Utility of the NIH Stroke Scale as a Predictor of Hospital Disposition

Daniel Schlegel; Stephen J. Kolb, MD, PhD; Jean M. Luciano, CRNP; Jennifer M. Tovar, MSW; Brett L. Cucchiara, MD; David S. Liebeskind, MD; Scott E. Kasner, MD

Background and Purpose—Early identification of stroke patients in need of rehabilitation or long-term nursing facility (NF) care may promote more efficient use of health care resources and lead to better outcomes. The NIH Stroke Scale (NIHSS) is an attractive candidate predictor of disposition because it is widely used, is easily learned, and can be performed rapidly on admission.

Methods—We present a retrospective study of stroke patients admitted within 24 hours of symptom onset to a university hospital from March through June 2000. Medical records were reviewed for demographic information, stroke type, prestroke living arrangement and independence, initial NIHSS, and medical complications during hospitalization.

Results—Among 94 patients evaluated during the study period, 59% were discharged home, 30% to rehabilitation, and 11% to NF. In multivariate analyses, disposition was associated only with initial NIHSS. For each 1-point increase in NIHSS, the likelihood of going home was significantly reduced (odds ratio, 0.79; 95% CI, 0.70 to 0.89, \(P<0.001\)). Categorization of NIHSS was also predictive of disposition, with NIHSS \(\leq 5\) being most strongly associated with discharge home, NIHSS 6 to 13 with rehabilitation, and NIHSS \(>13\) with NF (\(P<0.001\)). Although no other baseline characteristics predicted disposition, major medical complications during hospitalization tended to reduce the odds of going home (odds ratio, 0.30; 95% CI, 0.08 to 1.0, \(P=0.07\)).

Conclusion—The NIHSS predicts postacute care disposition among stroke patients. Predicting disposition on the first day of admission may facilitate the time-consuming and costly process of securing a bed at rehabilitation or NF, and perhaps decrease unnecessary length of stay in acute care settings. (Stroke. 2003;34:134-137.)

Key Words: nursing homes ■ rating scales ■ stroke, acute

Stroke usually requires hospitalization for emergent therapy, diagnostic evaluation, initiation of secondary preventative measures, and planning of the next level of care. Prolonged hospitalization is undesirable, however, because this postpones rehabilitation for the patient, exposes patients to the risk of nosocomial infections, inhibits mobilization, and increases costs. Nevertheless, delays are common and are related to the need for comprehensive assessments by physical, occupational, and speech therapists and approvals by patients/families, insurers, and rehabilitation sites prior to hospital discharge. If the process of assessment and approval were streamlined, patients could benefit by having more rapid access to aggressive rehabilitation, hospitals by having a bed available sooner, and third-party payers by paying for fewer days of hospital care. Early identification of stroke patients in need of rehabilitation or long-term nursing facility (NF) care thus may promote more efficient use of resources and improve outcomes.

The NIH Stroke Scale (NIHSS) is a quantitative measure of stroke-related neurologic deficit that has proven intra- and inter-rater reliability and has predictive validity for long-term stroke outcome. It includes items to assess level of consciousness, gaze, visual fields, facial palsy, motor strength, ataxia, sensation, language, dysarthria, and extinction/attention. It is an attractive candidate predictor of posthospital disposition because it is widely used, is easy to learn, and can be performed rapidly on admission. We hypothesized that the NIHSS in the first 24 hours after stroke onset could predict the next level of care after acute hospitalization.

Subjects and Methods

Patients with stroke were identified from inpatient logs at a single university hospital from March through June 2000. Medical records of all patients were reviewed, and they were included in the current analysis if evaluated within 24 hours of symptom onset and diagnosed with ischemic stroke or intracerebral hemorrhage. Patients with transient ischemic attack and subarachnoid hemorrhage were excluded. Subjects were also excluded if they resided in an NF prior to the stroke, were discharged against medical advice, eloped from the hospital, or died during hospitalization, as such cases are not helpful in determining typical disposition after stroke care. Medical records for all eligible patients were obtained and the following information was retrospectively collected: age; sex; race; independence prior to admission; living alone prior to admission; medical
history; time of symptom onset, admission, first physician-assessed neurologic examination, and initial assessment by physical, occupational, speech therapists; hemispheric location of stroke and stroke type (ischemic or hemorrhagic); use of tissue plasminogen activator (tPA); and major complications during hospitalization (infection, deep venous thrombosis, pulmonary embolism, myocardial infarction, recurrent stroke, and respiratory failure). The NIHSS was estimated by 2 independent chart abstractors based on the initial recorded neurologic examination. Among patients who received intravenous tPA, the NIHSS measured 24 hours after tPA was used as the initial NIHSS for this analysis. Disposition to next level of care (home, rehabilitation, or NF) and length of stay were determined by record review and confirmed independently by a social worker.

### Statistical Analysis

Bivariate analyses were performed to test the relationship of disposition with each of the initial patient characteristics. Continuous variables were tested using ANOVA, and categorical variables were evaluated using the chi-square test, or Fisher’s exact test when indicated. All tests were 2-sided. Variables were considered for multivariate analysis if they were associated with disposition in bivariate analyses at the P<0.10 level, to reduce the chance of type II error due to the modest sample size. Multivariate logistic regression was performed to identify the independent variables associated with each disposition, using discharge home as the reference. NIHSS was analyzed both as a continuous variable and as a categorical variable. Stepwise procedures were avoided, because these may lead to suboptimal final models, but instead the regression was performed to assess the importance of each potential variable as it affects the other parameter odds ratio estimates in the model. In the final model, associations were considered significant if P<0.05. Given that poststroke medical complications were expected to have associations with both stroke severity (NIHSS) and disposition, additional analyses were performed that incorporated the major complications into the baseline models derived above. All analyses were performed using STATA version 6.0 (Stata Corp).

### Results

Ninety-four patients met all eligibility criteria during the study period. Twenty-five other patients with stroke were admitted during the study period but were excluded from this analysis: 13 arrived more than 24 hours after symptom onset, 1 lived in an NF prior to the stroke, 1 left against medical advice, and 12 expired while in the hospital. The mean age of the study population was 65±15 (SD) years, and 51% were women; 52% were white, 46% were black, and 2% of the total considered themselves Hispanic. The vast majority (85%) were independent prior to the stroke, and 22% lived alone. Stroke was ischemic in 84% and hemorrhagic in 16%. The NIHSS scores ranged from 1 to 29 with a median of 5. At the time of discharge, 59% of patients were discharged home, 30% to a rehabilitation facility, and 11% to an NF.

As summarized in Table 1 and depicted in the Figure, most (81%) patients with NIHSS ≤5 were discharged home. Those with scores between 6 and 13 (moderate stroke) most frequently (48%) went to acute rehabilitation, and those with scores >13 (severe stroke) most often (50%) required NF placement. There were some notable outliers, including 2 patients with severe strokes who were taken home to be cared for by their families. These outliers were included in all analyses. In bivariate analyses, disposition was associated with initial NIHSS (P=0.005) and independence prior to stroke (P=0.015), but not with age, sex, race, living alone prior to stroke, or stroke type. In multivariate analysis, only initial NIHSS was associated with disposition. In this logistic regression model adjusted for age, sex, and race, for each 1-point increase in NIHSS, odds of discharge home were reduced by 21% (odds ratio [OR], 0.79; 95% CI, 0.70 to 0.89, P<0.001), while odds of NF placement increased by 39% (OR, 1.39; 95% CI, 1.13 to 1.72, P=0.002). However, the approach assumes that the NIHSS is linear and that all individual points in the NIHSS carry equal importance, which may not be true. A categorical approach may be more appropriate. Thus, when compared with patients with NIHSS ≤5, patients with NIHSS 6 to 13 were nearly 5 times more likely to be discharged to rehabilitation, and those with NIHSS >13 were nearly 10 times more likely to require rehabilitation and more than 100- fold more likely to be placed in an NF (see Table 2).

Major complications occurred in a total of 20 patients (21%) and were multiple in 6 patients: 12 infections, 1 myocardial infarction, 6 recurrent strokes, and 8 cases of respiratory failure requiring mechanical ventilation. Major complications were significantly associated with increased NIHSS (P<0.001) and with disposition, such that the occurrence of any single complication reduced the odds of going home by 70% (OR, 0.30; 95% CI, 0.08 to 1.0, P=0.07), although this effect was of borderline statistical significance.

The median length of stay was 5 (range 1 to 30) days and the mean was 6.8±4.9 (SD) days. Length of stay was associated only with NIHSS (1.4 days longer per 5-point increase; 95% CI, 0.6 to 2.1 days, P<0.001) and major
TABLE 2. Associations Between Posthospital Disposition and Baseline Factors

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rehabilitation OR (95% CI)</th>
<th>Nursing Facility OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (per year)</td>
<td>1.02 (0.98–1.05)</td>
<td>1.15 (0.98–1.35)</td>
</tr>
<tr>
<td>Living alone before stroke</td>
<td>1.2 (0.3–4.8)</td>
<td>0.8 (0.2–3.1)</td>
</tr>
<tr>
<td>Independent before stroke</td>
<td>0.7 (0.1–3.5)</td>
<td>0.2 (0.01–2.8)</td>
</tr>
<tr>
<td>NIHSS 6–13 vs ≤ 5</td>
<td>4.8 (1.6–14.7)</td>
<td>6.4 (0.3–130)</td>
</tr>
<tr>
<td>NIHSS &gt;13 vs ≤ 5</td>
<td>9.5 (1.3–67.9)</td>
<td>310 (7.8–12 434)</td>
</tr>
<tr>
<td>Ischemic vs hemorrhagic stroke</td>
<td>2.1 (0.4–11.3)</td>
<td>0.7 (0.02–20.1)</td>
</tr>
</tbody>
</table>

Odds ratios (ORs) reflect the odds of discharge to rehabilitation or nursing facility relative to the odds of discharge to home, and are adjusted for sex and race/ethnicity. ORs in bold are statistically significant ($P<0.05$).

Discussion

This retrospective study supports the use of the NIHSS as an early predictor of disposition after acute hospitalization for stroke. In particular, patients with scores ≤ 5 can be expected to go home, those with scores >13 most often go to a nursing facility, and those with scores in between most often go to acute rehabilitation. Prior studies have demonstrated that the NIHSS is predictive of outcome measured 3 months after stroke,4,8 but little attention has been directed to the utility of this tool in predicting and potentially streamlining the process of discharge planning. While analyzing our data, an analysis of 910 survivors of first ischemic stroke in the Northern Manhattan Stroke Study (NOMASS) demonstrated that age and stroke severity were the major predictors of discharge destination, with NIHSS 6 to 13 most closely associated with subsequent rehabilitation and NIHSS >13 most predictive of discharge to a nursing home.9 However, the generalizability of the NOMASS analysis may be limited, considering that it began in 1990 and focused on a predominantly Hispanic population in a relatively small geographical area. Although our study population is smaller, we observed very similar NIHSS thresholds to predict disposition in a more recent analysis of patients with different racial/ethnic characteristics. Our study also offers limited generalizability because it is a single hospital-based study, but it is reassuring that our results are compatible with those of NOMASS.

Although it is not surprising that stroke severity is a major indicator of outcome, posthospital disposition, and resource utilization, few studies have been able to demonstrate that the initial deficit could quantifiably predict these subsequent parameters. Other stroke measurement scales have been examined in this context, but rarely as early as on admission to the hospital. For example, the NIHSS, Canadian Stroke Scale,10 and Middle Cerebral Artery Neurological Scale,4,11 measured within 72 hours of stroke onset, were all found to correlate with long-term outcome, but short-term outcomes and need for acute rehabilitation were not addressed.4 In this analysis, the NIHSS performed the best among these scales. In the Copenhagen Stroke Study, in which the Scandinavian Stroke Scale (SSS) was used to measure stroke severity, the SSS on admission was not predictive of poor outcome.12 Only severe strokes were included in this analysis, which could have limited the discriminatory properties of the analysis when baseline SSS was evaluated. However, improvement in the SSS during the first week after onset was found to correlate with functional outcome. Use of rehabilitation facilities was not evaluated in the Copenhagen Stroke Study because this was incorporated into the initial hospitalization in a stroke unit setting. In a population-based study in Rochester, Minnesota, a very severe stroke-related deficit, defined as a maximal (not necessarily onset) score of 4 or 5 on the modified Rankin Scale,13 was shown to correlate with subsequent long-term NF care.14 However, outcome after less severe stroke and the use of rehabilitation were not defined. Other studies that have attempted to predict recovery and nursing facility placement have done so in rehabilitation settings, often long after the initial stroke onset.19

A relationship between poststroke medical complications and disposition was also demonstrated in this study. As expected, the development of complications reduced the odds of discharge home and extended the length of stay. Although the NIHSS offers an early estimation of disposition, complications typically alter the course of stay and discharge plans should be modified accordingly. Similarly, worsening or relapse after the initial presentation of the stroke would also be likely to impact disposition, but this was not accounted for in our analysis as we sought to identify a mechanism for very early prediction, in order to begin planning for discharge and the next level of hospital care. Further research should continue to refine and reevaluate the role of these subsequent developments.

Other demographic and clinical factors were not found to be predictive of disposition in this study. It is likely that the predictive value of these characteristics was overshadowed by the NIHSS and medical complications, both with regard to effect size and the power of the current analysis. Such other factors may still play a role in anticipating postacute care disposition, age in particular, as suggested by the analyses of NOMASS and the Copenhagen Stroke Study.9,12

Our study has several potential limitations. The data were obtained from a single academic hospital setting and therefore may not be generalizable to other settings. The measurements of NIHSS were estimated retrospectively from medical records, and, although this approach has been shown to be reliable and valid, small errors in calculation could have impacted our results. Also, criteria for discharge to each destination were not clearly defined but were based on a composite of clinical and socioeconomic factors. Other potentially important factors such as insurance status and bed availability were not evaluated in this study. Although these parameters almost certainly affect disposition, they are not likely to be associated with NIHSS and therefore are unlikely to confound the primary results of the study. Our results are obtained from a retrospective analysis, and prospective validation is required before they can be considered for making decisions in clinical practice. In addition, further follow-up research may be warranted to identify the determinants of longer-term disposition, particularly after rehabilitation.

Early prediction of hospital disposition (at the time of admission) may allow discharge planning to begin immedi-
ately, accelerating the identification and approval of the next level of care. Using the NIHSS to provide an early indicator of subsequent disposition may streamline this process, shorten length of stay, and reduce costs for patients and their families, hospitals, and third-party payers. It may enable patients who are eligible for acute rehabilitation to enter such a program sooner and realize the potential benefits of early initiation of rehabilitation following stroke. Further evaluation is needed to determine if patients could be preapproved for the next level of care based on initial NIHSS scores, and if this reduces length of stay and costs. However, efforts must also be made to account for subsequent in-hospital events and for more refined assessments by therapists and rehabilitation specialists in making final discharge decisions.

**Acknowledgments**

Mr Schlegel was supported by NIH Clinical Research Education in Mental Health grant MH58818, and Dr Kasner was supported by NIH/NINDS K23 grant NS02147.

**References**

Utility of the NIH Stroke Scale as a Predictor of Hospital Disposition

Daniel Schlegel, Stephen J. Kolb, Jean M. Luciano, Jennifer M. Tovar, Brett L. Cucchiara,
David S. Liebeskind and Scott E. Kasner

Stroke. 2003;34:134-137; originally published online December 5, 2002;
doi: 10.1161/01.STR.0000048217.44714.02

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2002 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
http://stroke.ahajournals.org/content/34/1/134

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

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

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