hispanic	15.2 years	13.9 years	12.4 years	8.9 years

Narayan, *JAMA* 2003;290:1884-1890

Individuals Will Suffer Huge Decreases in Quality of Life Due to Diabetes

One important measure of a disease's burden is the loss of quality-adjusted life years. A healthy person living one year has had one QALY. However, with disability, suffering, impaired health or degradation of quality of life, that person would not have lived a comparable full quality year. The QALY methodology is used to assess various forms of a disease's burden and disability and estimate how much a person's quality of life would be reduced over a year period. For instance, if a person has paraplegia, severe pain and depression, their quality of life experience for a year might be equated to two-tenths of a QALY compared to a healthy year. Tallying the QALYs lost over a period of time is a quantitative way to express and compare the amount of disability or disease burden a person has suffered.

Table 7, taken from Narayan's article, estimates QALYs lost based on age of onset of diabetes, sex and ethnic group. As can be seen, there is significant long-term disability from complications of diabetes, which are particularly

severe in black females. **In the future, it will be common for people with diabetes to lose 20 to 25 QALYs.**

Table 7. Quality-Adjusted Life Years Lost Depending Upon Sex, Race and Duration of Diabetes

Age at Onset:	20 y/o	30 y/o	40 y/o	60 y/o
MALE				
White	26.0 years	22.0 years	18.0 years	10.8 years
Black	28.9 years	24.2 years	19.1 years	11.1 years
Hispanic	28.8 years	24.2 years	19.5 years	12.2 years
FEMALE				
White	28.5 years	25.1 years	21.4 years	13.4 years
Black	32.0 years	28.1 years	23.4 years	14.3 years
Hispanic	28.5 years	25.1 years	21.5 years	14.2 years

Narayan, *JAMA* 2003; 290: 1884-1890

Huge Socioeconomic and Ethnic Disparities Will Continue to Exist; the Mortality Rate for Diabetic Black Men 45-55 Years Old Will Be Twice as High as the Rate for Whites

Blacks, Mexican Americans and Native Americans have a significantly increased risk for both obesity and diabetes. Those who have diabetes have more complications, lose more QALYs and die younger.

Part of the problem is due to genetic risk factors. The rest is due to the social determinants of poor health, reduced access to the health care system and discrimination. One-third of Hispanic Americans do not have health insurance, compared to 19.3 percent of blacks and 11.3 percent of whites.^{xvii} Access to a health clinic is often difficult for poor, inner-city residents. In addition, Medicaid often does not cover services provided by dietitians, nurse educators and others who provide valuable services to aid in chronic disease management. Studies document multiple forms of discrimination against minorities in health care delivery, including withholding of advanced therapies, substandard care and not taking the time to educate minority patients on how to better manage their disease.^{xviii}

The social determinants of health are equally important but often not appreciated by society. Access to childhood health services, education, adequate housing, job opportunities, financial security and the feeling of being respected in the community are all factors that shape people's perception of themselves and their expectations for the future. The disadvantaged have feelings of loss of control and hopelessness, which are translated into measurable elevated cortisol levels, increased inflammatory levels and depressed immune systems. This is a major factor in their being more susceptible to diseases and less able to overcome them. In the U.K., these conditions have led to a 10-year difference in life expectancy, a

fourfold difference in cardiovascular disease, and a more than twofold difference in lung cancer, depending upon a person's postal code.^{xix}

These are professional, social and politicoeconomic issues that require changes in societal values, changes in institutions, active political involvement, and the acceptance that every segment of society shares a collective responsibility for the health and well-being of all citizens. America has not been willing to address these issues and make the difficult societal changes. These Diabetes Crisis Forecasts, in extrapolating recent conditions and trends, assume this failure in health disparities continues, so little improvement will have occurred by 2025.

Why Haven't Outcomes for Diabetes Improved in 2025 - A Complacent Society in an "Obesogenic" Environment

The Diabetes Crisis Forecasts assume that the outcomes have worsened. There are many reasons for this. We will raise two here and explore a broader range in IAF's 2006 scenarios for diabetes.

First, according to Egger and Swinburn, obesity and the subsequent diabetes epidemics are normal physiological responses to a pathological "obesogenic" environment, rather than due to metabolic defects or genetic mutations within individuals.^{xx} The solution is to reshape the macro environment's sociocultural, economic and physical components by changing diets and eating habits, increasing opportunities and incentives for daily physical activity, modifying beliefs and attitudes, and making choices financially available to all citizens.

Second, the U.S. health care system is largely focused on sophisticated therapy for established late stage diseases rather than simple, elegant approaches to prevention and coordinated, ongoing management of multiple chronic conditions. Our current health care paradigms and incentives prevent the most effective and cost-effective measures for dealing with our worst twin epidemics of obesity and diabetes.

Solutions require a national mobilization of the public's will with an appreciation that all segments of society—individuals, families, businesses, institutions, communities and governments—share in the responsibility and must work in unison toward a vision of health for all. If the public and the country's leadership do not have sufficient vision to deal with these twin grand challenges, by 2050 the U.S. will have suffered greatly.

In 2006, IAF will develop a broader range of scenarios that explore the alternatives for prevention, better treatment, and greater equity in diabetes and the environment that reinforces it.

APPENDIX A: EXPLANATION OF THE FORECAST MODELS

The Base Extrapolative Forecast: The Honeycutt et al. 2003 Study

The Diabetes Crisis Forecasts essentially extrapolate current or recent trends. Our major source for these extrapolative forecasts is a study by Amanda Honeycutt of the Research Triangle Institute and her colleagues at the CDC (Honeycutt et al. 2003), which projects the burden of diabetes in the U.S. to 2050 based on recent trends.^{xxi} The Honeycutt et al. study forecasts an increase of diagnosed diabetes from 12 million in 2000 to 39 million in 2050. The study uses a Markov modeling framework to weigh changes in population, age, sex and ethnic groups over time. Based on the growth in the prevalence of diabetes among the U.S. population from 1984 to 2000, the study projects that the prevalence rate for diabetes in the U.S. population will rise from 4.35 percent in 2000 to 9.71 percent in 2050.

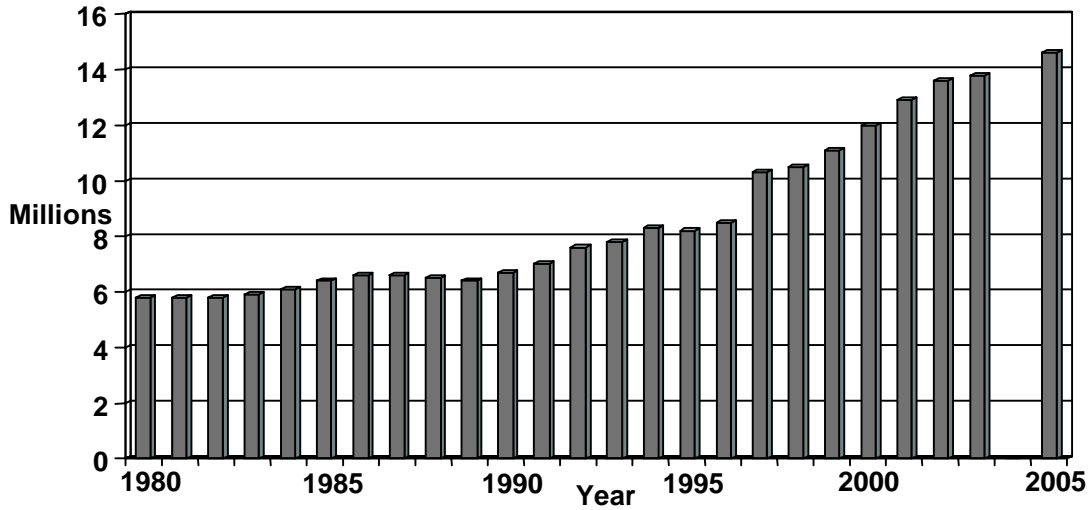
This growth in the total number of people with diabetes will result from increases in the population, changes in the demographic mix (particularly the higher percentage of older Americans, Hispanics and blacks) and the rising prevalence of diabetes. The Honeycutt et al. study assumes that population growth between 2000 and 2050 alone will account for 20 percent of the growth in the number of people with diabetes. Twenty six percent will be the result of demographic shifts, while 54 percent will be from the growing prevalence of the disease itself.

The Honeycutt et al. study uses prevalence data from 1984 to 2000 to develop its model. The dramatic increase in obesity had only begun to make its impact on the prevalence of diabetes in the 1990s, particularly in the later 1990s. Figure 1 below shows the growth of diabetes from 1980 to 2005. Note the dramatic increase from 1997 on. While part of the 1997 increase shown in Figure 1 may be due to changes in the collection methods used in the National Health Information Survey, the overall upward shift of the trend is clear. Thus it is plausible that the 2050 numbers of Honeycutt et al. may be too low.

Developing an Alternative: The Diabetes Crisis Forecasts

This forecast from Honeycutt et al. is tragic, but it is probably understating how bad conditions can get. Looking at historic data from the National Diabetes Surveillance System, prevalence grew slightly from an age-adjusted rate of 2.8 percent of the total population in 1980 to 2.9 percent in 1990. By 1995, it was 3.2 percent, and in 2000 it reached 4.5 percent. By 2003 it had reached 4.9 percent.^{xxii} Researchers will get very different rates of growth in the prevalence rate for diabetes depending on which time segment they use as the basis of their forecasts. Table 8 compares how fast the prevalence rate grew for different time periods.

Figure 1: Prevalence of Diabetes: Number (in Millions) of Persons with Diagnosed Diabetes, United States, 1980-2003



CDC Diabetes Statistics – 2003 table with recent 2005 number added

Table 8. How Fast Has Diabetes Grown? Comparing Rates across Years

		Compounded Average Annual Growth Rate	Beginning and Ending Amounts
Diabetes Prevalence			
	1980-1990		2.8% to 2.9%
	1980-2000	2.5%	2.8% to 4.5%
	1990-2000	5%	2.9% to 4.5%
	1990-2003	4.5%	2.9% to 4.9%
Number of People with Diabetes			
	1980-2005	3.75%	5.8 million to 14.6 million
	1998-2005	5%	10.5 million to 14.6 million

The Diabetes Crisis Forecasts Alternative

The Honeycutt et al. forecasts assume 3 percent annual growth in diabetes from 2000 to 2010. Yet given the experience of 5 percent annual growth in diagnosed prevalence from 2000 to 2005, it is plausible to assume that this higher rate will hold until 2010. Therefore, our Diabetes Crisis Forecasts assume that diagnosed prevalence grows by 5 percent per year from 2000 to 2010. The Honeycutt et al. study assumes that the yearly growth rate

declines from 3 percent to 0.75 percent from 2010 to 2050. Our alternative forecast assumes that the growth rate goes from 3.75 percent to 1.5 percent in five year segments from 2010 to 2050. This puts our projected annual growth rate from 2010 to 2050 0.75 percent higher than the Honeycutt et al. rate. Since only 54 percent of the increase in diabetes from 2000 to 2050 in the Honeycutt et al. forecasts is driven by the prevalence increase (rather than the population increase or demographic shifts), we weighted the increases accordingly. Table 9 illustrates the differences in prevalence rates at five year intervals between the Honeycutt et al. model and the Diabetes Crisis Forecasts model.

**Table 9. Diabetes Prevalence 2000-2050:
Comparing Honeycutt with the Diabetes Crisis Forecasts**

Year	Honeycutt et al.	Diabetes Crisis Forecasts
2000	4.35%	4.5%
2005	5.20%	5.74%
2010	6.02%	7.33%
2015	6.77%	8.81%
2020	7.46%	10.46%
2025	8.06%	12.35%
2030	8.55%	13.76%
2035	8.94%	15.19%
2040	9.24%	16.57%
2045	9.49%	17.97%
2050	9.71%	19.48%

Given the recent rapid rise in diabetes prevalence, we believe that if conditions do not change, our Diabetes Crisis Forecasts are more plausible than those made by Honeycutt et al. We acknowledge that there is a range of other assumptions that would drive estimates higher or lower. In 2006, IAF will develop a range of diabetes scenarios to explore these alternatives, particularly the more positive opportunities. It should be noted, however, that some positive developments could lead to an increase in the prevalence of diabetes. For example, Honeycutt et al., in doing their sensitivity analysis, argued that reducing the risk factors for those with diabetes (e.g., through better treatment) could prolong lives, thus increasing the diabetes burden by having a higher number of people with diabetes alive each year and, therefore, a higher prevalence in any given year.

References

- ⁱ CDC, National Diabetes Fact Sheet: United States, 2005.
http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2005.pdf accessed 10/26/05.
- ⁱⁱ Narayan, KMV, et al. "Lifetime Risk for Diabetes Mellitus in the United States." *JAMA* 2003; 290: 1884-1890.
- ⁱⁱⁱ Ibid.
- ^{iv} Flegal, KM, et al. "Prevalence and Trends in Obesity Among US Adults, 1999-2000." *JAMA* 2002; 288: 1723-1727.
- ^v Vasan, RS, et al. "Estimated Risks for Developing Obesity in the Framingham Heart Study." *Ann Intern Med* 2005; 143: 473-480.
- ^{vi} CDC, National Diabetes Fact Sheet: United States, 2005.
http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2005.pdf accessed 10/26/05.
- ^{vii} Honeycutt, AA, et al. "A Dynamic Markov Model for Forecasting Diabetes Prevalence in the United States through 2050." *Health Care Management Science* 2003; 6: 155-164.
- ^{viii} CDC, National Diabetes Fact Sheet: United States, 2003.
<http://www.cdc.gov/diabetes/pubs/factsheet.htm> accessed 10/26/05.
- ^{ix} Honeycutt, Op cit.
- ^x ADA, <http://www.diabetes.org/diabetes-statistics/national-diabetes-fact-sheet.jsp>; for the blindness figures we have used the ADA's highest 2000 estimate.
- ^{xi} ADA, <http://www.diabetes.org/diabetes-statistics/national-diabetes-fact-sheet.jsp>
- ^{xii} American Diabetes Association, "Economic Cost of Diabetes in the US in 2002." *Diabetes Care* 2003; 26: 917-932.
- ^{xiii} Narayan, KMV, et al. "Lifetime Risk for Diabetes Mellitus in the United States." *JAMA* 2003; 290: 1884-1890.
- ^{xiv} Ogden, CL, et al. "Prevalence and Trends in Overweight Among US Children and Adolescents, 1999-2000." *JAMA* 2002; 288: 1728-32.
- ^{xv} Salynn Boyles, "Supersized Kids, Diminishing Health." *WebMD Feature*, December 11, 2001.
http://www.webmd.com/content/Article/13/3606_1052.htm?printing=true accessed 10/26/05.
- ^{xvi} Davis, JL. "Childhood Obesity Seen Even in Preschool." *WebMD Medical News*, May 5, 2003.
<http://my.webmd.com/content/Article/64/72383.htm?printing=true> accessed 10/13/05.
- ^{xvii} Census Bureau's Annual Report on Poverty, 2005.
- ^{xviii} Agency for Healthcare Research and Quality. 2004 National Healthcare Disparities Report.
<http://www.qualitytools.ahrq.gov/disparitiesreport/browse/browse.aspx>.
- ^{xix} Dr. Harry Burns. NHS Glasgow. Global Medical Forum III, Zurich. March 24, 2004.
- ^{xx} Egger, Garry and Swinburn, Boyd. "An 'ecological' approach to the obesity pandemic." *BMJ* 1997; 315: 477-480.
- ^{xxi} Honeycutt, AA, et al. "A Dynamic Markov Model for Forecasting Diabetes Prevalence in the United States through 2050." *Health Care Management Science* 2003; 6: 155-164.
- ^{xxii} Prevalence of Diabetes. CDC National Center for Chronic Disease Prevention and Health Promotion. <http://www.cdc.gov/diabetes/statistics/prev/national/tprevage.htm>.

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