Improving Outcomes for Persons With Aphasia in Advanced Community-Based Treatment Programs

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Background and Purpose—Studies have yet to document that community-based aphasia treatment programs routinely produce results comparable or superior to published research protocols. We explore this issue here in an outcome study of individuals with aphasia enrolled in 2 community-based, comparably managed and equipped therapy programs, which use a specially designed computer-based tool that is employed therapeutically in adherence to an extensive, detailed, and formally trained patient care algorithm.

Methods—Patients (n=60) were assessed before and after treatment with standardized instruments at both the impairment and the disability levels. Pretreatment and posttreatment means were calculated and compared, with statistical significance of differences established with the use of 1-tailed matched t tests. One-way ANOVAs were used to analyze the comparability of patient performance changes among various subgroups, eg, patients in acute versus chronic stages of aphasia, patients by aphasia diagnostic type at start of care, patients by severity level at start of care, and patients by treatment location.

Results—Analysis shows that patients spanned a wide range of aphasia diagnostic types, impairment severity levels at start of care, and times after onset. Patients' mean performance scores improved significantly in response to treatment in all measures assessed at both the impairment level and the functional communication level. Mean overall improvements ranged from 6.6% to 19.8%, with statistical significance ranging from $P=0.0006$ to $P<0.0001$. ANOVAs revealed no significant differences between improvements in patients in the acute versus chronic stages of aphasia, between those at different impairment severity levels at start of care, between those treated at different locations, or, at the functional level, between those with different diagnostic types of aphasia at start of care.

Conclusions—Measures of both language impairment and functional communication can be broadly, positively, and significantly influenced by therapy services that are delivered to persons with aphasia in these community-based programs. The significant improvements are shown to be available to individuals with chronic as well as acute aphasia and independent of diagnostic type of aphasia, impairment severity at start of care, or geographic program location. (Stroke. 1999;30:1370-1379.)

Key Words: aphasia ■ rehabilitation ■ therapy, computer-assisted ■ treatment outcomes

Approximately one third of stroke patients will suffer the disruptive, often devastating consequences of aphasia. The efficacy of aphasia treatment, including computer-based interventions, has been widely evaluated by individual studies,2-13 by expert opinion after literature review,14,15 and by meta-analysis.16,17 The general consensus is that aphasia therapy is helpful for improving specific measures of language function if delivered over a sufficient period of time with adequate intensity. Holland et al.14 for example, concluded in 1996 after thorough literature review that "considering this evidence collectively in its most conservative form, the conclusion can be drawn that people who become aphasic following a single, left-hemisphere thromboembolic stroke and who receive at least 3 hours of treatment each week for at least 5 months, regardless of the time post-onset of stroke, make significantly more improvement than people with aphasia who are not treated."

Such conclusions derive from results achieved primarily in the context of academic research; however, it is primarily in the community that individuals with aphasia must be identified, reached, and treated. There, given current healthcare constraints, the establishment and maintenance of programs for effective aphasia remediation are posing myriad new challenges. Nonetheless, the long-term viability of aphasia therapy depends on its ability to promote and improve functional outcomes in real-world settings of constraints and
Subjects and Methods

Treatment Programs

The 2 community-based treatment programs participating in this study are located in different parts of the country and provide speech-language therapy services to adults for reimbursement. One of these is a freestanding, for-profit speech-language clinic in Palo Alto, Calif (PA site), and the other is an outpatient facility owned and operated by a for-profit hospital in Kansas City, Kan (KC site). Operationally, both programs are similarly organized, equipped, and managed. Both sites offer comparable, formally structured speech-language therapy.

Descriptions of these programs, organizationally and operationally, appear elsewhere. They are distinguished by the presence of several key components, including the following: (1) an extensive and detailed patient care algorithm, which helps treating clinicians specify therapeutic clinical pathways; (2) an online database that captures, holds, and reports patient demographic, diagnostic, assessment, treatment, and response-to-treatment data; (3) a proprietary treatment technology called the Lingraphica System, providing access to, among other things, an extensive toolbox of specially designed, interactive multimodal materials for use with and by patients; and (4) a formal training program for the speech-language pathologists who must competently draw on and integrate use of the preceding 3 components. Figure 1 shows representative appearances and behaviors of selected icons from the treatment technology and illustrates icon use in one type of therapy exercise, namely, “icon plus spelling.”

Subjects

Subjects in this study were drawn from individuals diagnosed with aphasia and treated in one of the community-based treatment programs. Referrals for treatment in these programs came from physicians, hospitals, other community-based programs, speech-language pathologists, friends, family, and self-referral. To qualify for inclusion in this study, subjects had to meet 3 criteria: (1) assignment to 1 of 8 aphasia diagnostic categories through administration of the Western Aphasia Battery (WAB); (2) completion of at least 1 month of therapy in the community-based program; and (3) receipt before and after treatment of the language subtests from the WAB. We did not require subjects to be either right-handed or primarily English speaking.

Demographic, diagnostic, and treatment characteristics of the subject sample are presented in Table 1. Subject language diagnoses spanned the full spectrum of the 8 aphasia types from the WAB, with cases of global, Wernicke’s, Broca’s, and anomic aphasia combined accounting for 53 of the 60 cases (88.3%). Forty-six of the 60 subjects (76.7%) were ≥6 months after onset, placing them beyond the presumed period of spontaneous recovery and into the period of chronic aphasia; the remaining 14 subjects (23.3%) were still in the period of acute aphasia (<6 months after onset) at start of care. For 53 of these 60 subjects (88.3%), Center-based treatment represented resumption of therapy after discharge from 1 or more previous courses of speech-language therapy elsewhere.

The subject sample reported on here accrued from the referral streams of the 2 programs. Analysis of the fates of referrals to these programs reveals a stepwise winnowing process, with patient numbers diminishing at each step. For example, during the accrual period at the PA site, a total of 258 patients were referred as potential candidates for benefit. After speech-language evaluation, 185 of the 258 were given a treatment diagnosis of one or another type of aphasia (as opposed to other treatment diagnoses, such as voice disorders or apraxia of speech). After resolution of any scheduling, transportation, and support issues, 170 were enrolled in treatment. Of the enrollees, 143 received treatment for ≥30 days. Of those, 105 were assessed before treatment with the WAB (others, particularly during the earlier period of this program, received instead the Boston Diagnostic Aphasia Examination, whose results were reported in an earlier article). Of these latter, 64 received posttreatment assessment with the WAB, with 52 receiving the relatively complete posttreatment assessment that allows for the calculation of the Aphasia Quotient (AQ) of the WAB. The current PA sample comprises the first 30 of this latter group chronologically. Of the 12 cases without the AQ-required administration of all first 4 WAB subtests (and who are not described in this article), analysis shows that the Spontaneous Speech subtest was omitted in 7 cases, the Auditory Verbal Comprehension subtest was omitted in 8 cases, the Repetition subtest was omitted in 3 cases, and the Naming subtest was omitted in 7 cases, in various overlapping patterns. Two subtests not involved in the calculation of the AQ were also omitted in some of these administrations: the Reading subtest in 13 instances and the Writing subtest in 26 cases.

Treatment

Patients participated in therapy with their treating clinicians in individual, hour-long sessions. Table 1 presents quantita-
tive information on treatment for subjects in this sample. The overall mean number of treatment sessions per patient was 41.7 (SD 24.1; range, 10 to 132).

In clinical sessions, therapists typically employed stimulus-response strategies in treatment activities, using stimuli from specified materials loaded on the treatment technology. For any particular patient, of a given aphasia diagnostic type, at a given level of severity, the patient care algorithm suggests clinical pathways through a sequence of therapeutic exercises that have been found in our experience to be beneficial to patients of the given type. During treatment, focus was invariably on improving patients’ functional communication outside the clinic, as opposed to training for higher scores on discharge retesting. When patient responses in therapy sessions so indicate, batteries of exercises are loaded onto the patient’s system as prescribed home practice. At home, patients are to complete the prescribed clinical exercises, and additionally they may pursue materials of their own choosing, explore semantic domains to review lexical items within, or find other activities that engage their interest. Analysis has shown that patients typically engage in such self-directed activities approximately 2 hours per day.18 Patients were discharged from treatment when any of the following occurred: (1) progress in functional communication reached a plateau as determined by the clinician; (2) funding became unavailable for continued therapy; or (3) intercurrent medical or other problems required discharge. Most patients were discharged because of the first condition, reaching a plateau in their functional communication.

**Tests**

Treatment program procedures specify administration of the WAB,33 and, more recently, the Communicative Effectiveness Index (CETI)28 to persons with aphasia at start of care and at discharge. The former provides assessment at the impairment level, and the latter provides assessment at the disability (functional) level.22

The WAB, in addition to assessing speech-language impairment overall, assigns patients to 1 of 8 aphasia diagnostic categories and also provides an overall quantitative metric of aphasic severity: the AQ, which ranges from 0 to 100. The WAB has been psychometrically characterized and found valid and reliable.29 Its 6 language subtests were administered to this sample, except for 9 subjects in whom the Reading subtest was not completed (1 in the PA program, 8 in the KC program) and 23 subjects in whom the Writing subtest was not completed (8 in the PA program, 15 in the KC program). The reason most frequently given by clinicians for failure to complete all WAB subtests was lack of time.

The CETI was administered at start of care and at discharge to 13 PA patients and 16 KC patients of more recent enrollment. It provides ratings of functional performance of patients in important communicative activities of everyday life, as assessed by persons with opportunities for observing them frequently in relevant situations. The CETI consists of a 16 visual analog scale items assessing areas of functional communication in the patient’s living environment. It is designed to be administered by caretakers and has been shown to be sensitive to change in

### TABLE 1. Patient Characteristics (n=60)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean (SD)</th>
<th>Range</th>
<th>Differentiation</th>
<th>No. (%) of Subjects</th>
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</thead>
<tbody>
<tr>
<td>Sex</td>
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<tr>
<td>Male</td>
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<tr>
<td>Female</td>
<td></td>
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<tr>
<td>Age at start of care, y</td>
<td>68.6 (12.3)</td>
<td>24–86</td>
<td></td>
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<tr>
<td>Years after onset</td>
<td>2.05 (2.33)</td>
<td>0.02–12.02</td>
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<tr>
<td>Etiology</td>
<td></td>
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<tr>
<td>L-CVA</td>
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<td>TBI</td>
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<td>Hypoxia</td>
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<tr>
<td>Unknown</td>
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<tr>
<td>WAB aphasia assignment at start of care</td>
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<tr>
<td>Broca’s</td>
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<td>Anomic</td>
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<tr>
<td>Global</td>
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<tr>
<td>Wernicke’s</td>
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<td>Conduction</td>
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<td>Transcortical motor</td>
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<tr>
<td>Transcortical sensory</td>
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<tr>
<td>Isolation</td>
<td></td>
<td></td>
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<tr>
<td>Treatment duration, wk</td>
<td>20.5 (10.7)</td>
<td>4.00–46.7</td>
<td></td>
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<tr>
<td>Treatment frequency, sessions/wk</td>
<td>2.07 (0.55)</td>
<td>0.64–3.92</td>
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<tr>
<td>Standardized assessment</td>
<td></td>
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<tr>
<td>WAB Speech-language impairment</td>
<td></td>
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<tr>
<td>CETI Functional communication</td>
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</tbody>
</table>

L-CVA indicates left cerebrovascular accident; TBI, traumatic brain injury.
TABLE 2. Analyses of Responses to Treatment at Impairment and Functional Levels

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>Pretreatment Mean (SD)</th>
<th>Posttreatment Mean (SD)</th>
<th>Difference of Means (SD)</th>
<th>t&lt;sub&gt;obs&lt;/sub&gt;</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impairment level (WAB)</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Spontaneous Speech</td>
<td>60</td>
<td>7.8 (6.3)</td>
<td>10.2 (6.5)</td>
<td>+2.4* (3.3)</td>
<td>+5.63</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Auditory Verbal Comprehension</td>
<td>60</td>
<td>129.5 (51.2)</td>
<td>139.5 (50.1)</td>
<td>+13.6* (18.6)</td>
<td>+5.67</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Repetition</td>
<td>60</td>
<td>39.0 (35.9)</td>
<td>45.6 (36.3)</td>
<td>+6.6* (11.0)</td>
<td>+4.66</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Naming</td>
<td>60</td>
<td>30.4 (31.1)</td>
<td>39.1 (32.8)</td>
<td>+8.7* (11.4)</td>
<td>+5.92</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Reading</td>
<td>51</td>
<td>47.4 (26.2)</td>
<td>54.8 (24.2)</td>
<td>+7.4* (14.0)</td>
<td>+3.80</td>
<td>&lt;0.0004</td>
</tr>
<tr>
<td>Writing</td>
<td>37</td>
<td>28.4 (22.8)</td>
<td>37.2 (28.7)</td>
<td>+8.8* (14.2)</td>
<td>+3.74</td>
<td>&lt;0.0006</td>
</tr>
<tr>
<td>AQ</td>
<td>60</td>
<td>42.5 (27.4)</td>
<td>51.6 (28.7)</td>
<td>+9.1* (8.8)</td>
<td>+7.98</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>Functional communication level (CETI)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Means of 16 items</td>
<td>29</td>
<td>42.8 (19.0)</td>
<td>62.6 (18.6)</td>
<td>+19.8* (12.5)</td>
<td>+8.51</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

*P<0.05.

Results

Table 2 shows pretreatment and posttreatment mean scores (raw) for all assessed areas, with associated observed t values and P values for the differences of means. For the WAB language subs tests, absolute percent mean improvements were as follows: Spontaneous Speech, +12.0%* (P<0.0001); Auditory Verbal Comprehension, +6.8%* (P<0.0001); Repetition, +6.6%* (P<0.0001); Naming, +8.7%* (P<0.0001); Reading, +7.4%* (P=0.0004); Writing, +8.8%* (P=0.0006); and AQ, +9.1%* (P<0.0001). For the functional communication items from the CETI, absolute percent improvement overall was +19.8%* (P=0.0001).

Figure 2 graphically displays the AQ changes of the 60 subjects versus the times after onset. Of the 60 subjects in the study, 55 (91.7%) showed a higher AQ score after treatment, while 5 (8.3%) showed a lower AQ score. Figure 2 shows that these improvements are found across severity levels at start of care and throughout the range of times spanned after onset in this sample.

Figure 3 graphically displays the CETI overall changes available for 29 of the patients versus the times after onset when the changes occurred. Analysis of CETI score changes before and after treatment showed improvement in all 29 patients tested. Figure 3 reveals that all patients improved, regardless either of the initial level of severity or of the time after onset when they received the treatment.

Fourteen patients were still in the acute stage of recovery (<6 months after onset) at start of care, while the remaining 46 were in the stage of chronic aphasia (≥6 months after onset). Mean AQ improvement in patients in the acute stage was +8.0* points (SD 10.9, P=0.017), while in patients in the chronic stage mean AQ improvement was +9.4* points (SD 8.2, P<0.0001). One-way ANOVA showed no significant difference between these groups (F<sub>1,53</sub>=0.28, P=0.597) with respect to AQ improvement.

Analysis of mean pretreatment and posttreatment CETI overall scores revealed significant improvement in both the acute and chronic groups. Among patients in the acute group (n=10), the CETI improvement was +23.3* (SD 11.2, P=0.0001), while in patients in the chronic group (n=19), the improvement was +17.9* (SD 13.1, P<0.0001). One-way ANOVA reveals no significant difference between these groups (F<sub>1,28</sub>=1.24, P=0.275) with respect to CETI overall improvement.

Figure 4 shows AQ changes in the sample as a function of AQ severity at start of care. Twenty-one subjects fell into the

communication behaviors. The CETI has been psychometrically characterized and found valid and reliable.28

All testing and rating were accomplished in standard ways, assessing subjects’ unaided, natural-language performance, without the specialized treatment technology. Specifically, the WAB was given to subjects by a trained and licensed speech-language pathologist familiar with its contents and practiced in its administration and scoring. The CETI, in turn, was rated by a person who was close to the subject and who also was familiar with that person’s communicative strengths and weaknesses in activities of normal everyday living. This rater was most commonly a spouse, sibling, or adult child of the subject, less commonly a close friend, neighbor, or caregiver. As a rule, patients had no access to test materials between start of care and discharge (on average ≥20 weeks apart) to minimize the likelihood of practice effects accounting for patient performance improvements.

Statistical Analysis

Data were analyzed with the use of Data Desk 6.0 software on a Macintosh Quadra 840AV. Using raw WAB and CETI scores, we calculated pretreatment and posttreatment means and compared them with 1-tailed matched t tests.30 WAB AQS were also calculated for subjects and analyzed. When significant differences were found with the use of matched t tests, 1-way ANOVAs were conducted to explore a possible further dependence on additional parameters, such as aphasia diagnostic category at start of care, impairment severity of aphasia at start of care, program location, or patient assignment to acute versus chronic aphasia. When the 1-way ANOVA revealed a significant difference, post hoc analysis was conducted with the Bonferroni test to identify underlying factors.31 Finally, the chi-squared test was used to probe the significance of the distribution of aphasia diagnostic types among chronic patients after treatment compared with their pretreatment distribution.30 Throughout, the level for rejection of the null hypothesis was set at P=0.05. Where achieved, statistical significance is denoted below by an asterisk (*).
lowest quarter (AQ <25), and in response to treatment their mean AQ score improved +6.7* (SD 6.1, P=0.0001). Eighteen subjects fell in the low-mid quarter (AQ 25 to 50), and in response to treatment their mean AQ score improved +12.6* (SD 12.1, P=0.0004). Nine subjects fell into the high-mid quarter (AQ 50 to 75), and in response to treatment their mean AQ score improved +12.2* (SD 7.5, P=0.0013). The remaining 12 subjects fell into the highest quarter (AQ

Figure 2. Speech-language impairment (AQ) changes vs years after onset (ypo).

Figure 3. Functional communication (CETI) changes vs years after onset (ypo).
>75), and in response to treatment their mean AQ score improved \(+5.8^*\) (SD 5.6, \(P=0.0041\)). One-way ANOVA revealed a trend toward significance in overall AQ responses to treatment among these groups (\(F_{3,56}=2.59, P=0.062\)). Figure 4 suggests that the trend toward significance may reflect floor and ceiling effects apparently manifesting in the lowest and highest quarters, in contrast to the middle 2 quarters.

When we compare the programs in different geographic locations, the 30 patients treated at the PA site showed a mean AQ improvement after treatment of \(+9.6^*\) (SD 10.1, \(P=0.0001\)), while the 30 patients treated at the KC site posted a mean AQ improvement after treatment of \(+8.5^*\) (SD 7.5, \(P=0.0001\)). One-way ANOVA of these AQ changes showed no significant difference between improvements at the 2 locations (\(F_{1,58}=0.26, P=0.61\)). In functional communication, the 13 CETI-assessed patients at the PA site showed a mean overall improvement after treatment of \(+124.3^*\) (SD 13.6, \(P=0.0001\)), while the 16 CETI-assessed patients at the KC site showed overall improvement of \(+161^*\) (SD 10.5, \(P=0.0001\)). One-way ANOVA of these CETI score changes revealed a trend toward significance at the 2 locations (\(F_{1,27}=3.41, P=0.076\)).

One-way ANOVAs showed no significant dependence of treatment parameters on aphasia diagnostic category at start of care. In particular, 1-way ANOVA of duration of treatment by aphasia diagnostic category (\(F_{7,52}=1.88, P=0.09\)), frequency of treatment by type of aphasia (\(F_{1,52}=1.19, P=0.33\)), and total number of treatment sessions by aphasia diagnosis (\(F_{3,52}=1.33, P=0.26\)) revealed no significant differences among the various aphasia categories at start of care.

Figure 5 graphically depicts, in dot plot format, AQ responses to treatment of all 60 subjects, grouped by their aphasia diagnostic categories at start of care. All categories showed overall improvement in response to treatment, and in the majority of categories in which \(n\) is >1, the improvements were significant. Thus, patients at start of care with Broca’s aphasia (\(n=21\)) showed a mean AQ improvement of \(+13.9^*\) points (SD=10.0, \(P<0.0001\)), those with anomic aphasia (\(n=13\)) improved \(+5.8^*\) points (SD=6.4, \(P=0.007\)), those with global aphasia (\(n=11\)) improved \(+6.2^*\) points (SD=3.9, \(P=0.0004\)), those with Wernicke’s aphasia (\(n=8\)) improved \(+3.6^*\) points (SD=10.1, \(P=0.347\)), those with conduction aphasia (\(n=3\)) improved \(+16.0^*\) points (SD=5.5, \(P=0.038\)), and those with transcortical motor aphasia (\(n=2\)) improved \(+13.1^*\) points (SD=2.7, \(P=0.092\)). One-way ANOVA of AQ changes by aphasia type at start of care revealed the presence of significant differences over the spectrum of aphasia categories (\(F_{7,52}=2.58, P=0.023\)). Post hoc analysis using the Bonferroni test showed that the overall significance resulted from trends toward significance in 2 pairwise category comparisons: Broca’s (+13.9*) versus Wernicke’s (+3.6), for which \(P=0.053\), and Broca’s (+13.9*) versus anomic (+5.8*), for which \(P=0.096\). At the functional level as assessed by the CETI overall category, there were no significant differences among the aphasia categories available for analysis (\(F_{6,22}=0.41, P=0.87\)).

Table 3 shows the evolution in aphasia diagnostic categories in response to treatment among patients in the chronic
It is based on patients’ WAB assignments to aphasia categories before and after treatment; however, to eliminate borderline cases, we required that reassignment to a different diagnostic category posttreatment be accompanied by a concurrent AQ shift, upward or downward, of $\geq 5.0$ points from the pretreatment AQ score. By these criteria, 29 of the 46 patients in the chronic phase showed no change of diagnostic category after treatment, while 17 showed a change of aphasia type to a less severe diagnostic category (e.g., from global to Broca’s aphasia) accompanied by a rise in AQ score. No patients in the chronic phase showed a change to a more severe diagnostic category that was accompanied by an AQ drop of $\geq 5.0$ points. This pattern is fundamentally different from that documented in the 1977 report of Kertesz and McCabe, $^3$ in which they followed 22 untreated persons in chronic aphasia longitudinally using the WAB. In that study, patients on the whole did not change AQ score significantly in a year’s time, and only 1 patient changed diagnostic category (to a more severe category: from Broca’s to global aphasia). A $\chi^2$ test for changes among more severe, same, or less severe categories, with the published data of Kertesz and McCabe $^3$ as representative of the expected pattern, shows the present changes among 46 patients in the chronic stage to be significantly different from the pattern described by Kertesz and McCabe.

![Figure 5. Responses to treatment (AQ) by aphasia diagnostic type (n=60).](image)

<table>
<thead>
<tr>
<th>Pretreatment Diagnosis</th>
<th>Global</th>
<th>Isolation</th>
<th>Broca’s</th>
<th>Wernicke’s</th>
<th>Motor</th>
<th>Sensory</th>
<th>Conduction</th>
<th>Anomic</th>
<th>Within Normal Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global (9)</td>
<td>5 (+3.8)</td>
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<td></td>
<td></td>
<td>4 (+8.6)</td>
<td></td>
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<tr>
<td>Isolation (1)</td>
<td>1 (+1.9)</td>
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<tr>
<td>Broca’s (18)</td>
<td></td>
<td>1 (+11.0)</td>
<td>1 (+14.0)</td>
<td>1 (+17.0)</td>
<td>5 (+20.2)</td>
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<tr>
<td>Wernicke’s (6)</td>
<td>1 (+7.8)</td>
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<td>Conduction (2)</td>
<td>1 (+9.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (+20.7)</td>
</tr>
<tr>
<td>Anomic (9)</td>
<td>7 (+4.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 (+6.4)</td>
</tr>
</tbody>
</table>

In body of table (excluding Pretreatment Diagnosis column), more severe types of aphasia are toward top and left and milder types are toward bottom and right; same-type diagnoses are underlined; italics indicate a change of diagnostic category accompanied by an AQ rise of $\geq 5.0$; patient counts are given outside parentheses, with average AQ improvements for those samples following within parentheses.
Discussion

There is an extensive, often contradictory, literature on aphasia recovery and the impact of therapy. Since study methodologies vary, it can be difficult to compare individual studies and draw meaningful conclusions regarding the relative merits of any particular treatment approach. Depending on which study is cited, improvement may or may not occur in a given population. Wertz et al3 elegantly demonstrated Porch Index of Communicative Abilities score improvements of up to 18.6 percentile points in intensively treated (8 to 10 h/wk) acute stroke patients, whereas Lincoln et al4 were not able to show treatment effects for a group of 104 patients treated with less intensive (2 h/wk) therapy. Additionally, community-based studies whose main focus was not aphasia but that retrospectively inspected this parameter (and possibly more closely reflected the natural course of individuals with aphasia in contexts in which speech-language therapy is not always a primary focus) have reported little benefit from speech therapy in an aphasic stroke population.1

Many such studies are open to criticism on grounds of flawed design and/or execution.33,34 Even when this is not the case, aphasia therapies are idiosyncratic and frequently highly individualized by the treating clinician to conform to a particular patient’s unique combination of deficits and residual capabilities.16,17 Because of such treatment variability, few therapy approaches are sufficiently defined and codified to lend themselves to critical evaluation. In this regard, the positive assessment recently accorded to melodic intonation therapy represents a laudable if instructive exception.35 There is an extensive, often contradictory, literature on which study is cited, improvement may or may not occur in a given population. Wertz et al3 elegantly demonstrated Porch Index of Communicative Abilities score improvements of up to 18.6 percentile points in intensively treated (8 to 10 h/wk) acute stroke patients, whereas Lincoln et al4 were not able to show treatment effects for a group of 104 patients treated with less intensive (2 h/wk) therapy. Additionally, community-based studies whose main focus was not aphasia but that retrospectively inspected this parameter (and possibly more closely reflected the natural course of individuals with aphasia in contexts in which speech-language therapy is not always a primary focus) have reported little benefit from speech therapy in an aphasic stroke population.1

In this context, we believed it important to investigate the effects of a community-based aphasia treatment program that provided therapy of known intensity using a structured and consistent therapeutic model and standardized measurement tools, thus diminishing effects attributable to varying treatment criteria, therapeutic approaches, and evaluation methods. We also believed it important to demonstrate our results in the context of the real-world financial constraints of current healthcare settings.

The data presented here corroborate and extend the pattern reported earlier of significant improvements in persons with aphasia treated through these programs, across a broad range of aphasia types, severities, and times after onset.18–21 Moreover, with a sample size here considerably >30, the means and SDs herein reported represent, by the central limit theorem, fair approximations to the underlying population means for outcomes from these treatment programs.36 ANOVA, furthermore, shows that the improvements are replicable across geographic sites. Of note, significance is herewith established for every language subtest of the WAB, for the WAB AQ, and for functional communication overall as assessed by the CETI. Lomas et al28 found a mean gain of +11.4% in CETIs administered 6 weeks apart in recovering persons with aphasia undergoing speech/language therapy. This diverges from the current report of +19.8% gain, but neither the patient populations from which the samples were drawn nor the test-retest periods are comparable. In particular, the present patient sample was, in its majority, well into the chronic stage of aphasia and comprised mainly patients discharged from previous courses of speech-language therapy elsewhere.

Overall recovery from aphasia has been related to a variety of variables, including lesion size, aphasia type, and, perhaps most importantly, initial severity.37 Recovery furthermore does not follow a random pattern but tends to move along more or less predictable paths. Kertesz and McCabe32 noted that persons with global aphasia have the poorest prognosis, while anomic, transcortical, and conduction aphasics have the best. This formulation is consonant with the present findings. For example, Figure 5 shows that the present sample of persons with global aphasia at start of care had, on discharge, the poorest AQ profile of any diagnostic category, whether measured by lowest AQ score or highest AQ score; those with anomic, transcortical, and conduction aphasia had the highest AQ profile for these same measures. However, it is worth noting that the analogous statements hold for these same groups compared at start of care as well: those with global aphasia are ranked lowest, while those with anomic, transcortical, and conduction aphasia are ranked highest. What is most striking about Figure 5 in this regard is, in fact, the stability of pretreatment versus posttreatment order rankings of AQ means across diagnostic types, in the presence of such widespread and significant patient improvements. Patients emerge from these treatment programs with improvements spread relatively evenhandedly and equably across the diagnostic spectrum rather than concentrated in particular diagnostic categories. Interestingly, this is the improvement pattern that one would expect when the mechanisms underlying the remediation processes are of a general cerebral character rather than tied to more specific capabilities—psycholinguistic or other—that may be differentially compromised in the various aphasia diagnostic categories.

In addition, a relatively consistent pattern within aphasia diagnostic types is also discernible when data from Figure 5 are analyzed. This pattern includes the following, in comparing posttreatment scores with pretreatment scores of the same category: (1) a relatively small rise in the lowest AQ scores, with mean low score improvements in Figure 5 of +0.98; (2) a much larger rise in the highest AQ scores, with mean high score improvements in Figure 5 of +11.23; and (3) a notable extension of range between the highest and lowest scores, with a mean range extension in Figure 5 of 34.3% (from mean range=32.70 before treatment to mean range=43.93 after treatment). Such a pattern suggests a situation in which, within each diagnostic category, almost all patients improve somewhat, with the least impaired patients within categories more advantageously poised to derive additional benefits. In this regard, the ANOVAs conducted earlier in this article serve to underscore the fact that many of the traditional prognostic indicators, such as time after onset, severity at start of care, or aphasia diagnostic category, are in fact not those that differentiate between patients showing
greater and lesser improvements after this treatment program. If this is borne out by further studies, the question of the relevant prognostic indicators for attainment of benefit from this treatment program must be considered.

To complicate matters, whether and how the “canonical” prognostic indicators correlate with response to therapy is even less well understood in chronic aphasia than in acute aphasia: fewer studies have been conducted, fewer subjects involved, and fewer hypotheses tested. In our chronic population, we were able to show a significant evolution to less severe aphasia diagnostic categories after treatment. Tantalizingly, these upward pathways broadly recapitulate, diagnostically, natural courses of recovery from aphasia during the period of spontaneous recovery. Persons with global aphasia in our sample who improved all evolved to Broca’s aphasia; persons with Broca’s aphasia evolved to either conduction or transcortical aphasia; transcortical aphasia became anomic aphasia; and, when such evolution took place, persons with anomic aphasia at start of care performed within normal limits after treatment. These changes cannot be fully understood in terms of the expected underlying structural lesions of classic language areas38; rather, they support the notion of more widely distributed language mechanism underlying latent or residual language capacity.15,39,40

Patient sample bias, incomplete test administration, and choice of test instruments are potential sources of error in these results. Patients arrived at these programs through referrals, which means that this is not a random sample of persons with aphasia but rather one of patients who, in the judgment of the referral sources, would be able to participate in therapy and make significant functional gains. Such a sample will not include those individuals with aphasia—too low functioning, too high functioning, or other—who were deemed not treatable or not worth the effort of treating by referers. In a study of 335 acute stroke patients with aphasia, Pedersen et al1 reported 52% as severe, 16% as moderate, and 32% as mild on the basis of a 3-point scale. Twenty-one of the 60 patients (35%) in our study had AQs < 25, and 9 of the 60 (15%) had scores in the top quartile, broadly consistent with the findings of Pederson et al. Although the 2 groups are not entirely comparable because our sample included persons with both acute and chronic aphasia, this suggests that our patients were fairly representative of the natural distribution of aphasia severity and therefore mirrored the typical caseload of community aphasia programs.

Some uncertainty in interpreting these results also arises from the fact that not all tests were administered to all patients. Absence of subtest scores for whatever reasons—perception of no improvement by treating clinician, patient at ceiling on pretest, lack of time for testing, or others—introduces distortions of unknown type, direction, and magnitude. In addition, our results are viewed through a specific set of test instruments. We elected to use one language measure exclusively, the WAB, in the interest of consistency and comparability. The WAB can clearly differentiate between normal and aphasic language and has demonstrated good test-retest reliability23,29 but may not have been sensitive to small changes in language performance, which could have been detected by other more specific or specialized instru-

ments. Similarly, a number of functional assessment instruments exist, each with a differing perspective on functional communication. We chose the CETI because of its demonstrated sensitivity to change and because it investigates the caregiver/family perspective of communicative function, which may not always coincide with the clinician’s opinion.41

A large majority of patients treated in these specially equipped community-based aphasia treatment programs showed significant improvements in both language impairment and communicative function, regardless of time after onset, severity at start of care, or type of aphasia. In one sense, these findings should not surprise: indeed, they are in accord with the emerging view that patients in both acute and chronic aphasia may be candidates for significant improvement through resumption of treatment.14,16,17 The corroborating evidence that is offered here comes specifically from an outcome study, the proper topics of which are the existence, direction, magnitude, and statistical significance of changes between 2 points in time. With these particular focuses, outcome studies represent a variety of research that is assuming ever-increasing importance in the environment of managed care.42 This is because superior clinical outcomes, when available at competitive costs through replicable programs, are attractive to payers. Outcome studies also have their limitations. They do not, for example, allow the determination of conclusions regarding either absolute or comparative efficacy or for any attribution of causality. Answers to these latter questions come from properly designed, prospective, randomized, scientifically controlled research. It is hoped, in fact, that the present report will spur such research activity to investigate these latter questions. At present, for example, whether one specific element of the program or a synergy of components contributes more to these improved outcomes remains an open issue.

If the present findings warrant special interest, it would have to center on questions of why and how such changes—widespread, beneficial, and large—are taking place. These improvements strike not by ability to be documented but by their ubiquity, magnitude, generalization, and robustness. Aphasiologists have sometimes speculated about latent capacities for additional speech-language improvements that could be stimulated in late aphasia.43 In preceding decades, such hypotheses could only remain speculation. More recently, brain imaging techniques have shown value in revealing significant relationships between language performance and brain functioning.44 It is submitted that such newer study techniques must complement the more traditional, behaviorally based study methodologies, such as efficacy and effectiveness trials, to fully understand these outcomes, if we are to learn how best to proceed to improve the tools, materials, and methods for aphasia rehabilitation in community-based clinical practice.

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References
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