The destinations of stroke patients after discharge from acute-care hospitals were studied to ascertain the current use of health care resources. The 1984-1985 acute-care hospital discharge listings for the province of Quebec were consulted to identify 3,045 adults of the Montreal area who were discharged, deceased or alive, with a primary or secondary diagnosis of stroke. The relation between the length of stay (i.e., the time to death or discharge to long-term care, rehabilitation, or home) and the explanatory variables (age, sex, neighborhood socioeconomic status, type of stroke, and university affiliation of the discharging hospital) was assessed using Cox's proportional hazards models. Older patients and those with hemorrhagic strokes had the highest risk of death. However, patients with hemorrhagic strokes were more likely to survive if admitted to a university teaching hospital. Older patients, those with nonhemorrhagic strokes, and those admitted to university teaching hospitals were more likely to be discharged to long-term care. A greater proportion of patients discharged to rehabilitation centers were young, lived in a high-socioeconomic-status neighborhood, and had suffered a nonhemorrhagic stroke. Patients had a significantly higher probability of going home if they were young, had had a nonhemorrhagic stroke, had been admitted to a university teaching hospital, or were male. (Stroke 1989;20:351-356)

Of physical illnesses requiring acute in-hospital care, stroke is the fourth most frequent (after heart disease, cancer, and fractures). Among patients >65 years old, only heart disease and cancer more frequently result in hospitalization.1,2 Stroke patients account for 2% of discharges from acute-care hospitals1-3 and 5% of acute-care bed-days.1,2 In Quebec, the average length of stay for stroke patients in acute-care hospitals is 30 days.1 Thus, stroke patients are major consumers of acute-care health resources.4

The health care system makes a long-term commitment when providing care for stroke patients. This commitment includes both acute care and prolonged care in the home, a rehabilitation center, or a long-term care facility. Despite the declining incidence of stroke,5-7 greater resources will probably be required in the future to care for stroke patients owing to the increasing population, the increasing proportion of elderly people in the population, the increased rate of survival following stroke,8 and the increasing costs of health care.9 Thus, careful planning is necessary to assure that health funds will be available to meet the considerable needs of this handicapped population effectively.

Accurate estimates of the current use of health-care facilities are clearly required. As a first step in estimating current rates of resource use, the destinations of stroke patients discharged from acute-care hospitals were examined to estimate the proportion of stroke patients discharged from acute-care hospitals to various destinations and to identify factors determining which patients will be discharged to which destinations.

Subjects and Methods

The acute-care hospital discharge listings were obtained from the MedEcho system for the fiscal year April 1, 1984, to March 31, 1985, for the
province of Quebec and were consulted to identify adults of the Montreal area who were discharged, deceased or alive, from Montreal area hospitals with a primary or secondary diagnosis of stroke. Diagnoses at discharge were coded according to the International Classification of Disease, 9th revision (ICD9). Patients discharged with a diagnosis of transient ischemic attack (ICD9 code 433) or late effects of cerebrovascular accident (CVA) (ICD9 code 438) were not included in the study. Three broad diagnostic categories were formed from seven ICD9 codes: hemorrhagic strokes (430, 431, 432), cerebral infarctions (433, 434), and ill-defined CVAs (436, 437). The latter two diagnostic categories will usually be referred to as “nonhemorrhagic” strokes.

According to the 1981 Canadian census, metropolitan Montreal consists of 27 municipalities, including the city of Montreal; it covers an area of 2,814 km² and has a population of more than 2.8 million people. All 27 public, acute-care hospitals in the Montreal area, including two hospitals that are classified as psychiatric facilities, report to the MedEcho system and were included in this study.

The hospitals, with a total of 12,596 beds, were classified according to university affiliation: teaching, affiliated, and nonteaching/nonaffiliated. Eleven hospitals associated directly with one or the other of the two medical schools in the Montreal area were classified as teaching hospitals. Six hospitals that maintained an association with the medical schools but were neither entitled nor obligated to provide training for residents and interns were classified as affiliated hospitals. Ten hospitals were classified as nonteaching/nonaffiliated hospitals. The teaching hospitals had 7,616 beds, accounting for 60% of the total hospital beds. The number of beds in the affiliated and nonteaching/nonaffiliated hospitals were 1,863 (15%) and 3,117 (25%), respectively.

The municipality in which the patient resided was used as a surrogate for socioeconomic status. Municipalities (hereinafter referred to as neighborhoods) were classified as having “low” or “high” socioeconomic status based on census information on median household incomes.

The discharge listings enumerated 31 categories for discharge disposition; we grouped these into six discharge destinations: deceased, other acute-care hospital, long-term care facility, rehabilitation center, home, or other. The latter category included such diverse placements as foster homes, private and public pavilions, and discharges without medical authorization. All discharge destinations were included for descriptive analyses, but only four end points, that is, death, discharge to long-term care facility, discharge to rehabilitation center, and discharge to home, were considered for in-depth analyses.

Proportions of deaths and discharges to long-term care facilities, rehabilitation centers, and home were calculated for each type of hospital.

For those deceased and for those discharged alive, mean and median lengths of stay were calculated according to type of hospital and category of stroke (i.e., hemorrhagic or nonhemorrhagic). A comparison of the mean lengths of stay among the three types of hospitals, controlling for the effects of age, sex, and category of stroke, was carried out using multiple linear regression. To reduce heteroscedasticity, length of stay was subjected to a fourth-root transformation.

To identify determinants of stroke patients' destinations at discharge, the four end points were treated as independent outcomes. For each end point, two groups of patients were identified: those who experienced the end point ( termed “failures”) and those who did not ( termed “censored”). A set of Cox's proportional hazards models was used to assess whether age, sex, socioeconomic status, category of stroke, and type of discharging hospital were associated with the time to death or to one of the three destinations.

Results

For the 1-year period, a total of 3,045 discharges having ICD9 codes 430-434, 436, and 437 were identified. Approximately 58% of these stroke patients were treated at teaching hospitals, and the remaining 42% were divided almost equally between affiliated hospitals and nonteaching/nonaffiliated hospitals (Table 1). Two thirds of the patients were ≥65 years old. The ratio of men to women varied among the types of hospitals, but over all types, men and women were equally represented. The three types of hospitals had similar proportions of patients from low- and high-socioeconomic-status neighborhoods.

Hemorrhagic strokes accounted for 14.5% of the discharges; the discharges attributed to cerebral infarctions and ill-defined CVAs were 37.1% and 48.3%, respectively (Table 2). Teaching hospitals discharged proportionately more patients with hemorrhagic strokes (18.5%) than did the affiliated hospitals (7.1%) or the nonteaching/nonaffiliated hospitals (10.9%), whereas affiliated hospitals discharged more patients with ill-defined CVAs and fewer with cerebral infarctions than the other two types of hospitals (Table 2).

The discharge destinations are presented in Table 3.

The lengths of stay in acute-care hospitals ranged from 1 to 780 days (Table 4). When adjusted for age, category of stroke, and sex, the mean length of stay in teaching hospitals was significantly shorter than in the other two types of hospitals (p=0.0001). Moreover, teaching hospitals discharged their patients to long-term care facilities, rehabilitation centers, and home sooner (p=0.0001). However, for those patients who died, the survival time in the affiliated hospitals was longer than in the teaching hospitals when adjusted for age, category of stroke, and sex (p=0.0001); in contrast, the survival time in nonteaching/nonaffiliated hospitals was not significantly different from that in teaching hospitals.
The survival analyses revealed that those who died before leaving the acute-care hospital were more likely to be older, to have had a hemorrhagic stroke, and to have been admitted to a nonteaching (i.e., an affiliated or a nonteaching/ nonaffiliated) hospital. Discharge to a long-term care facility was more likely for older patients, for those with nonhemorrhagic strokes, and for those admitted to teaching hospitals. The patient discharged to a rehabilitation center was likely to be young, to have had a nonhemorrhagic stroke, and to live in a high-socioeconomic-status neighborhood. The patient discharged to home was likely to be young, to have had a nonhemorrhagic stroke, to have been admitted to a teaching hospital, and to be a man.

There was a significant interaction between age and category of stroke for all four end points, for deaths there was an additional significant interaction between age and type of hospital.

The hazard ratios (HRs) and the 95% confidence intervals (CIs) that were calculated for each type of hospital, taking into account the interaction terms, are presented in Table 5 according to end point and category of stroke (β and SE are available from the authors on request). For all end points, the HR corresponding to hemorrhagic strokes served as the referent category (HR=1). For each category of stroke, types of hospitals can be compared using the 95% CI; CIs that do not overlap indicate highly significantly different HRs (p<0.001).

**Discussion**

The crude death rate for stroke patients admitted to teaching hospitals was approximately 18%, compared with 25% for the other two types of hospitals. In-hospital death rates ranging from 18% to 37% have been reported.12-18 These differing results could be
attributed to the category of stroke studied, the population studied, and the management of stroke. Gilmum et al\textsuperscript{13} reported an 18% death rate for Rochester, Minnesota, hospitals in 1981; however, patients with transient ischemic attacks were included in their study population. Bonita et al\textsuperscript{14,15} reported a 32% death rate for New Zealand, where one third of stroke patients were managed in the community and, thus, those admitted to hospitals were likely to have had the more severe strokes.

In our study, the risk of dying of a hemorrhagic stroke was significantly higher in affiliated hospitals than in teaching hospitals (Table 5). For nonhemorrhagic strokes, the death HR was similar for the three types of hospitals. Thus, the lower death rate in teaching hospitals for both categories of stroke appears to be due largely to the better outcomes in patients with hemorrhagic strokes. The concentration of highly trained staff and sophisticated diagnostic equipment in teaching hospitals may predispose these types of hospitals to be more effective in dealing with life-threatening situations.

Alternatively, the differences in death rates could be due to differences in unmeasured factors such as diagnostic accuracy.\textsuperscript{19} Hospitals that do not have sophisticated diagnostic equipment may differentially misclassify mild hemorrhagic strokes as non-hemorrhagic. Under these circumstances, the death rate for hemorrhagic strokes would be spuriously high in affiliated and nonteaching/nonaffiliated hospitals, as these rates would be based mainly on patients with serious hemorrhagic strokes who could be at a higher risk for death. In support of this theory is the observation that teaching hospitals categorized 18.5% of strokes as hemorrhagic and 44.7% as ill-defined CVA; in contrast, affiliated hospitals categorized 7.1% as hemorrhagic and 66.9% as ill-defined CVAs and nonteaching/nonaffiliated hospitals categorized 10.9% as hemorrhagic and 41.4% as ill-defined CVAs (Table 2). However, we cannot determine from this data whether these discrepancies arise from differences in coding practices or from true differences in the patient population.

An observation of particular importance, given that two thirds of stroke survivors\textsuperscript{18,20} have residual disabilities, is that only 291 stroke patients (<10%) were discharged to rehabilitation centers. While there is, as yet, no consensus that rehabilitation affects the outcome of stroke positively,\textsuperscript{21-26} increasing the use of rehabilitation centers could be a more efficient way of providing care for many stroke patients. Patients could be discharged to rehabilitation centers as soon as they are medically fit, thus liberating space in acute-care hospitals and giving patients the opportunity to participate in programs that are specifically designed to facilitate independent living.

Although other studies\textsuperscript{12,16,27} have reported similar rates of discharge to rehabilitation centers, ranging from 10% to 18%, the estimates were based on information drawn from experiences in the United States, where the individual’s financial situation is an important factor in access to health care. Higher rates of discharge to rehabilitation centers were expected in Montreal because individuals are not required to pay directly for medical services. The low rate of use could be a reflection of the limited number of places available in rehabilitation centers or could indicate that many treating physicians have a restricted view of the importance of rehabilitation for this population.

Patients who were discharged to rehabilitation centers were more likely to be young, to have had nonhemorrhagic strokes, and to live in neighborhoods classified as having a high socioeconomic status. Because most rehabilitation centers are concentrated in those neighborhoods that were classified as having a high socioeconomic status, the association between socioeconomic status and use of rehabilitation services may not reflect income but rather reflect geography.

Overall, 18% of survivors were discharged to long-term care facilities; older patients and those

### Table 3. Destinations of Patients Discharged From Montreal Area Acute-Care Hospitals (1984–1985)

<table>
<thead>
<tr>
<th>Destinations</th>
<th>Teaching (n=1,764)</th>
<th>Affiliated (n=602)</th>
<th>Nonteaching/ nonaffiliated (n=679)</th>
<th>Total (N=3,045)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>% D</td>
<td>% S</td>
<td>No.</td>
<td>% D</td>
</tr>
<tr>
<td>Deceased</td>
<td>313</td>
<td>17.7</td>
<td>156</td>
<td>25.9</td>
</tr>
<tr>
<td>Long-term care facility</td>
<td>280</td>
<td>15.9</td>
<td>19.3</td>
<td>40</td>
</tr>
<tr>
<td>Rehabilitation center</td>
<td>177</td>
<td>10.0</td>
<td>12.2</td>
<td>74</td>
</tr>
<tr>
<td>Home</td>
<td>920</td>
<td>52.2</td>
<td>63.4</td>
<td>289</td>
</tr>
<tr>
<td>Transferred to another acute-care hospital</td>
<td>48</td>
<td>2.7</td>
<td>3.3</td>
<td>15</td>
</tr>
<tr>
<td>Other</td>
<td>26</td>
<td>1.5</td>
<td>1.8</td>
<td>28</td>
</tr>
</tbody>
</table>

% D, percent of all discharges with respect to column totals; those columns not adding to 100% are due to rounding errors; % S, percent of all survivors. Home includes referral for outpatient follow-up; Other includes foster homes, private and public pavilions, and discharges without medical authorization.
with nonhemorrhagic strokes predominated. When adjusted for age and category of stroke, a patient admitted to a teaching hospital was twice as likely (HR 2.3, 95% CI 1.8–2.9) to be discharged to a long-term care facility as a patient admitted to a nonteaching/nonaffiliated hospital and eight times as likely (HR 8.3, 95% CI 5.9–12.5 calculated from $\beta$ and SE available from the authors on request) as a patient admitted to an affiliated hospital.

The reasons for the difference in these rates of discharge to long-term care facilities may stem in part from pressures in teaching hospitals to discharge patients early. The significantly shorter mean length of stay in teaching hospitals (25 days) compared with that in affiliated hospitals (47 days) or nonteaching/nonaffiliated hospitals (36 days) may be an indication of this pressure. For stroke patients not yet ready for admission to a rehabilitation center, the only option may be discharge to a long-term care facility. Although long-term care does not preclude rehabilitative services, the type and intensity of the therapy offered is aimed more toward maintenance and socialization than toward active reintegration into the community.

Almost two thirds of surviving patients went home from the acute-care hospital. Somewhat higher rates have been reported elsewhere. In Rochester, Minnesota, for the years 1975–1979, 71% of stroke survivors (or 58% of admissions) were discharged to their homes.13 In the 1981–1982 New Zealand study,14 75% of hospitalized stroke patients were discharged to their homes; this rate is particularly high considering that patients with only the most severe strokes were admitted to acute-care hospitals.

Whereas returning home directly from the acute-care hospital is usually considered a desirable out-

### Table 4. Lengths of Stay (Days) for Patients Discharged From Montreal Area Acute-Care Hospitals (1984–1985) According to Discharging Hospital and Discharge Destination

<table>
<thead>
<tr>
<th>Destination</th>
<th>Teaching (n=1,764)</th>
<th>Affiliated (n=602)</th>
<th>Nonteaching/nonaffiliated (n=679)</th>
<th>Total (N=3,045)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deceased</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean±SD</td>
<td>18.6±27.1</td>
<td>56.5±118.2</td>
<td>23.2±30.3</td>
<td>29.0±64.8</td>
</tr>
<tr>
<td>Median</td>
<td>9.0</td>
<td>17.0</td>
<td>9.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Long-term care facility</td>
<td>Mean±SD</td>
<td>51.4±46.4</td>
<td>137.4±124.7</td>
<td>67.7±69.1</td>
</tr>
<tr>
<td>Median</td>
<td>39.0</td>
<td>91.5</td>
<td>71.5</td>
<td>51.0</td>
</tr>
<tr>
<td>Rehabilitation center</td>
<td>Mean±SD</td>
<td>38.6±26.5</td>
<td>52.8±29.8</td>
<td>43.8±28.1</td>
</tr>
<tr>
<td>Median</td>
<td>33.0</td>
<td>41.5</td>
<td>44.0</td>
<td>37.0</td>
</tr>
<tr>
<td>Home</td>
<td>Mean±SD</td>
<td>16.5±17.8</td>
<td>23.5±28.0</td>
<td>19.4±22.5</td>
</tr>
<tr>
<td>Median</td>
<td>12.0</td>
<td>15.0</td>
<td>15.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Total</td>
<td>Mean±SD</td>
<td>24.8±30.0</td>
<td>47.0±85.0</td>
<td>31.6±49.9</td>
</tr>
<tr>
<td>Median</td>
<td>15.0</td>
<td>20.0</td>
<td>19.0</td>
<td>17.0</td>
</tr>
</tbody>
</table>

### Table 5. Hazard Ratios and 95% Confidence Intervals for Three Types of Hospitals and Two Categories of Stroke

<table>
<thead>
<tr>
<th>Type of hospital</th>
<th>Deceased*</th>
<th>Long-term care*</th>
<th>Rehabilitation†</th>
<th>Home†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhagic strokes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Affiliated</td>
<td>1.8</td>
<td>0.1–2.7</td>
<td>0.1–0.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Nonteaching/nonaffiliated</td>
<td>1.7</td>
<td>1.2–2.4</td>
<td>0.3–0.6</td>
<td>3.3</td>
</tr>
<tr>
<td>Nonhemorrhagic strokes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching</td>
<td>0.1</td>
<td>0.0–0.2</td>
<td>2.4–177.9</td>
<td>9.1</td>
</tr>
<tr>
<td>Affiliated</td>
<td>0.1</td>
<td>0.0–0.2</td>
<td>0.2–22.4</td>
<td>6.7</td>
</tr>
<tr>
<td>Nonteaching/nonaffiliated</td>
<td>0.1</td>
<td>0.0–0.3</td>
<td>0.1–78.2</td>
<td>29.6</td>
</tr>
</tbody>
</table>

HR, hazard ratio; CI, confidence interval.
*Adjusted for age.
†Adjusted for age and socioeconomic status.
‡Adjusted for age and sex.
come, it may not be of benefit to all patients. Stroke patients suffer from a wide variety of residual disabilities that interfere with daily functioning. The training and planning necessary to prepare patients and families to function at home are difficult to accomplish in acute-care settings because these hospitals do not have a primary commitment to rehabilitation. Providing services after discharge, either home care or outpatient therapy, cannot always substitute for inadequate preparation of the patient prior to discharge.

It was of considerable interest to note that women were significantly less likely to be discharged to their homes than men. Men may be less experienced with care-giving than women and may thus be more reluctant to bring home a spouse who requires care. Also, there could have been some residual confounding by age. “Age” in our model was the age of the patient, not the age of the spouse. Considering that the women in our study were an average of 5 years older than the men and that women commonly marry men older than themselves, the male care-givers could be quite a bit older than the female care-givers. That difference could account for the disparity between women and men in the rate of discharge to home.

Two main findings were of particular importance and provide stimulation for future study. First, the teaching hospitals had the lowest death rate among the three types of hospitals. It would be relevant to determine if differences in admission, diagnostic, and treatment practices affect these rates. Second, few patients were discharged to rehabilitation centers, which was surprising given that the rate of morbidity following stroke is known to be high. By increasing the use of these centers, the cost of stroke care could be effectively reduced; acute-care hospitals would have the opportunity of discharging patients earlier and, concomitantly, patients would be given the opportunity to master those skills required to function independently in the community.

Acknowledgment

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