A Randomized, Controlled Trial to Teach Middle School Children to Recognize Stroke and Call 911
The Kids Identifying and Defeating Stroke Project

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Background and Purpose—Underutilization of acute stroke therapy is driven by delay to hospital arrival. We present the primary results of a pilot, randomized, controlled trial to encourage calling 911 for witnessed stroke among middle school children and their parents.

Methods—This project occurred in Corpus Christi, an urban Texas community of 325,000. Three intervention and 3 control schools were randomly selected. The intervention contained 12 hours of classroom instruction divided among sixth, seventh, and eighth grades. Parents were educated indirectly through homework assignments. Two-sample t tests were used to compare pretest and posttest responses.

Results—Domain 1 test questions involved stroke pathophysiology. Intervention students improved from 29% to 34% correct; control students changed from 28% to 25%. Domain 2 test questions involved stroke symptom knowledge. Intervention school students changed from 28% correct to 43%; control school students answered 25% correctly on the pretest and 29% on the posttest. Domain 3 test questions involved what to do for witnessed stroke. Intervention school students answered 36% of questions correctly on the pretest and 54% correctly on the posttest, whereas control students changed from 32% correct to 34%. A comparison of change in the mean proportion correct over time between intervention and control students was P<0.001 for each of the 3 individual domains. A poor parental response rate impaired the ability to assess parental improvement.

Conclusions—A scientific, theory-based, educational intervention can potentially improve intent to call 911 for stroke among middle school children. A different mechanism is needed to effectively diffuse the curriculum to parents. (Stroke. 2007;38:000-000.)

Key Words: behavior ■ community ■ education ■ school ■ stroke, acute

Intravenous recombinant tissue-type plasminogen activator (IV rt-PA) remains the only US Food and Drug Administration–approved acute stroke treatment. This therapy must be administered within 3 hours of symptom onset. Estimates of the proportion of ischemic stroke patients who receive IV rt-PA for acute ischemic stroke vary by study design but do not exceed more than a few percent except in selected center series.1-5 The single most important factor limiting use of acute ischemic stroke therapy is that patients arrive at the hospital too late for time-limited therapies.6 As neurons die in a time dependent fashion, the biology of ischemic stroke suggests that time to treatment will continue to be an important factor limiting use of any acute stroke therapy.7 Few studies have actively investigated the potential of reducing time to hospital arrival in acute ischemic stroke patients. One controlled study performed in nonurban East Texas found that an aggressive, theory-based behavioral intervention aimed at both the community and healthcare professionals could increase the use of IV rt-PA for acute ischemic stroke from 2.2% to 11.2%. There was no change in the control community over the same time period.8 One critical finding of this study is that knowledge of stroke symptoms and a reminder to call 911 were not enough to promote that behavior. Instead, rather than fear, encouragement and motivation in the form of improved outcome expectations were key to that intervention’s success.4

When a patient experiences a stroke, they frequently develop hemiparesis, aphasia, and/or a neglect syndrome that prevents reaching a phone, dialing 911, and requesting help. In a population-based study, only 4.5% of stroke patients...
The population of Nueces County was 313,645 in 2000,15 with 86% of Nueces County, Texas, is located on the Texas Gulf coast. The

Table 1. Learning Objectives of KIDS Lessons by Grade Level

<table>
<thead>
<tr>
<th>Grade</th>
<th>Lesson Objectives</th>
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| 6     | ○ Recognize the common signs and symptoms of stroke when presented with different sudden illness scenarios.  
○ Demonstrate, using clear plastic tubing, the types of ischemic stroke and how the clot-busting drug rt-PA helps in the treatment of stroke.  
○ Explain the importance of calling 911 as soon as symptoms of stroke are recognized.  
○ Demonstrate how to call 911 when seeing someone showing symptoms of stroke.  
○ List basic first aid steps to take while waiting for the ambulance.  
○ Describe why it is important to share stroke knowledge and skills with family members and significant others.  
○ Describe why signs and symptoms of stroke can vary from person to person, based on the part of the brain affected by the stroke.  
○ Explain why a person having a stroke needs to get to the hospital within 2 hours of having the first symptom.  
○ Create or use a slogan to encourage others to call 911 when they see someone with symptoms of stroke.  
○ Design, laminate, and display at home a poster promoting calling 911 in response to seeing someone with symptoms of stroke.  
○ Interview adult partners about the internal and external influences that would affect their willingness to call 911 immediately when seeing someone with symptoms of stroke.  
○ Explain why seeing someone having a symptom of stroke would be a stressor.  
○ Demonstrate 2 stress management techniques (deep breathing and positive self-talk) that can help a person stay calm in an emergency. |
| 7     | ○ Describe why it is important to understand influences on health-related behaviors.  
○ List influences on calling 911 identified by adult partners in the seventh-grade interviews.  
○ Write and perform a 30-second public service announcement designed to influence middle school students to call 911 right away if they see someone with symptoms of stroke.  
○ Identify racial/ethnic groups who are at a higher risk for stroke (including MAs).  
○ List primary and secondary prevention actions for stroke.  
○ View a video and describe a real-life example of a teacher who had symptoms of stroke that were quickly recognized, 911 was called, and rt-PA was given at the hospital, resulting in a good recovery. |
| 8     | ○ Describe why the knowledge, motivation, and behavioral intent of middle school children and their parents/guardians to call 911 for witnessed acute stroke. Children were a focus owing to the success of school-based interventions10,11 and the desire to teach a new generation about stroke, because studies have shown poor stroke knowledge among current adults.12 Mexican Americans (MAs) were also a target of this intervention because of their high stroke risk.13 |

themselves contacted emergency medical services directly. The remaining 95.5% of calls were made by family members, coworkers, or other bystanders.9 This implies that education about stroke symptoms and calling 911 must be directed not only at those individuals at risk but also at the general community.

With this background information, the Kids Identifying and Defeating Stroke (KIDS) study was designed as a randomized, controlled, health services intervention trial to improve the knowledge, motivation, and behavioral intent of middle school children and their parents/guardians to call 911 for witnessed acute stroke. Children were a focus owing to the success of school-based interventions10,11 and the desire to teach a new generation about stroke, because studies have shown poor stroke knowledge among current adults.12 Mexican Americans (MAs) were also a target of this intervention because of their high stroke risk.13

Subjects and Methods
The detailed methods of the KIDS project were previously reported.14 In brief, the research was conducted in partnership with the Corpus Christi School District (CCISD). The project was approved by the University of Michigan’s and University of Texas at Houston’s institutional review boards and the CCISD administration and parent review board.

Setting
Nueces County, Texas, is located on the Texas Gulf coast. The population of Nueces County was 313,645 in 2000,15 with 86% of the county population residing within the city of Corpus Christi. The study’s setting is therefore urban. Of the total population, 56% are Hispanic, 38% are non-Hispanic white (NHW), and 6% are black or of other races. The MA community in Corpus Christi is not an immigrant population.12 The MAs in this community are mostly second- and third-generation-born US citizens.

The CCISD was established in 1909. There were 19,296 students enrolled in 2000 to 2001, just before this project began, and 8,827 were in middle school. The attendance rate is 95%. Two thirds of the children are MA. There are 12 middle schools. Middle school begins in sixth grade and concludes at the end of eighth grade. The middle school years were chosen for this project because of time availability in the curriculum and the suggestion of CCISD educators that this would be an ideal time to disseminate a health education message.

End Point Assessment
At the beginning of sixth grade, students in the intervention and control schools completed a pretest that contained 12 multiple-choice questions. This new test was written by a stroke neurology professor and a health behavior professor with stroke education experience. These individuals had no role in the intervention curriculum design or conduct. All other study personnel were blinded to the test questions. The test contained 4 multiple-choice questions for each of 3 domains: stroke pathophysiology, stroke symptoms, and what to do for a witnessed stroke. The students completed the pretests in class and brought pretests home for 2 parents/guardians to complete independently. Students and parents self-reported ethnicity at enrollment.

The cohort of control school students received no stroke education. They were contacted at the end of eighth grade to complete the same 12-question test (posttest). In all cases, the students were
required to complete the test in class and were then asked to take home 2 copies of the test for the same parents/guardians to complete. The parents/guardians were identified by name and were asked to sign the test to ensure that the same individual took the test at both testing points (pretest and posttest). The cohort of intervention school students and parents/guardians received the same testing schedule as the control cohort.

Description of the KIDS Intervention

The KIDS intervention curriculum was designed to increase the correct identification of stroke signs and symptoms and encourage immediate contact with emergency medical services (calling 911) when these signs and symptoms were detected. The 3-year curriculum was designed to reach both middle school students and their parents or adult partners. Social cognitive theory was used as the fundamental construct in designing the intervention. Social cognitive theory is recognized as the fundamental theoretical basis for the design of educational interventions targeted toward children.16,17 This theory recognizes the integration of behavior, environment, and personality factors in describing human action. Cognition influences behavior but may be enhanced or prevented by environmental influences. Personality factors including attitudes, beliefs, and self-efficacy also influence behavior. Outcome expectations and the ability to analyze the consequences of behaviors are critical.16,17 Youth-based interventions incorporate this theory through a multi-level intervention targeting existing behavioral repertoires, environmental influences from school and parents, and personality factors, including outcome expectations, self-efficacy, and cognitive analysis of behavior.

Classroom Component

Students in the KIDS intervention schools received four 50-minute classroom-based lessons each year in grades 6, 7, and 8, taught by 2 KIDS project staff, including a neurologist and a health teacher. The lessons were designed to build knowledge about stroke signs and symptoms and improve skills, self-efficacy, and outcome expectations related to immediately calling 911 when stroke signs and symptoms were detected. Each grade’s lessons were age appropriate and built on previous lessons (see Table 1). The lessons were designed to be interactive and culturally appropriate for MA and NHW adolescents in Corpus Christi, Tex. In the sixth grade, students learned how blood clots block cerebral arteries causing a stroke. Students also learned about the availability of rt-PA and the time constraints on its use. Students were taught to recognize signs and symptoms of stroke and practiced identifying them in role-play scenarios. In the seventh grade, students used the KIDS interactive website to view different parts of the brain and how damage to a particular part of the brain results in differing symptoms of stroke. Students were also introduced to the many internal and external influences that affect an individual’s decision to call 911 right away. The KIDS website presented students with a Tejano (Texas-Mexican) dance scenario (see Figure 1), in which a middle school student recognizes the symptoms of stroke in a woman at the dance and recommends calling 911, even when the adults around him are recommending other actions, such as going home to rest or calling the woman’s doctor. The website directs students to choose which recommendation they think is correct. For each response, students received feedback on the time it took to get to the hospital, if rt-PA was given, and outcomes for the woman. Seventh-grade students were also assigned to interview their adult partners to determine what might influence them to call 911 right away or to delay calling. Between the seventh- and eighth-grade lessons, the KIDS staff analyzed interview responses and created a handout highlighting the most common influences on calling 911 or delaying. During the eighth-grade lessons, students reviewed these data and then demonstrated their understanding of influences by creating and delivering a 30 second public service announcement designed to influence other middle school students to call 911 right away when witnessing a stroke. In the eighth grade, students were also introduced to the common risk factors for stroke and to both primary and secondary prevention strategies. Although the main focus of the KIDS intervention was acute stroke treatment, we wanted students and adult partners to understand that MAs are at an increased risk and that there are behaviors that can decrease risk. For the final KIDS lesson, students watched and discussed a video developed for the KIDS project that illustrated the real-life rt-PA success story of a local teacher who had experienced a stroke.

Parents/Adult Partners Component

Homework assignments were designed to facilitate sharing of information and skills between the students and their parents/adult partners, with the intent to increase knowledge about stroke signs and symptoms and improve skills, self-efficacy, and outcome expectations among the parents/adult partners, as well as among the students. Each classroom lesson ended with a student homework assignment for which students were asked to take the information learned and teach their parents or adult partners. The student–adult partner interview on influences to call 911 is a good example. Using 2 stroke scenarios (witnessing stroke symptoms in a stranger at the local mall and in a neighbor), students were asked to find out what would influence their adult partners to call 911 right away or to delay calling. In the eighth grade, students were given an analysis of all adult partner responses to the interview scenarios, and myths were addressed. Students were assigned to share the interview findings with their adult partners as an eighth-grade homework assignment.

All written homework materials included both English and Spanish versions and were designed to be completed in a short amount of time. Homework assignments were collected by KIDS staff members at the lesson immediately after each assignment. Late homework...
assignments were accepted. Small incentives, such as gel pens and movie passes, were given to students who participated in class and turned in homework assignments. Greater participation resulted in more rewards.

**Sample Size and Randomization**

This pilot study had little previous information on which to base sample size calculations. As a guide, we used data from a professional survey conducted in this community regarding stroke knowl-
edge.12 The survey demonstrated that only 17% of MAs and 22% of NHWs recognized focal motor weakness as a stroke symptom; 54% of MAs and 63% of NHWs said that they would call 911 for stroke; and 48% of MAs and 57% of NHWs knew that specific acute stroke therapy existed. As a rough estimate for sample calculations, we wished to have >80% power to detect an increase in knowledge as follows (1): a 50% improvement for knowledge of focal motor weakness as a stroke symptom; (2) an 80% improvement in plan to call 911 for an acute stroke; and (3) an 80% improvement in knowledge that a treatment for acute stroke existed. Type I error was apportioned across the 6 hypotheses (3 questions for the entire cohort and separately for the MA subset) to account for multiple comparisons. The type I error rate was distributed as follows for the entire cohort and the MA subset, respectively: question 1, 0.001, 0.001; question 2, 0.018, 0.028; and question 3, 0.001, 0.001. Sample size was calculated for parents/guardians, because this was a more difficult educational objective than students. Responses from 216 parents/guardians, 108 in the control group and 108 in the treatment group, were determined to be necessary to achieve these goals.

To enroll this number of parents, it was determined that 6 middle schools would be required to participate. Six of the 12 middle schools were randomly chosen for participation via simple randomization. Of these 6, 3 were randomly selected by simple randomization as intervention and 3 as control. Excel (Microsoft Corp) was used for randomization. Because return of posttests among parents did not meet the targeted goal, the study was considered uninformative regarding the parents, and statistical analysis of parent tests is not reported. Before any analysis was performed on the final data set, a new analysis plan was devised to evaluate student test performance.

### Statistical Analysis

Comparisons between baseline demographics for students from control and intervention schools were assessed with χ² tests. A comparison of sex and ethnicity was performed for those who completed the pretest only versus those who completed both the pretest and posttest, by intervention group, by χ² tests.

Three domains were questioned as part of the pretest and posttest. These domains were as follows: domain 1, stroke pathophysiology; domain 2, stroke symptom knowledge; and domain 3, behavioral intent to call 911 for witnessed stroke. Each domain was addressed by 4 test questions within the 12-question test used for the pretest and posttest. Control students were included in the analysis if they completed a pretest. Intervention students were included if they completed the pretest and attended at least 1 class.

The planned primary analysis related to the parents is not reported owing to poor participation, as described earlier. For each child, the proportion correct within each domain was then tabulated for each student. Mean differences in proportion correct were compared between intervention and control groups with a 2-sample t test. The mean proportion correct is therefore defined as the fraction of the responses within a domain answered correctly on average. To be conservative, when year 3 scores were missing, they were imputed simply by carrying the pretest scores forward.14 The aforementioned analysis was repeated for the MA student subgroup. A target analysis replicated the first analysis for only those subjects who completed both the pretest and the posttest. Within the intervention and control groups, the difference in the proportion of correct responses between the pretest and posttest within each domain was compared with paired t tests. S-plus 7.0 for Windows (Insightful Corp) was used for the analyses.

### Results

Figure 2 demonstrates the flow of subjects in the study. Of the students, 47% of the intervention and 46% of the control group completed both pretest and posttest. Of the parents/guardians, 18% of the intervention and 16% of the control completed both tests. No further analysis of the parents was performed because of the low completion rate.

Males represented 55% of intervention students (141/257) and 41% of control students (106/258, P = 0.0018). MAs represented 77% of intervention students (198/257) and 89% of control students (230/258, P = 0.0002). A comparison of demographics by treatment group for those who completed both a pretest and posttest with those who completed only a pretest showed no difference in sex. There was a lower proportion of MAs taking only a pretest in the control group (pretest only, 82%, or 113/137; both tests, 95%, or 115/121; P = 0.0017) but no difference in the intervention group. The homework return rate for at least 1 of the 3 homework assignments, based on the number of students with continuing enrollment in the intervention school, was 39% in year 1, 34% in year 2, and 35% in year 3.

For students, there was greater improvement in the mean difference of proportion of correct responses from pretest to posttest in the intervention group compared with the control group for all domains (P < 0.001 for each domain). Intervention students improved over time in all 3 domains; improvement was less dramatic in the control group for domains 2 and 3 and showed worse posttest scores for domain 1 (Table 2).

### Table 2. Comparison of Means of the Proportion of Correct Responses for Pretest vs Posttest by Domain for Students

<table>
<thead>
<tr>
<th>Domain</th>
<th>Intervention group, n=257</th>
<th>Control group, n=258</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain 1 (Pathophysiology), Mean (SD)</td>
<td>0.29 (0.19)</td>
<td>0.28 (0.25)</td>
</tr>
<tr>
<td>Domain 2 (Symptom Knowledge), Mean (SD)</td>
<td>0.34 (0.21)</td>
<td>0.43 (0.29)</td>
</tr>
<tr>
<td>Domain 3 (Behavioral Intent to Call 911), Mean (SD)</td>
<td>0.36 (0.23)</td>
<td>0.54 (0.31)</td>
</tr>
</tbody>
</table>

| P value* | <0.001 | <0.001 | <0.001 |

Subjects lost to follow-up between the pretest and posttest were assigned the same score on the posttest that they received on the pretest.

P value for comparison of pretest vs posttest scores by group (intervention or control) and within specific domain (1, 2, or 3).
These associations were also found when assessing the MA subgroup (P<0.001 for each domain; data not shown) and when assessing only those subjects who completed both a pretest and a posttest, the target analysis (P<0.001 for each domain; Table 3).

Discussion

The students in this study showed a significant benefit, whereas the educational objective for parents/guardians did not succeed. Analysis of the parent portion of the study was uninformative owing to the large attrition rate of parents between the pretest and posttest. One possible unmeasured benefit of the homework assignments was a positive benefit on the students by asking them to teach their parents/guardians. Solidifying knowledge in an individual by having that individual teach the subject matter to others is a well-established learning technique.19

The students did increase their knowledge of acute stroke and their behavioral intent to call 911 for a witnessed stroke. Despite the attrition rate in children, a conservative analysis, assuming no improvement in those lost to follow-up, still found a robust benefit in intervention students compared with controls. This holds the promise that a new generation will grow up with stroke knowledge and the clear understanding that calling 911 for stroke immediately is the right thing to do. Children may play a vital role in notifying emergency medical services for acute illnesses affecting adults.

Combating the knowledge gap for stroke20 is not an easy endeavor. Moreover, knowledge about stroke warning signs and a message to call 911 are not enough and likely play into denial mechanisms regarding a dreaded disease. Motivation related to positive outcome expectations must be coupled with knowledge to effect behavior change.4

This study has limitations. The loss to follow-up was high and raises the concern of bias. To guard against this, we analyzed the data on an intent-to-treat basis and assumed that those lost to follow-up did not show any improvement. This imputational method, in which those who missed the posttest were simply assigned the same value that they received on the pretest, follows the principal of the last observation carried forward and may have resulted in an underestimation of the intervention’s effect. There were more MAs in the control arm and more NHWs in the intervention arm of the study. However, the association of improvement with intervention was found in the MA group alone, as well as in the entire cohort. The test used was new and not validated. This study took place in a community in southeast Texas with a majority of MA children. Care must be taken to generalize these results to other populations. A formal cost analysis is needed, but because the curriculum is now packaged, all that is needed is training teachers and applying the curriculum to be community specific.

The KIDS project suggests that a theory-based, scientifically developed educational intervention program may contribute to the knowledge and behavioral intent of middle school students to recognize and appropriately seek help for acute stroke. Further study needs to determine whether this method can succeed in other communities, whether attrition can be minimized, and whether behavioral intent translates into appropriate 911 calls for stroke. Reliance on indirect contact with parents, through homework assignments sent home with their children, is unlikely to yield information dissemination to parents.

Sources of Funding

This study was funded by National Institutes of Health grants P50 NS44227 and R01 NS38916.

Disclosures

None.

References


Table 3. Means of the Proportion of Correct Responses for Pretest vs Posttest by Domain for Students in Only Those Who Took Both the Pretest and Posttest

<table>
<thead>
<tr>
<th>Domain 1 (Pathophysiology), Mean (SD)</th>
<th>Domain 2 (Symptom Knowledge), Mean (SD)</th>
<th>Domain 3 (Behavioral Intent to Call 911), Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intervention group, n = 128</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>0.30 (0.20)</td>
<td>0.29 (0.26)</td>
</tr>
<tr>
<td>Posttest</td>
<td>0.40 (0.23)</td>
<td>0.59 (0.23)</td>
</tr>
<tr>
<td><strong>Control group, n = 121</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>0.30 (0.20)</td>
<td>0.26 (0.23)</td>
</tr>
<tr>
<td>Posttest</td>
<td>0.23 (0.20)</td>
<td>0.32 (0.25)</td>
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</table>


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