Who Benefits From Treatment and Rehabilitation in a Stroke Unit?
A Community-Based Study

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**Background and Purpose**—The beneficial effects of treatment and rehabilitation of patients with acute stroke in a dedicated stroke unit (SU) are well established. We wanted to examine if these effects are limited to certain groups of patients or if they apply to all patients independent of age, sex, comorbidity, and initial stroke severity.

**Methods**—This was a community-based study of outcome in 1241 consecutive stroke patients from 2 communities in Copenhagen: In one (Frederiksberg), treatment and rehabilitation were given in general neurological and medical wards (GW), and in the other (Bispebjerg) in one single large SU. Outcome measures were initial, 1-year, and 5-year mortality rates, a poor outcome (initial death or discharge to a nursing home), and length of hospital stay (LOHS). Multivariate regression analyses were used to examine the independent effect of SU treatment on the various subgroups.

**Results**—The relative risks of initial death, poor outcome, and 1-year and 5-year mortality rates were reduced by 40% on average in patients treated in the SU compared with the GW. A beneficial effect of SU treatment was observed regardless of the patient’s age, sex, comorbidity, and initial stroke severity. Those who benefited most appeared to be the patients with the most severe strokes (poor outcome: OR 0.17; 95% CI 0.05 to 0.58). Those who benefited least were patients with mild or moderate strokes (poor outcome: OR 0.66; 95% CI 0.41 to 0.98) and patients <75 years of age (poor outcome: OR 0.66; 95% CI 0.36 to 1.19). LOHS was reduced by 2 to 3 weeks in all who had their treatment in the SU except in patients with the most severe strokes. LOHS in these patients was similar to LOHS in the GW.

**Conclusions**—A beneficial effect of treatment in a SU is achieved in completely unselected patients independent of their age, sex, comorbidity, and stroke severity. Those who had the most severe strokes appeared to benefit most. All patients with acute stroke should therefore have access to treatment and rehabilitation in a dedicated SU. (Stroke. 2000;31:434-439.)

Key Words: age ■ comorbidity ■ mortality rate ■ stroke outcome ■ stroke unit

Treatment and rehabilitation of patients with acute stroke in dedicated stroke units have been proven superior to treatment and rehabilitation in general neurological and medical wards. Initial mortality rates, the need for institutional long-term care after stroke, and even long-term mortality rate and functional dependency are reduced. We have previously shown that these beneficial effects are present also on a community-based level in completely unselected patients.

Different groups of patients may respond differently to the treatment given in a stroke unit. A meta-analysis of randomized stroke unit trials showed that the initial effect of stroke unit treatment on mortality rate and dependency is independent of age, sex, and initial stroke severity. However, these trials have been carried out in selected patients and therefore may not apply to the general stroke population.

In this study we have examined the short-term as well as long-term effects of stroke unit treatment versus treatment in general neurological and medical wards on a community-based level in subgroups of patients defined by age, sex, initial stroke severity, and comorbidity.

**Subjects and Methods**

**Study Design**
The study was designed to compare outcome after stroke in 2 neighboring communities within the city of Greater Copenhagen, the communities of Frederiksberg and Bispebjerg. The study and the overall results have previously been described in detail. Patients with subarachnoid hemorrhage were not included. The admission rate of acute stroke patients in the area was high (88%). Each community was served by a single hospital, and all stroke patients were treated and rehabilitated at the hospital that served their home.

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community. The incidence rates of stroke patients admitted to hospital were identical in the 2 communities (3.6 per 1000 inhabitants).

In the community of Bispebjerg, acute treatment as well as all stages of rehabilitation took place exclusively in a dedicated stroke unit at Bispebjerg Hospital, regardless of the age of the patient, the severity of the stroke, and the condition of the patient before the stroke. The stroke unit is located at the department of neurology. The department has 72 beds, of which 61 beds are occupied by the stroke unit. In the community of Frederiksberg, acute treatment as well as rehabilitation took place exclusively on a general neurological ward (patients \(\leq 70\) years of age) and in 2 medical wards (patients \(> 70\) years old) at Frederiksberg Hospital. The effect of stroke treatment between the general neurological ward and the general medical wards was quite similar. No stroke patient from the community of Frederiksberg received treatment in a stroke unit during the study period.

Both Bispebjerg and Frederiksberg Hospitals are public hospitals serving urban communities of 124,000 and 85,600 inhabitants, respectively. The 2 communities share a border, and the distance between the 2 study hospitals is 2 miles. Expenditures per bed day is comparable between the 2 hospitals. They both have all major medical and surgical specialties as well as radiologic and laboratory facilities needed for modern evaluation of stroke patients. There are no differences in the general quality of the staff employed in the caretaking of patients at the 2 hospitals, and salaries for doctors, nurses, and training staff are identical at the 2 hospitals. Both hospitals have a good reputation, and one is not considered superior to the other. Frederiksberg is a more wealthy community than Bispebjerg, and the average income is higher.

For patients treated in the stroke unit, a plan for evaluation, medical treatment, and rehabilitation was made on admission. A standardized diagnostic evaluation program including routine blood tests, ECG on admission, chest radiography, and a CT scan was performed in each patient. Other diagnostic procedures such as Doppler examination of the carotid arteries, single-photon emission tomography, echocardiography, and so forth were performed when required. Aspirin (150 mg per day) was given to all patients with ischemic strokes. Anticoagulation treatment with warfarin was given to ischemic stroke patients with atrial fibrillation if not contraindicated by the overall clinical condition. Anticoagulation treatment with heparin and warfarin was given to patients with stroke in progression if not contraindicated. As prophylaxis against pulmonary embolism, patients with severe lower extremity paresis were given antiembolism stockings. Low-dose heparin was not used. Rehabilitation was given to all patients by a trained stroke team of medical and nursing staff, physiotherapists, occupational therapists, speech therapists, and neuropsychologists. The rehabilitation program was individualized according to the needs of the patient and started on arrival to the stroke unit.

Patients in general neurological and medical wards at Frederiksberg hospital were given the traditional treatment offered to patients at Danish hospitals without a stroke unit: There was no standardized program for diagnostic evaluation except for CT scan. Aspirin (150 mg per day) was given to all patients with ischemic strokes. Physical therapy, occupational therapy, and speech therapy were given when prescribed by physicians. Posthospital care and medical treatment in most patients from both communities were handled by the general practitioners. We know of no differences in care, secondary prevention measures, or in any other social and medical aspects between the 2 communities after discharge from the hospital.

### Inclusion Criteria and Data Collection

The principal investigator (H.S.J.) was responsible for the prospective collection of data in the 2 communities. Patients from Frederiksberg community were prospectively studied in the period from April 1, 1989, to March 31, 1990. Patients from Bispebjerg community were prospectively studied from the establishment of the stroke unit on September 1, 1991, to September 30, 1993, at Bispebjerg hospital. An analogous approach to data collection was ensured by the fact that the same neurologist (H.S.J.) was responsible for the data collection in the 2 populations. Funding made it possible to extend the length of the second inclusion period. All patients admitted within 1 week from stroke onset were included (n = 1241).

### Outcome Measures

Outcome measures were (1) initial mortality rate, (2) poor outcome (death during hospital stay or discharge to a nursing home facility), (3) length of hospital stay (LOHS), (4) 1-year mortality rate, and (5) 5-year mortality rate.

### Subgroup Analyses

The following subgroups were defined: men, women, young patients (age \(< 75\) years), elderly patients (age \(\geq 75\) years), mild/moderate stroke (fully conscious on admission), severe stroke (lowered consciousness on admission), and no comorbidity (not ischemic heart disease, not hypertension, not diabetes, not a former stroke, and not atrial fibrillation) or comorbidity present (patients with at least 1 of the listed comorbidities). The effect of stroke unit treatment was analyzed for each of these subgroups with both univariate and multivariate analyses. Statistics were performed with the SPSS package. In the univariate analyses the Student’s \(t\) test was used for the comparison of continuous data between 2 groups. The \(\chi^2\) test was used for noncontinuous data. Multivariate logistic (death and poor outcome) and linear (LOHS) regression analyses were applied to evaluate the independent effect of stroke unit treatment on each subgroup. The following factors were included in the analyses as prognostic variables: age, sex, marital status, comorbidity, and initial stroke severity (level of consciousness, presence of aphasia, and extremity paresis on acute admission). All variables of interest were tested by use of the backward procedure. The level of significance was chosen to be \(P < 0.05\).

### Ethics

The study was approved by the Ethics Committee of Copenhagen.

### Results

Table 1 shows the univariate comparison of sociodemographics between patients treated in the stroke unit and in the general wards. The following subgroups were defined: men, women, young patients (age \(< 75\) years), elderly patients (age \(\geq 75\) years), mild/moderate stroke (fully conscious on admission), severe stroke (lowered consciousness on admission), and no comorbidity (not ischemic heart disease, not hypertension, not diabetes, not a former stroke, and not atrial fibrillation) or comorbidity present (patients with at least 1 of the listed comorbidities). The effect of stroke unit treatment was analyzed for each of these subgroups with both univariate and multivariate analyses. Statistics were performed with the SPSS package. In the univariate analyses the Student’s \(t\) test was used for the comparison of continuous data between 2 groups. The \(\chi^2\) test was used for noncontinuous data. Multivariate logistic (death and poor outcome) and linear (LOHS) regression analyses were applied to evaluate the independent effect of stroke unit treatment on each subgroup. The following factors were included in the analyses as prognostic variables: age, sex, marital status, comorbidity, and initial stroke severity (level of consciousness, presence of aphasia, and extremity paresis on acute admission). All variables of interest were tested by use of the backward procedure. The level of significance was chosen to be \(P < 0.05\).

### Table 1: Basic Characteristics of Patients

<table>
<thead>
<tr>
<th></th>
<th>Patients Treated in General Wards</th>
<th>Patients Treated in Stroke Unit</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>305</td>
<td>936</td>
<td></td>
</tr>
<tr>
<td>Age, y</td>
<td>74.9±10.1</td>
<td>74.4±11.2</td>
<td>0.44</td>
</tr>
<tr>
<td>Male sex</td>
<td>139 (46%)</td>
<td>428 (46%)</td>
<td>0.96</td>
</tr>
<tr>
<td>Married or cohabitation</td>
<td>123 (40%)</td>
<td>391 (41%)</td>
<td>0.63</td>
</tr>
<tr>
<td>Nursing home residence</td>
<td>13 (4%)</td>
<td>29 (3%)</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Continuous data are expressed as mean±SD. Categoric data are expressed as No. of patients and in (%).

### Table 2: Comparison of Risk Factor Distribution Between Patients Treated in the Stroke Unit and Patients Treated in the General Neurological and Medical Wards

<table>
<thead>
<tr>
<th></th>
<th>Patients Treated in General Wards</th>
<th>Patients Treated in Stroke Unit</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>67/216 (24%)</td>
<td>289/586 (33%)</td>
<td>0.003</td>
</tr>
<tr>
<td>Diabetes</td>
<td>33/252 (12%)</td>
<td>145/745 (17%)</td>
<td>0.05</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>55/224 (20%)</td>
<td>207/664 (24%)</td>
<td>0.16</td>
</tr>
<tr>
<td>Former stroke</td>
<td>60/236 (20%)</td>
<td>212/677 (24%)</td>
<td>0.20</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>42/251 (14%)</td>
<td>153/732 (17%)</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Data are expressed as number of patients with/without a given characteristic and in (%).
TABLE 3. Comparison of Initial Stroke Severity, Stroke Type, and Lesion Size Between Patients Treated in the Stroke Unit and Patients Treated in the General Neurological and Medical Wards

<table>
<thead>
<tr>
<th>Patients Treated in General Wards</th>
<th>Patients Treated in Stroke Unit</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowered consciousness</td>
<td>69 (23%)</td>
<td>233 (25%)</td>
</tr>
<tr>
<td>Extremity paresis</td>
<td>224 (73%)</td>
<td>686 (73%)</td>
</tr>
<tr>
<td>Aphasia</td>
<td>106 (39%)</td>
<td>293 (35%)</td>
</tr>
<tr>
<td>Infarction on CT</td>
<td>147 (66%)</td>
<td>472 (63%)</td>
</tr>
<tr>
<td>Hemorrhage on CT</td>
<td>17 (8%)</td>
<td>63 (8%)</td>
</tr>
<tr>
<td>No focal abnormality on CT</td>
<td>58 (26%)</td>
<td>223 (29%)</td>
</tr>
<tr>
<td>Lesion diameter on CT</td>
<td>38.5 ± 30.5</td>
<td>39.2 ± 27.4</td>
</tr>
</tbody>
</table>

Continuous data are expressed as mean ± SD. Categoric data are expressed as No. of patients and in (%).

Figure 1. Presentation of results for subgroups of the multivariate logistic regression analysis of death during hospital stay in patients treated in the stroke unit compared with in general neurological and medical wards. ORs and their 95% CIs and probability values are given.

General neurological and medical wards. No difference was found between the 2 groups. Table 2 shows the univariate comparisons of various comorbidities between the 2 groups. Patients treated in the stroke unit in general more frequently had a comorbidity than did patients treated in the general wards. Table 3 depicts the univariate comparisons of initial stroke severity and stroke subtype between the groups. There were no statistical differences between the groups. Table 4 shows the univariate comparisons of outcomes for the various subgroups. All comparisons favored stroke unit treatment, but not always significantly so.

Initial Mortality Rate
Figure 1 shows the results of the multivariate logistic regression analysis of initial mortality rate for each subgroup. Treatment and rehabilitation in the stroke unit significantly decreased the relative risk of in-hospital death in men by 45% (95% CI 5% to 66%), in women by 46% (95% CI 13% to 66%), in elderly patients by 51% (95% CI 22% to 70%), in patients with severe stroke by 89% (95% CI 40% to 98%). There was a trend toward a decreased risk in young patients (by 41%; 95% CI −21% to 72%), in patients with mild/moderate stroke (by 20%; 95% CI −28% to 50%), and in patients with comorbidity (by 33%; 95% CI −10% to 59%), but this did not reach statistical significance.

Poor Outcome
Figure 2 shows the results of the multivariate logistic regression analysis of poor outcome for each subgroup. Treatment and rehabilitation in the stroke unit significantly decreased the relative risk of a poor outcome in men by 48% (95% CI 15% to 69%), in women by 46% (95% CI 13% to 66%), in elderly patients by 50% (95% CI 22% to 68%), in patients with mild/moderate stroke by 34% (95% CI 2% to 55%), in patients with severe stroke by 83% (95% CI 42% to 95%), in patients with no comorbidity by 48% (95% CI 10% to 70%), and in patients with comorbidity by 40% (95% CI 5% to 62%). Elderly patients with a severe stroke also had a significantly decreased risk of a poor outcome (risk decreased by 89%; 95% CI 40% to 98%). There was a trend toward a decreased risk in young patients (by 34%; 95% CI −19% to 64%), but this did not reach statistical significance.

Length of Hospital Stay
Figure 3 shows the results of the multivariate linear regression analysis of LOHS in survivors for each subgroup.

TABLE 4. Univariate Comparisons Between General Ward and Stroke Unit Treatment Regarding Initial Mortality, Poor Outcome, LOHS, and 1-Year and 5-Year Mortality Rates in Subgroups

<table>
<thead>
<tr>
<th>Died</th>
<th>Poor Outcome</th>
<th>LOHS</th>
<th>1-Y Mortality Rate</th>
<th>5-Y Mortality Rate</th>
<th>Univariate P</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW</td>
<td>SU</td>
<td>P</td>
<td>GW</td>
<td>SU</td>
<td>P</td>
</tr>
<tr>
<td>Men</td>
<td>27% vs 20%</td>
<td>0.09</td>
<td>38% vs 28%</td>
<td>0.03</td>
<td>0.004</td>
</tr>
<tr>
<td>Women</td>
<td>31% vs 25%</td>
<td>0.15</td>
<td>49% vs 41%</td>
<td>0.08</td>
<td>0.001</td>
</tr>
<tr>
<td>Age &lt;75 y</td>
<td>21% vs 15%</td>
<td>0.13</td>
<td>31% vs 23%</td>
<td>0.04</td>
<td>0.003</td>
</tr>
<tr>
<td>Age ≥75 y</td>
<td>36% vs 29%</td>
<td>0.08</td>
<td>54% vs 44%</td>
<td>0.02</td>
<td>0.001</td>
</tr>
<tr>
<td>Mild stroke</td>
<td>16% vs 12%</td>
<td>0.11</td>
<td>31% vs 22%</td>
<td>0.01</td>
<td>0.001</td>
</tr>
<tr>
<td>Severe stroke</td>
<td>74% vs 55%</td>
<td>0.01</td>
<td>90% vs 74%</td>
<td>0.01</td>
<td>0.064</td>
</tr>
<tr>
<td>−Comorbidity</td>
<td>22% vs 14%</td>
<td>0.03</td>
<td>32% vs 25%</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>+Comorbidity</td>
<td>35% vs 26%</td>
<td>0.05</td>
<td>51% vs 39%</td>
<td>0.01</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Died indicates died during hospital stay; poor outcome, died during hospital stay or discharge to a nursing home facility; LOHS, length of hospital stay in days; GW, general ward; SU, stroke unit; mild stroke, fully conscious on admission; severe stroke, reduced consciousness on admission.
Treatment and rehabilitation in the stroke unit significantly decreased LOHS in men by a mean of 17 days (95% CI 5 to 29), in women by 21 days (95% CI 8 to 33), in elderly patients by 20 days (95% CI 8 to 32), in patients with mild/moderate stroke by 21 days (95% CI 12 to 29), in patients with no comorbidity by 16 days (95% CI 5 to 28), and in patients with comorbidity by 20 days (95% CI 8 to 33).

Length of hospital stay did not differ between the 2 facilities in patients with severe strokes (15 days; 95% CI 24 to 52).

1-Year Mortality Rate
Figure 4 shows the results of the multivariate logistic regression analysis of 1-year mortality rate for each subgroup. Treatment and rehabilitation in the stroke unit significantly decreased the relative risk of death within 1 year by 38% (95% CI 1% to 61%) in men, by 38% (95% CI 2% to 61%) in women, in elderly patients by 34% (95% CI 0% to 57%), in patients with severe stroke by 73% (95% CI 30% to 90%), and in patients with comorbidity by 36% (95% CI 2% to 59%). There was a trend toward a decreased risk also in young patients by 41% (95% CI 26% to 67%), in patients with mild/moderate stroke by 33% (95% CI 4% to 53%), and in patients with no comorbidity by 34% (95% CI 13% to 62%), but this did not reach statistical significance.

5-Year Mortality Rate
Figure 5 shows the results of the multivariate logistic regression analysis of 5-year mortality rate for each subgroup. Treatment and rehabilitation in the stroke unit significantly decreased the relative risk of death within 5 years by 42% (95% CI 6% to 64%) in men, by 39% (95% CI 1% to 62%) in women, in elderly patients by 43% (95% CI 5% to 65%), in young patients by 36% (95% CI 0% to 60%), in patients with mild/moderate stroke by 33% (95% CI 4% to 53%), and in patients with comorbidity by 47% (95% CI 10% to 69%). There was a trend toward a decreased risk also in patients with severe stroke by 70% (95% CI 15% to 93%), and in patients with no comorbidity by 28% (95% CI 15% to 55%), but this did not reach statistical significance.

Discussion
This is the first study to show that completely unselected patients with stroke all appear to benefit from treatment and rehabilitation in a dedicated stroke unit regardless of their age, sex, comorbidity, and stroke severity. This was the case regarding initial mortality rate, poor outcome, and mortality rates for 1 and 5 years after stroke. In general, the relative risk of initial death was reduced by ≈40%, and this reduction was most pronounced in patients with the most severe strokes, in whom the risk reduction was 86%. The relative risk of a poor outcome was in general reduced by 50%, and again this reduction was most pronounced in patients with the most severe strokes. Also, long-term mortality rate was reduced in all patients by ≈40%. Despite these marked improvements in outcome, the LOHS was also reduced by at least 2 weeks in all subgroups, except in patients with the most severe strokes, in whom there was no difference in length of stay between the 2 treatment facilities. The results are in line with the results of a meta-analysis of randomized trials from the 1970s and 1980s in selected patients. The meta-analysis showed that the effect of stroke unit treatment on initial mortality rate/long-term institutional care was independent of patient age,
sex, and stroke severity. However, a relatively small number of events limited the statistical power of this analysis.

Patients with the most severe strokes were those who initially benefited most from stroke unit treatment. Five-year mortality rate was, however, not significantly reduced, reflecting that almost all patients in this group had died at this point time. They were also the only subgroup in whom length of hospital stay was not reduced by stroke unit treatment: Length of hospital stay was comparable to LOHS on the general wards. In patients with the milder strokes, poor outcome and 5-year mortality rate were both significantly reduced, probably reflecting a marked initial impact on function and subsequently thereby also mortality rate in this group of only mild to moderately affected patients.

Elderly patients benefited markedly in all outcome measures from stroke unit treatment. Although all of these patients were ≥75 years of age at the time of stroke, even 5-year mortality rate was significantly reduced. Even elderly patients with severe stroke had a pronounced beneficial effect of stroke unit treatment. In contrast, younger patients were those who appeared to have the least benefit from treatment in a stroke unit. Only LOHS was significantly reduced in this group of patients. Explanations for this finding could be that younger patients were relatively few in number and that their mortality rate compared with that in elderly patients was somewhat lower.

The presence of a comorbidity did not by large alter the beneficial effects of treatment in a stroke unit as compared with treatment in general wards. However, long-term mortality rate was markedly reduced in patients with comorbidity. This may indicate an optimized treatment of comorbidity in the stroke unit as compared with in the general wards. Men and women appeared to have equally good benefit from stroke unit treatment.

The special organization of the Danish health care system made this study possible. This allowed us to study the effect of stroke unit treatment at an unselected, community-based level. Patients were allocated to treatment in the stroke unit/general ward not by chance but by home community. Although the randomized controlled trial remains the most important aspect of stroke unit treatment. These serious problems have been overcome by the present design because we compared stroke unit treatment with general ward treatment in 2 different communities.

The allocation-by-community method could have resulted in incomparable groups of stroke patients if the 2 community populations had differed in demographic or medical factors, but the 2 groups were comparable in all relevant aspects: age, sex, marital status, living place before stroke, and stroke severity. That patients were not blinded to the investigator at the time of evaluation and data entry could present a theoretic bias to baseline characteristics. However, patients were comparable not only regarding soft data such as clinical evaluation of stroke severity but also with regard to age, sex, marital status, living place, and lesion type and size on CT. Patients treated in the stroke unit had a higher rate of comorbidity, which could have biased the results toward lower significance. When all possible differences between groups were accounted for in the multivariate analysis, the conclusion of the study remained unchanged.

Secular changes in mortality rates could theoretically interfere with results because of the small difference in study periods between the 2 communities. However, a profound spontaneous change in mortality rate in the study period is not probable, and no new treatment was introduced in the study period. The incidence rates of stroke patients admitted to the hospital were identical in the 2 communities (3.6 per 1000 inhabitants). The admission policy therefore appears unchanged during the 2 periods of inclusion. Thus stroke unit treatment is a likely explanation of the better long-term outcome found in patients from the Bispebjerg community.

Stroke units are not standardized entities. They may differ in several aspects from country to country or even within the same country. Results may therefore not be readily generalizable. It is important to realize that the marked improvement in outcome shown in this and in other studies comes from stroke units emphasizing a team approach to nursing and rehabilitation and patient and family participation and not acute intensive monitoring. A beneficial effect of stroke units taking care of patients in an intensive or semi-intensive way in the first few days after stroke has not been proven. This further highlights early mobilization and rehabilitation as the most important aspect of stroke unit treatment.

This study shows that the beneficial effects of treatment and rehabilitation in a dedicated stroke unit are profound and independent of the patient’s age, sex, comorbidity, and initial stroke severity. These findings refer to completely unselected study would require informed consent from every patient. The patients with the most severe strokes thus would not qualify for inclusion (because of decreased consciousness, disorientation, severe aphasia, etc). Furthermore, in comparing stroke unit treatment and treatment on general wards at the same hospital, it would be difficult to prevent dissemination of the program and methods used in the stroke unit to the general wards (treatment contamination). Finally, because of the ethical problems of denying some patients a believed effective therapy, it has become impossible to conduct a traditional randomized study of the long-term effect of stroke unit treatment. These serious problems have been overcome by the present design because we compared stroke unit treatment with general ward treatment in 2 different communities.
patients with stroke. All patients with acute stroke should therefore have access to treatment and rehabilitation in a dedicated stroke unit.

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References
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