Background and Purpose—There are few population-based data available regarding nursing home use after stroke. This study clarifies the use of a nursing home after stroke, as well as its dependence on stroke severity, in a defined population.

Methods—All first stroke events among residents of Rochester, Minn, during 1987–1989 were ascertained, subtyped, and assigned Rankin disability scores (RS) before the event, at maximal deficit, and at specified intervals after stroke. Persons were followed from the date of stroke event to death, emigration from Rochester, or December 31, 1994, in complete community-based medical records and Minnesota Case Mix Review Program data tapes to determine nursing home residency before stroke and at 90 days and 1 year after stroke, proportion of survival days in a nursing home, and cumulative risk of admission to a nursing home.

Results—There were 251 cases of first cerebral infarction, 24 intracerebral hemorrhages, and 15 subarachnoid hemorrhages among residents of Rochester during 1987–1989. The maximal deficit RS was 1 or 2 for 62 (25%), RS 3 for 72 (29%), and RS 4 or 5 for 117 (47%) of the cerebral infarct patients. Among patients surviving to 90 days or 1 year after cerebral infarction, 25% were in nursing home at 90 days and 22% at 1 year, respectively. Within these maximal deficit RS categories, the percentages of follow-up time spent in a nursing home during the first post–cerebral infarction year are as follows: RS 1 to 2, 4%; RS 3, 10%; and RS 4 to 5, 54%. Multivariate logistic regression revealed that increasing age and RS 4 to 5 at maximal deficit were independent predictors ($P<0.0001$) of nursing home residency at 90 days and 1 year after stroke, whereas stroke type was not an independent predictor. At 1 year after cerebral infarction, the Kaplan-Meier estimates of proportion of people with at least 1 nursing home admission were 11% for RS 1 to 2, 22% for RS 3, and 68% for RS 4 to 5.

Conclusions—This study provides unique population-based data regarding the short- and long-term use of a nursing home after stroke and its dependence on stroke severity. More than 50% of people with a severe cerebral infarction are in a nursing home 90 days and 1 year after the stroke, and by 1 year, nearly 70% will have required some nursing home stay. Age and stroke severity are independent predictors of nursing home residency after stroke. (Stroke. 1999;30:924-929.)

Key Words: cerebral infarction ■ intracerebral hemorrhage ■ nursing homes ■ quality of life ■ stroke outcome

Stroke is the third highest cause of death in the United States, resulting in 150,000 deaths per year. In addition to mortality, the social and economic impacts of stroke are striking. Recently published data have clarified the impact of acute care services after first stroke, and population-based estimates of the impact of all stroke have been published. However, the importance of stroke type and severity on nursing home use is poorly defined.

Currently available nursing home utilization data primarily obtained from administrative databases or from sites outside the United States may not be valid for generalization to all episodes of stroke in the US population. In addition, estimates of the dependency of nursing home use on stroke type and severity have not been previously available on a population basis. This study uses the resources of the Rochester Epidemiology Project to evaluate the use of nursing homes after stroke and to clarify the dependence of such use on stroke type and disability level in a defined population. These data can be used to assess the impact of medical or surgical interventions on short- and long-term nursing home use. They can also be used to clarify the effect of stroke prevention strategies on nursing home use. Because acute stroke treatments do not alter the occurrence of stroke but instead may lessen stroke severity, the severity-dependent

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Stroke is available at http://www.strokeaha.org
nursing home use data will allow impact of these treatments to be estimated.

Subjects and Methods

The Rochester Epidemiology Project Medical Records Linkage System provides resources to identify nearly all cases of stroke in a community.17,18 Virtually all medical care in the community is supplied by Mayo Clinic and its 2 affiliated hospitals or by Olmsted Medical Center, a smaller group practice that includes an outpatient and inpatient facility. All medical diagnoses made for a resident of Rochester are entered on a master sheet in the provider linked medical record, which is then entered into a central computer index. The index includes Rochester residents who have been seen in other medical practices in surrounding communities, the University of Minnesota, and the Veteran’s Administration Hospital in Minneapolis. Previously reported studies have demonstrated the completeness of case ascertainment for stroke with the use of the medical records linkage system compared with a prospective cohort study.19

The medical records of all residents of Rochester who had a diagnosis of stroke or a diagnosis that could be mistaken for stroke or transient ischemic attack during the 3-year period from January 1, 1987, through December 31, 1989, were screened by a neurologist or trained nurse abstractor under the supervision of a neurologist to determine whether the case met the criteria for a stroke.19 The medical record includes all inpatient and outpatient visits, including urgent care and emergency department visits, nursing home care, and autopsy or death certificate data. The medical records were reviewed to determine whether there were any clinical symptoms consistent with stroke. Death certificates and autopsy protocols were also reviewed to identify those with diagnosis of stroke. Cases diagnosed on radiological imaging alone without any associated clinical symptoms were not included. The type of stroke was determined with the use of imaging studies and autopsy results when available. In summary, all patients had clinical symptoms consistent with cerebral infarction, intracerebral hemorrhage (ICH), or subarachnoid hemorrhage (SAH).

All confirmed cases then had verification of Rochester residence based on information from city and county directories and medical records. To exclude persons who may have moved to Rochester to facilitate treatment or diagnosis of an existing disorder, subjects were eligible only if they were residents of Rochester for at least 1 year before stroke. Level of disability before stroke, at maximal deficit, and at specified intervals after stroke was obtained from comprehensive review of the medical record. Rankin disability scale,20 a 6-point scale of functional disability. Grade 0 indicates no symptoms; grade 1, no significant disability; grade 2, slight disability with inability to perform previous activities; grade 3, moderate disability but able to walk without assistance; grade 4, moderate to severe disability with inability to walk without assistance and inability to attend to own needs; and grade 5, severe disability with bedridden status requiring constant nursing care.

This study was approved by the Mayo Clinic Institutional Review Board.

Determination of Nursing Home Use

All individuals were followed for nursing home activity from date of stroke until emigration, death, or December 31, 1994. The community-based medical record, which includes inpatient and outpatient data, with hospital discharge disposition, location and cause of death, nursing home visit notes, and correspondence, was comprehensively reviewed. Additional data regarding nursing home use were provided by the State of Minnesota Department of Health Care Case Mix Review public research files. This large data set includes detailed periodic nursing home resident assessment, including demographic data, medical diagnoses, and dates of entry and discharge for all residents of all Medicaid-certified nursing homes in the community. It is important to note that the case mix review data included information on all nursing home residents, regardless of payment source. A single continuing care retirement center owned by Mayo Foundation is not included in the case mix review files. The number of nursing home admissions and days for the 24 stroke cases admitted to that facility was available with comprehensive review of the Mayo Clinic medical record.

During the period of this study, nursing home beds in the community were relatively readily available. There is a large inpatient physical medicine and rehabilitation facility at Saint Mary’s Hospital in Rochester, making admission to a nursing home for temporary rehabilitation purposes uncommon.

Statistical Analysis

All cases were followed for at least 1 year after stroke, and the proportion of individuals in the nursing home among those surviving was determined at 90 days and 1 year after stroke, by stroke type and severity at maximal deficit. Among those surviving, the proportion of survival days spent in a nursing home was estimated. Logistic regression analysis was used to assess the influence of such factors as sex, age, stroke type, stroke severity, and their interactions on the odds of residency in nursing home at 90 days and 1 year after stroke. Significance was defined as P<0.05 in the final model. Among persons not in the nursing home at stroke onset, survival free of nursing home use was estimated for cerebral infarction cases with Rankin score at maximal deficit 1 to 2, and 4 to 5 with the use of the Kaplan-Meier product-limit method.21

Results

There were 301 confirmed cases of first stroke among residents of Rochester, Minn, for the period January 1, 1987, through December 31, 1989. Eleven people were identified as having been hospitalized out of the region or as residing at a local convent that provides nursing home care. Nursing home use for the 11 individuals could not be reliably established, and they were excluded from the analysis. For the remaining 290 cases, the distribution by stroke type was as follows: cerebral infarction, n=251; ICH, n=24; and SAH, n=15. The mean age at stroke onset was 73.5 years, and 63% were women. The mean Rankin score before the stroke event was 1.7. The distribution of Rankin disability score at maximal deficit for cerebral infarction is outlined in Table 1.

Among stroke cases who survived to 90 and 365 days, the proportion in a nursing home at each of these times was calculated and is displayed by stroke type and Rankin score at maximal deficit in Table 1. Thirty-three patients were in the nursing home at the time of cerebral infarction. None of the SAHs or ICHs occurred among nursing home residents. Of the 33 cerebral infarction cases occurring in nursing home residents, 1 was Rankin 1 and 32 were Rankin 4 to 5 at maximal deficit. Most of these 33 people had significant disability before the stroke, with prestroke Rankin scores of 4 or 5 in 22 (67%), Rankin 3 in 9 (27%), and Rankin 1 or 2 in 2 people (6%). Eighteen of the 33 had died by 90 days after the cerebral infarction, and 15 survived (1 with Rankin 3 at maximal deficit and 14 with Rankin 4 or 5 at maximal deficit). One year after cerebral infarction, 6 more of these 33 had died.

Overall, 25% of surviving cerebral infarction cases were in a nursing home at 90 days (95% CI, 20% to 32%) and 22% (95% CI, 16% to 29%) at 365 days. At 90 days, 5% of surviving cerebral infarction patients with maximal deficit Rankin score of 1 to 2 resided in a nursing home compared with 10% of those with maximal deficit Rankin score of 3 and 59% of those with maximal deficit Rankin score of 4 to 5 (P<0.0001). At 1 year these proportions were 5%, 11%, and 56% (P<0.0001), respectively. Although the numbers were
quite small, it was noted that 22% of ICH patients and 10% of SAH patients surviving to 90 days resided in a nursing home. When we excluded the 33 people in the nursing home at the time of stroke, 19% of surviving cerebral infarction cases were in the nursing home at 90 days (95% CI, 14% to 26%) and 18% (95% CI, 12% to 24%) at 1 year.

The impact of stroke recurrence on nursing home use among people with cerebral infarction was studied. Sixty-one people had recurrent cerebral infarction within 5 years of first cerebral infarction, among 218 cases that were not in a nursing home at the time of the first cerebral infarction. Twenty-eight (46%) of these had no nursing home use after the recurrence, up to 5 years after first stroke, 14 (23%) were already in the nursing home at recurrence. For the remaining 19 people (31%), there were 362 days of nursing home use during days 0 to 90 after first stroke, 849 days during days 91 to 365 after first stroke, and 7084 days from 1 to 5 years after first stroke. These nursing home use figures after recurrent stroke made up 13% of all nursing home days among cerebral infarction cases from days 0 to 90 (362/2817; Table 2), 10% from days 91 to 365 (849/8334), and 22% from 1 to 5 years (7084/32 302).

To evaluate the effect of Rankin score on nursing home residency at 90 days and 1 year after stroke (cerebral infarction, ICH, or SAH) while adjusting for other potential predictors of nursing home residency (sex, age, stroke type),

### TABLE 2. Number of Nursing Home Days After Stroke for Various Intervals Following Event, by Stroke Type

<table>
<thead>
<tr>
<th>Stroke Type</th>
<th>0–90 Days</th>
<th>91–365 Days</th>
<th>1–5 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>NH Days*</td>
<td>Total Days†</td>
</tr>
<tr>
<td><strong>Including patients in nursing home at time of stroke</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Cerebral infarction</td>
<td>251</td>
<td>4385</td>
<td>19258</td>
</tr>
<tr>
<td>Rankin 1–2</td>
<td>62</td>
<td>225</td>
<td>5517</td>
</tr>
<tr>
<td>Rankin 3</td>
<td>72</td>
<td>512</td>
<td>6423</td>
</tr>
<tr>
<td>Rankin 4–5</td>
<td>117</td>
<td>3648</td>
<td>7318</td>
</tr>
<tr>
<td>ICH</td>
<td>24</td>
<td>119</td>
<td>980</td>
</tr>
<tr>
<td>SAH</td>
<td>15</td>
<td>86</td>
<td>917</td>
</tr>
<tr>
<td><strong>Excluding patients in nursing home at time of stroke (n=33)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerebral infarction</td>
<td>218</td>
<td>2817</td>
<td>17689</td>
</tr>
<tr>
<td>Rankin 1–2</td>
<td>62</td>
<td>225</td>
<td>5517</td>
</tr>
<tr>
<td>Rankin 3</td>
<td>71</td>
<td>422</td>
<td>6333</td>
</tr>
<tr>
<td>Rankin 4–5</td>
<td>85</td>
<td>2170</td>
<td>5839</td>
</tr>
</tbody>
</table>

* Days spent in a nursing home.
† Total days of survival.
stepwise logistic regression was used. In the final model, in the analysis of the cohort that includes the 33 people in a nursing home at the time of stroke, increasing age (P<0.0001; odds ratio [OR], 11.7 for each 10-year increase) and a Rankin disability score at maximal deficit of 4 or 5 were independent predictors of nursing home residence at 90 days after the stroke. The OR for maximal Rankin score of 4 to 5, compared with maximal Rankin of 1 to 2, was 11.8 (P<0.0001). Similarly, among patients surviving 365 days, increasing age and Rankin score at maximal deficit were independent predictors of nursing home residence at 90 days (P<0.0001) with an OR = 13.8 for severe stroke (maximal Rankin 4 to 5) compared with minor stroke (maximal Rankin 1 to 2). Stroke type, sex, and interactions were not significant in either analysis. The results of the analyses were similar when we excluded the 33 cases in the nursing home at the time of stroke, except that the OR for severe stroke was slightly lower at 90 days (OR = 8.9) and at 1 year (OR = 10.8).

Among cerebral infarction cases not in a nursing home at the time of the cerebral infarction, survival free of nursing home use was estimated by the Kaplan-Meier method. At 1 year after cerebral infarction, the estimated proportions with at least 1 nursing home admission were as follows: 11% for Rankin score 1 to 2, 22% for Rankin score 3, and 68% for Rankin score 4 to 5 (Figure). Survival free of admission to a nursing home was significant between the 3 groups of maximal deficit Rankin scores (P<0.0001, log-rank test).

The number of nursing home and follow-up days by 90 days, 1 year, and 5 years after stroke by stroke type and severity are presented in Table 2. Among the 251 persons with cerebral infarction, the mean number of nursing home days during the first year was 64 days. The mean number differed as a function of stroke severity. Among those with minor stroke, defined as a Rankin score at maximal deficit of 1 to 2 at maximal deficit (43%, 8%, and 4% respectively, when those in a nursing home at the time of cerebral infarction were excluded). There was a strong dependence on severity at maximal deficit, with 54% of all survival days during the first year spent in a nursing home among those with Rankin 4 to 5, compared with 10% with Rankin 3 and 4% with Rankin 1 to 2 at maximal deficit (43%, 8%, and 4% respectively, when people in a nursing home at the time of cerebral infarction were excluded).

There were few cases of ICH and SAH. The proportion of all survival days spent in the nursing home among those with SAH was 10% during the first year compared with 30.2% in persons with ICH. Because of the small number of cases, the relative impact of age on nursing home use in the people with hemorrhage for a comparison of ICH and SAH could not be determined with certainty, nor could conclusive estimates of long-term nursing home use. It was noted that people with ICH are older, with mean age of onset at 65.4 years compared with 54.1 years for SAH.

### Discussion

This is the first US study to provide unique population-based data regarding nursing home use as a function of stroke type and severity. This study confirms the widely recognized morbidity and mortality after stroke and the striking effect of cerebral infarction and other types of stroke on nursing home use, with its associated social and economic cost. After first cerebral infarction, the most common type of stroke, nearly 25% of patients were in a nursing home at 90 days, including 5% of those with minor cerebral infarctions and 59% of those with severe cerebral infarctions. At 1 year, the figures were quite similar, with 22% of all surviving cerebral infarction survivors, 5% of minor cerebral infarction survivors, and

### Table 2. Continued

<table>
<thead>
<tr>
<th>0–5 Years</th>
<th>NH Days</th>
<th>Total Days</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56 570</td>
<td>274 778</td>
<td>21 (20.5–20.9)</td>
<td></td>
</tr>
<tr>
<td>8925</td>
<td>101 335</td>
<td>9 (8.6–9.0)</td>
<td></td>
</tr>
<tr>
<td>11 257</td>
<td>101 561</td>
<td>11 (10.9–11.3)</td>
<td></td>
</tr>
<tr>
<td>36 388</td>
<td>71 882</td>
<td>51 (50.3–51.0)</td>
<td></td>
</tr>
<tr>
<td>3088</td>
<td>10 052</td>
<td>31 (29.8–31.6)</td>
<td></td>
</tr>
<tr>
<td>504</td>
<td>18 140</td>
<td>3 (2.5–3.0)</td>
<td></td>
</tr>
<tr>
<td>43 453</td>
<td>261 660</td>
<td>17 (16.4–16.8)</td>
<td></td>
</tr>
<tr>
<td>8925</td>
<td>101 335</td>
<td>9 (8.6–9.0)</td>
<td></td>
</tr>
<tr>
<td>10 946</td>
<td>101 250</td>
<td>11 (10.6–11.0)</td>
<td></td>
</tr>
<tr>
<td>23 582</td>
<td>59 075</td>
<td>40 (39.5–40.3)</td>
<td></td>
</tr>
</tbody>
</table>
56% of major cerebral infarction survivors in a nursing home at 1 year after the event. These figures were not markedly different when we excluded people in the nursing home at the time of stroke occurrence. Small numbers in the hemorrhage subgroups precluded precise estimates of nursing home use. However, it is apparent that should a patient with SAH survive the event, the likelihood of nursing home admission is quite low. Among the 10 survivors of SAH at 1 year after the event, only 1 was still in the nursing home. Only 7 of 24 cases of ICH survived 1 year; the 42% of patients using a nursing home in that group was an imprecise estimate.

The effect of stroke severity on the proportion of days spent in the nursing home after the event was similar to its effect on residency at 90 and 365 days. In the 5 years after a cerebral infarction, 21% of all survival days were spent in a nursing home, ranging from 9% for minor cerebral infarction to 51% for a severe cerebral infarction. In a logistic regression analysis, increasing age and severe cerebral infarction were predictors of being in a nursing home at 90 days and 1 year after stroke event.

Temporary nursing home stays were also occasionally noted, as indicated by a number of new nursing home admissions between 90 and 365 days. There is a large inpatient rehabilitation facility in Rochester, making temporary nursing home stays for physical rehabilitation relatively uncommon. Temporary placement may be used for inability to care for the patient at home because of caregiver availability issues, other social factors, or transient nonneurological or neurological related functional disability.

There are few other population-based studies of nursing home use after stroke. These have largely come from Europe, however, and comparisons are problematic because of differences in patterns of care delivery. In a Swedish study of cerebral infarction patients, at 3 months after the event 27% of all surviving patients were in a nursing home compared with 25.4% in the present study, and at 1 year, 14% of survivors were in a nursing home compared with 21.8% in the present study. In that study, the mean use of “geriatric beds” during the first poststroke year was 59 days compared with a mean of 63.7 nursing home days among all persons with cerebral infarction during the first year in the present study. The definitions of minor stroke and major stroke were also different from those used in the present study. In the Swedish study, patients with minor stroke included those who had complete remission of symptoms within 1 to 3 weeks, whereas patients with a more severe residual were classified as having major stroke.

The present data may also be compared with a study evaluating discharge placement after stroke unit admission in Denmark. In that study, it was noted that patients with initially mild strokes as defined by a Scandinavian neurological scale score were less likely to be admitted to a nursing home than those with moderate strokes, and those with moderate strokes were less likely to be admitted than those with severe strokes. However, since the Danish data were presented on the basis of hospital discharge disposition, they are not comparable to the 90- and 365-day nursing home residency and use after stroke in this study, which included nonhospitalized cases. Another study that only considered hospitalized cases of stroke was based on the Lehigh Valley stroke cohort. In that cohort based on patients hospitalized during 1987–1989, older age was a predictor of not being discharged to home from the hospital, whereas sex and living with a spouse were not predictors of discharge other than to home. Data regarding long-term nursing home use were not reported.

During the 12 months after stroke, the mean number of nursing home days among persons with a mild cerebral infarction was 21.9 days per person; among those with severe cerebral infarction, the mean was 188 days. The charges for nursing home days are quite variable and dependent on acuity and Medicaid reimbursement; the mean Medicaid reimbursement for 1988 and 1989 stroke cases in Rochester, Minn, was $67 (State of Minnesota, unpublished data, 1988, 1989). Assuming a mean nursing home reimbursement of $67 per day, the Medicaid reimbursement for those with mild cerebral infarction would be $1474. This would add an additional 16% to the acute care services charges in the 12 months after stroke as reported for mild cerebral infarctions in a previous publication of acute care charges for Rochester, Minn, stroke incidence cases. Among those with severe cerebral infarction, the 188 days (at $67 per day) would contribute $12,596, or a 79% addition to the acute care services charges during the 12 months after stroke for severe cerebral infarction. The mean Medicaid reimbursement for 1994, the most recent year for which this information is available, was $92, indicating that the updated nursing home charges in the year after mild cerebral infarction would be $2024 and after severe cerebral infarction would be $17,296. It is apparent that the relative contribution of nursing home charges to overall medical care charges in the year after stroke is high for those with major cerebral infarction.

The generalizability of the Rochester data must be considered. The frequency of nursing home admission after hospitalization is somewhat higher for the West/North Central region of the United States than for other sites. However, age- and sex-specific rates of nursing home use from the present study applied to the 1990 Minnesota census demonstrated a number of persons aged ≥65 years in nursing homes (C. Leibson, PhD, unpublished data) that was essentially similar to that reported by the state.

The present study has other limitations. Data regarding some potential predictors of nursing home use were not available. These include presence of a spouse, socioeconomic status, and presence of medical and neurological comorbid conditions. However, gender, which is a correlate of spousal support, was not a predictor of being in a nursing home at either 90 or 365 days. This is in agreement with others who have reported that gender or living with a spouse were not predictive of discharge to a nursing home after hospitalization for stroke, whereas age, severity of deficit, and length of hospital stay were predictive. This study clarifies the impact of the occurrence of stroke on one’s ability to independently live at home. It also shows that the contribution of minor strokes to nursing home use is relatively small. An intervention that could either prevent stroke or lessen the severity of stroke could have a marked
impact on nursing home use. The relative contribution of nursing home care to the economic impact of stroke is also striking, particularly among those with more severe cerebral infarctions. Further study will be necessary to define the benefit of acute stroke therapy, such as intravenous tissue plasminogen activator, and of medical and surgical stroke prevention management techniques on nursing home use after stroke when used on a more widespread basis, outside the setting of clinical trials.

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Use of Nursing Home After Stroke and Dependence on Stroke Severity: A Population-Based Analysis

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