Evaluation of the North Carolina Stroke Care Program

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SUMMARY A study of 774 patients in eastern North Carolina was undertaken to determine the effects of a coordinated program of care and follow-up on recovery from stroke. The program was designed to coordinate and improve in-hospital stroke care and rehabilitation, to provide for education and training of the family for post-hospital care, and to coordinate and facilitate continued access to services after discharge.

As measured by the Barthel Index at discharge, three, six and 12 months, the impact of the program was found to be minimal. Patients' scores throughout follow-up were influenced by age, whether the stroke event was new or recurrent, and the state of consciousness at admission. Follow-up Barthel scores were also related to scores obtained at discharge.

This paper reports results from the evaluation of a program designed to improve recovery following stroke, a major cause of disability among adults in the United States. In spite of an overall reduction in mortality from stroke, there is no evidence of a decline in the prevalence of this condition. Since this condition primarily affects the elderly, the increasing average age of Americans foreshadows an increasing problem.

The value of stroke rehabilitation has been accepted for some time. However, the mode of delivery of rehabilitative services, whether through specialized stroke units or integration with 'regular' medical units, as well as the range and intensity of services have been subjects of continued debate. Most reports of stroke rehabilitation have dealt with specific hospital populations. Community settings rarely have been studied, and we found no reports of American efforts to provide coordinated stroke care and rehabilitation using a network of community hospitals and home health agencies.9

In North Carolina, 15 contiguous, primarily rural counties in the eastern part of the state were selected for study. These counties are part of the 'stroke belt', an area of documented excess stroke incidence. This report concerns evaluation of the effects of a program designed to coordinate stroke diagnostic and rehabilitative services on post-stroke function as measured by the Barthel Index.

The Stroke Care Program

The program was a community-based effort designed to improve in-hospital care of stroke patients as well as to coordinate provision of post-hospitalization services. To reach the primary goal of the project, the participating hospitals agreed to a uniform system for the provision of coordinated care to stroke patients. Stroke team members from the hospital staffs, as well as nurses performing data collection, were given special training provided by the staff of the Stroke Care Program. The second goal of the project was met through coordination of follow-up care. To accomplish this, agreements were established with home health agencies serving the target population. Formal presentations to home health agency administration and staff, as well as identification and training of key personnel to facilitate follow-up, were carried out. Follow-up personnel were employed and kept administratively independent of the home health agency.

Physicians' orders were developed to direct effective, coordinated care in each phase. During the acute illness, in addition to basic medical care, status of neurological function was assessed and physical therapy was begun for passive range of motion. The nursing staff was instructed to evaluate the family's understanding of stroke, provide emotional support, and begin basic education about the stroke. After the acute phase, physical therapists began active exercises and evaluated sitting and standing balance. Social worker evaluation and speech therapy were begun. Nursing staff began teaching the family about skin care, positioning, how to move the patient and other aspects of care of the stroke victim. At this point, assessment of Activities of Daily Living (ADL), using the Barthel Index was done. In the convalescent phase, medical rehabilitation was intensified. Physical therapists trained patients to use the walker, cane, and wheelchair as needed. Family teaching continued regarding skin care, positioning, bowel and bladder training and other necessary techniques. ADL evaluation was completed and the home health nurse, who was to coordinate post-hospitalization care, evaluated the home setting. During rehabilitation, the physical therapist taught transfer techniques to the patient and family, and the nursing staff involved the family with basic care, gradually transferring responsibility from the nursing staff to the family. Final evaluations and modifications were carried out by the speech therapist, social worker and home health nurse; referrals were...
made to necessary home health agencies. ADL evaluation was reassessed by project staff at three, six and 12 months after discharge.

**Methods**

The entry period was January 1979 through January 1980. Nineteen hospitals in Eastern North Carolina were included. Identification of strokes, interviews with patients, follow-up diagnoses, and completion of stroke forms were carried out by trained registered nurses. Neurologists validated all stroke diagnoses. For the intervention, the participating hospitals were divided into three groups, A, B and C. During the first six months, the community stroke program was established in the A hospitals, while the B and C hospitals served as controls. During the next six months both A and B hospitals were provided the community stroke program while the C hospitals served as controls. During the subsequent six months, all hospitals were providing the community stroke program. A patient was considered as being “on” the program if the hospital to which he was admitted was providing the community stroke program at the time of his admission. These admissions were to the 19 hospitals in the survey area. Data were provided by the patient, or the family if the patient was unable to communicate.

Data collected on hospitalized stroke admissions included: (1) standard demographic measures (age, race, sex, marital status, employment status, and education); (2) diagnostic and disease-related information including type of stroke, the presence or absence of specific risk factors and comorbid diseases, consciousness level at admission and discharge from hospital, length of hospital stay, type of diagnostic procedure administered; and (3) a measure of functional status using the Barthel Index at discharge from the hospital and at three, six and 12 months post-discharge. The Barthel Index is a widely used ADL evaluation instrument that has been used to assess the impact of stroke. It can also be used to assess the relative effectiveness of different ways of treating stroke victims.

We evaluated the impact of the Community Stroke Care Program on independence in ADL as measured by the Barthel Index, after controlling for age, race, sex, first versus recurrent stroke and admission consciousness level. We evaluated the impact of the program on continuing improvement, as measured by the Barthel Index at three, six, and 12 month follow-ups, after controlling for the above factors as well as the Barthel Index score at discharge.

The impact of the individual factors on the Barthel Index scores at each time period (discharge, three months, six months, and 12 months) was determined using linear regression. Forward stepwise regression was used. Any missing data eliminated a patient from the analysis, but to obtain the best possible estimates, and use as much patient data as possible, separate analyses were rerun after the regression equations had been developed. These analyses included all patients with complete data for the variables included in the regression equations.

**Results**

Data were collected on a total of 774 admissions to the 19 study hospitals with a diagnosis of stroke. Of the 744 admissions, 482 (62%) were white and 364 (47%) were male. A total of 614 (79%) were admitted for a first stroke. Table 1 presents descriptive data on the patients at discharge, divided into program and control groups.

As shown in table 1, at discharge, the program and control patients were alike in all ways except admission consciousness. There were approximately twice as many patients admitted in a comatose state to the program hospitals as to the controls. Thus, because the general prognosis for recovery from stroke is strongly related to consciousness, the program and control groups were not equivalent at the outset of the evaluation and the program group was therefore at some disadvantage. Effectiveness of the Stroke Care Program was measured by the Barthel Index scores. Figure 1 depicts the Barthel Index scores, over the course of the study, including measurements at discharge, three, six and 12 months.

As seen in figure 1, the Barthel Index scores, for the program and control groups, showed the controls having better scores, on average, at discharge. This difference disappeared by the three month evaluation, reappeared at a lower magnitude at the six month evaluation, and became even smaller at the twelve month follow-up.

Stepwise linear regression was used to estimate the impact of the Stroke Care Program on the patients’ recovery, as measured by the Barthel Index. This choice of analytic procedure allowed us to control for difference between the groups while testing for program effect. Like analysis of covariance, this procedure allows for “adjustment” for the documented significant difference in consciousness levels between the control and program groups, as well as for nonsignificant differences that may influence the comparison of

<table>
<thead>
<tr>
<th>Measure</th>
<th>Group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
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<td></td>
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<tr>
<td>Mean</td>
<td>70.4</td>
<td>68.7</td>
</tr>
<tr>
<td>Median</td>
<td>71.6</td>
<td>70.1</td>
</tr>
<tr>
<td>Percent white</td>
<td>64.3</td>
<td>61.2</td>
</tr>
<tr>
<td>Percent male</td>
<td>45.1</td>
<td>47.6</td>
</tr>
<tr>
<td>Admission consciousness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent alert</td>
<td>52.9</td>
<td>61.9</td>
</tr>
<tr>
<td>Percent stuporous</td>
<td>24.9</td>
<td>26.3</td>
</tr>
<tr>
<td>Percent comatose</td>
<td>22.2</td>
<td>11.9</td>
</tr>
<tr>
<td>Percent first stroke</td>
<td>76.4</td>
<td>79.9</td>
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<tr>
<td>Percent hypertensive</td>
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<tr>
<td>Percent cardiac disease</td>
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<td>49.8</td>
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<tr>
<td>Percent diabetic</td>
<td>26.5</td>
<td>30.8</td>
</tr>
</tbody>
</table>

Notes: p values for differences in means were via the t test, for difference in median were via the median test, and between proportions were via the chi-square test.
At discharge, the Barthel Index score was found to be significantly affected by age \((p < .0001)\), sex \((p = .013)\), admission consciousness level \((p < .0001)\), and whether the stroke was a first or recurrent event \((p = .0002)\). The fact that admission consciousness contributes to regression verifies our aim to control for its effects on program results. With each yearly increase in age, the average discharge Barthel Index score was found to be about one-half point lower. This one-half point difference is estimated after "control" for other significant factors in the final model; adjustment for sex, admission consciousness level, and whether the event was a first versus recurrent event. Females were found to have an average discharge Barthel Index score 5.3 points lower than males. Patients with recurrent strokes had scores that averaged about 10 points lower than those with first strokes. The admission consciousness level had a major impact on the discharge Barthel Index score, with disoriented patients having scores averaging 18 points below their alert counterparts and lethargic or comatose patients having scores which averaged 15 points lower. The scores of the disoriented, lethargic or comatose patients were significantly lower than those of the alert patients. After controlling for age, sex, admission consciousness, and the first vs. recurrent stroke episode, the Barthel Index scores, as measured at discharge, were not affected by the community stroke program \((p = .9833)\).

At three months the Barthel Index score was found to be affected by the age of the patient \((p < .0001)\) and the Barthel Index score \((p < .0001)\) obtained at discharge. The impact of admission consciousness disappeared. With each yearly increase in age, the three month score was lowered, on average, by 0.4. Also, with each decrease in the Barthel score at discharge, the three month Barthel score was 0.7 lower. After controlling for age and the discharge Barthel Index score, the three month Barthel Index score was not affected by the community stroke program \((p = .07)\).

At six months, the Barthel Index score was affected by age \((p = .0001)\), race \((p = .012)\), whether the stroke was a first or a repeat event \((p = .017)\), admission consciousness \((p = .035)\), and the discharge Barthel Index score \((p = .0001)\). For each yearly increase in age, the six month Barthel Index score decreased by approximately one-half point. Nonwhite patients had six month scores which averaged 6.2 points higher than whites and victims of repeat strokes had six month scores averaging 7.6 points below first stroke victims. Patients who were disoriented at admission had average scores that were 7.7 points below the alert patients \((p = .01)\); however, patients who were stuporous or comatose had scores which, while 3.1 points higher than the alert patients, were not found to be statistically different. Discharge Barthel scores continued to exert a significant impact on Barthel Index scores at follow-up periods, where for each point of decrease in the discharge score the six month score averaged one-half point lower.

At 12 months, the Barthel Index score was affected by only first vs. recurrent stroke episode \((p = .0001)\), and the discharge Barthel Index score \((p = .0001)\). Twelve month Barthel Index scores decreased an average of 14.6 points lower on their 12 month Barthel index score. The discharge Barthel Index scores were again related to the follow-up scores, where the 12 month score was .54 points lower.

**Table 2:** Probability Values from Stepwise Linear Regression of Selected Factors on Barthel Scale Scores at Discharge, Three, Six and 12 Months

<table>
<thead>
<tr>
<th>Factor</th>
<th>Follow-up period</th>
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<tbody>
<tr>
<td></td>
<td>Discharge</td>
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<tr>
<td>Age</td>
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<tr>
<td>Sex</td>
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<tr>
<td>First vs recurrent stroke</td>
<td>.0002</td>
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<tr>
<td>episode</td>
<td></td>
</tr>
<tr>
<td>Consciousness</td>
<td>.0001</td>
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<tr>
<td>Program vs control</td>
<td>.9833</td>
</tr>
<tr>
<td>Race</td>
<td>.0942</td>
</tr>
<tr>
<td>Diabetes</td>
<td>.1002</td>
</tr>
<tr>
<td>Hypertension</td>
<td>.2482</td>
</tr>
<tr>
<td>Cardiac disease</td>
<td>.8065</td>
</tr>
<tr>
<td>Previous TIA</td>
<td>.6290</td>
</tr>
<tr>
<td>Discharge Barthel Scale score</td>
<td></td>
</tr>
</tbody>
</table>

*All underlined values are those that were judged to significantly contribute to the "best" model predicting ADL.*
lower for each point decrease in the discharge scores. After controlling for the above factors, program participation still did not affect Barthel scores \( (p = .8) \).

As a further test for program impact, the data were also analyzed after eliminating those subjects with the worst prognosis. Those admitted in stuporous or comatose states of consciousness and those with a recurrent stroke were eliminated from this analysis. The results of this analysis still showed no program effect.

**Discussion**

The primary goal of this study was to assess the impact of a program intended to coordinate care of stroke patients, hospital and home-health, as well as educate the family about stroke care. Because the groups differed in admission consciousness, with more of the program patients unconscious, the prospects for the program showing any difference was diminished at the outset. The fact that the program patients, on average, did not fare significantly worse than the controls is a possible argument for the Stroke Care Program’s effectiveness. However, the statistical approach undertaken in this report provided an “adjustment” for this difference in admission consciousness, and after controlling for factors found to affect the outcome of stroke patients, the impact of the community stroke program (as measured by Barthel Index scores), was negligible at discharge and did not change through 12 months of follow-up. That is, with other factors affecting recovery held constant, there were no differences in the Barthel Index scores of patients who had the benefit of the program from those who were denied the program.

The factors related to the ADL status varied with the time period. Patient age seemed to influence the Barthel Index score at discharge and at all three follow-up periods with older patients generally having poorer scores. At each of the four follow-up periods, with other factors held constant, the Barthel Index score decreased approximately one-half point with each year increase in age.

The second factor influencing Barthel Index scores at the follow-up periods was the discharge Barthel Index score. For each point change in the discharge score, the scores at three, six, and 12 months also changed approximately one-half to three-fourths of a point. Not surprisingly, patients with high discharge Barthel Index scores also tended to have high Barthel Index scores at the follow-up assessments. However, the differences in patients’ Barthel Index scores (all other factors held constant) tended to decrease through the follow-up time periods.

Third, whether the stroke was the first or a recurrent episode made a difference in the Barthel Index scores at discharge, six, and 12 months and had a marginally significant effect on the three month score. At discharge, the Barthel scores of those patients with repeat strokes averaged 9 points lower than their first stroke counterparts; at three months, the difference averaged 5 points, 7 points at six months, and 14 points at 12 months. We speculate that this pattern in which differences at discharge decreased at three months, and then increased at six and 12 months, was due to worsening in the status of patients suffering a repeat stroke compared to those suffering an initial stroke.

In addition to age, discharge Barthel Index scores and recurrent versus first strokes, several other factors played significant roles during selected time periods. Admission consciousness strongly affected discharge Barthel Index scores, with alert patients having scores averaging over 15 points higher than patients with some disturbance in consciousness level. Because the effect of admission consciousness would be contained in the Barthel Index score at discharge, after controlling for the discharge scores, we would not expect admission consciousness to be reflected at the three, six or 12 month follow-up assessments. While admission consciousness did not affect the three or 12 month Barthel Index score, it was found to have a significant impact on the six month score. The six month Barthel Index scores of those patients disoriented at admission were significantly below those who were alert. However, there was no difference between the alert and stuporous or comatose patients. This apparent inconsistency could be due to differential mortality, removing the worst patients from the stuporous or comatose group, leaving patients who had a reasonable chance of recovery, despite their consciousness level.

Sex affected only the discharge Barthel Index score, with females averaging approximately 5 points lower than males. Race had an effect only on the six month score, in that nonwhite patients had scores averaging six points higher than their white counterparts \( (0.1 < p < 0.05) \). History of risk factors had no effect on Barthel Index scores at any of the four follow-up periods. This would suggest that once an individual has developed a stroke, risk factors are not related to the recovery of the patient as measured by the Barthel Index.

It has been well accepted that rehabilitation following stroke is essential and should begin as soon as possible. \(^13\)\(^-\)\(^17\) Numerous reports have shown positive correlations between early introduction of rehabilitation efforts and better recovery. What has remained unresolved is whether the recovery was due to the efforts or timing of rehabilitation, spontaneous recovery, or early rehabilitation interacting with characteristics of the patient and his/her disease to produce a superior outcome. \(^18\)\(^-\)\(^20\)

Our program sought to provide high quality care to stroke patients through enhanced professional communication; professional and family education; planning of stroke care in 19 community hospitals; and coordinated, informed and well-trained post-hospitalization care and rehabilitation. By working closely together in an organized manner, it was planned that the stroke teams would be able to overcome any barriers that might exist between hospital medical care and long term rehabilitation. This approach would insure continuous, high quality rehabilitative services whether from long term care facilities, home health nurses, the family, or some combination of the three. \(^21\)\(^-\)\(^23\) This
approach was used to seek answers to two primary questions: (1) Was the organized approach that included professional organization and family education any better than the standard community level care in helping stroke victims to recover to their maximum potential? and (2) which patients would or would not become functionally independent if they were served by a coordinated stroke team?

The impact of the community stroke program was found to be minimal as assessed at discharge, three, six and 12 months. The Barthel Index scores varied specifically with the age of the patients at every assessment; older patients had lower scores. In addition, patients experiencing recurrences of stroke fared worse than those with initial strokes and this difference increased through the 12 month follow-up period. Those patients admitted in a stuporous or comatose state of consciousness also did more poorly than those admitted alert or lethargic.

If we assume that spontaneous recovery was a major factor influencing the outcome of the study, we would not expect to find any difference in the Barthel Index scores between the program and control patients. Our results supported this postulate and, given the effects of age, discharge Barthel scores and consciousness, showed no significant difference between the program and control groups through the 12 month follow-up. Thus spontaneous recovery, which is assumed to have equal impact on program and control hospitals and their patients, is a plausible explanation for the lack of significant difference between the two groups of patients.

In conclusion, although the Community Stroke Care Program included extensive education of the patient and family about rehabilitation and physical therapy in addition to coordination of all medical services, the benefit to patients in terms of recovery was minimal. The Barthel Index scores were clearly influenced by the age of the patients and, at follow-up, by the score that was obtained at discharge. In addition, patients suffering from repeat episodes of stroke fared worse than their first stroke counterparts, with the difference apparently increasing through the course of the follow-up period. These findings make it apparent that the use of a coordinated stroke team provided no special advantage for patients' recovery as measured by the Barthel Index.


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