Costs of Stroke in Sweden
A National Perspective

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Background and Purpose Cost-effectiveness analyses of stroke management are hampered by paucity of economic data. We made an update of the direct and indirect costs of stroke in Sweden (population, 8.5 million).

Methods Direct costs (ie, the costs for hospital and outpatient care and social services) were estimated on the basis of two prospective population-based studies of stroke and of two nationwide cross-sectional inventories of bed-days and diagnoses. Indirect costs (ie, the costs for loss of productivity and early retirement) were based on official statistics.

Results The direct annual costs of care for stroke patients in 1991 equaled 7836 million Swedish krona (SKr) ($1306 million in US dollars), and the indirect costs, 2430 million SKr ($405 million). The cost of stroke care was 1208 SKr ($201) per inhabitant in Sweden. The expected direct costs per patient from first stroke to death were 440 000 SKr ($73 333). When prestroke costs for other diseases and advanced age were subtracted, the sum was reduced to 180 000 SKr ($30 000).

Conclusions Costs for hospital and outpatient care and social services accounted for 76% of Swedish stroke costs and for 24% of costs for loss of production and early retirement. Only 41% of direct costs were stroke-related. (Stroke. 1994;25:2363-2369.)

Key Words • cerebrovascular disorders • costs and cost analysis • hospitalization • Sweden

The rapidly growing body of knowledge from randomized trials on the effects of various aspects of prevention and management of stroke provides an important prerequisite for cost-effectiveness analysis. However, there are as yet few analyses of costs in relation to the gains in stroke management. Such analyses are hampered by the paucity of accurate and up-to-date economic data on stroke. Estimations of the costs of stroke have been performed in the United States,1-4 the United Kingdom,5-7 and Sweden.8-10 Many of these studies are based on data from the 1970s, and only three of them5-7 include indirect costs, ie, cost of absenteeism, disease-related early retirement, and death before the age of 65.

Based on incidence data,11 it can be calculated that 33 000 people suffer from stroke each year in Sweden.

Of this annual total, 25 000 experience stroke for the first time.11

As part of its work to critically assess central issues in Swedish health care, the Swedish Council on Technology Assessment in Health Care has reviewed the state of the art in stroke prevention and management (Table 1, source A). The aim was to define and promote those procedures that are of documented value and to identify useless and questionable procedures in routine care of stroke patients in Sweden. An important component of the evaluation has been to assess the costs of stroke itself. We report here on the results of these assessments, using a national perspective and including both direct and indirect costs.

Subjects and Methods

A large number of sources provide background data in the study. Many of the sources have been compiled by Swedish healthcare authorities and other official agencies and are not available in the international scientific literature. These sources are listed in Table 1 and are referred to as source A, source B, etc, in the text.

Direct Costs Per Patient

The incidence approach has been used to estimate direct costs. The incidence approach assigns all direct and indirect costs to the calendar year in which the stroke occurred.3 For example, a patient has a stroke in 1983, and he lives handicapped until 1990. He cannot work, and he needs hospital care in periods and home help in between. All costs of this patient until he dies will, according to the incidence approach, be assigned to the year his stroke occurred, 1983. The prevalence approach, which assigns the costs to the calendar years in which they occur,3 was used only for estimating costs of absenteeism (sickness benefit) in the present investigation. According to the prevalence approach, the costs of absenteeism in our example are based on all persons receiving sickness benefits in 1983 because of stroke, irrespective of whether their stroke occurred in 1983 or a previous year.

To estimate direct costs for individual stroke patients, data from two population-based Swedish studies were used. The first was the Soderhamn stroke register study, which was started in 1975 and has since been updated regularly.11,12 The study covers a population of 30 000 in a small town and the surrounding rural area in central Sweden. The population is served by a single community hospital. About 80% of the stroke patients are admitted to the Department of Medicine, and the rest are identified by active case identification in the population. Screening for stroke patients is performed weekly...
on hospital wards, in nursing homes, in assisted-living homes, at the offices of general practitioners, and in the centers for home-help services. Death certificates are also scrutinized. The patients included in this study (162 men and women with first-ever stroke, including patients with subarachnoid hemorrhage) were registered in 1983 through 1984 and were followed up for 2 years. Their mean age was 75 years.

The second study, the Lund-Orup survey, covering a population of 200 000 inhabitants, was performed in 1983 in the south of Sweden. 9 A random sample of patients admitted to the Department of Neurology, Lund University Hospital, because of first-ever stroke was chosen for the economic study. These 125 patients were good representatives of all stroke patients in the background population with one exception only: patients with subarachnoid hemorrhage were not included. 10 The follow-up of these patients lasted for 2 years. Their mean age was 73 years.

In both studies, costs during the first and second year after stroke have been separated. In the present investigation, annual stroke-related costs per patient were assumed to be constant after the second year. The number of patients, however, gradually decreased. Life tables of stroke patients covering 8 years of follow-up were obtained from another community-based Swedish study. 11 The tables were extrapolated up to 15 years, by which time it was assumed that all patients had died. In addition, the following assumptions were made: the cost for an individual patient is constant from the second year onward, and the discount rate is 5%. The annual growth of productivity was set at 1.5%. 12

In the Soderhamn stroke register study, information on costs of health care and social services during the year preceding the stroke is available. 13 This makes it possible to calculate the costs that are added to prestroke costs, ie, how large the stroke-related costs are.

Direct Costs, National Level

The prevalence approach was used to estimate the total direct costs on the national level. Information on the total number of hospital beds occupied by stroke patients was obtained from the National Board of Health and Welfare for 1988, the most recent year for which routine statistics are available (Table 1, source B). Data were subdivided by type of ward. This information was validated using a cross-sectional inventory performed by the Association of County Councils in all Swedish hospitals on one specific day in 1988 (sources C and D). In both analyses, only patients with stroke as the major cause of admission were included.

The number of outpatient visits for stroke was based on statistics at one local healthcare center in central Sweden (source E) and one university hospital in Stockholm (source F).

Indirect Costs

All indirect costs except cost for absenteeism have been estimated by the incidence approach. Thus, loss of productivity because of early retirement (Table 1, source I) and early death is calculated by its present value from the onset of the disease up to the year of regular retirement (in Sweden, at the age of 65). Estimates of the total value of loss of productivity were based on mean annual salaries, social costs, and employers' fees for each 10-year age group divided by the number of working days per year. Costs for absenteeism were based on all persons receiving sickness benefits because of stroke in 1983 (source J).

Unitary Costs

The unitary costs of health care and social services are shown in Table 2. Mean costs per hospital day and per outpatient visit, by type of clinic in both instances, were obtained from the official statistics of the Federation of Swedish County Councils (Table 1, source G). Costs of social services, assistive devices, and household modifications have been derived from the Soderhamn study. 14

All costs were adjusted to the 1991 prices, based on changes in the consumer price index of health care (source H). The exchange rate was approximately 6 Swedish kronas (Sk) to 1 US dollar in 1991. The same year, the total population of Sweden was 8.5 million.

Table 1. Sources of Information Not Available in the International Scientific Literature

<table>
<thead>
<tr>
<th>Source</th>
<th>Published by</th>
<th>Year</th>
<th>Title</th>
<th>Type of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Statens beredning för utvärdering av medicinsk metodik, Stockholm</td>
<td>1993</td>
<td>Slaganfall</td>
<td>Review of state of the art in stroke prevention and management. Available also in an English version (Stroke)</td>
</tr>
<tr>
<td>B</td>
<td>Socialstyrelsen, Stockholm</td>
<td>1991</td>
<td>Patientstatistik</td>
<td>No. of bed-days for stroke in different types of departments</td>
</tr>
<tr>
<td>C</td>
<td>Landstingsförbundet, Stockholm</td>
<td>1989</td>
<td>Patientinventerings inom somatisk långtidsvård 27 september 1988</td>
<td>Cross-sectional inventory of diagnostic category of all patients in somatic long-term hospital care</td>
</tr>
<tr>
<td>D</td>
<td>Landstingsförbundet, Stockholm</td>
<td>1990</td>
<td>Stickprovundersökning av beläggning med diagnosen stroke</td>
<td>Cross-sectional inventory of stroke patients in all Swedish hospitals</td>
</tr>
<tr>
<td>E</td>
<td>Uppsala University, (Smedby B, Korpela M)</td>
<td>1990</td>
<td>Diagnosredovisning för läkarbesök år 1989 vid vårdsentralen i Tierp</td>
<td>No. of outpatient visits by stroke patients in primary care</td>
</tr>
<tr>
<td>F</td>
<td>Huddinge Hospital, Stockholm</td>
<td>1990</td>
<td>Öppenvårdsstatistik 1990 (unpublished)</td>
<td>No. of visits by stroke patients in a hospital outpatient clinic</td>
</tr>
<tr>
<td>G</td>
<td>Landstingsförbundet, Stockholm</td>
<td>1990</td>
<td>Kostnader per vårddag, intagen och läkarbesök m m 1988</td>
<td>Inpatient and outpatient costs in different types of medical care</td>
</tr>
<tr>
<td>J</td>
<td>Riksförsäkringsverket, Stockholm</td>
<td>1987</td>
<td>Den ersatta sjukfrånvarons diagnoser 1983 (vol 8)</td>
<td>No. of sickness-benefit days because of stroke</td>
</tr>
</tbody>
</table>
TABLE 3. Average Annual Costs for Care of Patients With First-Ever Stroke in Two Swedish Population-Based Studies

<table>
<thead>
<tr>
<th>Cost</th>
<th>Söderhamn*</th>
<th>Lund-Orup</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td></td>
<td>SKr</td>
<td>US$</td>
</tr>
<tr>
<td>Inpatient care</td>
<td>110 000</td>
<td>18 333</td>
</tr>
<tr>
<td>Outpatient care†</td>
<td>3150</td>
<td>525</td>
</tr>
<tr>
<td>Social services†</td>
<td>18 700</td>
<td>3117</td>
</tr>
<tr>
<td>Total direct costs</td>
<td>131 850</td>
<td>21 975</td>
</tr>
</tbody>
</table>

†Including hospital wards for nursing care.
†Nursing beds outside hospital.

The total direct costs of a stroke patient, derived from the Söderhamn data and extrapolated to 15 years, were estimated at 440 000 SKr ($73 333), using a 5% discount rate.

In Söderhamn, the cost in the year preceding the stroke was high and on average amounted to more than half of the total cost during the first and second follow-up years (Table 4). The costs added by a first stroke were then estimated at 63 080 SKr ($10 513) during the first year and 47 080 SKr ($78 47) during the second.

When these figures are extrapolated to 15 years and sums not directly related to the stroke are deducted, the lifetime cost was reduced from 440 000 SKr ($73 333) to 180 000 SKr ($30 000).

Direct Cost, National Level

According to official hospital statistics, a total of approximately 3 million bed-days were recorded for patients with acute cerebrovascular disease as the main diagnosis at discharge in Swedish hospitals in 1988 (Table 5). The great majority of hospital beds for stroke patients were in geriatric and medical wards. Using average costs per bed in different types of wards, according to their proportion of the total, we estimated the annual cost for in-hospital care of stroke patients in Sweden at 5135 million SKr ($856 million).

The 1-day national inventory performed in 1988 found that 23% of all patients in Swedish hospital wards, including departments for long-term nursing care, had a diagnosis of cerebrovascular disease. The total number of hospital beds was 49 000, with a mean occupancy rate of 92%. (Ten thousand of these bed-days were assigned to nursing care.) On the basis of this background information, the number of stroke-related bed-days was calculated to be 3.8 million per year. This is 25% higher than the estimate based on hospital discharge diagnoses. There are technical reasons for this discrepancy, the most obvious being that, if a patient stays longer than 1 year in the hospital, he or she is not listed in the discharge register. If we assume that those patients staying more than 1 year in geriatric wards account for the total difference shown between the two methods of collecting data, the total annual cost for...
TABLE 4. Average Costs for Patients With First-Ever Stroke in the Söderhamn Study, 1 Year Before and 2 Years After Stroke Onset

<table>
<thead>
<tr>
<th>Cost</th>
<th>Before Onset</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Added Costs of Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inpatient care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical departments</td>
<td>SKr 12 500</td>
<td>US$ 2083</td>
<td>SKr 66 500</td>
<td>US$ 11 083</td>
</tr>
<tr>
<td>Long-term care*</td>
<td>SKr 3000</td>
<td>US$ 500</td>
<td>SKr 10 300</td>
<td>US$ 1717</td>
</tr>
<tr>
<td>Other departments†</td>
<td>SKr 18 800</td>
<td>US$ 3133</td>
<td>SKr 33 200</td>
<td>US$ 5533</td>
</tr>
<tr>
<td>Total</td>
<td>SKr 34 300</td>
<td>US$ 5716</td>
<td>SKr 110 000</td>
<td>US$ 18 333</td>
</tr>
<tr>
<td>Outpatient care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician visits</td>
<td>SKr 2350</td>
<td>US$ 392</td>
<td>SKr 2830</td>
<td>US$ 472</td>
</tr>
<tr>
<td>Physiotherapy/occupational therapy</td>
<td>SKr 80</td>
<td>US$ 13</td>
<td>SKr 320</td>
<td>US$ 53</td>
</tr>
<tr>
<td>Total</td>
<td>SKr 2430</td>
<td>US$ 405</td>
<td>SKr 3150</td>
<td>US$ 525</td>
</tr>
<tr>
<td>Social services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assisted living/nursing home†</td>
<td>SKr 21 280</td>
<td>US$ 3547</td>
<td>SKr 10 870</td>
<td>US$ 1812</td>
</tr>
<tr>
<td>Home help</td>
<td>SKr 11 760</td>
<td>US$ 1960</td>
<td>SKr 7830</td>
<td>US$ 1305</td>
</tr>
<tr>
<td>Total</td>
<td>SKr 33 040</td>
<td>US$ 5507</td>
<td>SKr 18 700</td>
<td>US$ 3117</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assistive devices</td>
<td>SKr 370</td>
<td>US$ 62</td>
<td>SKr 560</td>
<td>US$ 93</td>
</tr>
<tr>
<td>House modifications</td>
<td>SKr 270</td>
<td>US$ 45</td>
<td>SKr 1080</td>
<td>US$ 180</td>
</tr>
<tr>
<td>Total</td>
<td>SKr 640</td>
<td>US$ 107</td>
<td>SKr 1660</td>
<td>US$ 273</td>
</tr>
<tr>
<td>Total direct costs</td>
<td>SKr 70 410</td>
<td>US$ 11 735</td>
<td>SKr 133 490</td>
<td>US$ 22 248</td>
</tr>
</tbody>
</table>


*Including hospital wards for nursing care.
†Mainly general surgery.
‡Nursing beds outside hospital.

hospital care of stroke patients would be 6156 million SKr ($1026 million) when the inventory data are used. This is equivalent to 724 SKr ($121) per inhabitant.

Another method to estimate costs for hospital care is to base the calculations on incidence data from epidemiological studies in Sweden11-13,15-18 and to extrapolate the number of new strokes in the country. These data show that the number of first-ever strokes in Sweden is approximately 25 000 per year. Based on the economic data from Söderhamn, the total annual cost for in-hospital care would then be 7681 million SKr ($1280 million). Using the Söderhamn data for costs already

TABLE 5. Hospital Bed-Days and Costs for Patients With Acute Cerebrovascular Disease as Main Diagnosis at Discharge by Type of Department

<table>
<thead>
<tr>
<th>Type of Clinic</th>
<th>No.</th>
<th>%</th>
<th>SKr</th>
<th>US$</th>
<th>SKr</th>
<th>US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicine</td>
<td>474 993</td>
<td>15.0</td>
<td>2258</td>
<td>376</td>
<td>1072</td>
<td>179</td>
</tr>
<tr>
<td>Neurology</td>
<td>54 888</td>
<td>1.7</td>
<td>2600</td>
<td>433</td>
<td>143</td>
<td>24</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>15 180</td>
<td>0.5</td>
<td>7642</td>
<td>1274</td>
<td>116</td>
<td>19</td>
</tr>
<tr>
<td>Surgery</td>
<td>5253</td>
<td>0.2</td>
<td>3322</td>
<td>544</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>31 177</td>
<td>1.0</td>
<td>2781</td>
<td>464</td>
<td>87</td>
<td>15</td>
</tr>
<tr>
<td>Geriatrics*</td>
<td>2 525 751</td>
<td>79.7</td>
<td>1407</td>
<td>235</td>
<td>3554</td>
<td>592</td>
</tr>
<tr>
<td>Other</td>
<td>62 738</td>
<td>2.0</td>
<td>2327</td>
<td>388</td>
<td>146</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>3 169 960</td>
<td>100.0</td>
<td>1620</td>
<td>270</td>
<td>5135</td>
<td>856</td>
</tr>
</tbody>
</table>


*Including nursing beds at hospital.
incurred before the stroke indicates that the costs for
direct stroke-related hospital care would be 3161 mil-
lion SKr ($527 million). On the other hand, if calcula-
tions are based on the results of the Lund-Orup study,
the total annual costs for hospital care of stroke patients
(stroke due to events of concurrent diseases and events
directly related to stroke) would be 10 275 million SKr
($1715 million), which is considerably higher than in the
other estimates.

Thus, in three approaches, the total costs for stroke
patients in Sweden ranged from 5135 to 10 275 million
SKr ($856 to $1713 million). The costs estimated by the
second approach, the national inventory, came close to
the costs based on the Soderhamn study. They were
judged to represent a conservative measure of the costs
for hospital care. The national inventory, giving the
lowest cost of the two, was chosen for the final calcula-
tions (Table 6).

Based on detailed statistics from a local healthcare
center and the outpatient department of a large hospital,
the total annual number of outpatient visits for the
late effects of stroke in the country was estimated to be
100 000 at the offices of general practitioners and 50 000
at hospitals. The total cost for all outpatient visits was
then calculated to be 130 million SKr ($22 million)
(Table 6). When data are extrapolated from the popu-
lation-based studies, the expense for outpatient visits
would range from 87 million SKr ($15 million) (Lund-
Orup) to 225 million SKr ($38 million) (Soderhamn).

The two population-based studies from Soderhamn
and Lund-Orup also provide information on the cost of
social services for stroke patients. These costs differed
greatly. In Soderhamn, where costs for hospital care
were relatively low, the expenses for social services were
twice as high as in Lund-Orup (Table 3). To arrive at a
crude estimate of social costs at the national level, social
services were assumed to account for 25% of the costs
for hospital care during the first 2 years after stroke, as
they did in the Soderhamn study where all patients, not
only those hospitalized, were followed up. The total
annual costs for social services in Sweden would then be
1550 million SKr ($258 million).

Indirect Costs

Information on the number of days of sickness benefit
for stroke was available up to 1983. A total of 550 000
working days per year were lost because of stroke. The
value of each day lost for productivity was estimated at
940 SKr ($156). Consequently, the cost for loss of
productivity was 515 million SKr ($86 million).

In Sweden, approximately 700 people are granted
ey some as early retirement every year because of stroke. There are
approximately 5400 approved cases of early retirement
for the same reason. This corresponds to a cost for
productivity loss of 950 million SKr per year ($158
million).

In 1987, 662 patients died from stroke before the age
of 65 in Sweden. Knowing their age distribution, we
calculated the number of production years lost to be
7218. The total cost of loss of productivity due to early
death from stroke was estimated at 965 million SKr
($161 million).

Thus, total indirect costs for stroke were estimated at
2430 million SKr ($405 million) per year.

Total National Costs of Stroke

The estimates of national costs of stroke are summa-
rized in Table 6. When two or more alternative ap-
proaches to measure costs were used, the results that
were best validated in our opinion were chosen for
summarizing analyses. The total cost was estimated to
be 10 266 million SKr ($1711 million) nationwide and
1208 SKr ($201) per inhabitant.

As demonstrated above, different methods to calcu-
late costs at the national level give varying results. If the
lowest costs for each item were used throughout, the
total annual cost would be 9202 million SKr ($1534
million). If the highest alternative was used instead, this
would result in a grand total of 14 480 million SKr
($2413 million).

If only direct stroke-related costs (after deduction
of prestroke costs) were used, the direct costs would be
reduced by approximately 4630 million SKr ($772 mil-
lon). This corresponds to a reduction of the stroke costs
per inhabitant by 548 SKr ($91). Our data sources do
not provide information on how large a proportion of the
indirect cost for stroke patients is immediately
related to stroke.

Discussion

The estimation of stroke costs on the national level is
greatly dependent on the quality and precision of the

<table>
<thead>
<tr>
<th>TABLE 6. Summary of Annual Costs for Stroke Patients in Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Costs, millions</strong></td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td><strong>SKr</strong></td>
</tr>
<tr>
<td>Hospital care</td>
</tr>
<tr>
<td>Outpatient care</td>
</tr>
<tr>
<td>Social services</td>
</tr>
<tr>
<td>Total direct costs</td>
</tr>
<tr>
<td>Sickness benefit</td>
</tr>
<tr>
<td>Early retirement</td>
</tr>
<tr>
<td>Death before the age of 65</td>
</tr>
<tr>
<td>Total indirect costs</td>
</tr>
<tr>
<td>Grand total</td>
</tr>
</tbody>
</table>

SKr indicates Swedish krona; US$, US dollars.
data used. To reduce bias, we found it necessary to use all kinds of information available. Thus, our analyses are a mixture of incidence- and prevalence-based estimates. Whether the incidence or prevalence methodology is the more relevant depends on the purpose of the analysis. For decision makers concerned with controlling current medical costs and absenteeism, the prevalence approach is judged superior. For decision makers evaluating and ameliorating preventive programs, the prevalence approach is misleading because it focuses on current costs. In this case, the incidence method is more relevant.

The validity of hospital discharge data has been questioned. On the other hand, register data, which emerge from small prospective studies, will increase the risk for sampling error due to small numbers. In our study, both discharge and register data were used to minimize these kinds of bias. Comparing costs of stroke from one time period to another is also complicated, especially in an international perspective. The inflation rate over a prolonged period differs markedly between countries. Consequently, conversion of previous costs to the current monetary value by the use of the consumer price index may introduce bias. Furthermore, the exchange rate of Swedish kronas to US dollars has fluctuated considerably since 1992. Thus, for comparison, our cost data have been converted to the 1991 value only. During the period covered by our study, the exchange rate of Swedish kronas to US dollars was more stable than later on.

The estimation of stroke costs in different countries will give different results not only because of varying validity of background data and different rates of inflation but also because of medicosocial differences. The syndrome of stroke is etiologically heterogeneous, and the underlying cause is age dependent. Subarachnoid hemorrhage is more common in the young patient, intracerebral hemorrhage in the middle-aged, and cerebral infarct in the elderly. These differing etiologies lead to different prognoses for survival and functional disability. Consequently, differences in age distribution between countries have an impact on the national costs of stroke. The population of Sweden is one of the oldest in the world, with 18% above 65 years of age.

Previous studies have shown that stroke is one of the disorders of highest cost to societies in industrialized countries. Because stroke is largely a disease of the elderly, many patients are already disabled by other diseases at the time of their first attack. These comorbid diseases also may have an impact on the need for assistance after stroke. The advanced age of the population of Sweden results in high premorbid costs, as found in the present study. These premorbid costs may be relatively higher than in countries with essentially younger stroke populations.

On the other hand, the proportion of indirect costs (ie, costs incurred for sickness benefit, early retirement, and death before the age of 65) may be more modest in the more elderly Swedish population than in younger ones. In other costly disorders such as myocardial infarction, cancer, and traffic accidents, indirect costs account for 70% of total costs. Our present data show that only 24% of the costs for stroke are indirect. In previous reports comprising data from younger populations, the proportion of indirect costs has been considerably higher at 46% to 63%.

Estimating indirect costs is, in general, an unsolved problem in health economics. The theory of indirect cost is based on several assumptions. A perfectly functioning market and no unemployment are two of the cornerstones on which this theory is built. Thus, the validity of indirect-cost estimates may be less than the validity of estimates of direct costs in our work.

In Sweden, a greater proportion of young and middle-aged women are working outside their homes than in other countries. Thus, young family members of Swedish stroke victims take part in the care of their parents only to a limited extent. In the Söderhamn study, only 8% of the children assisted their parents after stroke (A.T., unpublished data, 1988). On the other hand, if more family members remain at home to care for their stroke-ridden parent, the cost of social services will appear to be less. In complete economic analyses, however, these private services should be estimated. Usually, they are counted as the loss of income due to absenteeism. We have not made such efforts in the present study.

Case fatality after stroke is comparatively low in Sweden, which provides another possible explanation for the high direct costs. In the MONICA study, in which 19 middle-aged populations were compared, Sweden had the lowest 28-day case fatality ratio in men and the second lowest in women. This means that there are more stroke survivors than in many other populations, which may have a bearing on costs.

The total direct costs of stroke found in this study may seem high in an international perspective. When inflation is taken into account (30% between 1988 and 1991), the direct costs are six times those reported in Scotland in 1988. Quite different approaches to estimate the costs of stroke were used, however. The Scottish figures were based on discharge diagnoses and the Swedish figures on expected lifetime costs. This makes direct comparisons difficult. By limiting the comparison to direct costs per person discharged, the relation between Swedish and Scottish figures is reduced to 1.6. Other comparisons are hampered by the lack of breakdown of national costs to costs per patient, with one exception. In 1975, the expenditure per stroke patient was $23 000 in the US state of Massachusetts compared with $20 640 in Söderhamn, Sweden, in 1977.

The payment for stroke in the diagnosis related grouping (DRG) was $4016 in the United States in 1985. This sum was paid for an average stay of 5 to 10 days in the hospital. Thus, the average cost per bed-day was $268 to $402. The 1985 Swedish cost per bed-day ranged from $250 (medicine) to $289 (neurology) in US dollars at the exchange rate of that year. It therefore seems that the hospital costs per day for stroke patients are not higher in Sweden than in the United States.

Costs should, in general, be related to what they give in return to the patient, his or her family, and society. For stroke, there is a plethora of documented and undocumented methods to prevent, diagnose, nurse, treat, and rehabilitate. International comparisons of cost-effectiveness or cost-benefit in stroke care may help to cast new light on which methods are better than others. The present study is one step toward promoting international comparisons that will permit us to find the most cost-efficient strategies in stroke management.
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Costs of stroke in Sweden. A national perspective.

Stroke. 1994;25:2363-2369
doi: 10.1161/01.STR.25.12.2363

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