

Comparison of Excess Costs of Care and Production Losses Because of Morbidity in Diabetic Patients

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OBJECTIVE — To assess and compare excess costs of care and production losses because of morbidity in diabetic patients and the general population of a Swedish community.

RESEARCH DESIGN AND METHODS — Costs of production losses were calculated from medical and social insurance records on sickness benefit days (short-term illness) and premature retirement (permanent disability) in people with diabetes and in the entire population of the community (a municipality comprising a town and rural surroundings, with 28,000 inhabitants). Care costs included those of consultations and inpatient care, as well as costs of insulin, oral antidiabetic medications, other drugs, test material, and treatment devices, and they were obtained from patient records, the health care administration, and the statistics of community pharmacy sales.

RESULTS — Of the diabetic patients <65 years of age, above which both diabetic and nondiabetic people get retirement pension, and sickness benefits cease, 62% of those on insulin treatment in each gender had insulin-dependent diabetes mellitus (IDDM). All insulin-treated non-insulin-dependent diabetes mellitus (NIDDM) patients were >40 years of age. Both the insulin-treated and the non-insulin-treated diabetic patients were prematurely retired twice as often as the average population and had twice as many inpatient days. The insulin-treated subjects also had twice as many sickness benefit days. The excess costs of production losses as a result of morbidity in people with diabetes were about \$7,000 per individual and year. The corresponding excess costs of inpatient care were \$800. The therapeutic expenditures for control of diabetes were about \$600 per individual and year. If converted to U.S. conditions, the costs of lost production as a result of excess morbidity (<65 years of age) would be \$12 billion and \$9 billion for people with insulin-treated and non-insulin-treated diabetes, respectively.

CONCLUSIONS — If improved metabolic control by intensified treatment would reduce excess morbidity in both IDDM and NIDDM, the predominant costs of production losses imply that intensified antidiabetic treatment might save costs.

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IDDM, insulin-dependent diabetes mellitus; NIDDM, non-insulin-dependent diabetes mellitus.

Part from being a serious medical and social problem, diabetes is a large economic burden to patients and society. A number of studies have identified, measured, and valued these costs (1–8). Most studies have focused on direct costs, i.e., those of hospital care, consultations, and drugs. Few studies have included indirect costs, i.e., those of lost production because of morbidity and mortality (2–4). Estimations of such costs pose at least two types of problems. First, diabetes is a chronic disease, which means that morbidity costs are spread over a long time and, hence, are difficult to measure. Second, previous calculations have usually involved only production losses recorded with diabetes given as the primary, specific cause (e.g., diabetic retinopathy), but not those losses that are consequences of diabetes-related illness (e.g., macrovascular disease). It may be more appropriate to include the latter costs if adequate control data are obtained; this would allow estimates of excess disease in diabetic subjects. This inclusion is particularly important for assessing the quantitative relation between costs of treatment and costs of production losses.

In Sweden, virtually all medical care and social services are under public control; county- and municipality-based registers are kept on diagnoses, in- and outpatient visits, and social benefits; all medication is distributed, sold, and registered by one national corporation of pharmacies; and patients receive all antidiabetic medication free of charge. Therefore, appropriate estimates may be obtained of care costs and costs of production losses because of morbidity in subjects with diabetes as well as in the general population. The current study tried to assess and compare these costs in a Swedish community.

RESEARCH DESIGN AND METHODS

Community

Sweden is divided into 24 counties that, in turn, are divided into 284 municipali-

ties. Public medical care is the responsibility of the county councils, while the municipality boards are responsible for public social service. Jönköping county lies in southern Sweden and is divided into 11 municipalities. One of them is Vetlanda, which comprises the town of Vetlanda and rural surroundings and has ~28,000 inhabitants. It has one public health care center and two pharmacies that attend to the entire municipality, but it has neither a hospital nor private practitioners. The health care center has a specialized diabetes nurse and treats most of the diabetic patients in Vetlanda. The few remaining diabetic patients in Vetlanda are treated either at the nearest referral hospital in the town of Eksjö or at the central county hospital in the city of Jönköping; these patients are also on record at the Vetlanda health center. The prevalence of diabetes (insulin-dependent diabetes mellitus [IDDM] and non-insulin-dependent diabetes mellitus [NIDDM]) in Vetlanda was recently assessed and validated (9). For these reasons, Vetlanda was selected as a suitable community for the current study.

Diabetes population and general population

The above-mentioned diabetes prevalence study (9) included all Vetlanda inhabitants with diabetes, i.e., those treated in Vetlanda, Eksjö, and Jönköping, during 1987. The nonadjusted prevalence of diabetes was 3.3%, and the age- and sex-adjusted diabetes prevalence was 3.0% (9). Of 914 total diabetic patients, the records of all those in the age range of 20–64 years in 1987 ($n = 285$) were studied (Table 1). (General retirement age in Sweden is 65 years; hence, neither disability nor sick leave payments are made after this age.) These data were compared with those of the entire 20- to 64-year-old population in Vetlanda (14,913 individuals), i.e., including the diabetic subjects, so as to obtain a representative comparison with normal conditions.

Sick days

The numbers of sick days for the 20- to 64-year-old diabetic patients in Vetlanda, for the entire 20- to 64-year-old population in Vetlanda, and for the entire 20- to 64-year-old population in Sweden during 1987 were obtained from Riksförsäkringsverket (the National Social Insurance Agency), which records all sickness benefit days via its municipality subsidiaries. Data were obtained for 10-year age-groups for each sex.

Early retirement

The numbers of subjects on premature (<65 years of age) retirement because of permanent disability among the 20- to 64-year-old diabetic patients, among the entire 20- to 64-year-old Vetlanda population, and among the entire 20- to 64-year-old Swedish population on 31 December 1987 were obtained from disability pension data at the National Social Insurance Agency. Data were obtained in 10-year age-groups for each sex.

Costs of production losses

The differences in the numbers of permanent disability pensions and sick days between people with diabetes and the general population were used to estimate the excess costs of production losses in diabetic subjects. The valuation of the production proceeds from the concept of income. The income is assumed to be equal to the value of output by the marginal or last-hired employee for whom a company is willing to pay wage plus social security contributions (10), and the 1990 income estimate was obtained from the National Survey of Income, Swedish Central Bureau of Statistics (10a). The value of lost production was calculated by multiplying the number of lost production years or days by average wages plus social security contributions, in 10-year age-groups and in each sex. Since the number of lost production years because of long-term morbidity was based on the prevalence of early retirement, not on newly granted early retirement (which has been a common way to estimate this production

loss), no discounting procedure was performed.

Inpatient care

The number of bed days for the 20- to 64-year-old diabetic patients of Vetlanda and for the entire 20- to 64-year-old population in Vetlanda during 1987 were obtained from the Jönköping county council. Data were subdivided into 10-year age-groups for each sex and for different hospital departments.

Costs were obtained from a study of per-day costs at different types of hospital departments in 1988 carried out by the Swedish Association of County Councils (11). The costs per day include all those associated with a patient's stay in a hospital. The average costs per day in orthopedic departments, SEK 1,790, were used for surgical and orthopedic departments. The average costs per day in medical departments, SEK 1,560, were used for all other types of clinics. The 1988 figures were upgraded to 1990 prices by assuming the same increase in costs as for the entire health care sector, i.e., 24.4% (12).

Expenditures for control and treatment

The numbers of consultations by the 20- to 64-year-old diabetes patients of Vetlanda to physicians and nurses were obtained from patient records at the municipal registers. The number of consultations due to control and treatment of diabetes were separated from the total number of consultations for the entire Vetlanda population. In estimating the costs for consultations, it was assumed that the average cost of a visit to a physician is about twice that to a nurse. The average cost estimates were taken from the Vetlanda primary health care center.

Information on individual prescriptions to diabetic subjects cannot be obtained retrospectively in Sweden. However, the expenditures of all antidiabetic drugs (insulin plus oral agents) sold by the Vetlanda pharmacies (all age-groups) could be obtained from the Na-

Table 1—Difference (in 1987) between actual and expected numbers of sick days for insulin-treated and non-insulin-treated diabetic patients in Vetlanda, divided by sex and age

Age	Men			Women		
	Number of patients	Expected number of sick days	Difference between actual and expected	Number of patients	Expected number of sick days	Difference between actual and expected
Insulin-treated diabetic patients						
20–29	14	147	83	11	176	–15
30–39	11	142	–11	9	136	122
40–49	23	317	642	12	202	46
50–59	19	401	355	13	309	368
60–64	15	453	24	12	312	–170
20–64	82	1,460	1,093	57	1,135	351
Non-insulin-treated diabetic patients						
20–29	1	11	–5	1	16	–16
30–39	3	39	–16	2	30	9
40–49	11	152	–74	6	101	–63
50–59	43	907	–249	32	762	90
60–64	20	604	108	27	702	–11
20–64	78	1,713	–236	68	1,611	9

Expected numbers are obtained by multiplying the average number of sick days in the general population by the number of diabetic patients in each sex- and age-group (as if there were no excess disease).

tional Corporation of Pharmacies; all drug sales in Sweden are recorded by this corporation (13). Because <5% of Vetlanda diabetes patients were treated outside Vetlanda (9) and because there are no pharmacies other than Vetlanda's own within a distance of 25 km (15 miles), this estimate should be sufficiently accurate. The same source supplied the expenditures (all age-groups) of material and devices sold at the Vetlanda pharmacies during the same years for treatment (i.e., injection material) and for treatment control (e.g., test strips). Total expenditures were acquired for 2 years (1986 and 1990) instead of data from 1987, because the strength of insulin formulations was altered from 40 to 100 IU/ml in 1987, causing unusually high costs from temporarily increased waste of insulin (cf. 9). Corresponding expenditures for the whole of Sweden were obtained from the same source. The 1986 figures were upgraded to 1990 prices by the drug price index given by the National Corporation of Pharmacies. The figures given are the resulting means of 1986 and 1990.

Because people with diabetes use

drugs other than antidiabetic medications, an attempt was also made to estimate the excess costs of such medication relative to that of the general population. The only data on individual prescriptions in a sufficiently large scale within Sweden are from an ongoing study in the county of Jämtland, carried out by the National Corporation of Pharmacies. Via prescriptions to diabetic patients and the general population in this area, excess costs of all nondiabetes drugs used by diabetic patients could be calculated as the difference between the sales of all drugs to diabetic patients and the sum of the costs for antidiabetic drugs and the ordinary drug consumption.

RESULTS

Sick days

The average annual numbers of sick days per individual 20–64 years of age in Vetlanda were 15.7 days for men and 18.6 days for women. For the diabetic population, these figures were higher, with means of 31.1 and 26.1 days for insulin-treated men and women and 18.9 and

23.8 days for non-insulin-treated men and women, respectively. However, because the diabetes patients, especially the non-insulin-treated ones, were older than the general population, age and sex adjustments were made. To obtain the expected number of sick days for the diabetic population (i.e., as if there were no excess disease), the average annual number of sick days for each sex and age-group in the general population was multiplied by the number of insulin-treated and non-insulin-treated diabetic men and women. Comparisons of the numbers of expected sick days with those of actual sick days for the diabetic population (Table 1) showed that insulin-treated men had 75% more sick days (31.1 vs. 17.8) and insulin-treated women 31% more sick days (26.1 vs. 19.9) than expected. For non-insulin-treated diabetic women, the actual number of sick days was about the same as expected, and for men it was even slightly below expectation.

Premature retirement

The expected numbers of permanently disabled and, hence, prematurely retired

Table 2—Difference (in 1987) between actual and expected numbers of prematurely retired (permanently disabled) insulin-treated and non-insulin-treated diabetic patients in Vetlanda, divided by sex and age

Age	Men			Women		
	Number of patients	Expected number of permanently disabled individuals	Difference between actual and expected	Number of patients	Expected number of permanently disabled individuals	Difference between actual and expected
Insulin-treated diabetic patients						
20–29	14	0.08	0.92	11	0.14	0.86
30–39	11	0.19	–0.19	9	0.19	–0.19
40–49	23	0.58	2.42	12	0.59	1.41
50–59	19	1.73	4.27	13	1.38	1.62
60–64	15	3.35	5.65	12	2.72	1.28
20–64	82	5.93	13.07	57	5.02	4.98
Non-insulin-treated diabetic patients						
20–29	1	0.01	–0.01	1	0.01	0.99
30–39	3	0.05	–0.05	2	0.04	–0.04
40–49	11	0.28	1.72	6	0.29	–0.29
50–59	43	3.91	4.09	32	3.39	3.61
60–64	20	4.46	3.54	27	6.13	7.87
20–64	78	8.71	9.29	68	9.87	12.14

Expected numbers are obtained by multiplying the proportion of permanently retired (permanently disabled) individuals in the general population by the number of diabetic patients in each sex- and age-group (as if there were no excess disease).

individuals in the diabetic population of Vetlanda were obtained by multiplying the proportion of individuals permanently retired because of permanent disability in each sex and age-group in the general population by the number of people with diabetes (Table 2). The actual number of permanently disabled insulin-treated diabetic subjects was three times higher than expected in men and twice as high as expected in women.

Because the mean age of the non-insulin-treated diabetic patients was higher than that of the insulin-treated ones, the expected number of prematurely disabled individuals was higher in the non-insulin-treated than in the insulin-treated group. In spite of this, the actual number of permanently disabled individuals was twice as high as expected among the insulin-treated subjects.

Table 3 shows the number of insulin-treated patients in each age-group divided by diabetes type (IDDM and NIDDM). All insulin-treated NIDDM patients were found in age-groups ≥40 years. IDDM patients comprised 62% of insulin-treated patients in each gender.

Inpatient care

The average annual number of bed days per individual 20–64 years of age in Vetlanda was 0.88 for men and 0.85 for women. In diabetic subjects, these figures were higher, 3.39 for men and 3.13 for women. However, because the diabetic population was older than the general population, age and sex adjustments were made in the same manner as used for sick days. As shown in Table 4, diabetic patients had more than twice as many bed days as expected. Most of the excess inpa-

tient care was related to surgical/orthopedic and medical departments (Table 4).

Costs of production losses

Table 5 shows the differences between actual and expected costs of production losses due to permanent disability (premature retirement) and to short-term illness among people with diabetes. The annual excess costs of lost production because of short-term illness and permanent disability in diabetic patients could be estimated to be about SEK 40,000 (\$7,000) per patient at 20–64 years of age. Most of these excess costs were attributed to permanent disability in the 40- to 64-year age-groups. For insulin-treated patients, ~80% of the excess costs of lost production resulted from more frequent permanent disability, especially among men. The remaining 20% of the excess costs of production losses resulted mainly from the fact that insulin-treated men had about twice as many sick days as expected. For non-insulin-treated patients, no excess cost of production losses seemed due to short-term illness, but the actual number of permanently disabled

Table 3—Number of insulin-treated NIDDM and IDDM patients, divided by sex and age.

Age	Men		Women	
	IDDM	NIDDM	IDDM	NIDDM
20–29	14	0	11	0
30–39	11	0	9	0
40–49	15	8	9	3
50–59	7	12	6	7
60–64	3	12	1	11
20–64	50	32	36	21

Table 4—Difference (in 1987) between actual and expected numbers of bed days in surgical/orthopedic departments, in medical departments, and in all other departments for diabetic patients in Vetlanda, divided by sex and age

Age	Men			Women		
	Number of patients	Expected number of bed days	Difference between actual and expected	Number of patients	Expected number of sick days	Difference between actual and expected
Surgical and orthopedic departments						
20–29	15	0.5	–0.5	12	0.3	–0.3
30–39	14	0.5	–0.5	11	0.3	1.7
40–49	34	1.3	7.7	18	0.6	5.4
50–59	62	3.6	24.4	45	1.9	30.2
60–64	35	2.8	103.2	39	1.9	22.1
20–64	160	8.7	134.3	125	5.0	59.0
Medical departments						
20–29	15	1.0	50.0	12	0.6	12.4
30–39	14	1.5	3.5	11	1.1	29.9
40–49	34	6.7	43.3	18	4.7	–4.7
50–59	62	18.9	131.1	45	15.3	91.7
60–64	35	18.1	4.9	39	21.7	35.3
20–64	160	46.2	232.8	125	43.4	164.6
All other departments						
20–29	15	7.3	–7.3	12	7.6	6.4
30–39	14	7.6	18.4	11	5.8	7.2
40–49	34	13.0	–13.0	18	7.7	–7.7
50–59	62	62.2	–45.2	45	29.7	8.3
60–64	35	43.8	65.2	39	33.5	20.5
20–64	160	133.9	18.1	125	84.3	34.7
Total	160	188.8	385.2	125	132.7	258.3

Expected numbers are obtained by multiplying the average number of bed days in the general population by the number of diabetic patients in each sex- and age-group (as if there were no excess disease).

individuals was more than twice as many as expected. This resulted in an excess cost of lost production of about the same size as for insulin-treated patients.

Costs of inpatient care

Table 6 shows the differences between actual and expected costs of inpatient care among the diabetic patients. The annual excess costs were estimated to SEK 4,600 (\$800) per patient at 20–64 years of age. Most of the excess costs related to care at surgical/orthopedic and medical departments.

Expenditures of control and treatment

Tables 7 and 8 show the annual expenditures of consultations, antidiabetic drugs, and treatment devices per diabetes pa-

tient in Vetlanda, in SEK 1990 prices. Expenditures of insulin treatment exceeded those of oral treatment about fourfold. The average annual number of physician

consultations per diabetes patient in the age range 20–64 years was 2.42. Of these consultations, an average of 1.02 (42%) were classified as consultations for con-

Table 5—Annual (1987) expected and actual costs of lost production because of sick days and premature retirement (permanent disability) in insulin-treated and non-insulin-treated diabetic patients in Vetlanda

	Costs of lost production		
	Actual	Expected	Difference
Short-term illness			
Insulin-treated	20,500	12,800	7,700
Non-insulin-treated	14,600	15,800	–1,200
Permanent disability			
Insulin-treated	54,400	19,900	34,500
Non-insulin-treated	67,800	25,600	42,200

SEK (1990 prices) per individual at 20–64 years of age. In 1990, \$1 equaled SEK 5.70.

Table 6—Annual (1987) expected and actual costs of inpatient care for diabetic patients in Vetlanda

Type of department	Actual	Expected	Difference
Surgical/orthopedic	1,617	107	1,510
Medical	3,317	610	2,707
All other	1,846	1,486	360
Total	6,780	2,203	4,577

SEK (1990 prices) per individual at 20–64 years of age. In 1990, \$1 equaled SEK 5.70.

trol and treatment of diabetes. The corresponding number of nurse consultations was 2.51 per year. The annual therapeutic expenditures per diabetes patient in the 20- to 64-year age-groups were estimated to be about SEK 3,500 (\$600). Of these costs, 41% were attributed to antidiabetic drugs, 19% to treatment devices, and 40% to consultations.

The expenditures of antidiabetic drugs and treatment devices in the whole of Sweden were SEK 312 million and SEK 140 million, respectively. The total, i.e., SEK 452 million, compared well with that of Vetlanda; correcting the Vetlanda figure by the population factor gave a cost estimate of SEK 473 million.

Costs of treatment with other drugs

The excess consumption of drugs other than antidiabetic medications in the diabetic patients in the reference county of Jämtland indicated an excess cost of SEK 1,173 (about \$200) per diabetic individual.

Table 7—Annual (mean of 1986 and 1990) costs of antidiabetic drugs and treatment devices per diabetes patient in Vetlanda

	Oral treatment	Insulin treatment
Oral agents	822	—
Insulin	—	2,125
Injection devices	—	553
Test strips	—*	816
Total costs	822	3,494

SEK 1990 prices. *Not available. It was assumed that test strips were predominantly used by insulin-treated patients.

CONCLUSIONS — Because the diabetes prevalence study in Vetlanda was most thorough, and because the Swedish insurance system's and county council's records of sick leave, disability, and care are very reliable, the recorded numbers of sick days, premature retirement, consultations, and inpatient care in people with diabetes and in the general population of Vetlanda should be accurate. In addition, the drug statistics from the Swedish Corporation of Pharmacies are highly accurate (13). Hence, the calculations of excess costs because of morbidity in diabetic patients in Vetlanda should be fairly correct estimates.

On the other hand, the average numbers of sick days and disability pensions for the general population in Vetlanda were lower than those in Sweden for each age-group. Furthermore, there is a considerable variation in the prevalence of diabetes within Sweden (9) and no reliable estimate of the mean national prevalence. Hence, it is not possible to know whether costs of diabetes in Vetlanda would be greater or smaller than the Swedish average. However, an earlier

study of diabetes costs in Sweden, based on aggregated data (3), estimated the costs of production losses due to short-term illness at SEK 134 million in 1978, which equals SEK 358 million in 1990 prices. The Vetlanda figure of the current study would equal a rather similar figure, SEK 325 million, for the whole of Sweden.

The previous Swedish study (3) indicated that the costs of permanent disability in diabetic patients were three times higher (SEK 1,170 million in 1990 prices) than those of short-term illness (SEK 358 million). The current data indicate that the costs of permanent disability in diabetic subjects exceed those of short-term illness even more; the difference was almost 10-fold. This finding reflects the fact that diabetes promotes and accelerates various forms of chronic morbidity, some of which are not recorded with diabetes as the primary cause, e.g., macrovascular disease. Our findings seem to include these costs of excess disease in diabetic patients, since the excess macrovascular disease in people with diabetes is not incidental but pathogenetically related (15).

The large excess disease costs in diabetic subjects because of permanent disability, i.e., chronic complications, were derived rather equally from insulin-treated and non-insulin-treated subjects. In contrast, the much lower excess costs due to excess sick days were restricted to insulin-treated subjects.

The findings further indicate that the excess costs of production losses in

Table 8—Annual costs per diabetes patient for physician and nurse consultations attributed to control and treatment of diabetes

	Annual average of consultations per patient	Costs per consultation	Annual cost per patient
Consultations			
Physicians	1.02	620	632
Nurses	2.51	309	776
Total			1,408

SEK 1990 prices.

people with diabetes (permanent disability plus short-term illness), which equal about SEK 40,000, i.e., \$7,000, per diabetic individual and year in 1990 prices, were almost 10 times higher than those of control and treatment, including not only expenditures of antidiabetic medication and devices for treatment control but also those of physician and nurse consultations. Because the treatment costs in Vetlanda seemed very close to those of Sweden in general, the nearly 10-fold difference may be representative for Sweden, as well. If applicable to U.S. conditions, assuming that there are ~3 million diabetic patients in the age range 20–64 years in the U.S. (5), the costs of production losses would equal a total of about \$21 billion for the entire U.S., with about \$12 billion and \$9 billion attributable to people with insulin-treated and non-insulin-treated diabetes, respectively. The latter figure is much higher than a previous U.S. estimate—\$2.6 billion in 1986 prices—of forgone productivity because of disability in NIDDM subjects 20–64 years of age (5).

The results also indicated that the excess cost in diabetic patients for drugs other than antidiabetic medications was \$200 and that excess cost due to inpatient care was about \$800 per diabetic individual and year. The latter figure may be an underestimation, because the difference of inpatient care costs between people with diabetes and the general population tended to increase with age and because the current analysis was restricted to age-groups of 20–64 years. However, this hardly reduces the predominance of the excess costs of production losses in people with diabetes. Therefore, it seems likely that intensified antidiabetic treatment would save costs, provided that im-

proved metabolic control would reduce morbidity not only in IDDM (16,17) but also in NIDDM patients. The latter remains to be substantiated.

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