Improved Management Can Help Reduce the Economic Burden of Type 2 Diabetes: A 20-Year Actuarial Projection

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EXECUTIVE SUMMARY

Diabetes is one of the major health problems and healthcare cost drivers of the early 21st century. People with diabetes are at higher risk of developing serious complications, including heart attacks, strokes, amputations, blindness and kidney failure.[1] People with poorly controlled blood glucose are at an even greater risk of developing these and other serious conditions. Improved control of blood glucose, blood pressure and cholesterol as well as reduction of obesity for people with diabetes are associated with improved clinical outcomes and lower mortality,[2] which typically translate into lower healthcare costs.

Our modeling shows that a 50 percent improvement in diabetes management and control will have immediate impact and in 20 years will reduce the following annually:

- Diabetes-associated deaths by 49,000;
- Incidence of diabetes-related complications by 239,000; and
- Annual medical costs for diabetes patients by $196 billion (in 2031 dollars).

The Model and Assumptions
This paper outlines type 2 diabetes burden projections grouped by major payer groups, including commercial insurance, Medicare, Medicaid, uninsured, and other (Veteran Affairs, Department of Defense, Indian Affairs, prisoners, etc.).* Healthcare reform implementation will influence the healthcare system in many ways. Regardless of these changes, key stakeholders including clinicians, patients, employers, health insurance plans, public programs, policy makers, public health, and communities will need to collaborate and coordinate efforts around improved diabetes care.

Many experts anticipate the future will bring new and improved treatment options for people living with diabetes. For this analysis, however, the authors did not include assumptions for any prevention and treatment breakthroughs (e.g. reduction of obesity prevalence). Instead, we model and project the impact of improving current type 2 diabetes control, specifically focusing on blood glucose (A1C), blood pressure and cholesterol. Our model includes the year-by-year impact of improved control on diabetes-related complication rates, medical costs and mortality over 20 years.

Current A1C, blood pressure and cholesterol control rates for people with diabetes are disappointing, so the opportunity for improvement is significant, as shown in Table 1. The American Diabetes Association (ADA) targets we apply in this report are a simplification as they are not indicated for all diabetes populations, particularly the frail elderly. In addition, recent studies have raised questions regarding the systolic blood pressure target of 130. Nonetheless, we use the ADA targets for our modeling and ask the reader to keep in mind that if these recommended targets change, the portion of people with diabetes who would be impacted by improved control could change, along with their utilization and costs.

Table 1: Control Rates for Blood Glucose, Blood Pressure and Cholesterol

	Control rate for people with diabetes < 65 years	Control rate for people with diabetes 65+ years
Blood Glucose Target Hemoglobin A1C < 7	49%	62%
Blood Pressure Target Systolic < 130	60%	33%
Cholesterol Target HDL >40 men, >50 women	49%	56%
Cholesterol Target LDL< 100	39%	48%

Source: Milliman analysis of NHANES data 2003-2006.
Target rates for A1C, systolic blood pressure and cholesterol are from the ADA

* Commercial includes coverage of working age people and their dependents through employer-sponsored plans (fully insured and self insured) and through insurance purchased by individuals. Medicare and Medicaid include both fee for service, Medicare Advantage and managed Medicaid.

The authors would like to acknowledge the significant innovations and efforts now being made across the healthcare system to address the epidemic of diabetes. These expansive efforts include:

- Information technologies that help patients comply with therapy or connect patients to their healthcare providers;
- Advanced certifications for clinicians caring for patients with diabetes;
- Translating evidence based medicine and comparative effectiveness research into medical practice;
- Measuring and public reporting of quality metrics;
- Public health efforts to address diabetes and sedentary lifestyles; and
- Condition management programs.

Overall, these efforts involve every stakeholder -- clinicians providing care, families, employers, health plans, governments, and communities. To the extent these efforts are successful, the future will not be as grim as status-quo models presented in this paper. Indeed, if these efforts succeed, the rate of diabetes could even decline.

Estimated Diabetes Prevalence

According to the U.S. Census Bureau, the total population will increase by 20 percent between 2011 and 2031. Based on our analysis and projection of National Health and Nutrition Examination Survey (NHANES) data approximately 22 million people will have type 2 diabetes in 2011 and this number may grow to nearly 32 million by 2031—an expected increase of 46 percent. Accordingly, diabetes prevalence is expected to increase from the current 7 to 8.6 percent. This means the increase in people with type 2 diabetes may outpace the growth of the U.S. population. Changes in the U.S. population, especially aging, will impact type 2 diabetes prevalence rates differently by different payers. For example, today Medicare covers 37 percent of people with diabetes, but this is expected to increase to 44 percent by 2031. See Table 2.

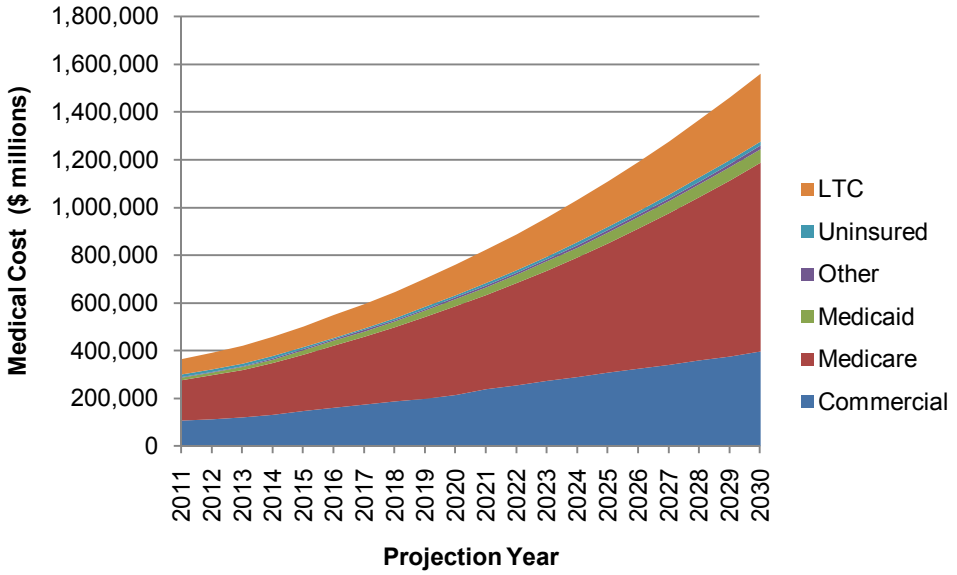
Table 2: The Growth in Type 2 Diabetes Grouped by Payer

Payer	Commercial	Medicare	Medicaid	Other	Uninsured	LTC	Total
2011 # of People With Diabetes	9,500,000	8,200,000	1,000,000	300,000	2,500,000	400,000	21,900,000
and % Distribution	43%	37%	5%	1%	11%	2%	100%
2031 # of People With Diabetes	12,800,000	14,300,000	2,100,000	500,000	1,800,000	700,000	32,200,000
and % Distribution	40%	44%	7%	2%	6%	2%	100%
Increase in Number of People With Diabetes	35%	74%	110%	67%	-28%	75%	47%
2011 U.S. Population (million)	177	46	36	4	50	NA	313
2031 U.S. Population (million)	207	73	62	5	30	NA	377
Increase in US Population	17%	59%	72%	25%	-40%		20%
US Diabetes Prevalence-- 2011	5.4%	17.8%	2.8%	7.5%	5.0%		7.0%
US Diabetes Prevalence -- 2031	6.2%	19.6%	3.4%	10.0%	6.0%		8.5%

*Based on the Congressional Budget Office model for covering the uninsured during the 2010 decade, which shifts many of the uninsured to Medicaid and commercial
Source: Milliman actuarial projection

Estimated Diabetes Cost and Potential Savings
Following this increase in diabetes prevalence rates, the portion of national healthcare expenditure (NHE) for people with type 2 diabetes is expected to increase from 10 percent in 2011 to 15 percent in 2031. In non-deflated dollars, this is an increase from nearly $340 billion in 2011 to $1.6 trillion in 2031, as shown in Figure 1.

Figure 1: Cost of People with Type 2 Diabetes by Year Grouped by Payer



Source: Analysis of 2007 Medstat and 2007 Medicare 5% Sample. Milliman actuarial projection.
Dollars are not discounted

We show the cost of people with type 2 diabetes, including all usual care even if not directly related to type 2 diabetes, for example, hip replacement, asthma management, etc. Other studies have estimated direct diabetes costs, notably the American Diabetes Association (ADA) 2007 estimate of $116 billion in medical costs attributed to diabetes.[3] The ADA study notes that diabetes-attributed costs are approximately half of patients' total medical costs, and our starting 2007 total medical cost for type 2 diabetes of approximately $240 billion is indeed approximately twice the ADA's published number.

We modeled scenarios showing the impact of a 10, 30 and 50 percent reduction in the number of people not meeting goals for A1C, blood pressure and HDL control rates. We chose to target these variables for improved control as these are modifiable variables in the United Kingdom Prospective Diabetes Study (UKPDS) model that impact diabetes complication rates. The UKPDS model variables include demographics, smoking history, BMI, A1C, systolic blood pressure and HDL. We report the impact of improved management on reducing seven diabetes related complications which are outputs of the UKPDS model: stroke, myocardial infarction (heart attack), amputation, ischemic heart disease, congestive heart failure, renal failure and blindness. The improvement in diabetes control rates will require enhancements in practice patterns, outreach efforts, screening and testing, patient education and other support currently in place.

As shown in Table 3. In the year 2031, assuming a 10 to 50 percent reduction in people not meeting goals,

- 48,000 to 239,000 diabetes related complications would be avoided (4 to 18 percent reduction);
- $39 billion to $196 billion from reduced diabetes related complications would be avoided (2 percent to 12 percent reduction); and
- 10,000 to 49,000 deaths from reduced diabetes related complications would be avoided (2 to 9 percent reduction).

Table 3: Reduction in Diabetes Related Complications, Associated Costs and Associated Mortality with 10% to 50 percent Improvement in Diabetes Control

	Reduction of Uncontrolled by 30%						Reduction of Uncontrolled by 50%	Reduction of Uncontrolled by 10%
	Commercial	Medicare	Medicaid	Other	Uninsured	Total	Total	Total
2011								
Number of reduced diabetes related complications	35,000	44,000	4,000	2,000	9,000	94,000	155,000	31,000
Savings from reduced diabetes related complications (million)	$1,100	$1,000	$100	< $50	$100	$2,300	$3,800	$800
Avoided deaths from reduced diabetes related complications	2,200	4,800	200	100	600	7,900	13,300	2,700
2031								
Number of reduced diabetes related complications	48,000	79,000	8,000	2,000	7,000	144,000	239,000	48,000
Savings from reduced diabetes related complications (million)	$60,800	$47,200	$4,800	$2,100	$3,000	$117,900	$196,500	$39,300
Avoided deaths from reduced diabetes related complications	10,900	14,700	1,600	500	1,500	29,200	48,700	9,700

Source: Milliman actuarial projection. Dollars are trended estimates for years. Diabetes related complications include stroke, myocardial infarction, amputation, ischemic heart disease, congestive heart failure, renal failure and blindness

Differentiating Factors

This analysis provides new information not previously published including:

- Presentation of prevalence rates, costs and type 2 diabetes related mortality grouped by major payer. This allows stakeholders to evaluate type 2 diabetes burden and opportunities for reducing related costs by population. Current published studies provide aggregate numbers often reported by age bands, which do not translate into payer categories.
- Calculation of costs from nationally-representative paid claim data, not survey data. Past studies used the Medical Expenditure Panel Survey (MEPS), which provides costs obtained from survey data, or charges data, neither of which capture actual payment rates. We used actual paid commercial and Medicare claims to calculate the costs of people with type 2 diabetes for each payer.
- Report of costs on a basis relevant to payers -- *total costs* for individuals with type 2 diabetes, which has practical value to payers, as opposed to *type 2 diabetes related costs,* which are difficult for payers to calculate.
- Presentation of costs as a portion of total NHE.
- Projections that consider the Congressional Budget Office estimate of covering the uninsured.

Assumptions

The history of healthcare humbles workers producing 20 year projections. For example, unforeseen breakthroughs over the past 20 years have revolutionized HIV/AIDS treatment and cardiac care in ways few would have predicted. Such breakthroughs for diabetes care or other changes in healthcare could make our forecasts miss actual results. The authors note that our assumptions and analysis are general and do not presume any particular therapy or the cost, efficacy or safety of particular therapies. In authoring this paper, the authors and Milliman are not endorsing any product or policy. Because forecasts cannot capture all potentially important factors, actual results are likely to differ from the ones we present here. Our forecasts rely on the chosen assumptions. Other assumptions and methodologies may generate different forecasts.

Sanofi-aventis U.S., a pharmaceutical company that manufactures and markets diabetes drugs, commissioned Milliman to develop and author this paper. Sanofi-aventis U.S.' role was limited to provision of background information, evidence confirmation and contextual clarification.

BACKGROUND

Diabetes is the seventh leading cause of death by disease.[4] Of particular concern is the increasing prevalence of diabetes with reports indicating diagnosed diabetes increased from 6.5 percent in 1999 to 7.8 percent in 2006.[5]

Glycemic control rates (portion of patients with hemoglobin A1C < 7), control of blood pressure (BP < 130/80) and control of cholesterol (LDL under 100) in people living with diabetes have improved but significant opportunity remains for further improvement. A1C control rates improved from 43 percent control rate in 1999 to 57 percent control rate in 2006: Blood pressure control rates improved from 39 percent control rate in 1999 to 45 percent control rate in 2006. LDL control rates improved from 36 percent control rate in 1999 to 47 percent control rate in 2006.[6]

People living with diabetes have higher mortality and morbidity with an age-adjusted risk of death nearly twice that of people without diabetes.[7] People living with diabetes have a dramatically higher rate of microvascular and macrovascular disease, including coronary artery disease (CAD), stroke, peripheral vascular disease (associated with amputation), end stage renal disease (ESRD), and retinopathy (associated with blindness).[8] Landmark studies consistently report that lower rates of these complications are associated with lower A1C levels. [9] [10] [11] A1C, a measure of average blood glucose levels over the two- to three-month period before the blood test, is the preferred standard for assessing and monitoring blood glucose control. A1C goals are to be individualized based on the needs of the patient, but, in general, the ADA guidelines recommend an A1C < 7 percent.[12]

Both patient adherence and physician practice patterns are identified as contributors to the poor rate of glycemic control. Research to date has documented wide variances in patient adherence to glycemic control management.[13] [14] [15] Studies consistently report delays in intensifying therapy when A1C is above goal, with many patients experiencing A1C levels > 8 percent resulting in years of glycemic burden.[16] [17] [18] [19] [20] [21] This is in light of the progressive nature of the disease with studies reporting an annual 0.15 percent point increase in A1C even with appropriate management.[22]

There have been several recent studies estimating the cost of diabetes. A 2008 study sponsored by the ADA reports a 2007 cost of diabetes of $174 billion, including $116 billion in excess medical expenditures and $58 billion in reduced national productivity. [23] A 2010 study used this base cost and estimated additional costs contributed by undiagnosed diabetes, people with pre-diabetes and women with gestational diabetes, for a total of $218 billion in 2007 dollars. [24]

With the increasing prevalence of type 2 diabetes, all stakeholders need to know how the prevalence and costs will change over time and how new policies may impact prevalence and cost trends. Several studies have projected prevalence and costs through 2050.[25] [26] [27] Those cost projections provide diabetes-associated costs and the prevalence and costs for the entire U.S. population. This study presents prevalence rates, costs and type 2 diabetes-related mortality by major payer group allowing stakeholders to evaluate the burden of type 2 diabetes and the opportunities for reducing diabetes-related complications, costs and mortality for their population.

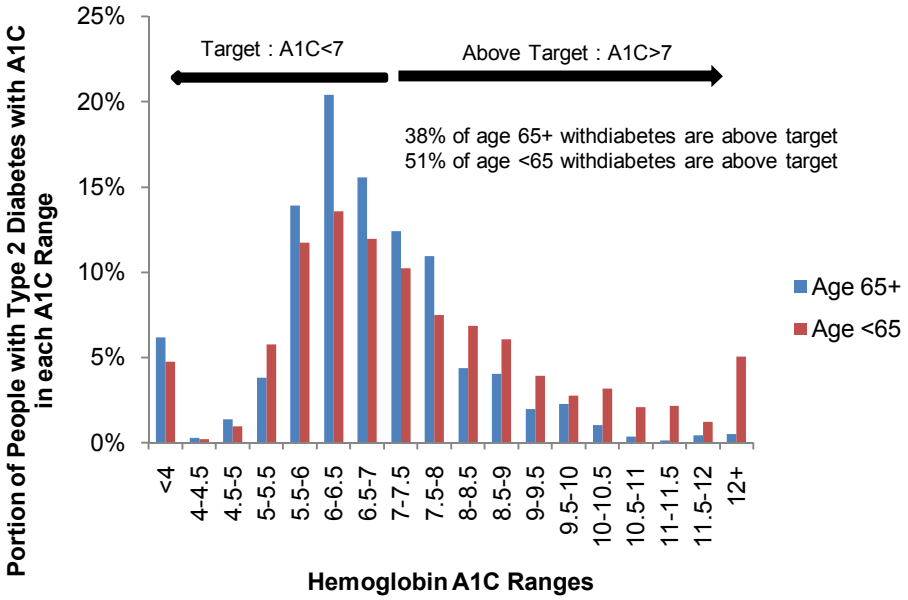
FINDINGS

Opportunity for Improved Diabetes Control

Diabetes management includes control of blood glucose, blood pressure and cholesterol. Controlling these three factors helps to reduce diabetes-related complications, some of which can be devastating. The NHANES data provides an authoritative source for evaluating the control rate of these three factors for people with diabetes in the United States. Our analysis of NHANES 2003-2004 data and 2005-2006 data shows the opportunity for improvement, which is consistent with other recent reports. We calculated the control rates of A1C, systolic blood pressure and HDL for our NHANES type 2 diabetes population. We selected these three variables as they are modifiable variables in the UKPDS model which impact the diabetes complication rates. The UKPDS model variables include demographics, smoking history, BMI, A1C, systolic blood pressure and HDL. In the model, these variables impact the occurrence rate of seven diabetes related complications: stroke, myocardial infarction (heart attack), amputation, ischemic heart disease, congestive heart failure, renal failure and blindness.

Figure 2 shows the A1C distribution, split between those <65 and 65+. Nearly 51 percent of people with type 2 diabetes under age 65 and 38 percent of people with type 2 diabetes 65+ have A1C greater than the ADA recommended target of < 7.0 percent.

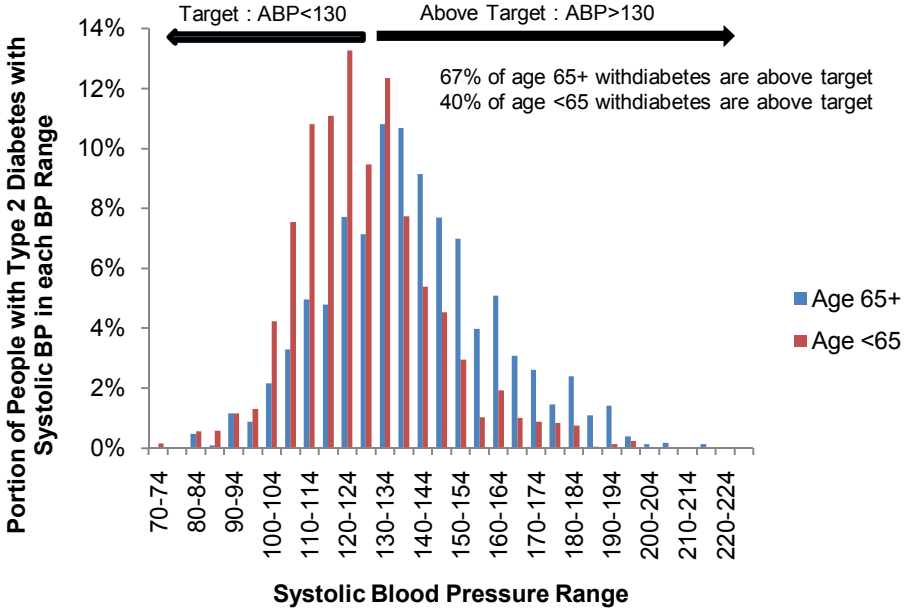
Figure 2: Distribution of People with Type 2 Diabetes by A1C



Source: Milliman analysis of NHANES 2003-2006

The blood pressure target for people with diabetes is systolic/diastolic of < 130/80 mm Hg. [28] Figure 3 shows the distribution of systolic blood pressure among people with type 2 diabetes. About 40 percent of people with diabetes who are under age 65 and 67 percent of people with diabetes age 65+ have systolic blood pressure greater than the target of < 130.

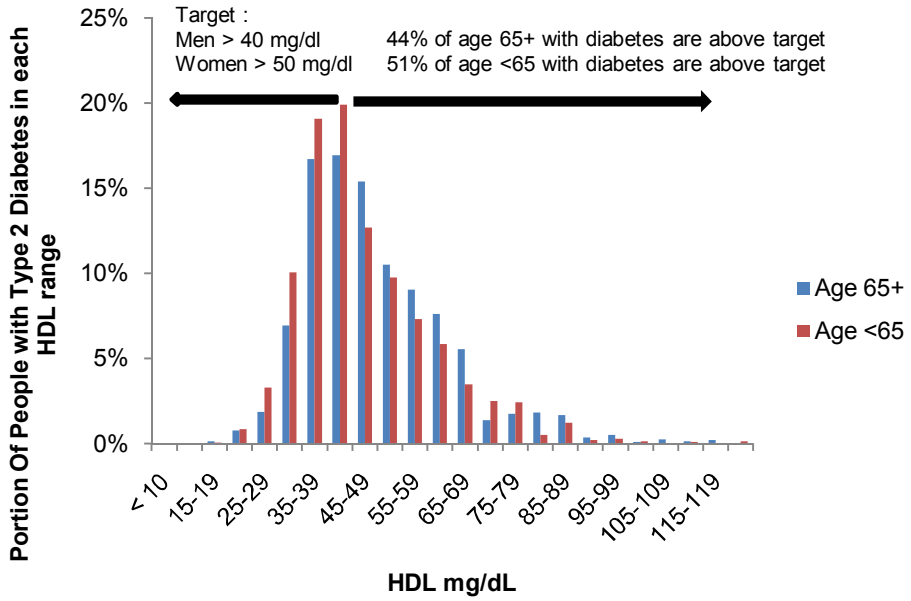
Figure 3: Distribution of People with Type 2 Diabetes by Systolic Blood Pressure



Source: Milliman analysis of NHANES 2003-2006

The target for people with type 2 diabetes for high density lipoprotein (HDL), often referred to as the "good cholesterol," is greater than 40 mg/dl for men and greater than 50 mg/dl for women.[29] Please note that, to meet or exceed the target, these people would need to increase HDL levels. Figure 4 shows the distribution of HDL among people with diabetes. About 49 percent of people with diabetes under age 65, and 56 percent of people with diabetes age 65 and older, have HDL below the target.

Figure 4: Distribution of People with type 2 Diabetes by HDL (unisex)



Source: Milliman analysis of NHANES 2003-2006

Diabetes Prevalence, Diabetes-Related Mortality and Cost Projections with Current Control Levels

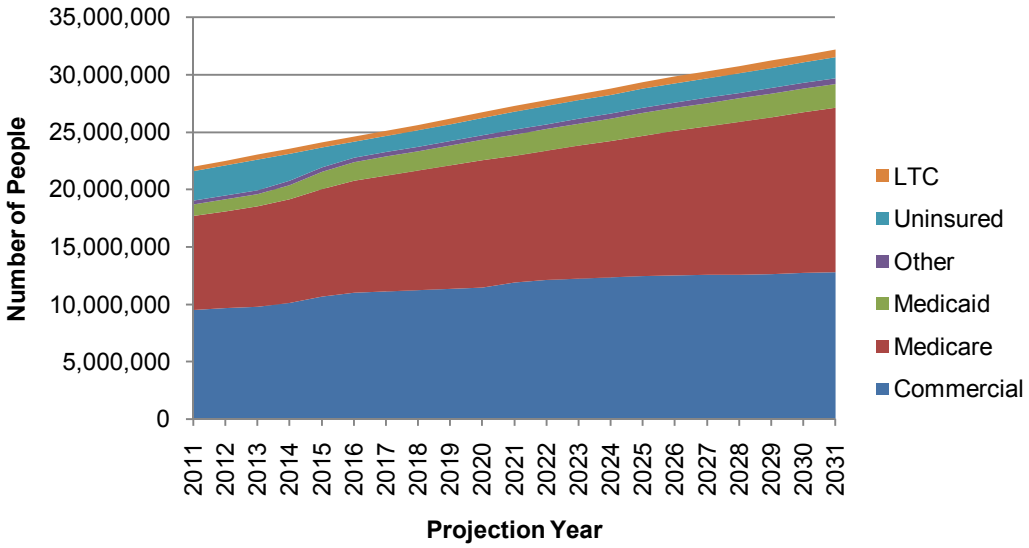
This section provides prevalence, diabetes-related mortality and cost projections under the current diabetes control rates for A1C, blood pressure and HDL reported in the tables above. See Appendix B for a description of the methodology.

Diabetes Prevalence Projections

Figure 5 shows the prevalence of type 2 diabetes by major payer. In figure 5, people in long-term-care (defined as nursing homes) are shown as a separate cohort, having removed their numbers from the other payers. Most nursing home residents have Medicare as the primary acute care payer although Medicaid pays for most long-term care costs.

Aging, including the baby-boom bulge coupled with longer life-span, will cause Medicare to cover a much higher portion of people with diabetes compared to commercial payers. For the projections the authors considered aging, an expected leveling of obesity, shifts in ethnic mix and a shift of uninsured to other payer coverage (see methodology Appendix B). We followed the Congressional Budget Office model of healthcare reform to shift many of the uninsured to commercial or Medicaid during the 2011 decade.

Figure 5: People with Type 2 Diabetes by Year by Payer Group



Source: Milliman actuarial projection

The prevalence of type 2 diabetes will increase as well as the total number of patients, as shown in Table 4. Based on our analysis and projection of NHANES data, approximately 22 million people will have type 2 diabetes in 2011, and this number may grow to nearly 32 million by 2031—an expected increase of 46 percent. Accordingly, diabetes prevalence is expected to increase from the current 7 percent to 8.5 percent. This means the increase in people with type 2 diabetes may outpace the growth of the U.S. population.

Table 4: 20-Year Forecast of Type 2 Diabetes Prevalence

	2011	2031
Total U.S. Population	313,000,000	377,000,000
People with Type 2 Diabetes	22,000,000	32,000,000
Type 2 Diabetes as percent of U.S. Population	7.0%	8.5%

Source: Milliman actuarial projection

The growing impact of type 2 diabetes will not affect payers in the same way. For example, table 5 indicates the number of people with diabetes in the Medicare population is projected to increase by about 74 percent between 2011 and 2031. This means that there will be more than six million new diabetes patients coming into the Medicare program during the next 20 years.

Table 5: The Growth in Type 2 Diabetes by Payer

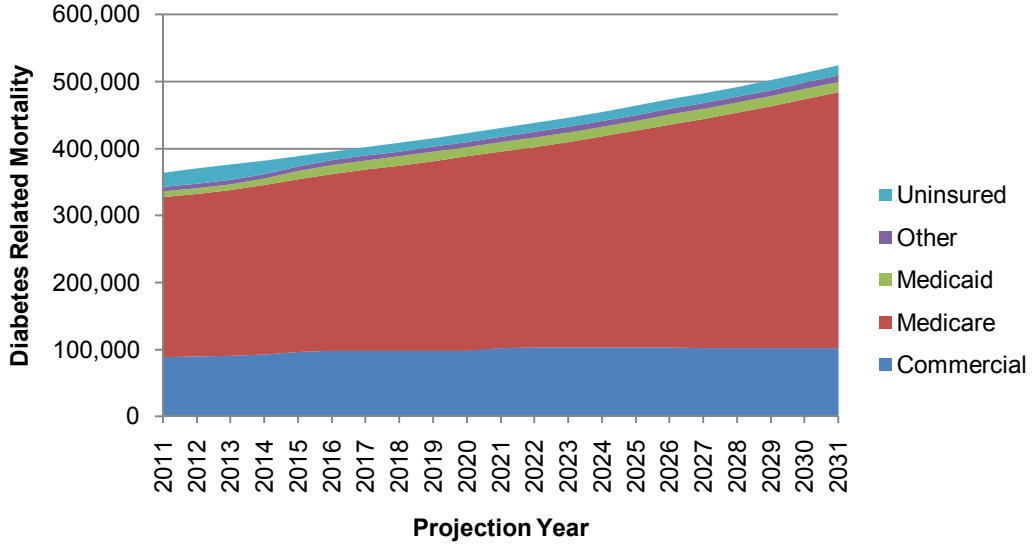
Payer	Commercial	Medicare	Medicaid	Other	Uninsured	LTC	Total
2011 # of People With Diabetes	9,500,000	8,200,000	1,000,000	300,000	2,500,000	400,000	21,900,000
and % Distribution	43%	37%	5%	1%	11%	2%	100%
2031 # of People With Diabetes	12,800,000	14,300,000	2,100,000	500,000	1,800,000	700,000	32,200,000
and % Distribution	40%	44%	7%	2%	6%	2%	100%
Increase in Number of People With Diabetes	35%	74%	110%	67%	-28%	75%	47%
2011 U.S. Population (million)	177	46	36	4	50	NA	313
2031 U.S. Population (million)	207	73	62	5	30	NA	377
Increase in US Population	17%	59%	72%	25%	-40%	0%	20%
US Diabetes Prevalence-- 2011	5.4%	17.8%	2.8%	7.5%	5.0%	0	7.0%
US Diabetes Prevalence -- 2031	6.2%	19.6%	3.4%	10.0%	6.0%	0	8.5%

*Based on the Congressional Budget Office model for covering the uninsured during the 2011 decade, which shifts many of the uninsured to Medicaid and commercial
Source: Milliman actuarial projection

Diabetes Mortality Projections

Diabetes carries a significant mortality burden. Figure 6 shows the diabetes related mortality from individuals with type 2 diabetes distributed by major payer. Diabetes related mortality is calculated by applying the higher mortality rate of people with diabetes compared to the general population mortality rate. Medicare will incur the overwhelming majority of the diabetes related mortality.

Figure 6: Diabetes Related Mortality for People with Type 2 Diabetes by Year by Payer Group



Source: Milliman actuarial projection

Table 6 shows how the mortality caused by type 2 diabetes will increase over the next 20 years, assuming no improvement in control rates of A1C, blood pressure or HDL. The deaths in Table 6 are due to the overall mortality burden associated with diabetes. In the year 2031, Medicare will incur close to 150,000 deaths associated with diabetes.

Table 6: Mortality Associated with Diabetes by Payer Group

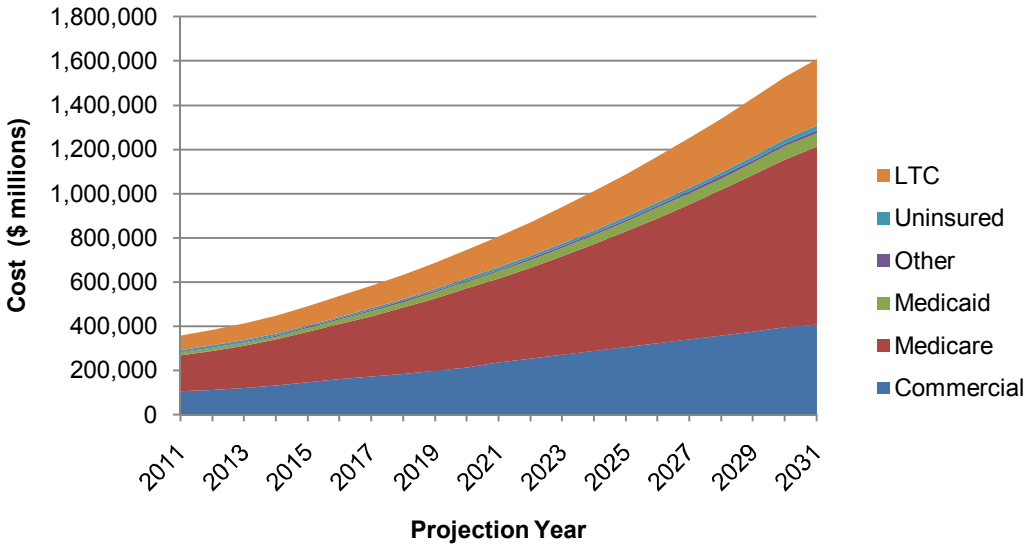
	Commercial	Medicare	Medicaid	Other	Uninsured*	Total
Diabetes Related Mortality 2011	89,000	238,000	9,000	7,000	22,000	365,000
Diabetes Related Mortality 2031	103,000	382,000	15,000	10,000	15,000	525,000
Projected Increase in Diabetes Related Mortality	14,000	144,000	6,000	3,000	-7,000	160,000

*Based on the Congressional Budget Office model for covering the uninsured during the 2010 decade, which shifts many of the uninsured to Medicaid and commercial
Source: Milliman actuarial projection

Diabetes Cost Projections

Figure 7 shows healthcare costs incurred by people with type 2 diabetes by year by payer. The projected costs assume current A1C, blood pressure and HDL control rates. Healthcare costs for people with type 2 diabetes are projected to increase from approximately $340 billion in 2011 to $1.6 trillion in 2031.

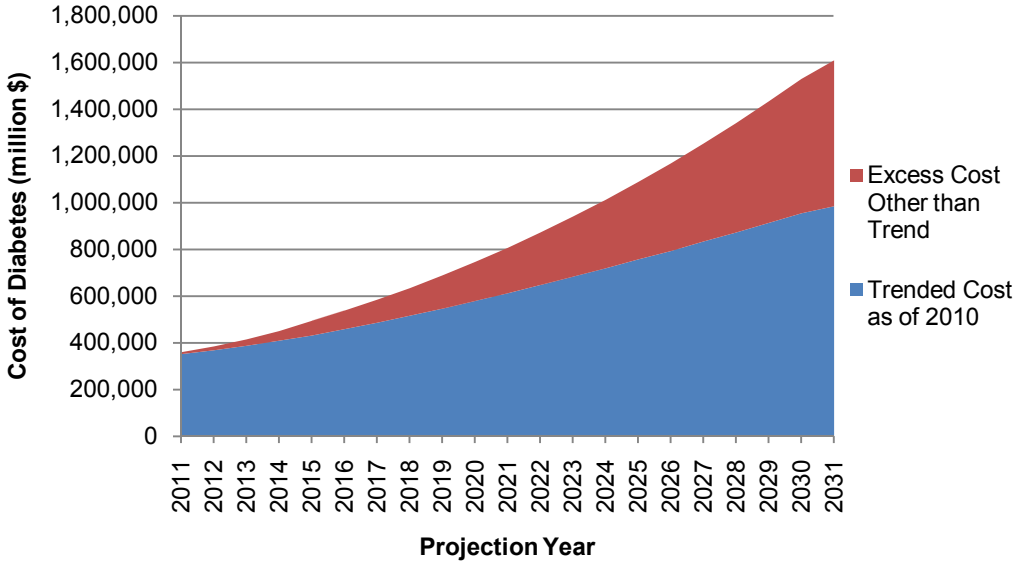
Figure 7: Cost of People with Type 2 Diabetes by Year by Payer Group



Source: Analysis of 2007 Medstat and 2007 Medicare 5 percent sample, Milliman actuarial projection
Dollars are not discounted

Figure 8 shows the portion of total costs contributed by year-over-year healthcare cost trend (blue section) and that contributed by the increased prevalence of type 2 diabetes year-over-year (red section). The majority of cost growth is from assumed medical inflation, but the non-inflation growth by 2031 is significant; excess costs other than trend are projected to be $590 billion and those from trend are projected to be $980 billion.

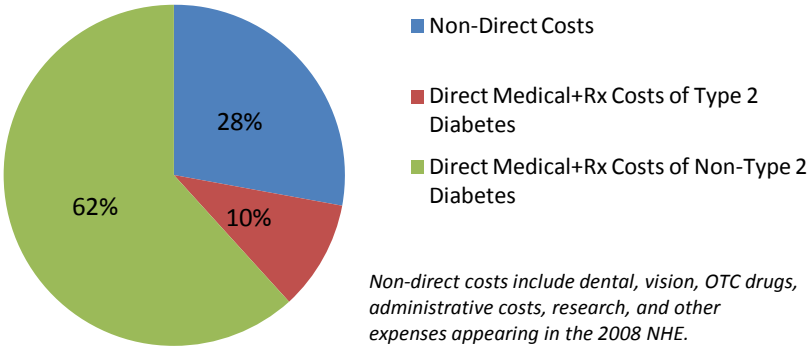
Figure 8: Impact of Trend on Cost of Diabetes by Year



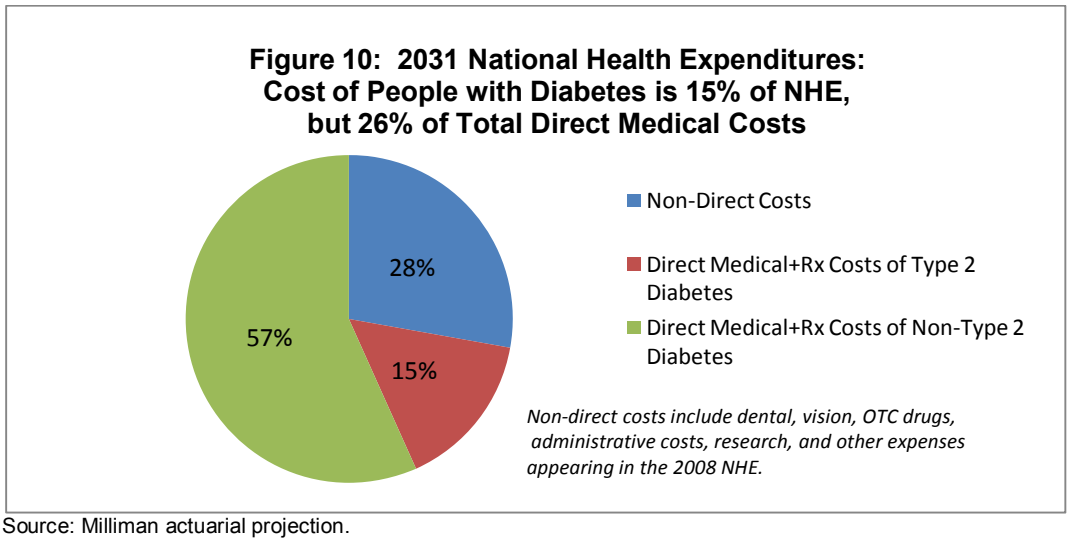
Source: Milliman actuarial projection

The medical costs of people with type 2 diabetes, as a portion of total National Health Expenditures (NHE), will be 10 percent in 2011. That portion is anticipated to increase to 15 percent by 2031 as the prevalence of type 2 diabetes grows, assuming current A1C, blood pressure and HDL control rates. Figures 9 and 10 show the split of NHE by non-direct costs and direct medical and prescription costs. The direct medical and prescription costs are split into two categories: those incurred for people with type 2 diabetes and those incurred by people without type 2 diabetes. For simplicity, in Figure 10 (2031), the portion of non-direct costs are kept constant at 28 percent of NHE as it is in Figure 9 (2011).

Figure 9: 2011 National Health Expenditures: Cost of People with Diabetes is 10% of NHE, but 16% of Total Direct Medical Costs

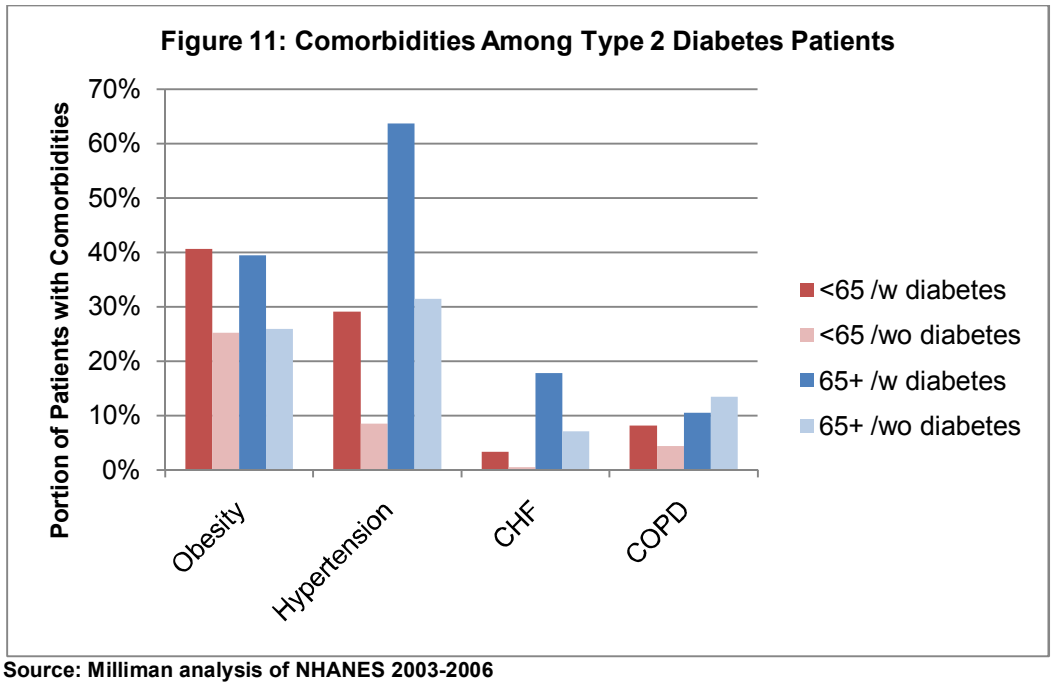


Source: Milliman actuarial projection



Source: Milliman actuarial projection.

People with type 2 diabetes have a higher prevalence of comorbidities than those without diabetes. Figure 11 shows the higher rate of several comorbidities that drive some of the type 2 diabetes costs: people with diabetes have two times the prevalence of hypertension and congestive heart failure (CHF) than people without diabetes.



Source: Milliman analysis of NHANES 2003-2006

How Improved Diabetes Control Can Improve Health and Reduce Cost

To model the impact of improved control, the authors assumed the portion of people who are not at target for A1C, blood pressure and HDL improved by 10 percent, 30 percent and 50 percent from current levels, as described in Appendix B. Current non-control levels are about 50 percent, so the model assumes that a portion of these type 2 diabetes patients will still not be under control. This improvement in diabetes control produces significant reductions in outcomes: diabetes related complications, mortality related to diabetes complications, and healthcare costs related to diabetes complications.

Populating the UKPDS model with the required risk factors of people in NHANES with type 2 diabetes, we reduced the portion of patients not meeting targets for A1C, blood pressure and HDL by 10 percent, 30 percent and 50

percent. The UKPDS model generates the rate of diabetes complications based on the input of UKPDS risk factors for each person with diabetes.

Table 7 shows improving control of A1C, blood pressure and HDL results in the reduction of diabetes-related complications. For example, heart attacks, the most common diabetes-related complication, show the biggest drop in number of events, but the smallest proportional drop.

Table 7: Annual Reduction in Diabetes-Related Complications with Improved Control

		Reduction of Uncontrolled by 30%								Reduction of Uncontrolled by 50%	Reduction of Uncontrolled by 10%
Year		Ischemic Heart Disease	Conges-tive Heart Failure	Ampu-tation	Vision Loss	Renal Failure	Stroke	Heart Attack	Total	Total	Total
2011	Status quo	105,000	133,000	29,000	105,000	18,000	186,000	105,000	681,000	681,000	681,000
	Reduction	14,000	14,000	6,000	14,000	5,000	18,000	22,000	93,000	155,000	31,000
	% Reduct	13%	11%	21%	13%	28%	10%	21%	14%	23%	5%
2021	Status quo	132,000	175,000	36,000	139,000	22,000	250,000	337,000	1,091,000	1,091,000	1,091,000
	Reduction	18,000	18,000	7,000	18,000	7,000	24,000	28,000	120,000	197,000	39,000
	% Reduct	14%	10%	19%	13%	32%	10%	8%	11%	18%	4%
2031	Status quo	158,000	218,000	42,000	176,000	26,000	317,000	416,000	1,353,000	1,353,000	1,353,000
	Reduction	21,000	21,000	8,000	21,000	8,000	30,000	34,000	143,000	239,000	48,000
	% Reduct	13%	10%	19%	12%	31%	9%	8%	11%	18%	4%

Source: Milliman actuarial projection

The reduction in diabetes-related complications will not be uniform by payer group, particularly because age is a significant risk factor for developing these complications. Table 8 shows how complication reduction will be distributed across payer groups, Medicare receiving the biggest share of reduced diabetes-related complications.

Table 8: Annual Reduction Diabetes-Related Complications with Improved Control by Payer

	Reduction of Uncontrolled by 30% by Payer Group						Reduction of Uncontrolled by 50%	Reduction of Uncontrolled by 10%
Year	Commercial	Medicare	Medicaid	Other	Uninsured*	Total	Total	Total
2011	35,000	44,000	4,000	2,000	9,000	94,000	155,000	31,000
2021	45,000	60,000	7,000	2,000	6,000	120,000	197,000	39,000
2031	48,000	79,000	8,000	2,000	7,000	144,000	239,000	48,000

*Based on the Congressional Budget Office model for covering the uninsured during the 2010 decade, which shifts many of the uninsured to Medicaid and commercial
Source: Milliman actuarial projection

Some diabetes-related complications are associated with significant mortality. The authors modeled the reduction in mortality associated with the reduction in complications from improved control, shown in Table 9. In 2031, the authors project 2 to 9 percent reduction in mortality for people with type 2 diabetes in 2031 for a reduction of 9,700 to 48,700 fewer deaths because of fewer diabetes-related complications.

Table 9: Annual Reduction in Mortality Associated with Diabetes-Related Complications for people with Type 2 Diabetes with Improved Control by Payer

	2011	2021	2031
Diabetes Related Mortality Assuming no Reduction	365,000	431,000	525,000
Reduction of Uncontrolled by 30%			
Commercial	2,200	7,300	10,900
Medicare	4,800	9,600	14,700
Medicaid	200	1,000	1,600
Uninsured*	100	300	500
Other	600	1,100	1,500
Total Reduction	7,900	19,300	29,200
% Reduction in Diabetes Related Mortality	2%	4%	6%
Reduction of Uncontrolled by 50%			
Total Reduction	13,300	32,100	48,700
% Reduction in Diabetes Related Mortality	4%	7%	9%
Reduction of Uncontrolled by 10%			
Total Reduction	2,700	6,400	9,700
% Reduction in Diabetes Related Mortality	1%	1%	2%

*We followed the Congressional Budget Office model for covering the uninsured during the 2010 decade and shifted many of the uninsured to Medicaid and commercial
Source: Milliman actuarial projection. Mortality reductions are estimated for reduced adverse events only.

According to our assessment, as diabetes-related complications decrease, so will the costs associated with them. Table 10 shows the cost decrease associated with the reduction in the seven diabetes-related complications. We project a reduction of $39 billion to $196 billion in costs for people with type 2 diabetes in 2031 with improved control of A1C, blood pressure and HDL.

Table 10: Annual Cost Reduction Associated with Fewer Diabetes-Related Complications with Improved Control by Payer

	2011	2021	2031
Cost Assuming No Reduction ($billion)	$359	$807	$1,610
Reduction of Uncontrolled by 30%			
Commercial	$1.1	$23.0	$60.8
Medicare	$1.0	$16.9	$47.2
Medicaid	$0.1	$1.7	$4.8
Uninsured*	$0.0	$0.8	$2.1
Other	$0.1	$1.3	$3.0
Total Reduction	$2.3	$43.5	$117.9
% Reduction in Cost	1%	5%	7%
Reduction of Uncontrolled by 50%			
Total Reduction	$3.8	$72.6	$196.5
% Reduction in Cost	1%	9%	12%
Reduction of Uncontrolled by 10%			
Total Reduction	$0.8	$14.5	$39.3
% Reduction in Cost	0%	2%	2%

*We followed the Congressional Budget Office model for covering the uninsured during the 2010 decade and shifted many of the uninsured to Medicaid and commercial
Source: Milliman actuarial projection

The authors did not include costs for improved diabetes therapy but did include costs for current drug therapy level. Diabetes therapy typically includes diet and exercise and pharmaceutical medications (generics and brand name medications). The additional costs of drugs should be considered in evaluating the projected cost savings.

Appendix A: Description of Key Data Sources and Their Application

Medicare 5 Percent Sample. This limited data set contains all Medicare paid claims generated by a statistically-balanced sample of beneficiaries. Information includes diagnosis codes, procedure codes, and diagnosis-related group (DRG) codes. It also includes site of service information as well as beneficiary age, eligibility status and an indicator for HMO enrollment. We used Medicare five percent beneficiary sample data in 2005-2008.

Thompson Reuters Medstat database. This dataset contains all paid claims generated by more than 20 million commercially-insured lives. Member identification codes are consistent from year-to-year and allow for multi-year longitudinal studies. Information includes diagnosis codes, procedure codes and DRG codes, NDC codes along with site of service information, and the amounts paid by commercial insurers. For this study, we used Medstat 2005 to 2008.

Milliman 2009 Health Cost Guidelines. The Guidelines provide a flexible but consistent basis for the determination of health claim costs and premium rates for a wide variety of health plans. The Guidelines are developed as a result of Milliman's continuing research on healthcare costs. First developed in 1954, the Guidelines have been updated and expanded annually since that time. The Guidelines are continually monitored as they are used in measuring the experience or evaluating the rates of health plans, and as they are compared to other data sources.

NHANES series 1999-2000, 2001-2002, 2003-2004, 2005-2006. This is from the series of National Health and Nutrition Examination Surveys. A department within the Centers for Disease Control's (CDC's) National Center for Health Statistics (NCHS) produces NHANES. Each year, the survey contains information from roughly 5,000 completed forms plus details of laboratory results and physical examinations. A representative sample of the non-institutionalized civilian population age 12 and older is selected by using a stratified, multistage sampling design. The data items list contains well more than 1000 items of an individual's clinical, demographic and health status

UKPDS Risk Engine. The UKPDS Risk Engine is a type 2 diabetes specific risk calculator based on 53,000 patient years of data from the UKPDS.[30]

Milliman Healthcare Reform Model. This flexible tool contains demographic, cost, use and coverage information on the U.S. population.

APPENDIX B: METHODOLOGY

Overall Approach to Modeling

To establish the "status quo" forecast, we derived medical and pharmacy costs from commercial and Medicare data. We developed part D costs for the Medicare cohort by calculating the expected Medicare Part D costs of diabetes patients according to Medicare's Hierarchical Condition Category risk adjuster methodology.[31] We adjusted commercial and Medicare cost levels for other payers. We applied population, cost and disease projection rates to develop estimates of future costs.

Our model uses a cohort of 750 individuals with type 2 diabetes from NHANES series 2003 to2006. We captured the characteristics of the individuals that were important for our forecast and for the UKPDS model including demographics, A1C, blood pressure, HDL, smoking status and body mass index (BMI).

To develop diabetes-related complication rates (including mortality), we applied the NHANES cohort to the UKPDS model on a seriatim basis. For each year of the forecast, we adjusted the NHANES cohort to match the projected U.S. population characteristics. To model improved control, we modified the clinical characteristics (A1C, blood pressure and HDL) of the NHANES cohort to reflect our improved control scenario. The cost reductions considered the impact of improved survival (which add cost) as well as the cost reductions from fewer events.

Improvement in control was simulated for three factors: reductions in A1C, systolic blood pressure, and increases in HDL. Our improved control scenario consisted of improving control for 30 percent of the uncontrolled population of people with type 2 diabetes. Any number of scenarios could achieve that improvement, and we chose the scenario shown in Table 11.

We chose to show the results for three scenarios -- reducing non-target prevalence by 10%, 30% and 50%. These reduction levels were chosen as possible targets. At this time, national targets have not been published in the public health literature or by any particular stakeholders. These figures can be modified as national targets become available

Table 11: Scenario for Improving Diabetes-Related Outcomes

Clinical Measure	Application to reach 30 percent Reduction in People Not Meeting Target (10% and 50% reduction scenarios follow similar pattern)
Hemoglobin A1C	A1C between 7 and 8.5: 42 percent move to target of 7.0 A1C between 8.5 and 11: 36 percent move to target of 7.0 A1C above 11: 36 percent move to A1C of 8.0
Systolic Blood Pressure	SBP > 135: 30 percent move to target of 130
HDL	HDL< 40 mg/dL for men, < 50 mg/dL for women: 30 percent move to target of 40 mg/dL for men and 50 mg/dL for women

The considerations for our 20 year prevalence projections include:

- Aging of the U.S. population (U.S. Census Bureau)[32] [33]
- Diabetes screening impact on shifts of undiagnosed diabetes. NHANES trends (Milliman analysis) indicate little change in the portion of undiagnosed diabetes, which we assumed.
- Obesity impact on diabetes prevalence. NHANES trends (Milliman analysis) and CDC obesity projections [34]
- Shifts in distribution of the ethnic mix of the U.S. population (U.S. Census Bureau)[35] [36]
- Shift in the uninsured population to other payer coverage (Oct. 7, 2009 CBO report healthcare reform analysis and estimates)[37] [38] [39]

Prevalence

To determine the prevalence of type 2 diabetes, we applied standard queries to the NHANES 2003 to 2006 databases. These queries identified individuals with diagnosed type 2 diabetes as well as their A1C, blood pressure, lipid levels, and other key clinical information and medical history, including prevalence of diabetes-related complications, smoking status, BMI, age, gender, ethnicity, use of oral diabetes drugs and insulin and age of diabetes diagnosis.

We applied the prevalence information to models from Milliman's Healthcare Reform Model to project the impact on all payer groups. We applied the considerations described above.

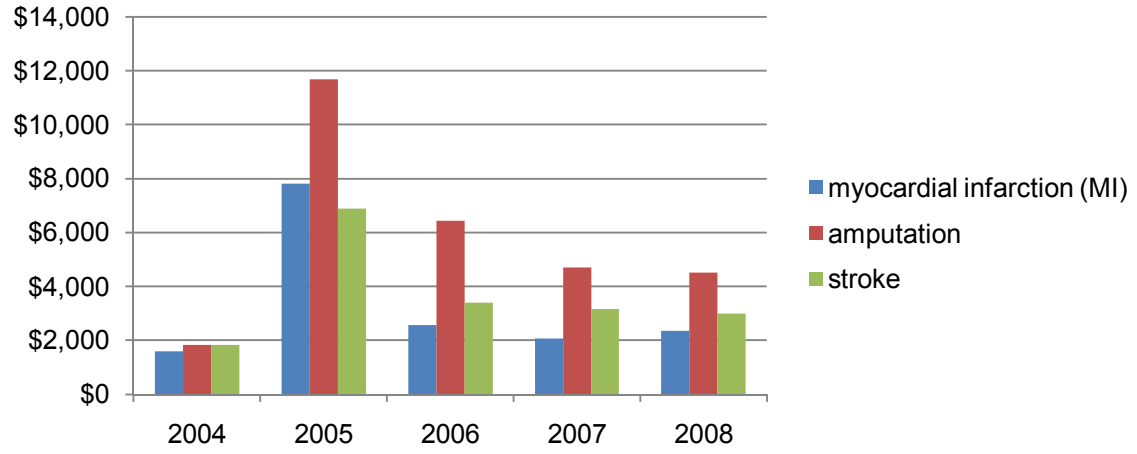
Costs

To model costs, we examined MedStat for commercial lives and the Medicare 5 percent sample for Medicare lives. We assumed Medicaid cost as 93 percent of commercial cost, VA and other as 90 percent of commercial, and uninsured as 35 percent of commercial.

We did not include costs for improved diabetes therapy, although costs for the current level of drug treatments are included. Diabetes therapy includes diet and exercise, as well as pharmaceutical medications (generic and brand medications). The additional costs of drugs should be considered in evaluating the projected cost savings.

The costs of reduced diabetes-related complications play a critical role in our model. Certain complications lead to significant costs in the years following the event. We developed complication costs by examining the actual claim costs of individuals having events in the year before the event, the year of the event and two years after the event. We developed per patient per month (PPPM) costs, which are the average monthly costs for the patients experiencing the event. The costs shown in Figure 12 are for commercially insured people with diabetes who had one of three important diabetes-related complications in 2005.

Figure 12 Allowed PPPM (2010 dollars) For Commercially Insured People with Type 2 Diabetes Having Diabetes-Related Complications in 2005



Source: Milliman analysis of Medstat 2004 to 2008

Our methodology developed similar relationships for the other diabetes-related complications we modeled: ischemic heart disease, blindness, congestive heart failure and renal failure.

The literature supports our assumption that people who suffer certain diabetes-related complications, such as a stroke, have increased mortality risk for years following the event. If avoiding those complications means avoiding the increased mortality risk – which is what we have assumed – then the saved lives from improved control can accumulate, year-after-year, through improved control. This dynamic explains the dramatically increasing reduction in mortality with improved control shown in Table 9.

For cost trends, we used NHE published figures, and adjusted these to decline after 2018. The average annual trend over the projection period (2011 to 2031) is about 5.4 percent.

Mortality rates for people developing each diabetes related complications were developed from rates reported in the literature and from our claim data analysis.[40] [41] [42]Mortality projections for the general population of people with diabetes (not just those with complications) were developed using mortality tables from the U.S. Census Bureau and the literature.

Appendix C: About the Authors

Milliman, Inc. is an independent actuarial and consulting firm with over 2200 employees serving the healthcare, financial services, property-casualty and employee benefits industries. We serve a full spectrum of private, insurer, employer, government, labor and non-profit organizations.

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Bruce Pyenson, FSA, MAAA, is a Principal & Consulting Actuary in the New York office of Milliman. During 23 years at Milliman, he has consulted to the full spectrum of healthcare and health insurance organizations. In recent years, his practice has focused on the financial consequences of therapies, medical practice patterns, reimbursement and benefit design. Bruce has published widely on healthcare reform and on payer-relevant therapeutic value.

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