Attitudes and Beliefs of Michigan Emergency Physicians Toward Tissue Plasminogen Activator Use in Stroke
Baseline Survey Results From the INcreasing Stroke Treatment through INteractive behavioral Change Tactic (INSTINCT) Trial Hospitals

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Background and Purpose—The objective of this study was to determine the baseline proportion of emergency physicians with favorable attitudes and beliefs toward intravenous tissue plasminogen activator (tPA) use in a cohort of randomly selected Michigan hospitals.

Methods—Two hundred seventy-eight emergency physicians from 24 hospitals were surveyed. A confidential, self-administered, pilot-tested survey assessing demographics, practice environment, attitudes, and beliefs regarding tPA use in stroke was used. Main outcome measures assessed belief in a legal standard of care, likelihood of use in an ideal setting, comfort in use without a specialist consultation, and belief that science on tPA use is convincing. ORs with robust 95% CIs (adjusted for clustering) were calculated to quantify the association between responses and physician- and hospital-level characteristics.

Results—One hundred ninety-nine surveys completed (gross response rate 71.6%). Ninety-nine percent (95% CI: 97.8 to 100) indicated use of tPA in eligible patients represented either acceptable or ideal patient care. Twenty-seven percent (95% CI: 21.7 to 32.3) indicated use of tPA represented a legal standard of care. Eighty-three percent (95% CI: 78.5 to 87.5) indicated they were “likely” or “very likely” to use tPA given an ideal setting. When asked about using tPA without a consultation, 65% (95% CI: 59.3 to 70.7) indicated they were uncomfortable. Forty-nine percent (95% CI: 43.0 to 55.0) indicated the science regarding use of tPA in stroke is convincing with 30% remaining neutral. Characteristics associated with favorable attitudes included non-emergency medicine board certification; older age, and a smaller hospital practice environment.

Conclusions—In this cohort, emergency physician attitudes and beliefs toward intravenous tPA use in stroke are considerably more favorable than previously reported. (Stroke. 2010;41:2026-2032.)

Key Words: attitude ■ belief ■ emergency medicine ■ stroke ■ thrombolytic therapy

Currently, 1% to 3% of patients with stroke in community settings receive intravenous tissue plasminogen activator (tPA) for acute ischemic stroke.1–6 Prior research suggests substantial improvement in treatment rates is possible.1,3,7,8 To enhance acute treatment, emergency departments—with key triage, evaluation, and management responsibilities—have been identified as a critical component in the Stroke Chain of Survival and Recovery.9

Prior reports suggest emergency physicians are resistant to the use of tPA in stroke. A 2005 survey of members of the American College of Emergency Medicine found 40% of respondents were either “unlikely” or “uncertain” to use tPA even in the ideal setting (defined as CT scanner availability, neuroradiology and neurology support, administrative support, appropriate candidate, etc.).10 No professional emergency medicine organization has endorsed the use of tPA in stroke. If broad emergency physician resistance to tPA use is confirmed, it represents a substantial barrier to increasing acute stroke treatment in the community setting. The objective of this survey was to determine the baseline proportion of emergency physicians with favorable attitudes and beliefs toward the use of tPA in a cohort of practicing emergency physicians from a broad variety of hospital environments in Michigan.
Materials and Methods
Survey Development
This survey was developed as part of the ongoing INCreasing Stroke Treatment through INteractive behavioral Change Tactic (INSTINCT) stroke trial (National Institutes of Health/National Institutes of Neurological Disorders and Stroke R01NS050372). We used a confidential, self-administered, self-reported survey assessing emergency physician demographics, practice environment, attitudes, and beliefs regarding tPA use in stroke.

The survey was iteratively pilot-tested on samples of emergency physicians from hospitals not participating in the study. Pilot testing focused on length, validity, question design, and implementation using an online survey system (see supplemental Appendix for details available at http://stroke.ahajournals.org). The University of Michigan and local Institutional Review Boards approved the INSTINCT trial and its survey.

Selection of Participants
The INSTINCT trial is a multicenter, cluster-randomized, controlled trial evaluating the efficacy of a barrier assessment and educational intervention to increase appropriate tPA use in Michigan community hospitals. The unit of randomization was the hospital. Because emergency physicians at the participating hospitals formed the survey cohort, the hospital selection process for the INSTINCT trial is reviewed here.

We selected all acute care hospitals in the lower peninsula of Michigan for potential inclusion in the INSTINCT trial. Hospitals were excluded if they had >100,000 emergency department visits, were affiliated with the University of Michigan emergency medicine residency program, had <100 stroke discharges annually as determined from Michigan Hospital Association data, or were self-identified in 2003 as an academic comprehensive stroke center.

These exclusions allowed focus on the unit of interest, acute care community hospitals. The exclusion of hospitals in the upper peninsula of Michigan was made for travel and budget considerations. Small hospitals with <100 stroke discharges per year were excluded to ensure an adequate number of treatable strokes for the INSTINCT trial.

From this available pool of hospitals (n=61), a single index hospital was randomly selected. Once a hospital was selected, all adjacent hospitals within 15 miles were excluded from the selection pool to provide geographic separation between sites and prevent cross-contamination between hospital staffs in the INSTINCT trial. From the remaining hospital pool, a match for the selected index hospital was chosen from those hospitals within ±20% of the index hospital’s annual stroke admissions. All hospitals within 15 miles of the match were then excluded from the selection pool as well. This pair of hospitals, matched on stroke admissions and geographically separated, was then added to the final cohort. This process was repeated until 12 pairs (24 hospitals) were selected. After selection, each hospital and their corresponding emergency department was contacted regarding participation and a site principal investigator recruited.

Of the original 24 hospitals identified, 4 declined participation in the study. This required selection of an additional 5 hospitals, using the process described previously, to fill the remaining 4 matches. This comprised the final hospital cohort. Site principal investigators identified all emergency physicians at these 24 hospitals as of January 1, 2007, and provided contact information for each (e-mail/phone) at their respective facilities. Primary pediatric emergency physicians were excluded from the survey cohort because tPA is not approved in patients <18 years of age. Resident physicians were also excluded. This formed the final baseline survey cohort of 278 emergency physicians.

Survey Administration
The 278 emergency physicians were surveyed beginning January 1, 2007, before any INSTINCT-related educational or system interventions. The survey was administered through a secure, web-based system (www.SurveyMonkey.com). Physicians preferring paper copies were sent surveys with a stamped return envelope. Data quality and logic checks were built into the reporting system and completed for every returned survey. The staff contacted responding physicians to clarify ambiguous responses.

Each individual was contacted up to 3 times to complete the consent and survey (either online or paper). Nonresponders were then contacted by phone or additional e-mail and offered the survey by phone interview, Internet, or paper. For continued nonresponders, the local site principal investigator was contacted and asked to personally contact them and provide a copy of the survey. Each hospital’s emergency physician group was allocated one $50 incentive to be awarded by random selection after completion of the survey.

Hospital Characteristics
Site investigators at each hospital provided detailed baseline demographic information regarding their respective hospitals, emergency departments, and availability of stroke resources as part of the INSTINCT trial. A standard form was used; complete data were obtained from all participating hospitals. We therefore were able to evaluate associations of the practice environment as well as demographic factors (education, board certification, and years since graduation, etc) with emergency physician beliefs about and attitudes toward tPA use.

Outcome Measures
The main outcome measures were: (1) the proportion of emergency physicians who believed the use of tPA in eligible patients with stroke represented the legal standard of care; (2) the proportion of emergency physicians likely to use tPA in the ideal situation; (3) the proportion of emergency physicians defining themselves as comfortable administering tPA to a patient without a consultation from a neurologist or stroke specialist; and (4) the proportion of emergency physicians who agreed that the existing science on tPA use in stroke is convincing.

In addition, the proportions of emergency physicians who felt that tPA use represented acceptable or ideal patient care; felt a telephone consultation was sufficient before treatment, and those identifying liability for tPA use (or nonuse) as a major concern were calculated.

Statistical Analysis
Summaries of the data were obtained using percentages and means as appropriate. Unadjusted rates for the 4 main outcomes mentioned previously were obtained. In this, a positive response was taken as either of the 2 responses most favorable to use of tPA in each case. ORs with 95% CIs were calculated to quantify the association between these responses and individual characteristics of the respondents and their practice environment. The CIs were based on robust SEs. SEs that are adjusted for the effects of clustering. To accomplish this, we used a logistic regression model and methods based on generalized estimating equations (GEEs) to allow for the clustered structure of the trial and the potential correlations among the responses of physicians within the same hospital.

We used the same methodology and regression analyses to verify the association between a single explanatory variable and the response variable when controlling for ≥1 other explanatory variables. The following physician-level explanatory variables were included in the model: board certification in emergency medicine, completion of emergency medicine residency, year of medical school graduation (divided into approximate quartiles), gender, prior participation in tPA treatment, and race (white versus nonwhite). Additionally, the following hospital-level explanatory variables were included: 2007 emergency department volume, teaching status of hospital, and Joint Commission certification as a stroke center. Estimated ORs were obtained for each factor in the model, having adjusted for others, and robust SEs calculated. SAS Version 9.1.3 (Cary, NC) was used for all statistical analysis.

Results
Response Rate and Demographics
Of the 278 eligible emergency physicians, 199 returned completed surveys, for an overall gross response rate of...
The response rate by hospital ranged from 30% to 100% (mean 73.3%; median 73.6%). Characteristics of the hospitals (locations and surrounding population density given in the Figure) and emergency physicians are shown in Tables 1 and 2, respectively. Survey participants reported working an average of 138 clinical hours in the month preceding the survey (median 135 hours) and 81% indicated they had participated (either independently or jointly with specialist consultation) in treating a patient with stroke with tPA in the preceding 5 years.

**Attitudes and Beliefs Toward tPA**

Specific survey items with their response options and percentage of respondents are shown in Table 3. Almost all respondents, 99% (95% CI: 97.8 to 100) indicated the use of tPA in eligible patients with symptoms of acute stroke represented either acceptable or ideal patient care. Evaluated by response option, 57% identified the use of tPA as “ideal,” 42% as “acceptable,” and 1% as “unacceptable” patient care. Twenty-seven percent (95% CI: 21.7 to 32.3) indicated the use of tPA represented a legal standard of care in eligible patients with symptoms of acute stroke.

As Table 3 shows, 83% (95% CI: 78.5 to 87.5) of respondents indicated they were “likely” or “very likely” to use tPA given an ideal setting. When asked about using tPA without a consultation, 65% (95% CI: 59.3 to 70.7) indicated they were uncomfortable. A similar majority, 67% (95% CI: 61.4 to 72.7), indicated a telephone consultation would be sufficient before treatment.

Forty-nine percent of respondents indicated the science regarding the use of tPA in stroke is convincing (95% CI: 43.0 to 55.0), with 30% remaining neutral. The majority also agreed that liability for use (or nonuse) of tPA is a major concern.

The proportion of emergency physicians responding favorably for various respondent characteristics and practice environments are given in Table 4. Practicing emergency physicians who were not board-certified in emergency medicine...
Table 2. Characteristics of Emergency Physicians

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Survey No./Total No.</th>
<th>Response (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>46/199</td>
<td>(23)</td>
</tr>
<tr>
<td>Age, years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Race or ethnic group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>171/192</td>
<td>(89)</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>21/192</td>
<td>(11)</td>
</tr>
<tr>
<td>Black</td>
<td>6/192</td>
<td>(3)</td>
</tr>
<tr>
<td>Asian</td>
<td>5/192</td>
<td>(3)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>4/192</td>
<td>(2)</td>
</tr>
<tr>
<td>Other</td>
<td>5/192</td>
<td>(3)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EM residency training</td>
<td>160/199</td>
<td>(80)</td>
</tr>
<tr>
<td>Specialty board certification†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency medicine</td>
<td>170/199</td>
<td>(85)</td>
</tr>
<tr>
<td>Internal medicine</td>
<td>8/199</td>
<td>(4)</td>
</tr>
<tr>
<td>Family practice</td>
<td>8/199</td>
<td>(4)</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>1/199</td>
<td>(1)</td>
</tr>
<tr>
<td>None</td>
<td>12/199</td>
<td>(6)</td>
</tr>
<tr>
<td>Other</td>
<td>11/199</td>
<td>(6)</td>
</tr>
<tr>
<td>Year of medical school graduation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997–2006</td>
<td>62/198</td>
<td>(31)</td>
</tr>
<tr>
<td>1987–1996</td>
<td>72/198</td>
<td>(36)</td>
</tr>
<tr>
<td>1977–1986</td>
<td>51/198</td>
<td>(26)</td>
</tr>
<tr>
<td>1957–1976</td>
<td>13/198</td>
<td>(7)</td>
</tr>
<tr>
<td>Year of EM residency completion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1977–1986</td>
<td>15/160</td>
<td>(9)</td>
</tr>
<tr>
<td>1987–1996</td>
<td>58/160</td>
<td>(36)</td>
</tr>
<tr>
<td>1997–2006</td>
<td>87/160</td>
<td>(54)</td>
</tr>
</tbody>
</table>

*Percentages may not total 100 due to rounding. †Multiple board certifications allowed.
EM indicates emergency medicine.

Multiple regression analyses for each of the 4 outcomes are presented in the Supplemental Appendix (available at http://stroke.ahajournals.org) and the results differ from those seen in the univariate analyses in Table 4. In the multivariate analysis of Variable 1 (likely to use tPA in an ideal setting) and Variable 2 (science on tPA is convincing), it was found that the apparent effect of teaching hospital becomes substantially larger (5.70 versus 0.61 in the first case and 2.08 versus 1.03 in the second). In both cases, the reason for the change is that teaching hospital is highly correlated with emergency department volume with larger hospitals more likely to have an educational role.

The adjusted analysis for Variable 3 (legal standard of care) is notable in that many variables were highly related to the outcome. The correlation between teaching status and emergency department volume again plays a role in making both variables more significant. In addition, there is a high correlation between year of medical school graduation and board certification in that physicians with the longest time since medical school tended more recently to hold emergency medicine board certification. This resulted in both variables becoming more significant when fitted simultaneously in the model. In both the adjusted and unadjusted models, however, there was a clear tendency for those without emergency medicine board certification to view tPA as a legal standard of care. There were no notable differences between the adjusted and unadjusted analyses for Variable 4 (comfortable giving tPA without a consultation).

**Discussion**

In this survey of emergency physicians from a cross-section of Michigan community hospitals, we observed greater acceptance of thrombolysis for stroke than previously reported. Nearly all respondents characterized tPA treatment as either ideal or acceptable patient care and approximately one fourth indicated tPA use represented a legal standard of care in eligible patients with stroke. Eighty-three percent indicated they would use tPA given the ideal setting at their local hospital.

Past surveys, from 2003 and 2005, provided acceptance estimates ranging from 53% to 60%. Possible explanations for the findings of increased acceptability of tPA use include secular changes in attitudes toward stroke treatment, differences in the survey cohort compared with prior studies, and differences in survey design.

A secular trend in physician attitudes toward tPA use in Michigan is plausible given the breadth of stroke activities statewide. The state has multiple hospitals with stroke research programs and an active Department of Community Health that has supported stroke education since 1997. In 2001 to 2002, 16 Michigan hospitals participated in the Paul Coverdell National Acute Stroke Registry6,13 and in 2003, hospitals in the state began participating in the Get With The Guideline–Stroke program. Schwamm et al previously found Get With The Guideline–Stroke improved stroke management performance.14

Other potential contributors to a secular trend include competitive efforts by hospitals to achieve primary stroke center designation (Michigan currently has 33 primary stroke
centers) as well as the publication of several studies, which were concordant with randomized trials on the efficacy and safety of tPA.15–18

Study cohort differences may also explain our findings of increased acceptability of tPA use. We note a higher number of primary stroke centers in our sample than anticipated from nationwide estimates. The reason is unclear, but increased overall presence, random chance, or unknown associations between stroke center status and size or geographic isolation of the included hospitals are all possible.

Previous studies evaluating acceptance of thrombolytics in stroke sampled the membership of the American College of Emergency Physicians.10,12 Although this is the largest of the 5 emergency medicine professional organizations, it is not known what proportion of practicing physicians are members. Additionally, response rates in these earlier studies (21% to 43%) were substantially smaller than our cohort, increasing the potential for bias. Finally, data indicate 38% of emergency physicians are not emergency medicine residency-trained nor emergency medicine board-certified and these clinicians are more likely to practice in suburban or rural locations.19 Their professional membership is unknown, but it is possible our survey methodology encompassed this population to a greater extent.

Differences in survey design may also explain the increased thrombolytic acceptability in our cohort. Although our question assessing use of tPA “in the ideal setting” was identical to that of Brown et al, our survey assessed emergency physician attitudes and beliefs across a number of questions and content domains to allow internal comparisons. In general, these were concordant in their findings; however, it is possible this conditioned the respondent to favor 1 answer modality over another.

Other findings regarding the attitudes and beliefs of emergency physicians are worthy of note. The percentage identifying thrombolytic use as a medical–legal standard of care was higher than expected and suggests that cumulative educational efforts and data may be changing perceptions. The gap between the medical–legal response and the overall acceptance of tPA may, in part, represent a perception of lack of access to needed acute stroke resources. This is supported by the finding that 83% were likely to use thrombolytics in an ideal situation.

In univariate analysis, there was apparently greater acceptance of stroke thrombolysis by older as well as non-emergency medicine residency-trained physicians. Not surprisingly, prior experience with stroke thrombolysis trended toward an association with positive attitudes toward tPA use. Interestingly, emergency physicians practicing at larger hospitals appeared less comfortable treating stroke with tPA without a consultant than their colleagues at moderate-sized hospitals. Several potential explanations for this exist. Physicians at larger facilities may have: less isolated responsibility for acute stroke care; increased access to emergent neurological consultation resources; greater physician and staff turnover (both in emergency department and consulting staffs); reduced personal contact with specialists; and/or increased reliance on physician extenders.

**Limitations**

In addition to limitations inherent in all survey research, some specific limitations should be noted. Our respondent population was determined by a 2-stage, cluster sampling in which the hospital was selected first, recruited, and then the emergency physicians within each recruited hospital surveyed. It is possible the 5 hospitals that declined to participate (and their...
accompanying physicians) differed in their prioritization of stroke care compared with participating hospitals.

Our sample included a high number of teaching hospitals; this most likely represents the definition used. A hospital with residents (of any specialty) was defined as a teaching hospital. Additionally, hospitals with a very small annual census of patients with stroke were excluded from the study. Thus, the attitudes and beliefs of physicians practicing in such environments are not represented here. Furthermore, given the historical development of stroke care in Michigan, caution is warranted in generalizing the results.

Summary
In conclusion, nearly all practicing Michigan emergency physicians responding to this survey indicated that tPA use in eligible patients was ideal or acceptable patient care. Large numbers (83%) reported they would likely use tPA assuming the ideal setting for its use existed at their hospital. This represents a shift in attitudes from prior reports. Characteristics associated with favorable attitudes included: nonemergency medicine board certification; older age; and a smaller hospital practice environment.

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Disclosures
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References
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