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Articles

Revealing the cost of Type II diabetes in Europe

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Abstract

Aims/hypothesis. 'The Cost of Diabetes in Europe – Type II study' is the first coordinated attempt to measure total healthcare costs of Type II (non-insulin-dependent) diabetes mellitus in Europe. The study evaluated more than 7000 patients with Type II diabetes in eight countries – Belgium, France, Germany, Italy, the Netherlands, Spain, Sweden and the United Kingdom.

Methods. A bottom-up, prevalence-based design was used, which optimised the collection of data at the national level while maintaining maximum international comparability. Effort was made to ensure consistency in terms of data specification, data collection tools and methods, sampling design, and the analysis and reporting of results. Results are reported for individual countries and in aggregate for the total study population.

Results. The total direct medical costs of Type II diabetes in the eight European countries was estimated at EUR 29 billion a year (1999 values). The estimated average yearly cost per patient was EUR 2834 a year. Of these costs, hospitalisations accounted for the greatest proportion (55%, range 30–65%) totalling EUR 15.9 billion for the eight countries. During the 6-month evaluation period, 13% of the Type II diabetic patients were hospitalised, with an average of 23 days in hospital projected annually. In contrast, drug costs for managing Type II diabetes were relatively low, with antidiabetic drugs and insulin accounting for only 7% of the total healthcare costs for Type II diabetes.

Conclusion/interpretation. Type II diabetes mellitus is a common disease and the prevalence is expected to increase considerably in the future, especially in developing countries. Current comprehensive economic data on the costs of diabetes are required for policy decisions to optimise resource allocation and to evaluate different approaches for disease management. [Diabetologia (2002) 45:S5–S12]

Keywords Type II diabetes, pharmacoeconomics, Europe.

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*B. Jönsson wrote on behalf of the CODE-2 Advisory Board

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Abbreviations: CODE-2, Cost of diabetes in Europe – Type II; DRG, diagnosis-related group; GP, general practitioner; HRQoL, health-related quality of life; ICD, international classification of diseases; ICU, intensive care unit; OECD, organization for economic co-operation and development.

Diabetes mellitus is a common disease and its prevalence is expected to increase in the future, especially in developing countries [1, 2]. As recently as 1995, an estimated 135 million people worldwide were affected by diabetes and by the year 2025, this figure is projected to increase to approximately 300 million [3]. The majority of these diabetic patients (over 90%) suffer from Type II (non-insulin-dependent) diabetes mellitus, which is by nature, a progressive disorder with a slow and insidious onset. As a consequence, the condition is frequently under reported [4] and, of the estimated 15.6 million adult diabetic patients in the United States, an estimated 5.4 million cases remain undiagnosed [5].

The control of Type II diabetes represents a considerable therapeutic challenge. The results of recent landmark studies, such as the United Kingdom Prospective Diabetes Study (UKPDS) [6] have shown that the relationship between glycaemic control and chronic complications is more complex than previously assumed. Long-term glycaemic control with currently available therapies remains an elusive target due to the progressive nature of the condition. Moreover, glycaemic control as evidenced by the reduction of HbA_{1c} with existing agents was found to have a weak and non-significant effect on the incidence of cardiovascular complications, although a correlation with the reduction of microvascular complications was noted. Consequently, one of the important messages to emerge from the study was that the management of Type II diabetes must be aimed at the comorbidities associated with the condition. Control of factors beyond the management of glycaemia (e.g. hypertension, hyperlipidaemia, insulin resistance, obesity) is vital in reducing the macrovascular complications.

Over the last 30 years, medical expenditure has increased throughout the world at a considerably faster rate than other sectors of the economy [7, 8]. It is estimated that the care of people with diabetes mellitus accounts for 4 to 5% of the total health budget of the United Kingdom. [9] A recent study by the American Diabetes Association showed that in 1997, diabetes accounted for $44.1 billion in direct healthcare expenditures, $37.1 billion in lost productivity due to disability and $17.0 billion from lost productivity due to premature mortality [10]. Of the diabetic complications, cardiovascular disease by far was found to have the greatest proportion of direct costs and more than half the mortality-related costs of the condition [10]. In a recent paper [11] it was shown that the per-person annual costs associated with Type II diabetes increased by more than 50% when cardiovascular complications started to appear, and by 360% when a major cardiovascular event occurred. Abnormal renal function increased diabetes treatment costs by 65%, and end-stage renal disease by 771%. Due to the large number of complications associated with diabetes, diabetic patients account for 1 in every $7 spent on healthcare in the United States [12].

Up-to-date and comprehensive economic data on the costs of diabetes are required for policy decisions, in order to optimise the allocation of resources and to evaluate the success of different approaches for disease management. While the economic aspects of Type II diabetes have been widely studied in the United States, information from Europe has been fairly limited until recently. There have been a few studies from European countries, for example two from Sweden [13, 14] and two from the United Kingdom [15, 16]. Although the information is difficult to compare and contrast, due to inconsistencies in research objectives, methods and the data sources used, all studies highlight the substantial healthcare costs associated with diabetes. For example, these and many other studies do not make a distinction between Type I (insulin-dependent) and Type II (non-insulin-dependent) diabetes mellitus. While these separate conditions have similar long-term consequences, they affect different, albeit overlapping age groups and require different treatment strategies. The approach taken to measure the cost of diabetes is also variable. Some studies estimate the cost of diabetes, while others measure the total healthcare costs for diabetic patients, including both diabetes-related and non-diabetes-related events. Furthermore, some studies use the main diagnosis to attribute costs to diabetes, while other studies use aetiological fractions.

The CODE-2 study is the first coordinated attempt to measure the cost of people with Type II diabetes in Europe. This study measured total healthcare costs for more than 7000 people with Type II diabetes in eight European countries – Belgium, France, Germany, Italy, the Netherlands, Spain, Sweden and the United Kingdom using a bottom-up, prevalence-based design. A number of secondary objectives were also addressed, including: the distribution of total cost and the main components of cost (ambulatory care, drugs and hospitalisation); a review of current management practice; an assessment of the impact of complications on cost; and from the patient perspective, consideration of quality of life, satisfaction with treatment and self testing.

The collection of data directly from patients to assess the health-related quality of life (HRQoL) associated with the disease added another unique and important aspect to the study [17]. Whereas the primary objective focused on measuring the consequences of the condition with respect to direct healthcare expenditure, the secondary objectives considered areas of possible intervention, providing opportunities to maximise future use of resources.

Subjects and methods

Study design. The design of the study (Fig. 1) was developed in consultation with an extensive panel of more than 100 experts including diabetologists, endocrinologists, health economists, general or primary-care practitioners and epidemiologists. In the design and implementation process, effort was made to ensure consistency across the eight countries in terms of data specification, data collection tools and methods, sampling design, and the analysis and reporting of results. Data was collected between January 1999 and June 1999 and covered a minimum period of 6 months, retrospectively. Estimates of healthcare utilisation and costs were projected for a 12-month period. Design modifications in accordance with differences in national healthcare systems were made when necessary, although limited as much as possible. The study design optimised the collection of data at the national level while maintaining maximum international comparability.

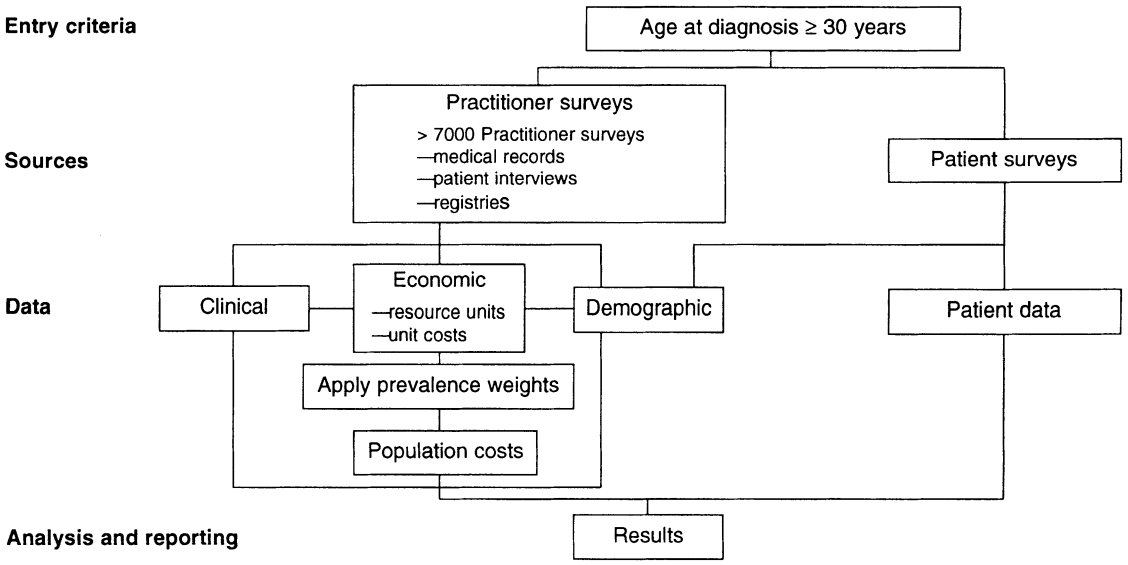

Fig. 1. Overview of the CODE-2 study protocol

After consultation with independent national experts and a review of existing epidemiological data, four of the eight countries (Belgium, France, Germany, and Italy) decided to collect data using stratified sampling techniques. Prior to the collection of CODE-2 data, Belgium, Germany, and Italy did a national survey of physicians, to ascertain the prevalence of known complications of Type II diabetes. In contrast, France used a national survey (ECODIA) [18], which included a representative sample of more than 4000 patients with Type II diabetes, to derive the sampling weights for the stratification. All definitions of microvascular and macrovascular complications were consistent across the four countries. These definitions are reported elsewhere in this supplement [19]. The remaining four countries collected data using a random sampling approach on the basis of known complications of Type II diabetes.

Study protocol. The data was collected by means of two questionnaires specially designed for practitioners and patients: the general practitioner (GP) questionnaire was used to collect information on direct medical resource utilisation and clinical data based on practitioner-held records; and the patient questionnaire provided complimentary socio-economic information.

Data collected from practitioners included clinical, economic and demographic information, while data collected from patients included indirect and direct non-medical resource use, quality of life (QoL), satisfaction with current diabetes treatment, and information on self-testing of blood and urine sugar concentrations.

The overall direct healthcare costs were calculated by multiplying the quantities of the resource used with the unit price of each resource. To determine the direct cost of the Type II diabetic patients who were sampled, estimates of the number of physician visits, paramedical visits, tests and procedures, hospitalisations, days in hospital, emergency room visits and drug use were multiplied by a unit cost for each country (Table 1). In general, the costs for standard resources are relatively similar between the countries in the study and any variation is usually the result of differences in accounting procedures. For example, the baseline costs for GP visits in Sweden appear relatively high; however, the value includes all the costs associated with an average visit, including all tests and procedures. The costs for these tests and procedures are calculated separately in other countries. To extrapolate the sample costs to population size in order to calculate the total direct healthcare cost for each country, the per-patient costs were multiplied by national prevalence weights:

- $P_i \times Q_i = Cost_i$
- $Cost_i \times$ prevalence weights = population cost
- P = price, Q = resource use, and i=1–*n* (where *n* = number of cost items)

All local currency total costs were converted to Euros using the official Euro conversion rate as of January 1, 1999. However, due to variations in the healthcare system in Germany, this extrapolation method using the values in Table 1 was not applicable for visits to GPs, diabetologists, or other specialists. These values included only the cost of the visit itself and the fees for each procedure are at an additional cost.

Results

Patients. The demographic data from CODE-2 are detailed in Table 2 and the Type II diabetes prevalence data, which was used for extrapolation of sample costs, are presented in Table 3. The demographics of the study population were relatively similar between each of the countries with a few notable exceptions. The study population of the United Kingdom had a higher proportion of male than female patients in comparison with the other countries. In addition, the time since diagnosis was higher than the 9-year average in Italy (13 years) and lower among the Dutch study population (6 years). The average age and body mass index (BMI) data were similar across all eight countries. The majority of patients recruited in the study were older than 65 years of age and were receiving treatment with oral antidiabetic agents (59%) (Fig. 2). The greatest proportion of oral pharmacotherapy was observed in France (84.69%) and the smallest in Sweden (42.45%).

Table 1. National costs for CODE-2 resource units

Resource item	Baseline unit price in Euros							
	Belgium[1]	France[2]	Germany[3]	Italy[4]	Netherlands[5]	Spain[6]	Sweden[7]	UK[8]
GP visit	14.87–17.85	17.5—22.1	13–21	11.3	14.35	10.11	102	37–44
Diabetologist visit	22.31	22.9–27.4	8–11 (basic fee) 2 (other visits)	20.7 74.4 (private)	53.18	44.99	111	101
Other specialist visit	22.31	22.9–34.3	4–21	20.7 80.1 (private)	53.18	27.23–92.52	84–271	61–149
Paramedical visit:								
dietician	–	32	Ambulatory	10.2	27.27	–	62	34/h
physiotherapist	13.06–14.08	5.9	nursing	10.2	16.30	30.05	–	44/h
nurse	1.64–4.94	13.7	care up to	7.4	19.52	12.48–13.48	51	54/h
foot care	–	–	383 per visit, up to 1913 per month	–	–	15.03	28–39	–
Day in hospital	197.03	–	916 (ICU) 221–299 (ward)	909 (ICU) 158–391 (ward)	1088.18 (ICU) 190.45 (ward)	1173.23 (ICU) 232.48 (ward)	278–680	172–630
Emergency	14.13–14.87	426.8	n/a	20.7	181.81	32.15–87.43	239	139–420

Range presented where more than one price is possible, GP, general practitioner (primary care physician); ICU, Intensive Care Unit; n/a, not applicable; –, no data available

Data sources:

[1] Cost data for medical and paramedical visits – Tarifering van de Geneeskundige Verstrekkingen (RIZIV/INAMI, 1998), Hospital costs were based on a weighted average cost per hospital-bed day from Ministry of Health and hospital cost database

[2] Cost for all medical procedures and ambulatory care provided by Nomenclature Générale des Actes Professionnels (NGAP) with 1999 values, and full values from the Ministry of Health through the National Hospital Costs Survey (1997 with latest data published in 1999). Micro-costing used where published costs and tariffs were unavailable

[3] All prices and charges based on reimbursement fees taken from the Einheitlicher Bewertungsmaßstab (1998 values), the German Association of Hospitals (1996 values), Nursing Care Insurance and the Rote Liste for medications. For visits to GPs, diabetologists, or other specialists, the values included only the cost of the visit itself and the fees for each procedure carried out must be added

[4] General practitioner visits are calculated based on Servizio Sanitario Nationale values from 1998; information on total visits was obtained from the Servizio Presrizioni Mediche (1996 values equivalent to 1998); hospitalisation costs were based on data obtained from the Servizio Sistema Informativo – Lombardy region. Where data were not directly available, information was obtained by personnel communication from an expert panel or survey

[5] Unit cost for GP visits based on tariffs from private and public health insurance from Centraal Orgaan Tarieven Gezondheidszorg (COTG), 1998; Unit costs for specialists were based on weighted average costs for consultations at hospitals; similar methodology was used to assign unit costs to hospital-day costs

[6] Cost data were obtained predominantly form the SOIKOS database of Health Unit Costs. Costs were inflated to 1998 values were only available for previous years. Where data was not available personnel communication was included from relevant sources (1999 values)

[7] Swedish sources included published folders of the Federation of County Councils (1993 and 1996 values inflated to 1998 values), Hospital Price Lists (1998 values), and personnel communications from relevant practitioners

[8] Principal sources include the Unit Cost of Health and Social Care 1998 and the Office of Health Economics Compendium of Health Statistics (1994/95 values inflated to 1997/98 prices)

Total healthcare expenditure. Total costs of Type II diabetes for the eight countries was estimated to be EUR 29 billion (1999 values). The annual costs per patient with Type II diabetes was estimated to be EUR 2834 (Table 4). The Netherlands was found to have the lowest expenditure per patient (EUR 1827), while Italy had the highest annual cost (EUR 2991). In contrast, the prevalence of Type II diabetes in the general population was estimated to range from 1.7% in the Netherlands to 4.2% in Germany (Table 3). On average, 3% of the population with Type II diabetes in the countries surveyed accounted for 5% of the total healthcare expenditure [25], where available data from the Organisation for Economic Co-Operation and Development (OECD) was used to estimate the percentage of total healthcare budget spent on Type II

Table 2. CODE-2 demographic data

Country	Study population (patients)	Age (years) ± SD	% Sex (M/F)	Mean BMI (kg/m^2) ± SD	Mean time since diagnosis (years) ± SD
Belgium	735	66.0 ± 11.7	42/58	29.3 ± 6.1	7.6 ± 6.9
France	751	64.0 ± 11.5	52/48	28.7 ± 4.8	9.1 ± 8.0
Germany	809	67.1 ± 1.6	48/52	28.4 ± 0.1	8.0 ± 0.9
Italy	1263	65.7 ± 9.5	50/50	28.0 ± 4.6	13.0 ± 8.7
Netherlands	909	64.8 ± 11.6	49/51	28.1 ± 5.1	6.4 ± 6.0
Spain	1004	67.4 ± 10.0	44/56	29.6 ± 4.9	10.1 ± 8.1
Sweden	773	67.6 ± 11.6	50/50	28.5 ± 4.8	8.3 ± 7.0
UK	756	63.3 ± 12.0	61/39	30.0 ± 5.8	7.8 ± 7.0
CODE-2 average	7000	65.9	50	28.7	9.3

Table 3. Prevalence of Type II diabetes in CODE-2 study countries

Country	Prevalence of Type II (non-insulin-dependent) diabetes mellitus		Reference
	Number of patients	% of population	
Belgium	332 000	3.3	
France	1.3 million	2.2	[18]
Germany	3.5 million	4.2	[20]
Italy	1.7 million	3.0	[21]
Netherlands	235 000	1.7	[22]
Spain	1.5 million	3.9	[23]
Sweden	325 000	3.6	[24]
UK	1.2 million	2.0	
All CODE-2 countries	>10 million	3.0 (average)	

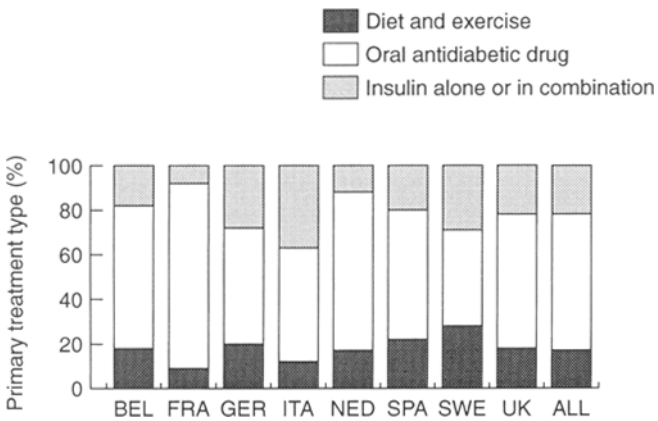

Fig. 2. Primary Type II diabetes treatment types by country

diabetes (Table 4). Comparing this study with the American study [12], some differences can be noticed. Whereas the average prevalence in the European countries was 3%, the prevalence in the United States was 4.5%. Furthermore, diabetic patients accounted for a larger share of the total health care expenditures in the United States compared to Europe (15% vs 5%). However, it is important to note the danger in comparing studies carried out in different countries in different years using different methodology. For example, the American study used a database as the main data source, it was carried out in 1992, it included both Type I and Type II diabetes and more resources than the CODE-2 study (e.g. dental care and medical equipment). In addition, relatively expensive inpatient care accounted for a larger fraction in the United States compared to the European average (63% vs 55%).

Distribution of costs. To investigate the distribution of costs, resource use was separated into three categories:

(1) ambulatory costs were defined as the sum of all costs of visits to GPs, diabetologists and other specialists (e.g. cardiologists), paramedical practitioners (e.g. physiotherapists, nurses, dieticians), accident and emergency departments, and all tests and procedures (e.g. blood tests, blood pressure measurements, etc);
(2) hospitalisation costs were defined as the sum of costs of all admissions to hospital (for example, based on length of stay, DRG: diagnosis-related group or ICD-9: International Classification of Diseases);
(3) drug costs, defined as the sum of costs of all drugs prescribed by GPs and specialists in outpatient settings.

Table 4. Yearly direct medical costs for people with Type II diabetes

Country	Total cost per country (Euros)	Total per-patient cost in Euros Mean ± SD (range)	Percent of total healthcare expenditures in each country[a]
Belgium	1,093,625,291	3295 ± 6550 (40–73885)	N/A
France	3,983,000,000	3064 ± 6696 (20–82680)	3.4
Germany	1,243,745,000	3576 ± 920 (80–70131)	6.5
Italy	5,170,028,166	2991 ± 9059 (23–81447)	6.6
Netherlands	443,915,000	1827 ± 4485 (29–67727)	1.6
Spain	1,957,785,697	1305 ± 2197 (16–27665)	N/A
Sweden	736,000,000	2630 ± 6630 (7–35620)	N/A
UK	2,607,799,104	2214 ± 3643 (25–50647)	2.5
Total CODE-2 average	28,429,836,630	2834	

[a] Using 1997 OECD total current expenditure on health

Table 5. Distribution of annual per-patient costs by main resource category in Euros[a]

Country	Resource category			
	Hospitalisation (mean ± SD)	Ambulatory care (mean ± SD)	Oral antidiabetic drugs only (mean ± SD)	All other drugs (mean)[a]
Belgium	1791 ± 5864	603 ± 931	127 ± 114	774
France	1540 ± 6252	683 ± 1433	207 ± 169	633
Germany	2173 ± 755	388 ± 47	119 ± 8	896
Italy	1787 ± 8778	555 ± 516	63 ± 71	586
Netherlands	548 ± 3570	450 ± 1307	102 ± 118	734
Spain	417 ± 1960	334 ± 307	61 ± 101	494
Sweden	1116 ± 6135	813 ± 1088	41 ± 37	661
UK	769 ± 4015	835 ± 775	60 ± 71	519
CODE-2 Average	1333	603	103	476

[a] No SD values available due to method of calculation; SD values for individual drug categories see Table 8 projected from 6-month survey data

Table 6. Mean cost per-patient by type of treatment in Euros

Country	Primary treatment type		
	Diet and exercise alone	Oral antidiabetic drugs	Insulin alone or in combination
Belgium	3120	2594	5724
France	1142	3039	5913
Germany	3004	2867	4997
Italy	4329	2445	3374
Netherlands	1142	1737	2973
Spain	886	1103	2309
Sweden	1612	2044	4215
UK	1501	2064	2676
CODE-2 average	2419	2400	4116

Table 7. Percentage or patients hospitalised, and overall number of days if hospitalised

Country	Percentage hospitalised in study period (6 months)	Mean length of stay per hospitalisation in days
Belgium	18.5%	20
France	13.1%	9
Germany	12.7%	18
Italy	17.8%	13
Netherlands	7.7%	12
Spain	8.3%	8
Sweden	12.5%	7
UK	11.4%	7
CODE-2 average	12.9%	13

Table 8. Mean drug costs per patient by country in Euros

Country	Oral anti-diabetics	Insulin	Cardiovascular agents	Lipid-lowering agents	Gastrointestinal agents	Anti-depressants	Anti-infectives	All others
Belgium	127 ± 114	47 ± 109	316 ± 294	70 ± 156	59 ± 179	33 ± 122	23 ± 170	227 ± 758
France	207 ± 169	16 ± 69	283 ± 308	93 ± 154	39 ± 122	18 ± 74	18 ± 182	167 ± 569
Germany	119 ± 8	135 ± 33	305 ± 47	68 ± 133	53 ± 7	9 ± 3	6 ± 1	229 ± 47
Italy[a]	63	62	221	35	38	7	16	207
Netherlands	102 ± 118	52 ± 212	154 ± 269	26 ± 122	95 ± 712	10 ± 59	10 ± 74	379 ± 1646
Spain	61 ± 101	61 ± 177	181 ± 251	55 ± 133	42 ± 127	17 ± 90	16 ± 80	113 ± 214
Sweden	41 ± 37	83 ± 167	197 ± 325	53 ± 173	67 ± 253	14 ± 164	15 ± 235	231 ± 627
UK	60 ± 71	78 ± 181	193 ± 264	103 ± 212	54 ± 184.4	13 ± 78	10 ± 54	68 ± 174
CODE-2 average	103 (11.9%)	83 (9.6%)	250 (29.0%)	66 (7.7%)	49 (5.7%)	12 (1.4%)	12 (1.4%)	184 (21.3%)

[a] SD values not available from Italian data
Drug costs applied to entire diabetic population (means ± SD)

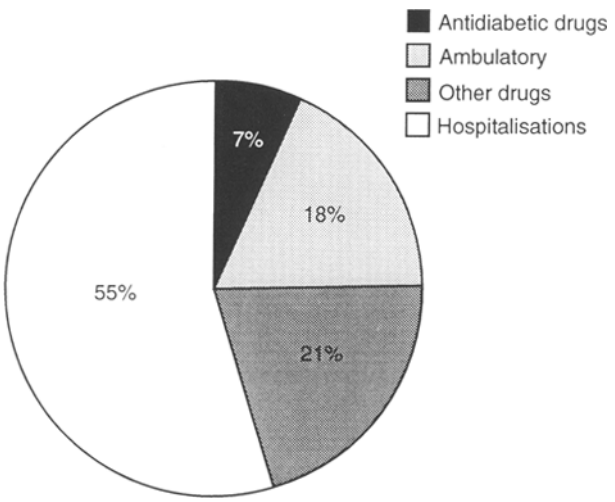

Fig. 3. Distribution of overall costs for individuals with Type II diabetes

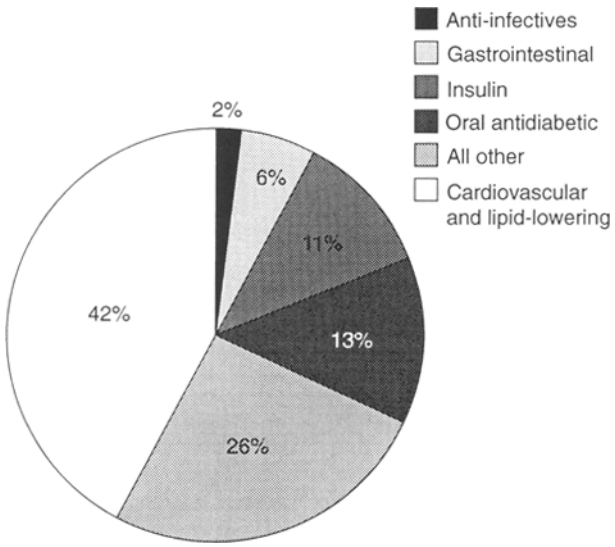

Fig. 4. Distribution of overall drug costs for individuals with Type II diabetes

The distribution of the overall direct healthcare costs for all countries in the CODE-2 study is shown in Figure 3 the direct costs per patient represented by country and for the total CODE-2 population are illustrated in Table 5 and mean per patient cost by treatment type is detailed in Table 6. Hospitalisations accounted for the greatest proportion of costs (55%, range 30–65%). In total, 13% of the study population were hospitalised in the 6-month study period. (Table 7). Of the categories investigated, ambulatory

costs represented the smallest proportion of overall direct healthcare costs (18%) (Fig. 3). The overall cost of drug therapy in these patients of EUR 7.9 billion represented 27% of the total healthcare costs. Although over 60% of patients were receiving oral antidiabetic agents, representing the largest primary treatment receiving drug therapy, the cost of these drugs accounted for only 4% of the total healthcare costs. When the components of the total drug cost category were considered in isolation, cardiovascular and lipid-lowering agents represented the largest proportion (42%) with oral antidiabetic drugs accounting for only 13% and insulin 11% of total drug costs (Fig. 4, Table 8).

Discussion

For the first time, the CODE-2 study has shown a comprehensive and practical insight into the costs of people with Type II diabetes across different European countries. The design of the study allowed for the direct comparison of international data on healthcare costs. The 6-month retrospective design could have some disadvantages. Recall bias could have been a problem but since the questionnaires relied mostly on stored information, such as medical records, this problem is minor. Collecting information during a six month period and extrapolating to one year disregards any seasonal variation which might exist. The CODE-2 study showed that more than 10 million people with Type II diabetes across eight European countries cost over EUR 29 billion in 1999. Of the direct costs, hospitalisation alone accounted for the largest proportion, while drug costs for managing the disease were relatively low. Indeed, the oral drug therapy for the management of glycaemic control accounted for about 4% of overall costs in Type II diabetic patients. The single factor having the largest impact on costs of patients with Type II diabetic is the presence of different diabetes-related late complications. The findings from the CODE-2 study therefore confirm that in all eight of the European countries studied, Type II diabetes is a costly and burdensome disease.

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