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Health service utilization and related costs attributable to diabetes

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What's new?

- Addressing many of the limitations of previous studies, our paper is one of the first European studies to quantify the excess health service use and costs independently attributable to diabetes.
- After accounting for important determinants of health service use, diabetes was associated with substantial additional health service use and costs across the health system. Hospital admissions account for two-thirds of the cost burden.
- We provide informative estimates for policy-makers, identifying the costs that can be directly targeted by diabetes prevention and management interventions and by highlighting areas for potential cost savings in the context of finite healthcare resources.

Abstract

Aims To estimate the health service use and direct healthcare costs attributable to diabetes using best available data and methods.

Methods A nationally representative sample of adults aged ≥50 years was analysed (n=8107). Health service use in the previous 12 months included the number of general practitioner visits, outpatient department visits, hospital admissions, and accident and emergency department attendances. Multivariable negative binomial regression was used to estimate the associations between diabetes and frequency of visits. Average marginal effects were applied to unit costs for each health service and extrapolated to the total population, calculating the incremental costs associated with diabetes.

Results The prevalence of diabetes was 8.0% (95% CI 7.4, 8.6). In fully adjusted models, diabetes was associated with additional health service use. Compared to those without diabetes, people with diabetes have, on average, 1.49 (95% CI 1.10, 1.88) additional general practitioner visits annually. Diabetes was associated with an 87% increase in outpatient visits, a 52% increase in hospital admissions and a 33% increase in accident and emergency department attendances (P<0.001). The incremental cost of this additional service use, nationally, is an estimated €88,894,421 annually, with hospital admissions accounting for 67% of these costs.

Conclusion Using robust methods, we identified substantially increased service use attributable to diabetes across the health system. Our findings highlight the urgent need to invest in the prevention and management of diabetes.

Introduction

The number of people with diabetes has increased fourfold in the past 35 years and it is now the seventh leading cause of years lived with disability worldwide [1,2]. The impact of diabetes on health systems and national economies is of growing concern. In 2015, the global cost of diabetes was estimated to be US$1.31 trillion, with direct medical costs accounting for two-thirds of the costs [3]. Increasing prevalence combined with rising per capita medical expenditure indicate that the burden of diabetes on health systems will continue to escalate [4]. An understanding of the health service use and related costs associated with diabetes is necessary to inform national policies and the allocation of scarce resources. It is also essential for identifying and evaluating methods of cost saving.

Worldwide, there is a lack of accurate, comprehensive and comparable estimates of the health service use and costs attributable to diabetes [3]. This is largely attributable to the variation in methodologies employed [5]. Furthermore, the approach used affects the policy relevance of the estimates. There are three main methodological approaches: the sum-all medical approach; the disease-attributable approach; and incremental cost analysis. The most common method applied for estimating the cost of diabetes is the sum-all medical approach [5]. This method fails to identify service use attributable to diabetes and, thus, does not identify costs that can be avoided by diabetes prevention or management interventions. As a result, the sum-all medical approach does not provide meaningful estimates to inform policy decisions. Another common method used is the disease-attributable approach, whereby attributable fractions for conditions associated with diabetes are applied to health service use data to identify the proportion attributable to diabetes [5]. This method underestimates service use and the costs associated with diabetes because of its inability to capture use that does not appear directly attributable to diabetes [5,6]. For instance, mental health comorbidities in people with diabetes increase health service utilization [7]; however, because of its reliance on established quantifiable causal associations, disease-attributable methodology will not capture such excess service use.

More recent studies adopt an incremental costing approach. This method identifies the incremental health service use and costs for people with diabetes compared to those without, therefore capturing all costs associated with diabetes. The incremental costing approach also allows consideration of other factors known to influence health service use, including age, sex, ethnicity, education, socio-economic status, health status and lifestyle factors [8]. Thus, it is possible to estimate health service use that is independently associated with diabetes [6,9]. To provide more precise estimates of the global cost of diabetes, there is an urgent need for valid and reliable country-level data [3]. The aim of the present study was to provide robust estimates of health service use and direct healthcare costs attributable to diabetes from a societal perspective by applying an incremental cost approach, with appropriate adjustment, using a nationally representative sample of a community-dwelling adults, aged ≥50 years, with and without diabetes.

Methods

Study design

A cross-sectional analysis of data from the first wave of The Irish Longitudinal Study of Ageing (TILDA) was conducted. TILDA is a nationally representative prospective cohort study of community-dwelling adults aged ≥50 years in the Republic of Ireland [10]. The sampling frame used for TILDA was the Irish Geodirectory, a comprehensive and up-to-date list of all residential addresses in Ireland. A multistage probability sampling design was used, with each residential address in the country having an equal probability of selection [10]. Eligible addresses were defined as any household with a person aged ≥50 years. All household residents aged ≥50 years were eligible to participate in the study. The estimated number of eligible households was 10 129. Of these, 6282 households participated (response rate 62%) and 8175 individuals were recruited. Ethical approval was obtained from the Trinity College Dublin Research Ethics Committee.

Data collection

Data collection occurred between October 2009 and November 2011. Participants were visited in their home by trained interviewers, who used computer-assisted personal interviewing. This included detailed questions about sociodemographics, physical and mental health, self-reported doctor-diagnosis of chronic conditions and health service use.

Variable definition

The outcome of interest was self-reported health service use. Participants were asked about the frequency of visits to general practitioner (GP) services, outpatient department visits, hospital admissions and accident and emergency department (A&E) attendances in the past 12 months. They were also asked whether they had attended any of the following ancillary state services in the 12 months preceding the survey: dietitian; chiropody; optician; public health or community nurse; or psychology/counselling services. Individuals were classified as having diabetes if they self-reported a previous doctor diagnosis of diabetes. To distinguish between people with Type 1 and Type 2 diabetes, we defined those who were aged <50 years at diabetes diagnosis and reported injecting insulin, but who were not taking oral hypoglycaemic agents, as having Type 1 diabetes. All others were classified as having Type 2 diabetes. Participants who reported a doctor diagnosis of diabetes during the computer-assisted personal interviewing were asked the question, 'Has a doctor ever told you that you have any of the following conditions related to your diabetes?'. The conditions listed were: leg ulcer; protein in urine; lack of feeling and tingling pain in legs and feet due to nerve damage; damage to the back of the eye. Any participant who answered 'yes' to any of the above was considered to have a microvascular complication. Any participant who self-reported a doctor diagnosis of heart attack (myocardial infarction), heart failure (congestive cardiac failure), stroke (cerebrovascular accident) and mini stroke (transient ischaemic attack) was considered to have macrovascular complications. Other variables of interest included age (in years), gender, marital status (yes/no), education (primary, secondary, third level), location (urban/rural), healthcare cover (means tested public health insurance, private health insurance, both, neither), self-reported health status (excellent, very good, good, fair, poor) and other chronic conditions deemed not to be associated with diabetes. These conditions were lung disease, asthma, arthritis, osteoporosis, cancer, Parkinson's disease and peptic ulcer disease.

Statistical analysis

Health service utilization was compared across populations with and without diabetes. The differences in the proportion of people attending each health service was analysed using Pearson's chi-squared test. An independent samples *t*-test was used to analyse the difference in the mean number of visits to each service. Logistic regression was used to model the association between diabetes and attendance at ancillary state services. Negative binomial regression models were used to analyse the association between diabetes and the frequency of health service use. Poisson, negative binomial, zero-inflated Poisson and zero-inflated negative binomial regression models were explored. Model selection was informed by Akaike Information Criterion and Bayesian Information Criterion statistics and by comparing predicted and observed probabilities, with negative binomial regression being selected as the most appropriate model (Appendix S1) [11]. Average marginal effects were calculated, providing an estimate of the excess number of visits/admissions attributable to diabetes on average. The average marginal effects were computed using the post-estimation command, *margins dydx*, in STATA. This calculates a predicted probability for each case with the fixed and observed values of variables, and then averages the predicted values [12].

The Anderson framework for the societal and individual determinants of healthcare utilization was used to inform the selection of appropriate variables to include in the multivariable regression models, with the aim of identifying the independent effect of diabetes on health service use [13]. The Anderson framework categorizes determinants as either predisposing, enabling or need factors. Any variables that could potentially mediate the association between diabetes and health service use were omitted. Multivariable regression was used to first adjust for predisposing factors (age, gender and marital status), then enabling factors (education, healthcare cover and location) and finally need factors (other chronic conditions).

Sampling weights were applied to all data analyses to adjust for differential non-response and to reduce the potential for participation or selection bias [10]. Complete data were available for 99.1% of the sample and so a complete case analysis was carried out. Analysis was carried out in STATA v.12 for windows (StataCorp, College Station, TX, USA) using the survey function (svy).

Calculation of costs

The average marginal effects for significant associations were applied to unit costs for the relevant health service. A societal perspective was adopted, applying average unit costs of €50 for a GP visit, €160 for an outpatient department visit, €5,030 for a hospital inpatient admission and €183 for an A&E attendance previously calculated for Ireland [14,15]. These costs were extrapolated to the total population with diabetes to calculate the incremental health service costs. The total population with diabetes was estimated by applying the prevalence of diabetes in the sample to the most recent Irish census figures (2016). Cost estimates are reported in Euro and US dollars (USD) and were inflated to represent costs for 2016 using the Consumer Price Index (CPI) Inflation Calculator for Ireland [16]. To reflect uncertainty in the estimates of average unit costs, a sensitivity analysis was conducted whereby these estimates were varied by ± 20% [17].

Results

Of the 8107 participants included in the analysis, 51.9% were female and 41.5% were aged ≥65 years. The prevalence of diabetes was 8.0% (95% CI 7.4, 8.6), only 11 participants had Type 1 diabetes. Among people with diabetes, 15.8% (95% CI 13.0, 19.2) reported a macrovascular complication, while 26.3% (95% CI 22.7, 30.3) reported a microvascular complication.

There were significant differences between the population with and without diabetes (Table 1). People with diabetes were older, included a lower proportion of women, lower levels of educational attainment and lower self-reported health status. They were also more likely to be covered by public health insurance. There was significantly higher service utilization among people with diabetes for all health services, except psychology/counselling services. Those with diabetes reported an average of 5.8 GP visits in the past 12 months compared with 3.8 visits among those without diabetes (P<0.001). Of people with diabetes, 60.8% (95% CI 56.7, 64.8) reported attending an outpatient department in the last year compared with 39.1%

(95% CI 37.7, 40.5) of those without diabetes. A higher proportion of people with diabetes also reported being admitted to hospital in the previous 12 months [19.8% (95% CI 16.7, 23.2)] than those without diabetes [12.4% (95% CI 11.6, 13.2)]. Similar variations were observed for A&E attendances, with 20.5% (95% CI 17.3, 24.1) of people with diabetes attending A&E compared with 14.9% (95% CI 14.0, 15.8) of people without diabetes.

There were large statistically significant differences in the proportion of people attending all ancillary state services in the previous year between the two populations, other than attendance at a psychologist or counsellor (Table 1). The proportion of people with diabetes attending these services did not exceed 21%. Table 2 documents the adjusted odds ratios for attending ancillary state services for people with diabetes compared to those without. The odds of people with diabetes visiting a dietitian were 19.2 times those of people without diabetes (95% CI 12.4, 29.6). People with diabetes were four times more likely to visit a chiropodist than those without (95% CI 3.0, 5.5). Diabetes was also significantly associated with ~60% increased odds of attendance at an optician or public health nurse, with odds ratios of 1.58 (95% CI 1.27, 1.96) and 1.57 (95% CI 1.17, 2.10), respectively.

The incidence rate ratios (IRRs) and average marginal effects from the multivariable negative binomial regression models are presented in Table 3. There were statistically significant positive associations between diabetes and the frequency of GP visits, outpatient department visits, hospital admissions and A&E attendances. Adjustment for important confounding variables resulted in an attenuation of the IRR point estimates. In the fully adjusted models, people with diabetes had a higher rate of GP visits, with an IRR of 1.39 (95% CI 1.29, 1.50). A similar pattern was observed for outpatient department visits and hospital admissions.

Diabetes was associated with an 87% increase in outpatient department visits and a 52% increase in hospital admissions ($P<0.001$). A&E attendance was also associated with diabetes (IRR 1.33; 95% CI 1.06, 1.66). On average, 1.49 (95% CI 1.10, 1.88) additional GP visits were attributable to diabetes in a 12-month period and approximately one additional outpatient visit [0.97 (95% CI 0.73, 1.21)].

The population-based cost estimates for the incremental health service use associated with diabetes are shown in Table 4. The total population in Ireland in 2016 aged ≥50 years was

1 446 460. The prevalence of diabetes in this sample was applied, estimating that 115 717 adults aged ≥50 years had diabetes in Ireland. The incremental health service use associated with diabetes was estimated to cost €88,894,421 per annum. Hospital admissions accounted for the majority of this spending, costing an estimated €60,002,517. The results of the sensitivity analysis are shown in Table 5. By varying the unit cost estimates by ± 20%, the cost of the incremental health service use associated with diabetes fluctuated from €71,115,537 to €106,673,305.

Discussion

Using a large nationally representative population-based study, we have provided robust estimates of health service use and related costs attributable to diabetes. We identified substantial increased service use associated with diabetes across the health system. Because of the high costs of hospital admissions, hospitalization costs place the largest burden on the health service, accounting for more than two-thirds of the total costs attributable to diabetes.

Diabetes was associated with a 39% increase in GP visits and an 87% increase in outpatient department visits. This translated to an additional 1.49 GP visits on average per annum and approximately one additional outpatient visit. Because of the higher unit cost of outpatient visits, the associated costs were more than twice those of primary care costs. With ageing populations and the increasing burden of chronic disease, greater attention has been paid to coordinating patient care according to levels of disease complexity. There has been a shift towards multidisciplinary, shared management of complex cases of diabetes across primary and secondary care settings, and structured management of people with uncomplicated diabetes in primary care, with suitable organizational support [18]. The present findings suggest this shift in routine care settings could result in considerable cost savings.

Diabetes diagnosis was associated with increased hospital admissions, in line with a number of international studies that document higher rates of hospitalizations in people with diabetes [19,20]. While many studies only take age and gender into consideration, the present findings add to the literature by indicating that, in a population-based sample, diabetes remains associated with a higher number of hospital admissions after controlling for a wide range of important potential confounders. Our analysis shows that diabetes was associated with a 52% higher number of admissions. Because of variations in study populations and methodological approaches, direct comparisons with previous studies are limited. One study conducted in Tayside, Scotland, reported a 100% higher rate of hospital admissions in people with diabetes compared to those without [21]. This was a crude estimate and the study population was significantly younger.

Almost 70% of the health service costs associated with diabetes resulted from hospital admissions. Numerous studies report hospital admissions as the main driver of costs associated with diabetes, and the present findings highlight the need to provide effective interventions for the management of diabetes and related complications [22,23]. Increased risk of hospitalization in people with diabetes is attributable to macrovascular and microvascular complications [19,24]. While significantly higher than the population without diabetes, it is concerning that less than one-quarter of people with diabetes reported attending ancillary state services, such as chiropody and dietetic services. A shortage of allied health professionals has previously been identified as a barrier to delivering diabetes care in Ireland [25]. International guidelines identify these services as part of routine care for people with diabetes [26]. Such services, specifically foot care services and dietetic interventions for people with diabetes, are effective in preventing complications and subsequently reducing healthcare expenditure [27]. While these services may be available privately, at a significant cost to the patient, it is imperative that such effective services are accessible to all people with diabetes.

Addressing many of the limitations of previous studies, we provide robust estimates of health service utilization attributable to diabetes. By adopting an incremental approach, we ensured that any excess health service use attributable to diabetes was identified, not just the service use that appeared directly related to diabetes. For instance, this approach ensured that excess service use associated with mental health issues was captured in our results. A nationally representative sample provides an appropriate comparison group to calculate incremental use and costs, avoiding the overrepresentation of people with diabetes and diabetes-related complications. To date, studies have largely relied on hospital-based samples or administrative healthcare data [5]. Unlike much of the existing literature on the cost of diabetes, we specifically address the issue of endogeneity [5]. The present study accounts for important confounding variables that have previously been recognized as predictors of service use, identifying the costs that can be independently attributed to diabetes [8]. The adjustment for such factors led to the attenuation of our estimates. Most incremental studies control for gender and age only, because of data availability constraints [3,5,24,28], and so may overestimate service use and costs attributable to diabetes. Furthermore, any variables identified as potential mediating factors were omitted from the analyses, ensuring that the findings were not an underestimation of the true association between diabetes and health service use. To date, the only nationally representative studies adopting the incremental costing approach and adjusting for additional factors were conducted in the USA [4,9].

While we cannot infer causality because of the cross-sectional nature of the data, almost 90% of the cohort had attended the GP in the previous year. Thus, the potential for reverse causality, whereby those who attend the GP are more likely to be diagnosed with diabetes and diabetes-related complications, is reduced. Furthermore, <1% of the cohort had undiagnosed diabetes on the basis of HbA_{1c} measurement [29]. While the reliance on self-report doctor diagnoses may potentially introduce misclassification bias and result in inaccurate estimates, evidence shows that self-report is a suitable measure for estimating the prevalence of chronic conditions including diabetes when compared to medical records [30]. Health service utilization is also based on self-report, introducing potential for measurement bias; however, recent studies suggest there is no evidence of differential recall bias according to demographics or health status [31]. This method is widely used in health services research. The data were weighted to adjust for differential non-response with the aim of minimizing the potential for selection bias and improving the representativeness of the findings; however, our estimates are only representative of the excess health service use and costs associated with diabetes in community-dwelling adults aged ≥50 years and so do not represent costs for the total population. It is estimated that <1.6% of the adult population aged ≥50 years in Ireland are in long-term residential care [32]. It is also important to note that cost estimates are based on average unit costs per visit/admission. Diabetes-related admissions are more expensive and, as a result, our cost estimates are likely to be an underestimation of the true costs of hospital admissions [22]. The cost estimates also only refer to additional service use for GP and hospital services. As a result of data limitations, we were unable to calculate the costs associated with ancillary service use or community care. Although we took a societal perspective in calculating the associated costs, our estimates represent the direct medical costs and do not consider the indirect costs associated with excess health service use. The accuracy of our estimates could be improved in further research by applying the demonstrated methods to individual-level cost data. The challenge, however, is to find a data source with all the necessary information. In the absence of a unique identifier in Ireland, this was not possible.

In conclusion, the present findings show that diabetes is associated with substantial additional health service use and costs, with hospital admissions accounting for more than two-thirds of the cost burden. We highlight areas for potential cost savings in the context of finite healthcare resources, such as a shift in routine management to primary care and improved access to effective ancillary services, such as foot care services and dietetic interventions [27]. We provide robust informative estimates for policy-makers by identifying additional health service use and costs that are attributable to diabetes. Effective interventions aimed specifically at both diabetes prevention and management therefore have the potential to have a direct impact on these healthcare costs. The challenge is to identify cost-effective interventions, examine the trade-offs between them, and determine how best to implement them.

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Competing interests

None declared.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Model diagnostics for the multivariable model.

Appendix S2. Health service utilization and socio-economic status.

Table 1 Characteristics of population by diabetes diagnosis

	General TILDA population (*n*=7486) %	Population with diabetes (*n*=621) %	*P*
Women, *n*	53	42	<0.001
Age, *n*			
50–64 years	60	44	
65–74 years	23	32	
≥75 years	17	25	<0.001
Rural residence, *n*	44	40	0.12
Married, *n*	66	63	0.11
Education, *n*			
None/primary	37	50	
Secondary	44	37	
Third level	19	13	<0.001
Healthcare cover, *n*			
Medical card	35	50	
Private health insurance only	38	25	
Dual cover	16	19	
No cover	11	7	<0.001
Diabetes-related condition, *n*			
Macrovascular	8	16	<0.001
Microvascular	-	26	
Other chronic illness*, *n*	47	51	0.07
Self-reported health, *n*			
Excellent/very good	55	33	
Good	30	32	
Fair/poor	15	36	<0.001
GP visits			
Attended past year, *n*	87	96	<0.001
Mean (SD) no. visits past year	3.8 (4.1)	5.8 (5.1)	<0.001
Outpatient department			
Attended past year, *n*	39	61	<0.001
Mean (SD) no. visits past year	1.1 (2.1)	2.2 (2.7)	<0.001
Hospital admissions			
Admitted in past year, *n*	12	20	<0.001
Mean (SD) no. admissions past year	0.2 (0.6)	0.3 (.08)	<0.001
A&E attendance			
Attended in past year , *n*	15	21	<0.001
Mean (SD) no. visits past year	0.2 (0.7)	0.3 (0.8)	0.01
Access to ancillary state service, *n*			
Dietitian	0.6	11	<0.001
Chiropody services	4	16	<0.001
Optician	12	21	<0.001
Public health/community nurse	6	12	<0.001
Psychology/counselling services	0.8	1.2	0.40

A&E, accident and emergency department; GP, general practitioner; TILDA, The Irish Longitudinal Study of Ageing.

*Lung disease, asthma, arthritis, osteoporosis, cancer, Parkinson's disease and peptic ulcer disease.

Table 2 Adjusted odds ratios for the association between diabetes diagnosis and ancillary service use in previous 12-month period

Ancillary service	**Adjusted odds ratio (95% CI)***	***P***
Dietitian	19.2 (12.4, 29.6)	<0.001
Chiropody	4.06 (3.00, 5.50)	<0.001
Optician	1.58 (1.27, 1.96)	<0.001
Public health/community nurse	1.57 (1.17, 2.10)	0.003
Psychology/counselling service	1.47 (0.66, 3.27)	0.34

*Models adjusted for age, gender, marital status, urban/rural location, education, healthcare cover, chronic conditions.

Table 3 Multivariable negative binomial regression results

Health service	Model 1: Crude		Model 2: Predisposing		Model 3: Enabling		Model 4: Need	
	IRR (95% CI)	AME (95% CI)	IRR (95% CI)	AME (95% CI)	IRR (95% CI)	AME (95% CI)	IRR (95% CI)	AME (95% CI)
GP visits	1.53 (1.42, 1.64)	1.99 (1.58, 2.40)	1.50 (1.38, 1.62)	1.88 (1.45, 2.32)	1.38 (1.28, 1.49)	1.46 (1.08, 1.84)	1.39 (1.29, 1.50)	1.49 (1.10, 1.88)
	P<0.001	*P*<0.001	*P*<0.001	*P*<0.001	*P*<0.001	*P*<0.001	*P*<0.001	*P*<0.001
Outpatient department	1.93 (1.73, 2.17)	1.04 (0.81, 1.27)	1.91 (1.70, 2.14)	1.01 (0.79, 1.24)	1.77 (1.58, 1.99)	0.87 (0.65, 1.08)	1.87 (1.65, 2.11)	0.97 (0.73, 1.21)
	P<0.001	*P*<0.001	*P*<0.001	*P*<0.001	*P*<0.001	*P*<0.001	*P*<0.001	*P*<0.001
Hospital admission	1.68 (1.35, 2.09)	0.12 (0.06, 0.19)	1.58 (1.26, 1.98)	0.11 (0.04, 0.17)	1.49 (1.20, 1.85)	0.09 (0.03, 0.15)	1.52 (1.21, 1.91)	0.10 (0.03, 0.16)
	P<0.001	*P*<0.001	*P*<0.001	*P*=0.001	*P*<0.001	*P*=0.002	*P*<0.001	*P*=0.002
A&E attendance	1.42 (1.15, 1.77)	0.09 (0.03, 0.16)	1.41 (1.13, 1.77)	0.09 (0.02, 0.16)	1.34 (1.07, 1.68)	0.08 (0.01, 0.14)	1.33 (1.06, 1.66)	0.07 (0.01, 0.14)
	P=0.001	*P*=0.006	*P*=0.002	*P*=0.008	*P*=0.01	*P*=0.02	*P*=0.01	*P*=0.03

A&E, accident and emergency department; AME, average marginal effect; GP, general practitioner; IRR, incidence rate ratio.

Model 1: crude association; Model 2: adjusted for age, gender, marital status; Model 3: adjusted for age, gender, marital status, education, healthcare cover, location; Model 4: adjusted for age, gender, marital status, education, healthcare cover, location, chronic conditions.

Table 4 Total incremental health service costs attributable to diabetes

Health service	Direct costs (95% CI) Euro	USD
GP visits	8,886,425 (6,560,448–11,212,403)	10,358,107 (7,645,924–13,069,288)
Outpatient department visits	18,512,617 (13,932,175–23,093,058)	21,578,491 (16,239,483–26,917,499)
Hospital admissions	60,002,517 (18,000,755–96,004,027)	69,939,533 (20,981,860–111,903,253)
A&E attendances	1,492,862 (213,266–2,985,725)	1,740,095 (248,585 - 3,480,191)
Total	88,894,421 (38,706,645–133,295,212)	103,616,226 (45,116,852–155,370,232)

A&E, accident and emergency department; GP, general practitioner; USD, US dollars.

Table 5 Sensitivity analysis: total incremental health service costs attributable to diabetes

Health service	Direct costs, € (95% CI)	
	–20%	+20%
GP visits	7,109,140 (5,248,359, 8,969,922)	10,663,710 (7,872,538, 13,454,883)
Outpatient department visits	14,810,093 (11,145,740, 18,474,446)	22,215,140 (16,718,612, 27,711,669)
Hospital admissions	48,002,013 (14,400,604, 76,803,221)	72,003,020 (21,600,906, 115,204,832)
A&E attendances	1,194,290 (170,613, 2,388,580)	1,791,435 (255,919, 3,582,870)
Total	71,115,537 (30,965,316, 106,636,169)	106,673,305 (46,447,974, 159,954,254)

A&E, accident and emergency department; GP, general practitioner.