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Medical Costs Associated with Diabetes Complications in Medicare Beneficiaries Aged 65 Years or Older with Type 1 Diabetes

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Abstract

Aims: To estimate medical costs associated with 17 diabetes complications and treatment procedures among Medicare beneficiaries ≥65 years old with type 1 diabetes.

Methods: Using the 2006–2017 100% Medicare claims database for beneficiaries enrolled in fee-for-service plans and Part D, we estimated the annual cost of 17 diabetes complications and treatment procedures. Type 1 diabetes and its complications and procedures were identified using ICD 9/10 codes, procedure codes, and diagnosis-related group codes. Individuals with type 1 diabetes were followed from the year when their diabetes was initially identified in Medicare (2006–2015) until death, discontinuing plan coverage, or December 31, 2017. Fixed-effect regression was used to estimate costs in the complication occurrence years and subsequent years. The cost-proportion of a complication was equal to the total cost of the complication, calculated by multiplying prevalence by the per person cost, divided by the total cost for all complications. All costs were standardized to 2017 US dollars.

Results: Our study included 114,879 persons with type 1 diabetes with lengths of follow-up from 3 to 10 years. The costliest complications per person were kidney failure treated by transplantation (occurrence year $77,809; subsequent years $13,556), kidney failure treated by dialysis ($56,469; $41,429), and neuropathy treated by lower-extremity amputation ($40,698; $7,380). Sixteen percent of the total medical cost for diabetes complications was for treating congestive heart failure.

Conclusions: Costs of diabetes complications were large and varied by complications. Our results can assist in cost-effectiveness analysis of treatments and interventions for preventing or

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delaying diabetes complications in Medicare beneficiaries aged 65 years or older with type 1 diabetes.

Keywords

Diabetes; complications; costs; Medicare

Introduction

Type 1 diabetes is a chronic condition that increases the risk for many serious health problems, including macrovascular and microvascular complications. Type 1 diabetes imposes large economic burdens on the health care system and on families of persons who have the disease (1). The number of Medicare beneficiaries with type 1 diabetes has been increasing and is expected to continue to grow due to increases in prevalence and incidence of type 1 diabetes in the younger population (2, 3) and increases in life expectancy of persons with type 1 diabetes (4). Assessing and reducing the economic burdens of type 1 diabetes have become increasingly important for Medicare.

Many interventions—such as managing HbA1c, blood pressure, and cholesterol—could prevent or delay the onset of diabetes complications in persons with type 1 diabetes (5, 6). Assessing the cost-effectiveness of these interventions requires information about the costs of individual complications to quantify the medical cost saved from preventing or delaying the complication. Simulation models have been developed for assessing the long-term cost-effectiveness of type 1 diabetes interventions, as the health and economic benefits of the interventions may not be realized immediately after initiating the intervention (7). Improving the parameterization of the simulation model requires current and accurate cost estimates of individual diabetes complications. Furthermore, assessing the need for health care resources of Medicare beneficiaries with type 1 diabetes requires estimates of the cost of diabetes complications.

Few prior studies have examined the cost of type 1 diabetes in the United States, and these studies were mainly focused on estimating the total medical cost attributable to type 1 diabetes in people ≤65 years old (8, 9). Medical costs in Medicare beneficiaries with type 1 diabetes likely differ from the costs derived from a younger population due to differences in the type of health insurance, duration of diabetes, and health profiles of the study population. Furthermore, estimates of the total medical cost of type 1 diabetes are of limited use for measuring the economic benefits of interventions for preventing different types of complications (10). Due to a lack of cost estimates by type of complication, existing type 1 diabetes simulation models either use cost estimates derived from the type 2 diabetes population as proxies or synthetic estimates derived from a micro-costing model based on recommended treatment patterns (7, 11). Costs of the same diabetes complication among persons with type 1 and type 2 diabetes likely differ due to age of diabetes onset, duration of diabetes, and management of the disease (12–15).

As the costs of diabetes complications in the older adult type 1 diabetes population are largely unknown, the objective of our study was to estimate the annual cost of individual complications in Medicare beneficiaries aged 65 years or older with type 1 diabetes.

Leveraging a large type 1 diabetes population included in the 100% Medicare claims data, we estimated the cost of 17 diabetes complications and treatment procedures in this population.

Research Design and Methods

Study Population

Our study sample was from a diabetes cohort previously identified (16) using 100% Medicare claims among those who enrolled in fee-for-service plans. This cohort contained Medicare beneficiaries aged ≥68 years or older with diagnosed diabetes, including both type 1 and type 2 diabetes. The algorithm used to identify beneficiaries' diabetes status though claims was validated and described in detail previously (16, 17). We used ICD-9 code 250.x1 or ICD-10 code E10 for type 1 diabetes and ICD-9 code 250.x0 or ICD-10 code E11 for type 2 diabetes to distinguish between the two types of diabetes. In our analysis, we included beneficiaries with type 1 diabetes claims only or beneficiaries with more type 1 diabetes claims than type 2 diabetes claims if they had both type 1 and 2 diabetes codes in their claims (18). We did not include beneficiaries enrolled in Medicare Advantage Plans, who represent about one-third of the total Medicare population (19), as we did not have claims data for them. We also excluded individuals who did not enroll in Part D plans as their prescription drug cost data were not available.

The first cohort from the database was from 2008. We required the beneficiaries to have a minimum of 2 years of follow-up after the fyear when they were initially identified with type 1 diabetes diagnoses. Using data from 2008 to 2017, we identified eight cohorts (one cohort in each year 2008–2015, plus at least 2 years of follow-up) of beneficiaries with type 1 diabetes.

Outcome Variables

The outcome variable for our analysis was the total annual per-person medical cost paid by Medicare, beneficiaries, and any third-party payers. Total cost included costs associated with inpatient, outpatient, home, and skilled nursing facility care; prescription drugs; and medical supplies. Data on costs of prescription drugs were available only for beneficiaries enrolled in Part D plans. All costs were adjusted to 2017 US dollars using the using Personal Health Care (PHC) Expenditure deflator(20).

Diabetes Complications

Diabetes complications and treatment procedures were the primary variables of interest. We used diagnosis and procedure codes and diagnosis-related group codes (Supplemental Table S1) to identify 17 diabetes complications. To precisely capture the cost pattern of different complications, we categorized the complications according to their natural histories and the associated treatment patterns and modeled their costs accordingly. Complications were categorized into two groups: 1) acute events that did not have costs in subsequent years; 2) chronic events with different cost estimates in the year when the complication occurred (i.e., occurring year) and in subsequent years. The first group included retinopathy intravitreal injections, photocoagulation, hypoglycemia, and ketoacidosis. The second group included the rest of the complications with some modifications for nephropathy, kidney failure treated by dialysis, kidney failure treated by transplantation, myocardial infarction (MI), stroke, angina, and revascularization. Because the progressive nature of the chronic kidney disease and treatment options, we set dummy variables associated with nephropathy and nephropathy history to be equal to 0 when either dialysis or transplantation occurred. Similarly, we set dummy variables associated with dialysis and its history to be equal to 0 at the year or afterward when a person had transplantation. For MI and stroke, we allowed recurrent occurring years whenever there was one or more claims for acute events in the year. We treated angina and revascularization the same as MI and stroke with exceptions, i.e., whenever MI or MI history variables and angina or revascularization history variables all appeared in the records, we set the value of angina or revascularization history as a zero to recognize that MI would absorb the effect of angina or revascularization during the subsequent years (see Supplemental Table S2). If a beneficiary had a complication before 2008, we treated the complication status as a subsequent year. All the subsequent years were grouped into one variable instead of being counted as separate variables such as subsequent year 1, subsequent year 2, etc.

Statistical Methods and Model Selection

As the proportion of beneficiaries with diabetes who had zero total annual costs was <1%, we used a one-equation regression model as opposed to a two-part model. We used the fixed-effect model for our anslayis. Unlike cross-sectional studies that use cross-sectional data to compare the medical cost between people with and without a specific complication, the fixed-effect model uses longitudinal data to compare the medical cost of a person before and after the person has a complication. Many factors such as those related to health care seeking behaviors, perceived health status, or ability to pay affect the health service utilizations and medical costs but were often unavailable in claim data. Omitting these variables could lead to estimate biases. The fixed-effect regression model can inherently adjust for these factors with missing data but do not change over time to reduce the estimation biases (Appendix)(21). We controlled for several comorbid conditions: liver disease, arthritis, depression, hip fracture, anemia, dementia, asthma, COPD, hypothyroidism, cancer, HIV/AIDS, and organ transplant (excluding kidney or pancreas transplants that could result from having diabetes) to adjust for potential confounding. Our cost estimates represented an independent assessment of a specific complication, not the total cost among beneficiaries who experienced that complication, which could be much higher because complications co-occur. All descriptive and regression analyses were performed using SAS Enterprise Guide 7.1 (SAS Institute, Carey, NC). We also conducted subgroup analysis that provided complication cost estimates by age (<75, ≥75 and <85, ≥85), race/ethnicity (black, white, Hispanic, Asian/Pacific Islander, American Indian / Alaska Native) and dual eligibility for Medicaid(yes/no)).

We estimated the total cost for each complication and its proportion in the overall cost of all complications in 2017 for Medicare fee-for-service beneficiaries with type 1 diabetes and Part D enrollment. The total cost of an individual complication was calculated by multiplying prevalence of the complication in the beneficiaries with type 1 diabetes and Part D enrollment by the estimated annual per person cost from the fixed-effect regression model.

The overall cost associated with all complications was the cost sum of all 17 complications. The cost proportion of each complication was the cost of each complication divided by the overall total.

To estimate the total medical cost associated with diabetes complications for all Medicare beneficiaries with type 1 diabetes in 2017, we conducted a sensitivity analysis by including both beneficiaries with and without Part D. The method used to estimate the annual cost associated with each complication was the same as the main analysis except that we added a dummy variable for those who did not enroll in Part D. We used the same method as used for the main analysis to estimate the total cost for an individual complication and for all 17 complications in the sensitivity analysis.

Results

Our study included 114,879 Medicare fee-for-service beneficiaries with type 1 diabetes. The 2008 cohort had the longest follow-up time and the largest share (61.1%) of beneficiaries as it included those beneficiaries who were enrolled in Medicare before 2008 (Supplemental Table S3). The average follow-up time was 5.73 years (range 3–10 years). Table 1 shows the characteristics of the study population in patients' baseline year. Individuals were, on average, 77 years old when they entered the study. The majority were non-Hispanic white (77.6%), and over half (63.3%) were female. Nearly half (49.3%) had at least one complication, and 2.8% had four or more complications at baseline. Having a complication increased the crude medical cost. The most common complications were nephropathy (74.3%) and congestive heart failure (CHF) (67.8%). The least common complications were kidney transplantation (0.2%), ketoacidosis (1.1%), and LEA (1.6%) (Supplemental Table S9).

The estimated annual per person costs associated with diabetes complications after adjusting for time-invariant characteristics of beneficiaries themselves ranged from $40 (chronic retinopathy history) to $77,809 (kidney failure treated by transplant), with a median cost of $5,799 (Table 2; Supplemental Figure 1). The two short-term complications—hypoglycemia and ketoacidosis—cost $6,400 and $11,204 respectively. The three costliest long-term conditions were all microvascular complications: kidney failure treated by transplantation ($77,809 in the occurrence year and $13,556 in subsequent years), kidney failure treated by dialysis ($56,469 and $41,429), and LEA ($40,698 and $7,380). Costs for other microvascular complications ranged from $872 to $10,639 in the occurrence year and $40 to $3,090 in subsequent years (Table 2; Supplemental Figure 1).

The costliest condition among macrovascular complications was MI ($18,575 in the occurrence year and $1,488 in subsequent years). Other macrovascular complications cost $12,813 in the occurrence year and $3,229 in subsequent year for CHF; $12,385 and $542 for stroke; $11,608 and $816 for revascularization; and $5,198 and $553 for angina (Table 2; Supplemental Figure 1).

Results of the subgroup analysis were provided in the Supplemental Tables S5–S7. Differences in annual complication costs between subgroups varied depending on the specific complication. Overall, black beneficiaries and beneficiaries with dual eligibility for Medicaid had a higher cost estimate for diabetes complications. There was no clear pattern in the cost of complications by age group.

The estimated total cost for all 17 complications in Medicare fee-for-service beneficiaries with type 1 diabetes and Part D enrollment was $704.4 million in 2017. Total cost of CHF (occurrence and subsequent years) was the highest among the 17 complications, accounting for 16% of the total (Supplemental Table S4). Second to CHF, nephropathy was 14% of the total. Stroke represented 13% of the total; revascularization, 12%; kidney failure treated by dialysis, 11%; MI, 10%; foot ulcer, 8%. Each other complication represented <5% of the total. Although kidney failure treated by transplantation was the costliest complication per person per year, it accounted for only 0.3% of the total complication cost as the number of beneficiaries who received this treatment was small.

Results from the sensitivity analysis showed that including beneficiaries without Part D in the study population changed the proportion of individual complications little (Table 3). However, the total estimated cost associated with diabetes complications were increased from $704.7 million to $910.5 million.

Discussion

To our knowledge, our study is the first to estimate the cost of a comprehensive set of diabetes complications among Medicare beneficiaries with type 1 diabetes. Unlike the cost of complications in persons with type 2 diabetes, the cost associated with complications in persons with type 1 diabetes has not been well studied, especially among older adults. Diabetes complications have increased among Medicare beneficiaries with type 1 diabetes due to increases in the number of beneficiaries with the disease (22). Our study estimated the individual and overall burden of complications in Medicare fee-for-service beneficiaries aged 65 years or older with type 1 diabetes.

Our study results indicate that costs of type 1 diabetes complications are substantial and impose large financial burdens on Medicare. A U.K.-based study demonstrated that when patients learned to monitor and manage their blood glucose levels to the recommended target levels or below, their risk of complications and the total medical cost in individuals with type 1 diabetes was reduced (23). Screening for microalbuminuria and retinopathy followed by treatments could lower the risk of kidney failure and blindness and has been found to be cost-saving (24, 25). Blood pressure control with angiotensin-converting enzyme inhibitors (ACEI) and angiotensin receptor blocker (ARB) has been demonstrated as highly effective in preventing kidney failure and in cost saving compared with no ACEI/ARB therapy in patients with type 1 diabetes (6). It may be beneficial to evaluate the cost-effectiveness of those interventions in Medicare beneficiaries with type 1 diabetes. If confirmed, implementing these interventions could improve health and lower the cost of diabetes complications in this population.

Using a similar study design with claims data from private insurance, Yang et al. estimated the cost of diabetes complications in persons aged <65 years old with type 1 diabetes

(26). Compared with their cost estimates, ours were higher for hypoglycemia, ketoacidosis, nephropathy, and neuropathy but were lower for all other complications. These differences could be due to reasons such as Medicare beneficiaries with type 1 diabetes have a different payment structure (the younger population is mostly covered by private insurance) (27) or the pattern of care for older adults with type 1 diabetes could be different because of age-related conditions and multiple comorbidities and because of the need for social support (28). In addition, our estimated cost for kidney transplantation did not include the cost of organ acquisition including expenditures associated with issue typing, crossmatching and transportation of living donors or their kidneys as well as the associated administrative costs. The cost of kidney transplantation would be higher than our estimates if these costs were included. However, the cost after the first year of kidney transplantation would be much lower.

Studies to estimate costs of diabetes complication have also been conducted in other countries, mainly among people with type 2 diabetes (29–33). Cost estimates from these studies are not directly comparable to ours due to different diabetes type as well as different healthcare systems and payment policies in those countries. However, ranking of the estimated cost by complication seems to share some similarities. For example, the two most expensive complications were renal failure treated by dialysis or transplantation and amputation. Retinopathy was the least expensive complication.

Using the same database and study design, we also estimated the cost of diabetes complications among Medicare beneficiaries aged 65 years or older with type 2 diabetes (34). Compared with cost estimates of complications in persons with type 2 diabetes, our estimates in persons with type 1 diabetes were lower for hypoglycemia ($6,400 for type 1 vs. $9,399 for type 2; 47% lower), ketoacidosis ($11,204 vs. $13,015; 16% lower), kidney failure treated by transplantation history ($13,556 vs. $15,568; 15% lower). Our type 1 cost estimates were higher for nephropathy history ($2,321 vs. $1,875; 19% higher), neuropathy history ($1,168.3 vs. $870.7; 25% hinger), foot ulcer history ($3,090 vs. $2,303; 25% higher), blindness and vision loss history ($740 vs. $447; 40% higher), chronic retinopathy ($872 vs. $682; 22% higher), revascularization history ($816 vs. $576; 29% higher). Differences in all other estimates by diabetes types were within 15%. The reasons for the differences and similarities in complication costs between beneficiaries with type 1 and type 2 diabetes are not clear. Differences in diabetes management, severity of the complications, obesity, or other characteristics of the two study populations could play a role. For example, previous studies showed severe hypoglycemia happens more often in patients with type 2 diabetes than type 1 diabetes (35, 36), which could lead to a higher cost for treating hypoglycemia in beneficiaries with type 2 diabetes.

Our cost estimates by individual complication can be used as a benefit measure to evaluate the medical costs that could be saved by interventions that can prevent or delay various diabetes complications. Furthermore, our cost equation can be directly programmed into type 1 diabetes simulation models to measure the cost of the complications in persons aged 65 years or older. In some of the current type 1 diabetes simulation models, estimates are derived from a type 2 diabetes population of all ages. If those estimates are replaced by our estimates, which were derived from older adults with type 1 diabetes, accuracy of the cost-effectiveness results generated by these models would improve. Since our estimates were generated from Medicare fee-for-service population aged 65 years or older with type 1 diabetes, these cost estimates may not be appropriate estimates for predicting complication costs in younger population with type 1 diabetes. CHF and nephropathy accounted for 30% of the total cost associated with diabetes complications in Medicare beneficiaries with type 1 diabetes with fee-for-service health plans in 2017. Efforts focusing on preventing or delaying these two complications could have a substantial effect on reducing the total medical cost associated with diabetes complications in this population. CHF and nephropathy are highly correlated with each other (37, 38). Using ACEI/ARB has been shown to be effective in slowing the progression of kidney disease in persons with type 1 diabetes (6), as well as in preventing heart failure for persons with diabetes (39).

One strength of our study is the large population with long follow-up times, which allows us to estimate all 17 major diabetes complications and produce reliable and accurate cost estimates for each complication. Another strength was the use of a longitudinal study design and individual-level fixed-effects model, which allowed us to control for all time-invariant characteristics of patients that were not available in insurance claim data. Health care service utilization and cost can be influenced by many other factors besides basic demographic information (age, sex, race) available in claims data. These factors include health-related behavior patterns, childhood experience, medication adherence, perceived health status, financial security, etc. (40). Using an individual-level fixed-effects model overcame this limitation of claims data by comparing the outcome of different complication statuses for the same individual.

Our study has some limitations. First, the panel data is truncated on both the left and the right sides of the follow-up period. Although we created a 2-year look-back period, some patients entered the analysis as established type 1 diabetes patients and may have had prior acute complication events that we could not observe. It is possible that patients with established complications had different costs when encountering the second event, which we analyzed as a first event. Second, costs of an initial event may run over 2 calendar years, leading to a slight underestimation of acute costs and an overestimation of the costs in subsequent years. Third, nearly half of the included individuals had more than one complication. We assumed the costs of multiple complications are additive. The cost of managing concurrent complications may not equal the sum of the costs of each complication, but may have interaction effects, thus increasing or decreasing the overall cost. The effect of two or more co-existing complications on medical costs could differ by complication. Future research is needed to entangle the cost relationship between complications. Fourth, even without inflation, the cost of complications may have increased over the years because of technological advancement. We might therefore be underestimating the relevant cost for the complications for which treatments have become much more expensive since 2006. Fifth, the algorithm to identify persons with type 1 diabetes versus type 2 diabetes used in our study could misclassify some cases. How this misspecification affected the estimated costs of diabetes-related complications is not clear. Finally, fixed effects models may not completely eliminate confounding because there are still variables that could change over time.

Costs of individual diabetes complications in older adults with type 1 diabetes were previously unknown. We estimated these costs associated with 17 diabetes complications and treatment procedures among Medicare beneficiaries ≥65 years old with type 1 diabetes. Our cost estimates provide the cost parameters needed by type 1 diabetes cost-effectiveness simulation models, as well as those needed to determine economic benefits of clinical and public health efforts to delay or prevent complications in Medicare beneficiaries with type 1 diabetes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1:

Demographic and clinical characteristics of Medicare beneficiaries in the year first identified as having type 1 diabetes

	Mean
N	114,879
Mean age (years)	76.92
Sex (%)	
Female	63.29
Male	36.71
Race/ethnicity (%)	
Non-Hispanic white	77.55
Hispanic	7.13
Non-Hispanic black	11.67
Asian/Pacific Islander	2.77
American Indian/Alaska Native	0.21
Unknown	0.36
Comorbidities (%)	
Cancer	33.83
HIV/AIDS	0.28
Organ transplant *	0.07
Mean number of complications (number)	0.82
Number of diabetes complications † (%)	
No complications	50.66
With 1 complication	28.65
With 2 complications	12.81
With 3 complications	5.13
With ≥4 complications	2.75

* Organ transplant: excluding kidney failure treated by transplantation.

† Diabetes complications: retinopathy intravitreal injections, photocoagulation, hypoglycemia, ketoacidosis, nephropathy, kidney failure treated by dialysis, kidney failure treated by transplantation, neuropathy, lower-extremity amputation, chronic retinopathy, blindness and vision loss, congestive heart failure, foot ulcer, myocardial infarction, stroke, angina, and revascularization.

The beneficiaries whose index year was 2008 included all persons with type 1 diabetes in Medicare, either being eligible for the first time or had been with Medicare for some time

Table 2:

Estimated annual per person diabetes complication costs in Medicare beneficiaries with type 1 diabetes, in 2017 U.S. dollars

Complications	Estimated costs	Standard Error
Short-term complications		
Hypoglycemia	6,400.2	155.3
Ketoacidosis	11,204.4	717.2
Microvascular complications		
Nephropathy	10,263.6	148.3
Nephropathy history	2,321.0	142.9
Kidney failure treated by dialysis	56,469.2	504.3
Kidney failure treated by dialysis history	41,429.3	543.1
Kidney failure treated by transplantation	77,808.9	3,000.4
Kidney failure treated by transplantation history	13,555.8	2,586.0
Neuropathy	4,434.2	182.8
Neuropathy history	1,168.3	161.2
Foot ulcer	10,639.3	198.0
Foot ulcer history	3,090.4	183.9
Lower-extremity amputation	40,697.7	776.5
Lower-extremity amputation history	7,379.8	932.0
Chronic retinopathy	871.8	279.0
Chronic retinopathy history	39.8	233.1
Retinopathy intravitreal injections	3,959.4	253.6
Photocoagulation	1,404.5	234.7
Blindness and vision loss	6,770.7	302.2
Blindness and vision loss history	739.7	271.3
Macrovascular complications		
Congestive heart failure	12,812.6	161.4
Congestive heart failure history	3,228.8	158.8
Myocardial infarction	18,575.1	203.2
Myocardial infarction history	1,488.2	200.6
Stroke	12,384.7	152.7
Stroke history	541.7	179.9
Angina	5,197.5	186.3
Angina history	552.9	225.1
Revascularization	11,608.0	168.9
Revascularization history	815.5	256.6

Table 3:

Estimated per person per year cost, frequency, and total cost of each diabetes complication in all Medicare fee-for-service beneficiaries with type 1 diabetes in year 2017, in 2017 U.S. dollars

Complications	**Estimated costs**	**Frequency**	**Percentage of total cost**
Short-term complications			
Hypoglycemia	6,247.7	5,244	3.6%
Ketoacidosis	10,828.6	879	1.0%
Microvascular complications			
Nephropathy	9,897.1	3,128	3.4%
Nephropathy history	2,156.2	41,520	9.8%
Kidney failure treated by dialysis	56,318.1	387	2.4%
Kidney failure treated by dialysis history	41,397.8	1,841	8.4%
Kidney failure treated by transplantation	73,868.2	5	0.0%
Kidney failure treated by transplantation history	12,610.1	178	0.2%
Neuropathy	4,472.2	808	0.4%
Neuropathy history	1,068.6	35,827	4.2%
Foot ulcer	10,280.3	1,466	1.7%
Foot ulcer history	2,902.8	19,050	6.1%
Lower-extremity amputation	39,318.1	250	1.1%
Lower-extremity amputation history	8,131.8	451	0.4%
Chronic retinopathy	913.0	20	0.0%
Chronic retinopathy history	45.2	27,084	0.1%
Retinopathy intravitreal injections	3,991.2	3,778	1.7%
Photocoagulation	1,338.1	1,446	0.2%
Blindness and vision loss	6,675.8	866	0.6%
Blindness and vision loss history	667.3	6,844	0.5%
Macrovascular complications			
Congestive heart failure	13,076.2	3,713	5.3%
Congestive heart failure history	3,267.6	32,047	11.5%
Myocardial infarction	18,469.6	3,855	7.8%
Myocardial infarction history	1,305.6	13,927	2.0%
Stroke	12,369.2	9,561	13.0%
Stroke history	341.9	12,615	0.5%
Angina	4,838.7	3,721	2.0%
Angina history	479.2	9,754	0.5%
Revascularization	11,168.4	9,192	11.3%
Revascularization history	431.8	5,146	0.2%
Total cost	910,544,059.5		