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Development and Validation of the Stroke Action Test

Susan Billings-Gagliardi, PhD; Kathleen M. Mazor, EdD

Background and Purpose—Accurately assessing the public’s readiness to respond to stroke is important. Most published measures are based on recall or recognition of stroke symptoms, or knowledge of the best action for stroke when the diagnosis is provided. The purpose of this study was to develop and evaluate a new written instrument whose items require the respondent to associate individual symptoms with the most appropriate action.

Methods—The Stroke Action Test (STAT) contains 21 items that name or describe stroke symptoms from all 5 groups of warning signs and 7 items that are nonstroke symptoms. For each item, the respondent selects 1 of 4 options: call 911, call doctor, wait 1 hour, or wait 1 day. The instrument validation sample included 249 subjects from community-based organizations. Score reliability and validity were analyzed using multiple data and information sources.

Results—the mean overall STAT score (all 28 items) for the lay people was 36.8%. On average, they chose call 911 for 34.1% of the stroke symptoms. They chose call doctor for 39.4% of the stroke symptoms, wait 1 hour for 20.1%, and wait 1 day for 6.0%. Score reliability is good (α=0.83). Evidence confirming score validity is presented based on analysis of item content and response patterns, and examination of the relationships between test scores and key variables related to stroke knowledge.

Conclusions—STAT directly assesses a critical aspect of practical stroke knowledge that has been largely overlooked and provides scores with good reliability and validity. (Stroke. 2005;36:1035-1039.)

Key Words: reproducibility of results ■ stroke ■ stroke assessment ■ survey instrument

To receive effective stroke therapy, lay people need to quickly access emergency medical services when early symptoms occur.1,2 Accurately assessing this critical component of stroke knowledge is important for epidemiological research and for evaluating the effects of public education programs. The ultimate and most meaningful “test” is the behavior of patients and witnesses during actual strokes.3,4 The challenge for researchers is to develop more practical assessments of this behavior, and to provide evidence of score validity.5–7 In this context, validity evidence consists of information and data supporting the argument that assessment scores predict the actions that lay people would take if a stroke occurs.

Most recent assessments of stroke warning sign knowledge in English-speaking countries use recall tasks, in which respondents named as many warning signs of stroke as they could,8–15 recognition tasks, in which respondents selected all stroke warning signs from short lists,10,16–18 or responses to a general question such as, “What would you do first if you or a family member were having a stroke?” using an open-ended9,12,15,16 or multiple-choice18 format. However, the content of these assessments is not directly related to the task facing a person in an actual stroke situation. During a stroke, symptoms are experienced or observed. Identification of a symptom as a stroke warning sign is of limited value unless identification leads to urgent action. A person may know that a 911 call is the best response to stroke when the diagnosis is provided, but may not know to call 911 when a stroke symptom presents.11 All of these factors confound interpretation of data that the assessments produce.

The purpose of this study was to develop and evaluate the Stroke Action Test (STAT), a new written instrument whose items require the respondent to associate a symptom with the most appropriate action. To investigate the validity of STAT scores, evidence was collected concerning item content (eg, do items approximate the task being measured, is the most important content emphasized, do examinees understand what is being asked, is the range of possible responses appropriate), reliability of scores, and relationship of scores to previously well-studied variables such as education, stroke experience, or reports of actual stroke situations.

Materials and Methods

STAT Content and Scoring

Content of the STAT is based on the consensus statement about stroke warning signs that major US organizations have agreed to use in their public education materials on stroke.19–21 Using this statement as the framework, items were written by a neuroscientist and a psychometrician, and reviewed by a neurologist. The draft instrument was refined through an iterative process that included think-aloud interviews with lay people to test comprehension and wording.
Additional Study Features Providing Data on Score Validity
To allow examination of the effect of item language on STAT scores, symptoms were presented in terse medical language (for the stroke symptoms, quotations from the consensus statement on stroke warning signs), or in lay language, based on descriptions given by lay people who had personally experienced or observed that symptom. For direct comparisons, 8 stroke symptoms were presented in both medical and lay language. To facilitate investigation of the STAT question format itself, 28 supplemental questions presented the same content but required only that the examinee decide whether knowledge of the appropriate response to stroke (diagnosis provided) is equivalent to knowledge of the appropriate response to stroke symptoms, examinees were also asked to respond to the statement, “The first thing to do if you think you are having a stroke is to call 911,” by selecting 1 of 5 options, ranging from strongly agree to strongly disagree.

Instrument Validation Sample
Two hundred forty-nine examinees were recruited from community-based organizations in Central Massachusetts. Criteria for inclusion were ages 25 to 75, self-assessed ability to read English, and lack of professional medical training. Examinees took the STAT in a witnessed small-group setting. Time to complete the test was observed, but no time limit was set. Examinees also provided demographic information, rated their overall health, and reported their level of experience with stroke. For this study, experience with stroke was coded as “yes” or “no,” in which “yes” was defined as any personal interactions with individuals who had strokes. Participants received a $7 stipend. To allow investigation of the effects of stroke training on scores, a group of first-year medical student (MS1) volunteers took STAT before (n=93) and after (n=72) 10 hours of instruction in stroke prevention and recognition. The study received exempt status from the Institutional Review Board at the University of Massachusetts Medical School.

Analyses
Descriptive statistics were used to summarize the characteristics of subjects, mean item and test scores, and frequencies with which they chose each response option. Reliability of test scores was evaluated using Cronbach α. To gather additional validity evidence, scores of subgroups of examinees and of MS1 before and after stroke instruction were compared (t tests and paired t tests). The possible effect of item language on scores was evaluated by calculating the proportion of lay people correctly answering equivalent items that named a symptom in medical language or described the symptom in lay language (see Table 1). Results were compared using McNemar χ² tests.

Results
Demographic characteristics, self-reported health, and personal stroke experiences of the 249 lay people in the instrument validation sample are summarized in Table 2. The majority of examinees completed the 28-item STAT in ≈5 minutes; almost no one took >10 minutes. The mean overall STAT score (based on all 28 items) for these lay people was 36.8%. The mean score on the 21 items containing stroke symptoms was 34.1%. This means that on average, participants in this study chose call 911 for 34.1% of the stroke
symptoms. They chose call doctor for 39.4% of the stroke symptoms, wait 1 hour for 20.1%, and wait 1 day for 6.0%.

To investigate how examinees were using the different response options, we counted the number of times an individual chose each of the 4 options; 24.9% (62 individuals) chose call 911 for ≥2 of the stroke symptoms. Only 4.8% (12 individuals) chose call 911 for ≥16 of the stroke symptoms. Only 10% (25 individuals) chose call doctor for ≥16 of the stroke symptoms, only 1.2% (3 individuals) chose wait 1 hour, and only 0.4% (1 individual) chose wait 1 day. The latter result indicates that examinees tended to distribute their responses across the 3 incorrect options rather than consistently selecting the same incorrect response.

The stroke symptoms for which the fewest of the examinees would call 911 were sudden dizziness, sudden trouble seeing in one eye, and a transient visual loss. The symptoms for which the highest percentage would call 911 were sudden weakness of the face and arm, sudden speech difficulties, and sudden trouble speaking.

The reliability of the 28-item test was good (α=0.83). Investigations of score validity included comparing mean STAT scores across subgroups of examinees. As Table 3 shows, STAT differentiated individuals with different levels of education and stroke training or experience, as would be expected. MS1s without training scored higher than lay people; lay people who reported personal stroke experiences scored higher than lay people without them; and lay people who were college graduates scored higher than lay people who were not. In addition, scores of the same individuals (MS1s) were significantly increased by intense instruction who were not. In addition, scores of the same individuals who were college graduates scored higher than lay people; lay people who reported personal stroke experiences expected. MS1s without training scored higher than lay people with stroke experiences.

Second, there is a logical relationship between the task the test-taker must perform and the underlying behavior that the test seeks to predict: specifically, calling 911 in the event of a stroke. Most previous measures are based on recall or recognition of stroke symptoms, or knowledge of the best action for stroke (diagnosis provided). By contrast, STAT assesses whether the respondent can connect symptoms and appropriate action. The importance of this distinction is underscored by our findings that 94% of examinees agreed that calling 911 is the best response to stroke; yet, on average, only 34% selected call 911 in response to specific symptoms. A similar discrepancy was reported in an epidemiological study.

### Table 3: Comparison of Mean STAT Scores by Examinee Subgroups

<table>
<thead>
<tr>
<th>Group</th>
<th>No.</th>
<th>Mean (SD)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lay people</td>
<td>249</td>
<td>36.8 (19.2)</td>
<td>t=−2.6 P&lt;0.011</td>
</tr>
<tr>
<td>MS1 before training</td>
<td>93</td>
<td>42.2 (16.2)</td>
<td></td>
</tr>
<tr>
<td>Lay people, no stroke</td>
<td>118</td>
<td>31.0 (18.6)</td>
<td>t=−4.3 P&lt;0.001</td>
</tr>
<tr>
<td>Lay people with stroke</td>
<td>120</td>
<td>41.4 (18.4)</td>
<td></td>
</tr>
<tr>
<td>Lay people, not college graduates</td>
<td>184</td>
<td>34.8 (18.8)</td>
<td>t=−2.7 P=0.008</td>
</tr>
<tr>
<td>Lay people, college graduates</td>
<td>64</td>
<td>42.1 (19.4)</td>
<td></td>
</tr>
<tr>
<td>MS1 before stroke instruction</td>
<td>72*</td>
<td>42.1 (17.0)</td>
<td>t=−13.3 P&lt;0.001</td>
</tr>
<tr>
<td>MS1 after stroke instruction</td>
<td>72*</td>
<td>73.6 (14.5)</td>
<td></td>
</tr>
</tbody>
</table>

*Paired data.

### Table 4: Effect of Language on STAT Scores for Equivalent Stroke Symptoms: Comparison of Lay People’s Descriptions and Medical Statements

<table>
<thead>
<tr>
<th>Stroke Symptom</th>
<th>% Correct Lay People’s Descriptions</th>
<th>% Correct Medical Statements</th>
<th>Significance, P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness of 1 side of face</td>
<td>47</td>
<td>39</td>
<td>NS, 0.013</td>
</tr>
<tr>
<td>Weakness of 1 arm</td>
<td>44†</td>
<td>32</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Trouble speaking</td>
<td>47†</td>
<td>36</td>
<td>0.002</td>
</tr>
<tr>
<td>Trouble understanding</td>
<td>37†</td>
<td>23</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Trouble seeing in 1 eye</td>
<td>12</td>
<td>14</td>
<td>NS, 0.461</td>
</tr>
<tr>
<td>Loss of coordination</td>
<td>43†</td>
<td>24</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Weakness of the face and arm and trouble speaking</td>
<td>74†</td>
<td>61</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

For each symptom, the language producing higher scores (P<0.01) is designated by †.
study of 882 Australian lay people conducted by telephone interviews.  

Third, STAT items are presented in lay and medical language, a decision made early in the process of designing the test in an effort to assure that the majority of test-takers would understand what was being asked. That decision is now supported by data showing that scores were higher on items that described stroke symptoms in lay language than on items that presented the same symptoms in the medical language of the consensus statement on stroke warning signs. We had expected that medical terms and terse style might increase scores because it would make a symptom appear more ominous or urgent. Because just the opposite occurred, we now hypothesize that some of the examinees did not recognize the symptom in medical language, or did not understand what was meant.

Fourth, scores show positive relationships with other variables reported in the stroke literature. For example, examinees reporting personal experiences with stroke scored higher than those with none. In addition, examinees scored highest on an item about sudden face and arm paralysis together with problems talking; these symptoms are among the most frequently reported by callers activating the emergency medical system in acute stroke. Finally, as the MS1 data show, STAT scores are significantly improved by stroke training. The purpose of this study was to develop and evaluate the STAT instrument, not to conduct an epidemiological investigation. Our study sample contains individuals with characteristics that are typical of the population to whom such a test would likely be administered in the future, including a range of ethnicities, ages, education, and experience. However, they are not intended to be a random sample of the US population at large.

An important limitation of STAT, or any similar instrument, is that it can replicate only a fraction of what would actually be experienced by a patient or witness in an actual stroke situation. We need to continue working on ways to portray symptoms more realistically, perhaps with the use of multimedia technology, because this should further increase the predictive value of test scores. In the future, it would also be important to evaluate the instrument for use with groups of older or less healthy individuals, and to develop and validate a culturally sensitive Spanish language version.

In summary, STAT directly assesses a critical aspect of practical stroke knowledge that has been largely overlooked and provides scores with good reliability and validity. Our findings also focus attention on the importance of directing public education to the critical link between individual stroke symptoms and calling 911, and of using lay and medical language in describing stroke symptoms to the public. If STAT were given to a larger, population-based sample, responses to individual items could help identify which stroke symptoms lay people are least likely to respond to and permit more targeted public education efforts. Additionally, use of a standardized instrument, such as STAT, would greatly facilitate cross-study comparisons.

Acknowledgments

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References


