Direct Costs of Transient Ischemic Attacks
A Hospital-Based Study of Resource Use During the First Year After Transient Ischemic Attacks in Denmark

Vibeke Porsdal, MD; Gudrun Boysen, MD, DMSc

Background and Purpose—Knowledge of costs of health care and social services for patients who have transient ischemic attacks (TIAs) is scarce. This study investigates the resource use and estimates direct costs during the first year after a TIA.

Methods—All patients admitted to a university hospital in Copenhagen, Denmark, because of TIA during 12 months in 1994–1995 were included in a database. The patients were followed until 1 year after admission, and data on resource use during and after the hospital stay were collected prospectively at interviews.

Results—The cost of the hospital stay had a mean of DKr 10100 (US $1800), and the cost of health care and social services after discharge had a mean of DKr 8800 (US $1600).

Conclusions—The total cost of health care and social services during the first year after a TIA had a mean of DKr 18800. The hospital stay and the services after discharge each made up half of the total direct cost. (Stroke. 1998;29:2321-2324.)

Key Words: cerebral ischemia, transient | cerebrovascular disorders | Denmark | economics

Descriptions of resource use and costs can be used when current services are evaluated and future services are planned. Previous research data on resource use for patients with transient ischemic attacks (TIAs) are limited, as most studies of resource use for patients with cerebrovascular diseases have excluded patients with TIA. This article presents data on resource use during and after hospitalization for TIA in a consecutive series of Danish patients. Total costs of health care and social services during the first year are calculated.

Subjects and Methods

The study is based on the Hvidovre Hospital Stroke Database, which comprises data on resource use during and after all admissions to Hvidovre Hospital because of stroke or TIA during a 1-year period from November 1994 to November 1995. Hvidovre Hospital is a 1000-bed university hospital located in Copenhagen, Denmark.

During the 12-month period, there were 77 admissions because of TIA out of 588 admissions for cerebrovascular disease. Some patients were admitted more than once during the year. For the analysis of resource use, these patients were classified according to the first event. The period of follow-up was until 1 year after the event, and the focus of the study was the resource use during the hospital stay as well as use of health care and social services after discharge. The patients were included prospectively in the database. The patients, or their relatives, were informed about the study, and if they agreed to participate, they were interviewed during the hospital stay and again at 3 months and 12 months after the TIA. All available written sources at the hospital, such as medical files, were reviewed to obtain and validate as much information as possible about the individual patients. Data on resource use after discharge were validated by contacts to local authorities.

The perspective chosen was that of the society, ie, the resource use was registered without considering who was the payer of the cost.1 The resource use registered was restricted to resources directly related to the TIAs.

Primarily, the resource use was registered in natural units, such as numbers of scans or hours per week of home help.2 The natural units were selected to be as well defined as possible and at the same time suitable for measuring the resource use for many patients simultaneously. During the primary hospital stay at Hvidovre Hospital, the following resource types were registered at patient level: length of stay and type of department, investigations (x-ray, including brain scans; clinical physiology; and clinical biochemistry), physiotherapy, occupational and speech therapy, social worker assistance, consultations from other specialties, and medication. Costs of nursing and doctoring, input from other staff, consumables, overheads, and capital costs were obtained from the accounts of the hospital (relating to the stroke unit, the department of neurology, or the whole hospital, the most specific level chosen) and allocated directly per bed-day. This implies that unit costs of resources monitored at patient level consist of costs for staff and consumables only. After discharge the following resource types were monitored: readmissions, visits to outpatient clinics (including investigations), visits to general practitioners, medication, nursing homes, sheltered housing, day center visits, aids in and modifications of homes, home help and nursing, meals-on-wheels, transport help, and recuperation.

Unit costs were established by means of different methods. When possible, microcosting was used, ie, the natural unit was disaggregated into components that could be costed separately, and the unit cost was derived as the sum of the costs of components.2 When

Received May 19, 1998; final revision received August 20, 1998; accepted August 20, 1998.
From the University of Copenhagen, Copenhagen, Denmark.
Correspondence to Vibeke Porsdal, MD, Kommunehospitalet, Centre for Gerodynamics R&D, Øster Farimagsgade 5, block 31, DK-1399 Kbh K, Denmark.
© 1998 American Heart Association, Inc.
Stroke is available at http://www.strokeaha.org

2321
disaggregation of the natural unit was not possible or information on the costs of components was not available, other, less precise, costing methods were used. These alternative methods were total costs and cost weights, prices, and estimates. For example, visits to day centers were measured in number of visits, and the cost per visit was calculated from the total cost of day centers, nursing homes, and other institutions in Copenhagen, allocated to the different types of institutions by means of weights. Estimates were used as a last resort when detailed information was not available and market prices did not exist. This was the case for home help and clinical physiological investigations. The unit cost of hospital bed-days after transfer to another hospital and at readmission was estimated to equal the mean cost per day across all bed-days during the primary hospital stays at Hvidovre Hospital. A variety of sources at Hvidovre Hospital and in the district of Copenhagen were used for establishing and validating unit costs. The costs we used apply to 1995. In 1995 the average exchange rate was US $100=DKR 560.25.

Use of most of the resource types at the hospital, and some resource types after discharge, was registered in the medical files and in the computer information system of the hospital, and information on these resources was obtained for all patients. For the other resource types, information was collected at the interviews with the patients who agreed to participate in the study and from written sources, when available, for the patients without consent. To make cost estimates based on all patients, including those with missing information, a resource-use model was constructed. When it was known that a patient had a certain resource type but the amount of the resource was unknown, the mean cost of the resource was allocated to the patient. When it was unknown whether a patient had a resource type, the proportion of patients who had the resource, multiplied by the mean cost of the resource, was allocated. Information on clinical and social factors was collected at the same times and with the same methods as the collection of resource-use data.

Data were entered and statistical analysis performed in EPI INFO version 6. Mann-Whitney and Kruskal-Wallis tests were used, with $P<0.05$ considered significant.

The study was approved by the Ethics Committee of Copenhagen.

Results

Patients

Among the 77 admissions because of TIA, 4 were readmissions during the year of inclusion of those patients into the database. Follow-up of the patients was timed from the first admission, and therefore this paper focuses on the 73 first admissions. This group of patients comprised 35 women (48%) and 38 men. The age range was 30 to 95 years, with a median age of 71 years (mean, 70 years). Women had a median age of 75 years and men a median age of 69 years ($P=0.02$).

At the time of hospitalization, all patients lived in their own homes: 27 lived alone, 40 lived with someone, and for 6 patients information was not available. Fifty eight patients were retired, 10 were salaried employees, and 2 were unemployed. The work status of the remaining 3 patients is not known.

The Oxford Handicap Scale was used for assessing "handicap" before hospitalization. Before admission, 65% of the patients were independent in activities of daily living (score, 0 to 2) and 35% were dependent on help (score, 3 to 4). No patient had a score of 5. Twelve percent of the patients had experienced a stroke prior to the TIA registered in the database, whereas 26% had previously had a TIA.

Services

The length of stay at Hvidovre Hospital ranged from 1 to 17 days, with a median of 2 days (mean, 4 days). During the hospital stay, 24 patients (33%) had consultations from other specialties (median, 1 consultation), and 7 patients (10%) had physiotherapy or were evaluated by a physiotherapist. One patient had social worker assistance. No patients had occupational therapy or speech therapy.

A total of 34 patients (47%) had CT scans during the hospital stay or after discharge (and 3 of these patients had MRI scans as well), and 33 patients (45%) had echocardiograms and/or ultrasound of carotid arteries. Thirty-seven patients (51%) visited an outpatient clinic for follow-up (median, 1 time). Seven patients were referred to a department of vascular surgery for further examination of carotid arteries. None of these patients had carotid endarterectomy.

During the year of follow-up, 5 patients had readmissions related to TIA: 3 of the readmissions resulted from new TIAs, 1 readmission was due to a stroke, and 1 patient was admitted for social reasons. Sixty-four patients did not have readmissions related to the TIA. Information was insufficient for 4 patients.

In approximately two thirds of the patients, information was available for the following items: a general practitioner was consulted by 31% in relation to the TIA; increased costs of medication after admission compared with costs before were noted by 85%; and anticoagulant treatment was initiated in relation to the TIA in 22%.

Aids were given to 13% of the patients, with the most common type of aid being a personal alarm, and modification of housing was done for 5%. More hours of home help after the admission compared with the situation before were needed by 19%, whereas no patient had an increased amount of home nursing. Only 5% had meals-on-wheels or an increased number of visits to a day center. No patients moved to a nursing home or to sheltered housing, and none required help for transportation.

As previously mentioned, the mean length of hospital stays was 4 days. A few of the patients had lengthy hospital stays: 1 patient was hospitalized for 17 days, and 2 patients were hospitalized for 14 days. These extended stays were due to complications (pneumonia, back pain) and waiting for investigations and consultations from other specialties. Length of hospital stay was independent of the Oxford Handicap Scale scores—reflecting restrictions in lifestyle and dependency in daily living—before admission ($P=0.6$). Similarly, there were no significant differences between length of hospital stay across age groups (defined in decades: under age 50, in the 50s, in the 60s, in the 70s, and over 80; $P=0.9$).

Approximately half of the patients had CT scans during the hospital stay or as outpatients, and approximately half had echocardiogram and/or ultrasound of the carotid arteries. For both of these types of investigation, the patients who were investigated were significantly younger than the those who were not investigated. The patients who had CT scans had a median age of 67 years, compared with a median age in the patients without scans of 81 years ($P=0.000$). The patients who had clinical physiological investigations had a median age of 67 years, whereas those without echocardiogram/
ultrasound of carotid arteries had a median age of 82 years ($P=0.000$).

**Costs**

The cost of the hospital stay had a median of DKr 4800 (mean, DKr 10100), the cost of health care and social services after discharge had a median of DKr 5700 (mean, DKr 8800), and the total cost during the first year had a median of DKr 11500 (mean, DKr 18800).

When costs for men and women were compared, no significant differences were found for either the costs of hospital care ($P=0.6$), the costs of health care and social services after discharge ($P=0.1$), or the total costs during the first year ($P=0.5$). When hospital costs, costs after discharge, and total costs were compared across age groups (defined in decades), no significant differences were found ($P=0.8$, $P=0.1$, and $P=0.7$, respectively).

The distribution of costs between resource types is presented in the Table, in which the resource use for an average patient during and after the hospital stay is shown. Unit costs were derived as sums over costs of components for all resource types at Hvidovre Hospital apart from echocardiograms and ultrasound investigations, for which the unit costs were estimated. Costs of services after discharge were mainly derived from total costs by means of cost weights. The exceptions were medication, aids in and modification of homes, where market prices were used, and the costs of home help and further hospitalization, which were estimated.

**Discussion**

Regarding the age difference between patients who did and those who did not have echocardiogram/ultrasound of the carotid arteries, the guidelines of the department of neurology recommended clinical physiological investigations only for patients under 70 to 75 years of age, as older patients would not have operations. The guidelines for CT scans of the brain were less clear.

Differing views on how to investigate patients with TIA have been presented in the literature. For example, the relevance of CT scans of the brain has been described by experts within the past few years as follows: “while CT may not be needed in a patient who has amaurosis fugax, the test should be performed in almost all patients who have focal neurological symptoms” (Adams and Davis); and “we believe that cranial CT should be reserved for patients with continuing TIAs of the brain (but not of the eye), particularly if they are in the carotid territory, and those who are being considered for carotid endarterectomy (to avoid operating on someone with a symptomatic meningeoma for example)” (Hankey and Warlow). In both of these assessments, the benefit as well as the cost of the investigation was considered.

A study from the United States based on data from 1992 from five academic medical centers found the average length

### Table: Costs of an Average Patient Admitted for TIA

<table>
<thead>
<tr>
<th>Resource Item</th>
<th>Unit Cost, DKr</th>
<th>Mean Cost per Patient, DKr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing, HH</td>
<td>691/per day</td>
<td>2740</td>
</tr>
<tr>
<td>Overhead, HH</td>
<td>633/per day</td>
<td>2510</td>
</tr>
<tr>
<td>Investigations, HH (x-rays, cl bio, cl phys)</td>
<td>Eg, CT scan of brain, 521</td>
<td>1170</td>
</tr>
<tr>
<td>Capital costs, HH</td>
<td>254/d</td>
<td>1010</td>
</tr>
<tr>
<td>Doctors, HH</td>
<td>251/d</td>
<td>990</td>
</tr>
<tr>
<td>Other staff, HH (secretaries, porters)</td>
<td>111/d</td>
<td>440</td>
</tr>
<tr>
<td>Consumables, HH</td>
<td>95/d</td>
<td>380</td>
</tr>
<tr>
<td>Consultations, HH</td>
<td>150/time</td>
<td>60</td>
</tr>
<tr>
<td>Therapy, HH (including social worker)</td>
<td>186/h</td>
<td>60</td>
</tr>
<tr>
<td>Medication, HH</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Transfers</td>
<td>2273/d</td>
<td>690</td>
</tr>
<tr>
<td>Readmissions</td>
<td>2273/d</td>
<td>1650</td>
</tr>
<tr>
<td>Outpatient services (including investigations)</td>
<td>Follow-up: HH, 390/time; dept vasc surg, 1599/time</td>
<td>1980</td>
</tr>
<tr>
<td>Medication (including anticoagulant treatment)</td>
<td></td>
<td>660</td>
</tr>
<tr>
<td>General practitioner</td>
<td>132/time</td>
<td>250</td>
</tr>
<tr>
<td>Home help</td>
<td>200/h</td>
<td>2750</td>
</tr>
<tr>
<td>Day center</td>
<td>380/d</td>
<td>910</td>
</tr>
<tr>
<td>Aids</td>
<td>Eg, personal alarm, 3500</td>
<td>360</td>
</tr>
<tr>
<td>Meals-on-wheels</td>
<td>23/meal</td>
<td>120</td>
</tr>
<tr>
<td>Modifications of home</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>18800</strong></td>
</tr>
</tbody>
</table>

HH: indicates Hvidovre Hospital, and that the resource use relates to the primary hospital stay at Hvidovre Hospital; cl bio, clinical biochemistry; cl phys, clinical physiology; and dept vasc surg, department of vascular surgery.
of stay for patients with TIA to be 4.9 days and estimated the cost of the hospital stay as US $4653.3 Whereas the average length of stay is close to ours, the cost of treatment and care is much higher (in 1995, DKr 10100 was equivalent to US $1800). The American cost estimate was based on administrative data sets, charges, and cost-to-charge ratios. An unknown part of the difference between the cost estimates is due to different methods and different unit costs. However, the patterns of treatment and care of patients with TIA are likely to differ as much as the opinions on investigations, and the gap between the American cost and ours probably also reflects differences in management.

As described, a significant proportion of the resource use took place after discharge from the hospital. Some of the resource items used after discharge may appear surprising, as only resource use related to the TIAs was registered. However, the diagnostic criterion of TIA of symptoms lasting <24 hours considers only the physical aspects of the disease, and the psychological and social aspects are not as limited in time. Patients may need more home help or new aids because of anxiety or a change of self-perceived health, which perhaps lasts forever.

To summarize, we followed a series of 73 patients hospitalized for TIA through a 1-year period and registered all related resource use in the health care and social service sectors. Services were costed and overall costs were calculated. The distribution of overall costs was such that the costs of primary hospital stays made up 53% and resource use after discharge made up 47%. As mentioned, previous research data on resource use for patients with TIAs are limited. More studies of the management of TIA, including data on costs, are needed before useful comparisons across centers can be performed.

Acknowledgments
We thank Marlene Gyldmark, Cand Polit, MSc (Health Economics), Novo Nordisk, Copenhagen, Denmark, for advice and comments.

References
Direct Costs of Transient Ischemic Attacks: A Hospital-Based Study of Resource Use During the First Year After Transient Ischemic Attacks in Denmark

Vibeke Porsdal and Gudrun Boysen

Stroke. 1998;29:2321-2324
doi: 10.1161/01.STR.29.11.2321

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 1998 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/29/11/2321

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org/subscriptions/