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Resource consumption and costs in Dutch patients with Type 2 diabetes mellitus. Results from 29 general practices

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Abstract

Aims The aims of this study were to estimate the costs incurred by Dutch patients with Type 2 diabetes, examine which patient and/or treatment characteristics are associated with costs, and estimate the medical and non-medical costs of patients with Type 2 diabetes in The Netherlands.

Methods Twenty-nine Dutch general practitioners provided information on all Type 2 diabetes patients in their practice (n = 1371), information on demography, clinical characteristics, treatment type, the presence of complications and the type and amount of medical consumption during the previous 6 months. Medical costs were analysed using multivariate linear regression. Estimates of costs seen in The Netherlands were based on these results plus information from other sources regarding costs of end-stage renal disease, appliances, travel and productivity loss.

Results Although only 9% of patients were hospitalized within the previous 6 months, hospitalization costs represented one-third of the medical costs, drug costs 40% and ambulatory costs 26%. Patients using insulin, patients with macrovascular complications only or in combination with microvascular complications incurred higher medical costs than other patients. Age and hyperlipidaemia were also positively related to medical costs. When these results were combined with other data sources, we estimated that patients with Type 2 diabetes are responsible for £365 500 000 (1 271 000 000 guilders) or 3.4% of the relevant parts of health care costs in 1998. The non-medical costs (travel costs, productivity costs) are limited: 52 500 000 (183 000 000 guilders).

Conclusions Independent determinants of the medical costs of Type 2 diabetes in The Netherlands include age, complications, insulin use and hyperlipidaemia.

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Keywords Type 2 diabetes, costs, complications

Introduction

Type 2 diabetes is a serious burden on global health care resources and its world-wide prevalence is expected to increase considerably in the future [1]. Comprehensive information on the cost of diabetes is required for informed policy decisions on the most appropriate ways to manage disease in a cost-effective manner. It is particularly important to investigate the relationship between the occurrence of complications and costs, in order to estimate both the health effects and cost consequences of alternative therapeutic options to postpone or prevent the most common complications of diabetes.

The CODE-2 study is a multinational co-ordinated effort to measure the cost of more than 7000 people with Type 2 diabetes in eight European countries: Belgium, France, Germany, Italy,

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The Netherlands, Spain, Sweden and the UK, using a cross-sectional prevalence-based survey [2,3]. In this paper we present in detail the cost estimates and its determinants for The Netherlands.

In the first phase of our study, we determined the volume and composition of medical and non-medical costs incurred by patients with diagnosed Type 2 diabetes mellitus in The Netherlands by surveying the care received over a 6-month period by a large population of general practice patients. We also examined the relationship between costs and various patient characteristics. In the second phase of our study, we estimated the medical and non-medical costs of patients with Type 2 diabetes in The Netherlands, using both the cost estimates made in the first phase as well as cost estimates from other sources.

Patients and methods

The patient population used in this study was created by asking Dutch general practitioners (GPs) to answer questions about diabetes patients in their practice. These physicians were selected at random from a computerized database of physicians' names and addresses. Additional inclusion criteria included a practice size of at least 2500 patients. In total, 29 GPs participated in the study. The average age of the participating GPs was 50 years, the average practice size was 3088 patients, and 74% of the GPs had a solo practice (17% dual practice; 9% a group practice). These GPs were asked to provide information on all persons in their practice with the diagnosis of Type 2 diabetes.

Two types of questionnaire were used: one for the physician and one for the patient. The physician questionnaire contained questions on the practice, as well as questions regarding the demographic and clinical characteristics (i.e. presence of complications, co-morbidity, laboratory results) of each patient. Physicians completed their questionnaires on the basis of the contents of their patient charts. Questions about medical consumption over the 6 months prior to the date of completion of the questionnaire were also included. The GP had to indicate whether the medical consumption was perceived to be directly related to diabetes, indirectly related (conditions for which diabetes is a risk factor) or not related to diabetes. In this manner, information on all patients with a diagnosis of Type 2 diabetes was collected in order to determine the medical costs. The patient questionnaire contained questions regarding quality of life, treatment satisfaction, travel costs, self-testing and the

Table 1 Description of the study population (n = 1371) (mean and SD, as well as 25th and 75th percentiles, are shown unless otherwise specified)

Demographic characteristics	
Age (years)	65.2 (11.7, 57–74)
Gender (number, % females)	703 (51.3%)
Body mass index (kg/m^3)	28.2 (5.1, 24.8–30.8)
Duration since diagnosis (years)	6.7 (6.2, 2.1–9.3)
Clinical characteristics	
Primary treatment type (number, %)	
Diet and exercise alone	214 (15.6%)
Oral glucose-lowering drugs	945 (69.0%)
Insulin alone or in combination	211 (15.4%)
Presence of complications (%)	
No complications	46%
Microvascular complications only	22%
Macrovascular complications only	15%
Microvascular and macrovascular complications	16%
Type of microvascular complications (%)	
Neuropathy	19%
Retinopathy	14%
Nephropathy	11%
History of myocardial infarction	11%
History of stroke	4%
Blood glucose	
Fasting blood glucose (mmol/l)	9.0 (4.0, 6.8–10.3)
HbA_{1c} (%)	7.7 (1.8, 6.5–8.4)
Systolic blood pressure (mmHg)	151.0 (18.9, 140–161)
Diastolic blood pressure (mmHg)	84.4 (9.2, 80–90)
Lipids	
Total cholesterol (mmol/l)	5.5 (1.1, 4.8–6.2)
Triglyceride (mmol/l)	2.2 (1.7, 1.3–2.5)
HDL cholesterol (mmol/l)	1.3 (0.9, 1.1–1.4)
LDL cholesterol (mmol/l)	3.4 (1.0, 2.8–4.0)

Microvascular complications were defined as: foot ulcer, amputation, blindness, photocoagulation or vitrectomy, dialysis, renal transplant, retinopathy, neuropathy, manifest nephropathy, and microalbuminuria. Macrovascular complications were defined as: myocardial infarction, angina, heart failure, cardiac surgery (CABG, PTCA), stroke, transient ischaemic attack, peripheral vascular disease.

ability to perform paid work and/or other activities. For the non-medical costs the patient response was 95%.

The societal perspective was used for estimating costs. This means that all costs within the society are included, irrespective of who pays them [4]. The unit costs for the different components of medical consumption were based on price levels as of 1998. Unit costs for all medication were determined using local pharmacy consumer prices excluding value added tax, including prescription fees (prices July 1998) [5]. Unit costs for hospitalizations, hospital out-patient visits and consultations with other physicians, emergency room visits and paramedical personnel were estimated from a Dutch costing manual specifically developed for economic evaluations [6]. The unit costs for all laboratory tests and other diagnostic and treatment procedures were based on recently established tariffs reflecting real resource costs [7]. All costs were calculated both in Dutch guilders and Euros (official conversion rate: 1 Euro = 2.20371 Dutch guilders).

In order to estimate the total costs of care for Type 2 diabetes patients in The Netherlands, we supplemented the results using Dutch published data [8–11], since we knew that some patients with diagnosed diabetes are not generally seen by GPs (e.g. patients living in nursing homes). The costs of medical care for patients with end-stage renal disease were determined based on very detailed data from a nation-wide registration system called RENINE for dialysis and renal transplants [12]. The costs of appliances were also estimated using other recent cost studies [8,9]. The costs of glucose self-testing were based on the frequency of self-testing as indicated in the patient questionnaires, combined with the cost per test. The productivity costs due to absence from work were measured using standard questions on the number of days absent from work over the previous 3-month period, separating absence due to diabetes and its complications from absence for other reasons [13].

The relationship between patient characteristics and costs was studied with univariate and multivariate linear regression analysis (Ordinary Least Squares), using SAS version 6.12. The final multivariate model was determined using stepwise analysis and best subsets analysis.

Results

Medical consumption

The demographic and clinical characteristics of the study population are shown in Table 1. Approximately two-thirds of the patients were receiving oral glucose-lowering drugs.

On average, patients had made 4.6 visits to the GP in the previous 6 months and approximately one visit to a medical specialist (Table 2). Visits made to a specialist were most often made to an internist (20%), an ophthalmologist (15%), and a cardiologist (10%). Although the average number of paramedical visits was 2.2, the variation was wide since some patients were seen daily while others were seldom seen. The health care workers seen most frequently were physiotherapists (45% of all visits), diabetes nurses (32%), and dieticians (6%). Emergency care was rare and the number of tests and procedures performed by specialists averaged 2.7. In total, the average cost of ambulatory care was £141 (490 Dutch guilders) per 6 months per patient.

Table 2 Medical consumption and costs (in (Dutch guilders) per patient with Type 2 diabetes (n = 1371) (6-month period, The Netherlands, 1998)

	n (%)	Mean (SD)	Cost per unit	Costs
Ambulatory care				
General practitioner visits	1371	4.63 (3.62)	32	150
Specialist visits	1371	1.08 (2.07)	117	127
Paramedical visits	1371	2.16 (13.92)	36–60	79
Emergency care	1371	0.04 (0.22)	400	14
Tests and procedures	1371	2.68 (2.56)	—	121
Total cost	1371			490*
Hospital care			419/day†	
Patients hospitalized	120 (8.8)			—
Number of hospitalizations (if hospitalized at least once)	135	1.13 (0.42)		—
Duration per hospitalization (days)	11.9 (16.6)		—	
Total cost				633
Medication				
Oral glucose-lowering drugs	988 (72.1)			108
Insulin	204 (14.9)			57
Cardiovascular drugs	814 (59.4)			164
Lipid-lowering drugs	95 (6.9)			29
Gastrointestinal drugs	307 (22.4)			74
Antidepressants	68 (5.0)			10
Anti-infective therapy	408 (29.8)			13
Other medications	1125 (82.1)			275
Total cost		5.5 (3.9)		729
Overall				1851*

*Differences due to rounding off.

†Cost per hospital day if not hospitalized on ICU or CCU ward.

Table 3 Relationship between direct medical costs and patient characteristics (costs reported per patient with Type 2 diabetes over a 6-month period)

	Mean costs in Dutch guilders (SD)	Mean costs in Euro (SD)
Overall	1852 (4335)	840 (1967)
Gender		
Female	2093 (5226)	950 (2372)
Male	1597 (3118)	725 (1415)
Age		
< 50 years	1152 (1812)	523 (822)
50–59 years	1642 (3379)	745 (1533)
60–69 years	1664 (3831)	755 (1739)
≥ 70 years	2286 (5449)	1038 (2473)
Duration since diagnosis		
< 5 years	1808 (4803)	820 (2179)
5–10 years	1866 (3858)	847 (1751)
≥ 10 years	1935 (3675)	878 (1668)
Treatment type		
Diet and exercise alone	1264 (2645)	574 (1200)
Oral therapy alone	1792 (4648)	813 (2109)
Insulin alone or in combination	2722 (4155)	1235 (1885)
Presence of complications		
No complications	1085 (3553)	492 (1612)
Microvascular complications only	1777 (4461)	806 (2024)
Macrovascular complications only	2634 (5484)	1195 (2489)
Microvascular and macrovascular complications	3301 (5757)	1498 (2613)

Microvascular complications were defined as: foot ulcer, amputation, blindness, photocoagulation or vitrectomy, dialysis, renal transplant, retinopathy, neuropathy, manifest nephropathy, and microalbuminuria. Macrovascular complications were defined as: myocardial infarction, angina, heart failure, cardiac surgery (CABG, PTCA), stroke, transient ischaemic attack, peripheral vascular disease.

One hundred and twenty patients were hospitalized within the 6-month period (108 patients once, 10 twice, one three times, and one four times) and hospitalizations lasted an average of 11.9 days, resulting in an average cost of £182 (633 guilders). The patients who were hospitalized within this period were hospitalized an average of 1.13 times.

As expected, patients used a variety of medications, the average number of medications being 5.5. Most patients used oral glucose-lowering drugs as well as cardiovascular drugs. The total cost of medication was £209 (729 guilders) per 6 months. The average cost of all care was £531 (1851 guilders) per 6 months.

Relationship

Table 3 shows the relationships between costs and demographic and clinical characteristics. Patients with a duration since diagnosis of ≥ 10 years incurred slightly more costs than patients with a shorter duration. This pattern was seen for both costs directly related to diabetes and costs indirectly related to the diabetes (not shown in Table 3). However, there was a large degree of variation around the average costs. Patients on insulin therapy incurred the highest costs. Patients with no complications incurred the lowest costs (£297 (1036 guilders)), whereas patients with both micro- and macrovascular complications incurred the highest (£947 (3301 guilders)). Patients with macrovascular complications incurred higher costs of all types of care (i.e. ambulatory care, hospital care and medications) than other patients. In addition, the costs of hospitalization represented 47% of the total costs for patients with macrovascular complications vs. 25% for those with no complications.

Many demographic and clinical characteristics seemed to influence the total medical costs (Table 4). However, in the multivariate stepwise linear regression analysis, only a limited number of variables showed an independent association with total costs: age, insulin use, presence of macrovascular complications only, the presence of both microvascular and macrovascular complications and hyperlipidaemia. Despite the statistically significant contributions of these components to the fit of the regression model, the variation explained by the model was limited (5.3%) (Table 4).

National level

The total annual cost of care given to Type 2 diabetes patients in The Netherlands was calculated by combining the cost per patient as estimated above with the prevalence of Type 2 diabetes in The Netherlands, and adding the cost estimates from other data sources (see Other medical costs, below). Known estimates of the prevalence of diabetes in The Netherlands date from 1993 and indicate a 1.7% prevalence [10,11]. However, since there was reason to think that the prevalence of diagnosed diabetes had risen over the past several years, we estimated the prevalence in 1998 by studying the patient

Table 4 Relationship between patient characteristics and costs using univariate and multivariate regression analysis (coefficients in the models refer to Dutch guilders)

	Univariate analyses		Multivariate model	
	Coefficient	*P*-value	Coefficient	*P*-value
Age (per year)	33	0.0011	26	0.0189
Female gender	496	0.0340		
Duration since diagnosis (per year)	9	0.6208		
Treatment type (three categories)				
diet vs. oral	−528	0.1069		
insulin vs. oral	930	0.0047		
Treatment type (insulin vs. no insulin)	1028	0.0015	971	0.0058
Presence of any complications	1471	0.0001		
Per complication category				
microvascular only	692	0.0206		
macrovascular only	1549	0.0001	1193	0.0005
micro- and macrovascular	2216	0.0001	1806	0.0001
Hypertension	834	0.0004		
Obesity (if BMI > 30)	330	0.1506		
Hyperlipidaemia	915	0.0008	615	0.0220
Microalbuminuria	641	0.0788		
Blood glucose (per mmol/l)	21	0.5156		
HbA_{1c} (per percentage unit)	162	0.0142		
Model intercept	–		−614	0.3996
Adjusted r-square	–			0.0531

The final multivariate model was determined using backward stepwise analysis and supplemented using best subsets analysis.

Table 5 Estimates of annual costs for The Netherlands for Type 2 diabetes, in millions of Dutch guilders and Euro for 1998

Cost category	Costs in million Dutch guilders	Costs in million Euro
Total medical costs	1271	577
Ambulatory care*	312	142
Hospital care*	413	187
Medications*	458	208
Nursing home care	23.3	10.6
Appliances	65.2	29.6
Total non-medical costs	183	83.0
Transportation	74	33.6
Glucose self-testing	21	9.5
Productivity loss due to diabetes	88	39.9

*Estimates of costs of ambulatory care, hospital care and medications were based on the resource consumption observed in the present study plus the costs incurred by patients with end-stage renal disease [12].

populations seen by the GPs who participated in this study. The prevalence of diagnosed Type 2 diabetes in this population was 2.0%. A similar estimate for prevalence (1.95%) was found in a large computerized GP database (IPCI database) [14]. Using a 2.0% prevalence (n = 312 550), the total costs per year on a national level were calculated to be £365 500 000 (1 271 000 000 Dutch guilders) or 3.4% of the relevant Dutch health care costs in 1998 (excluding psychiatric care, care for the handicapped and costs of administration and overhead) (Table 5). Included in this estimate were the costs incurred by patients with end-stage renal disease, since it was known that these costs are substantial and since patients with this condition are treated by specialists.

Other medical costs

Our study did not collect data on the costs of diabetes in nursing homes and the costs of appliances. For a complete cost estimate, we used additional published data on these costs. Nursing home costs for diabetes as a primary diagnosis were estimated for 1994 to be £6 900 000 (24 000 000 guilders) [8,9] and for 1998, £7 750 000 (27 000 000 guilders). Since it is estimated that 85% of the diabetes patients living in a nursing home have Type 2 diabetes [10,11], we calculated the nursing home costs for Type 2 diabetes (only as primary diagnosis) to be £6 700 000 (23 300 000 guilders).

The costs for appliances (predominantly appliances to administer insulin and prostheses) were estimated to be £25 250 000 (87 900 000 guilders) for 1994 [8,9]. However, the costs of appliances in general rose sharply (i.e. by more than 60%) between 1994 and 1998. Since the use of appliances is closely related to insulin therapy, we used the estimated fractions for patients using insulin for both types of diabetes (type 1 100%; type 2 15%, as seen in this study) in order to estimate the costs of appliances. Weighted using the prevalence of both types, this meant that 46% of the costs of diabetes appliances (£18 700 000 (65 200 000 guilders)) could be assigned to Type 2 costs.

Non-medical costs

Patients were asked to report the frequency, distance and mode of transport with respect to visits to medical and paramedical professionals. The costs per km by transport mode were derived from Oostenbrink [6]. Over the 6-month period, travel costs were estimated to be £36 (125 guilders) per patient, mainly for hospital visits.

Thirty percent of the patients performed blood self-testing and only 1.6% urine self-testing. On average, the costs per patient of self-testing were £10 (35.5 guilders) per 6 months.

We found that 19.5% of patients were presently employed and 43.7% had retired. Over a 3-month period, 20 of those presently employed had been absent from work due to diabetes, the productivity costs of this absence averaging more than £1435 (5000 guilders) per person [15]. However, since the number of absentees represented a small fraction of all patients, the average productivity costs per patient in the whole study population were only £22 (78 guilders). The annual national costs of absence from work due to diabetes were estimated to be £25 250 000 (88 000 000 guilders).

Discussion

In this study, we estimated the annual costs of care for Type 2 diabetes patients in The Netherlands mainly using data collected from a survey of 1371 patients seen in 29 GP practices.

GPs who provided the most data and GPs with a solo practice were over-represented in comparison with all Dutch GPs. Nevertheless, we found very good comparability in terms of age, sex, duration of diabetes, BMI, frequency of insulin therapy, and frequency of lipid-lowering drug use between our population and the patients included in another Dutch study where treatment was provided by an internist, a GP, or both (i.e. 'shared care') [16]. Moreover, on the basis of this comparison, there was evidence to suggest that the GPs participating in our study had also included patients being treated by an internist for their insulin. The frequencies of diet therapy (15.6%) and insulin therapy (15.4%) we observed in this study also correspond well with the frequencies seen in a separate study of 943 patients in 18 GP practices (18.6% diet, 16.5% insulin) [17]. In this study, we found that Type 2 diabetes patients made an average of 4.6 visits per half-year, a frequency very comparable to the 9.90 visits per year seen in a larger Dutch GP study (IPCI database) [14]. Although only 9% of the patients were hospitalized within 6 months, hospitalization costs accounted for one-third of all costs, drug costs for 40% and ambulatory costs 26%.

Older patients incurred more costs even after controlling for other characteristics. As expected, the costs per patient were higher for patients using insulin only or in combination with other medications. The presence of macrovascular complications (only or in combination with microvascular complications) was also associated with higher costs of all types of care. The multivariate model explained only 5.3% of the variance in costs. However, the literature on capitation payments shows that only a small part of variation in costs between individuals can be predicted [18].

Since this study was cross-sectional in orientation and aimed at mapping the costs of current care, it was not designed to demonstrate or examine the cost-effectiveness of interventions. However, the high costs of complications suggest that searching intensively for ways to prevent complications may be worthwhile.

The costs in The Netherlands for Type 2 diabetes patients were estimated at £365 500 000 (1 271 000 000 Dutch guilders), or 2.0% of total Dutch health care costs and 3.4% of relevant health care costs in 1998. A top down study on diabetes costs that we performed for The Netherlands for 1994 provides comparable results for the health care sectors studied [19]. If we correct for the costs of Type 1 diabetes and extrapolate costs from 1994 to 1998, that study estimates the costs as £369 000 000 (1 286 000 000 guilders), which is very close to our estimate of £365 500 000.

Despite the comparability between these two cost estimates, they are lower than those seen in other European countries [2]. The first reason for this is the relatively low prevalence of diagnosed diabetes, lower than the prevalence found in Belgium and Germany but comparable to those seen in the UK and France [2,20]. A problem with case identification in this study is unlikely since the estimate of the prevalence in these GP practices (2.0%) corresponded exceptionally well with the prevalence seen in a large Dutch GP database containing data on approximately 250 000 patients of 1.95% [14], as well as with expectations of present prevalence based on older estimates of prevalence [11].

Another issue concerns the information provided by GPs. The question can be raised about the extent to which the GP is informed about the consumption of specialist and hospital resources (i.e. possible information bias), with the consequence that medical resource use is underestimated if the GP is the source of the information. A general comment to be made here is the fact that in the Dutch system, GPs not only receive correspondence regarding consultations with specialists, hospitalizations, and medication use, but also provide 'follow-up prescriptions' initiated by medical specialists, since the GP is

viewed as the gatekeeper in this system. Furthermore, there is additional evidence that the magnitude of a possible problem with underestimating medical consumption is not large. For example, our hospitalization costs were lower than those reported in other countries. Interestingly, the number of hospitalizations in The Netherlands involving the ICD code 250 as the primary code has dropped substantially over time (Polder *et al.* 1997 [21], plus unpublished data from Prismant, the organization responsible for maintaining and reporting data on hospital use in The Netherlands). Moreover, while the number of hospitalizations has decreased over time (18 800 (1990), 15 600 (1994), 11 600 (1999)), the number of Dutch residents in the age category of 60–75 years has increased (1 745 000 (1990), 1 861 000 (1994), 1 900 000 (1999)). This decrease in hospitalizations was much larger than the general decrease in the frequency of hospitalizations observed over this period. Why has there been a sharp decrease in hospitalizations for diabetes patients? One possible explanation for the decrease stems from the increasing trend to treat Type 2 diabetes patients in a shared care manner, where the responsibility of care is shared between the GP, specialists and other health care professionals (e.g. podiatrist). Both national guidelines (first introduced in 1989) as well as various regional initiatives have emphasized the value of structured care and good communication amongst all who provide care to diabetes patients [22]. Moreover, the GP diabetes treatment guidelines have stressed the importance of GPs using a standard protocol, and maintaining a registration and appointment system [23]. This greater responsibility for the GP in diabetes care has possibly resulted in reduced hospitalization of patients. Two possible mechanisms might link these initiatives to decreased hospitalization. First, an average patient may be treated better today than 10 years ago (e.g. lower HbA_{1c}) and is therefore less likely to be hospitalized. Alternatively, an average patient may be treated differently today from 10 years ago and therefore less likely to be hospitalized. While we would prefer to attribute this reduction to improved care, there is at this time no hard evidence to support either explanation as the reason for decreased hospitalizations.

The relatively short time since diagnosis we observed suggests that this primary care population was milder on average than the average Dutch diabetes patient. On the other hand, it may also reflect a general tendency to diagnose Type 2 diabetes at an earlier, less costly stage.

We conclude that the resource consumption and costs in Dutch patients with Type 2 diabetes are relatively low. Although the possibility remains that the exact amount of care may have been somewhat underestimated, there is suggestive evidence that the low costs can be attributed to changes in diabetes care in The Netherlands. Regardless of the explanation, the total costs of diabetes treatment are certain to increase because of ageing of the population, earlier diagnosing, and an increasing number of patients with both micro- and macrovascular complications. The final factor might be a stimulus for enhanced preventive strategies.

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