Recommendations From the STAIR V Meeting on Acute Stroke Trials, Technology and Outcomes

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The STAIR meetings bring together stroke neurologists and other physicians, industry representatives and regulators to discuss issues related to the development of new stroke therapies. The first four STAIR meetings generated publications with recommendations for the preclinical evaluation of stroke therapies, phase II and phase III trial design, enhancing trial implementation and completion, novel approaches to measuring outcome and regulatory considerations.1-4 The impact of these recommendations from the prior STAIR meetings has been substantial, especially those related to preclinical assessment of purported stroke therapies.5 A fifth STAIR meeting was held on March 24 to 25, 2006 in Arlington, Virginia, and over 150 attendees discussed 3 main topics: considerations for measuring outcomes in acute stroke therapy trials, how to incorporate new technologies such as telemedicine and electronic databases into clinical trials, and how to best approach the development of multimodality approaches for acute stroke therapy. This report will summarize the discussions related to these 3 topics.

The recently reported SAINT-I trial has generated discussion regarding using the “shift analysis” to assess treatment efficacy in outcomes such as the modified Rankin Scale (mRS).6 This represented a novel approach because mRS data have previously been analyzed by dichotomization of the 7-point scale—for example, outcome of a Rankin score of 2 or less (slight or less disability) versus 3 or more (moderate handicap, severe handicap or death). It is well-known (at least among statisticians) that using such a dichotomization or categorization of data is likely to lose information—and thus make it harder to detect treatment differences (ie, lower statistical power to detect efficacy improvements). As such, the approaches used by the SAINT investigators likely produced a statistically more “powerful” measure of the treatment effect, allowing the hypotheses to be addressed with fewer subjects and over a shorter period of time than might otherwise be required. Future studies should consider using a similar approach.

The “shift analysis” approach, however, has not yet been widely accepted and there are arguments supporting other analytic methodologies. The dichotomous approach to the analysis of the mRS has some substantial advantages. Specifically, there are virtually no restrictive assumptions underlying the analysis of a dichotomous outcome. In contrast, the most common approaches for analysis of ordinal scale data requires the “proportional odds” assumption in which the magnitude of the improved efficacy associated with the new treatment is assumed to be consistent across the ordinal spectrum of responses. If this assumption is “reasonably” met then ordinal analysis captures the shift in the distribution of outcomes and the statistical power that is lost in the categorical analysis will be captured. If, however, this assumption is not met, the ordinal analysis may have lower power and fail to detect differences that would have been found using a categorical approach. Hence, in an attempt to gain additional statistical power there is a risk of actually lowering statistical power. There are statistical tests to assess whether these assumptions are reasonable, but unfortunately these tests have notoriously low power to detect violations of the assumption. The trial design decisions to gain power can be further extended by considering the mRS as a continuous scale; however, this gain in power comes with even more stringent assumptions.

The naive investigator might suggest that analyses be performed under categorical, ordinal, and even a continuous structure for the mRS with the final approach selected on the basis of the results. It is important that the analysis plan be specified before database-release to avoid incorrectly concluding a treatment effect by having “selected” the “best analysis”. Not only are more assumptions required as one moves from a categorical to an ordinal structure, or from an ordinal to a continuous structure, but it also becomes harder to interpret the results. The obvious implications of a 2-category outcome (for example, "12% more of the patients had a ‘good’ outcome with the new treatment") give way to subtler interpretations of results from an ordinal analysis (for example, “the pooled odds across the seven mRS categories of better outcome were 1.4 times greater with the new treatment”) or continuous outcome (for example, “the mean mRS was 0.8 points better with the new treatment”) can become problematic, particularly to patients. Hence, the decision to evaluate outcome using an ordinal or continuous...
measure runs the risk of losing power and obscuring a clear description of the treatment effects. Hence, before making this decision one needs to check the reasonableness of the assumptions by reviewing similar studies, and checking that both scientific and clinical audiences are comfortable with a subtler presentation of results. The global statistic, which often increases study power, is not accepted by the FDA Neuropharmacological Division as a primary end point analytic technique because it is difficult to interpret clinically. Shift analysis, in contrast, is accepted, as clinical interpretation is attainable.

The most commonly used end points for assessing treatment efficacy in phase III stroke trials are the mRS and the National Institutes of Health Stroke Scale (NIHSS). Regardless of the chosen end point, steps must be taken to reduce variability among personnel performing the assessments. Appropriate steps should be implemented to ensure that personnel performing the outcome scales receive adequate training and as appropriate have acceptable certification/documentation. Many acute stroke therapy trials have required such training and certification in the NIHSS via the viewing of a training tape and then completing an examination tape with centralized scoring for certification. The SAINT trial took such an approach with the mRS, and future trials that use the mRS should consider adopting similar procedures. If repeated assessments over time are required to evaluate temporal changes, having one individual perform each assessment eliminates inter-rater variability for that subject. Another approach to minimizing variability in the acquisition of outcome measures such as the mRS and the NIHSS could be to use centralized data collection. Both of these outcome measures can be performed reliably remotely and a qualified, blinded, centralized individual could gather the information needed to derive an outcome score. Such an approach is used in imaging-based trials in which centralized reading of images by one qualified reader is typical. In addition to using a functional outcome scale such as the mRS or a neurological deficit scale such as the NIHSS, consideration should be given to measuring cognitive outcome. The most appropriate scale to measure cognitive outcome remains contentious. A recent conference on vascular cognitive impairment harmonization standardization suggested a 5-minute protocol that could be readily adapted to the follow-up period of an acute stroke therapy trial once adequate validation of this protocol is available. The vascular cognitive impairment data could then be used as a secondary and perhaps primary outcome measure for an acute stroke therapy trial.

A variety of new information and other technologies are being used to improve or extend clinical practice. These technologies offer both opportunities and challenges for clinical trials. Three evolving information technologies that are potentially relevant for the design, implementation and performance of acute stroke therapy trials are telemedicine, electronic databases and electronic case report forms (CRF’s). Several telemedicine networks are currently available in the United States and elsewhere. They are being used to extend stroke-care expertise into smaller hospitals without these resources and specifically to increase the use of intravenous tissue plasminogen activator (t-PA) within the currently approved 3-hour treatment window. Several different platforms for stroke telemedicine are available, but they share commonalities such as high-speed secure access between participating central and remote hospitals, high-resolution video synchronized with a concomitant audio feed, and simultaneous DICOM access for viewing of images. These telestroke systems allow physicians at a remote site to directly interact with patients at the local hospital to provide clinical evaluations and decision-making support so that therapy can be given quickly, with or without subsequent transport to the hub hospital. Telestroke is, however, associated with a number of challenges and concerns. The system requirements for the best implementation and performance of stroke telemedicine have not been standardized. The safety and efficacy of stroke telemedicine consultations as compared with on-site evaluations is uncertain, although preliminary experience suggest that the 2 are comparable. Furthermore, telemedicine methods may not be more effective than telephone consultations. Administrative and legal hurdles such as how to best obtain appropriate credentialing at multiple hospitals and licensure in multiple states, how to provide adequate written or electronic documentation of service and adequate reimbursement remain unresolved issues. Despite these multiple hurdles to widespread implementation of telemedicine-based stroke networks and care delivery, it is likely that their availability and use will dramatically increase over the next few years. Stroke telemedicine can then be used in clinical trials for both on-site initiation of treatment or remote assessment of inclusion/exclusion criteria and then rapid transport of appropriate subjects to the central trial site. The number of potential trial sites and investigators could expand, leading to a larger and more diverse pool of subjects, and presumably more rapid completion of trials. The use of stroke telemedicine for acute therapy trials will, however, pose many challenges as outlined in Table 1.

The use of electronic databases for clinical stroke trials could provide several unique advantages but will also pose a number of challenges. An electronic database can be generated in conjunction with electronic data capture and an electronic CRF. Such an electronically derived and maintained database of trial participants could be used to improve the quality of data collection, provide standardization across

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### Table 1. Potential Challenges Posed by Telemedicine Use in Acute Stroke Trials

| 1. | Is a local coinvestigator for the trial needed? |
| 2. | How can local responsibility and accountability for conducting the trial and source documentation be managed? |
| 3. | How can local pharmacy support be implemented? |
| 4. | Is IRB oversight the responsibility of the local hospital or the central hospital? |
| 5. | Is follow-up of the patient the responsibility of the local or central hospital? |
| 6. | What are the most appropriate mechanisms for financial compensation to the local and central hospitals? |
| 7. | Will there be regulatory concerns about data derived via telemedicine accrual of patients? |

IRB indicates Institutional Review Board.
TABLE 2. Advantages and Disadvantages of Electronic CRFs

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<tr>
<th>Advantages</th>
<th>Challenges</th>
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<tbody>
<tr>
<td>Provide real-time monitoring capability</td>
<td>Regulatory concerns</td>
</tr>
<tr>
<td>Ease of data checking and enhanced data consistency</td>
<td>Is double entry, paper and electronic going to be required</td>
</tr>
<tr>
<td>Common training and data elements</td>
<td>Electronic Security of the data base</td>
</tr>
<tr>
<td>Interface with electronic data sources</td>
<td>Data security with computer failures, requiring extensive backup systems</td>
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The goals of the STAIR V meeting were to build on the foundation of recommendations provided by the prior STAIR meetings in a timely and innovative manner. The development of acute stroke therapies now encompasses both drugs and devices. It is important to recognize that the utility of either of these treatment approaches alone or in combination can only be evaluated with the use of appropriate outcome measures that are clinically meaningful and relevant. The mRS distribution shift used in SAINT-I represents a novel approach to trial data analysis. It is likely that new technologies such as telemedicine and electronic data forms will enhance trial implementation and expedite trial completion. The new era of combination stroke therapy development and implementation will be challenging for clinical trialists, industry sponsors and regulatory agencies. Most feel that combination therapies represent a future direction that will optimize patient outcomes and study design and regulatory
requirements must be carefully considered to avoid as many pitfalls as possible.

Appendix


Disclosures

None.

References


Key Words: ischemia • telemedicine • therapy • stroke trials
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