Methodology for a Community-Based Stroke Preparedness Intervention
The Acute Stroke Program of Interventions Addressing Racial and Ethnic Disparities Study

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Background and Purpose—Acute stroke education has focused on stroke symptom recognition. Lack of education about stroke preparedness and appropriate actions may prevent people from seeking immediate care. Few interventions have rigorously evaluated preparedness strategies in multiethnic community settings.

Methods—The Acute Stroke Program of Interventions Addressing Racial and Ethnic Disparities (ASPIRE) project is a multilevel program using a community-engaged approach to stroke preparedness targeted to underserved black communities in the District of Columbia. This intervention aimed to decrease acute stroke presentation times and increase intravenous tissue-type plasminogen activator utilization for acute ischemic stroke.

Results—Phase 1 included (1) enhancement of focus of emergency medical services on acute stroke; (2) hospital collaborations to implement and enrich acute stroke protocols and transition District of Columbia hospitals toward primary stroke center certification; and (3) preintervention acute stroke patient data collection in all 7 acute care District of Columbia hospitals. A community advisory committee, focus groups, and surveys identified perceptions of barriers to emergency stroke care. Phase 2 included a pilot intervention and subsequent citywide intervention rollout. A total of 531 community interventions were conducted, reaching >10256 participants; 3289 intervention evaluations were performed, and 19000 preparedness bracelets and 14000 stroke warning magnets were distributed. Phase 3 included an evaluation of emergency medical services and hospital processes for acute stroke care and a year-long postintervention acute stroke data collection period to assess changes in intravenous tissue-type plasminogen utilization.

Conclusions—We report the methods, feasibility, and preintervention data collection efforts of the ASPIRE intervention.

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Key Words: prevention & control • residence characteristics • stroke
importance of integrating systemic change with behavioral change when designing interventions.

The District of Columbia (DC) is an urban predominately black community with identified disparities in intravenous tissue-type plasminogen activator (IV tPA) administration for acute stroke.21 A survey among DC veterans found that blacks were less likely than whites to say they would call 911 if experiencing stroke symptoms (40% versus 51%). We have reported that blacks in DC were less likely to be treated with IV tPA, and these delays were associated with stroke severity, contraindications to treatment, or delayed presentation.21 Given disparities in stroke treatment and lack of acute stroke education in DC, we sought to address these issues through the design and evaluation of a citywide stroke preparedness intervention.

Acute Stroke Program of Interventions Addressing Racial and Ethnic Disparities (ASPIRE) is a multilevel program, examining whether a community-engaged, 3-pronged approach (individual/community, hospital, emergency medical services [EMS]) to acute stroke preparedness targeted to underserved black communities in DC will lead to behavioral change as defined by (1) improved arrival time to ED on stroke symptom onset, and (2) increased IV tPA utilization rates (Table 1). We report the methods, feasibility, and preliminary data collection efforts of the ASPIRE intervention.

Methods

Phase 1: Preintervention

Community

Key community stakeholders, including stroke survivors, stroke caregivers, a local community advocate, and a minister, were assembled to serve on the Community Advisory Committee. The Community Advisory Committee advised the research team on cultural sensitivity, appropriate outreach, and recruitment strategies and worked with the research team to interpret focus group results, key informant interviews, and surveys. Eight focus groups explored knowledge of stroke risk factors, signs and symptoms, attitudes, and beliefs on stroke treatment and experienced or perceived treatment barriers. Each audio-taped and transcribed focus group consisted of 8 to 10 individuals, balanced by sex. This process elucidated the subjective attitudes and norms of community members and examined themes identified in the brief survey, which then informed intervention development.

In developing stroke education materials for ASPIRE, existing tools were evaluated, including the National Institute of Neurological Disorders and Stroke Know Stroke campaign, the American Heart Association Power to End Stroke campaign, Stroke Warning Information for Faster Treatment, and the Massachusetts Health Department stroke video, Stroke Heroes Act FAST (Face, Arm, Speech, Time).22-24 The Community Advisory Committee reviewed these materials and helped culturally and linguistically tailor the materials to the community needs based on identified barriers. Specifically, the materials were community-placed (references to the DC metro area), contained simple messaging that focused on preparedness rather than the entire spectrum of stroke (including prevention, risk factors, recovery, and psychosocial issues), were visually appealing with people and locations appearing relatable to the DC community, and contained messages that provided instruction and hope. For example, because we found the largest barrier to calling 911 was the belief that nothing can be done to treat a stroke, we created clear messages that included the treatability of stroke with rapid action while promoting preparedness and self-efficacy, including “Stroke is Treatable, Call 911” and “Stroke; I am prepared to Call 911.”25 To tailor our materials culturally, a PowerPoint slide set and a chart presentation were developed with community-placed messaging. These included education on higher risk of stroke among black populations, use of lay terms and visuals for stroke symptoms, and active decision slides about costs and benefits of calling 911.25 ASPIRE integrated aspects of Stroke Heroes Act FAST, including animation, repetition (including song), and simple instructions about what to do coupled with self-efficacy, such as “You can beat a stroke by calling 9-1-1.”22 In partnership with National Institute of Neurological Disorders and Stroke Communications, ASPIRE developed reinforcement materials, including refrigerator magnets, bracelets, presentation charts, and bus advertisements that included pictures of stroke warning signs and action messages such as calling 911.

Hospital

Between January 2008 and February 2009, trained clinical research coordinators collected demographic information, acute stroke parameters (time to presentation and use of IV tPA), and risk factors for patients with ischemic stroke presenting to all 7 of the acute care hospitals in Washington, DC, including Howard University Hospital, Georgetown University Hospital, Washington Hospital Center, Providence Hospital, Sibley Memorial Hospital, and United Medical Center. Coordinator training included chart review protocols, documentation of acute stroke parameters (IV tPA eligibility, treatment, and discharge outcomes), cultural competence, and techniques for approaching patients and families. Coordinators conducted prospective stroke surveillance through identification of acute strokes from emergency department admissions using prespecified stroke screening terms. The stroke admission list was cross-referenced with each hospital’s neurology consultation service. Passive surveillance included identification by discharge International Classification of Diseases, Ninth revision, codes for acute ischemic stroke (433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, 436).

Table 1. Overview of the Multidimensional Nature of the Acute Stroke Program of Interventions Addressing Racial and Ethnic Disparities Intervention

<table>
<thead>
<tr>
<th>Phase</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
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<tbody>
<tr>
<td>Community</td>
<td>Barrier identification</td>
<td>Pilot and citywide intervention</td>
<td>Intervention sustainability</td>
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<tr>
<td></td>
<td>Materials development</td>
<td>Training DC stroke educators</td>
<td>Evaluation of intervention reach and impact</td>
</tr>
<tr>
<td>Hospital</td>
<td>Preintervention data collection/patient interviews</td>
<td>Hospital in-services</td>
<td>Postintervention data collection/patient interviews</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TJC stroke center certification assistance</td>
<td>Evaluation of stroke center certification assistance</td>
</tr>
<tr>
<td>DC EMS</td>
<td>EMS in-services</td>
<td>EMS patient interviews</td>
<td>Evaluation of changes in tPA utilization</td>
</tr>
<tr>
<td></td>
<td>Implementation of stroke transport protocol</td>
<td></td>
<td>Measurement of changes in tPA utilization</td>
</tr>
<tr>
<td></td>
<td>Collaborative community outreach efforts</td>
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</table>

DC indicates District of Columbia; ED, emergency department; EMS, emergency medical services; TJC, The Joint Commission; and tPA, tissue-type plasminogen activator.
A key objective of ASPIRE was to work with hospitals to attain primary stroke center certification through The Joint Commission (TJC). These hospitals already had neurology consultation available in the ED and an infrastructure to provide tPA. Physician stroke champions, who were already stroke leaders within their hospitals, were identified at each hospital to introduce ASPIRE and encourage participation.

A comparison group of 5 hospitals in Baltimore, MD, reported data annually by passive surveillance on the total number and demographics of acute ischemic strokes (identified by discharge International Classification of Diseases, Ninth revision, codes and patients treated with IV tPA). These hospitals had similar demographics and urban location but had no ongoing culturally focused stroke education efforts. This allowed us to capture secular trends in tPA utilization, which would be important in evaluating the effect of ASPIRE in DC.

**Washington, DC, EMS**

As part of the multilevel intervention, the ASPIRE team met quarterly with Washington, DC, EMS (DC EMS) to review and optimize stroke EMS protocols, discuss study progress, work with EMS database staff to link EMS log sheets to ASPIRE subjects, and evaluate potential increase in EMS utilization during the course of the study. The ASPIRE team worked with EMS database staff to identify all potential stroke cases residing in the DC metro area as defined by zip code and ward number. Each case had a unique EMS record number, which was also recorded in medical records when patients arrived at the hospital. EMS record numbers were retrieved for all ASPIRE cases as part of chart abstraction. If an EMS record number was missing, other variables (sex, age, address, and so on) were used to link EMS data with medical record data.

**Phase 2: Intervention**

**Community**

In July 2009, ASPIRE initiated a single DC ward pilot preparedness intervention to test the feasibility of identifying all stroke admissions with linkage to EMS utilization for the 6 months before and after intervention periods and to optimize the ASPIRE educational materials. The 1-year citywide ASPIRE intervention began in fall 2010, expanding the pilot intervention efforts to reach residents of all 8 DC wards. Educational sessions were administered at senior centers, schools, employee sites, churches, health centers, and other community organizations and included identification and training of a point person at each site to provide ongoing ASPIRE education.

**Hospital**

At the hospitals, a major effort was undertaken by the study team to work with physician stroke champions, including quarterly check-ins, to obtain updates on TJC stroke center certification. The ASPIRE team shared order set templates, provided guidance in recruitment of key personnel, and provided stroke education and training through clinical and research in-services. Stroke preparedness bracelets and magnets were provided for distribution to staff and patients.

**ASPIRE partnered with American Heart Association sponsored DC Stroke Collaborative to assist in DC EMS’s April 2009 diversion protocol, which required DC ambulances to transport all suspected stroke cases to a DC-certified primary stroke center. The research protocol was modified such that hospital data collected on patients with acute stroke presenting to DC emergency departments would evaluate the effect of this transport modification on stroke patient arrival times and treatment.**

**Phase 3: Postintervention Evaluation**

After completion of the citywide intervention, ASPIRE educational materials served as ongoing outreach resources. For the subset of community participants invited to participate in stroke knowledge assessments before and after education sessions, 6-month follow-up surveys were administered. Coordinators documented postintervention acute stroke data parameters. Structured interviews on ED arrival, barriers to calling 911, risk factors, and stroke knowledge were conducted with a subset of patients arriving within 3 hours and matched controls. These interviews included soliciting information about whether the patient had received prior stroke education and if so, from what source (eg, ASPIRE). ASPIRE documented progress toward TJC stroke center certification. DC EMS personnel shared ED and final stroke reports, providing data on dispatch and paramedic stroke impressions, transport times, hospital locations, and patient demographics.

**Statistical Analysis**

The ASPIRE intervention was designed to intervene at the individual/community, EMS, and hospital levels, and each level will be evaluated separately. The primary objective of ASPIRE is to compare tPA treatment rates pre- and postintervention in DC hospitals. Power was based on an a priori assumption of a difference between baseline (preintervention) tPA treatment rates and postintervention rate and assumed an increase from 2% to 5% with a secular increase of 1%. Sample sizes were estimated using $\chi^2$ tests with 1-sided type I error of 5% and 80% power and further adjusted to account for the within-cluster correlation in hospital using an inflation factor based on an assumption that care is different in different hospital settings.

The asymptotic $Z$ test will be used to evaluate the statistical significance of pre-post intervention increase in the percentage of tPA treatment of all patients with ischemic stroke in the DC Intervention hospitals combined, after adjusting for any secular increase in tPA treatment rates. For secondary analyses, multiple logistic regression models will be used to extend the primary analysis by examining the effect of age, sex, race, and health insurance status on change in tPA utilization before and after the intervention period. The proportion of tPA utilization among eligible patients during the baseline and postintervention periods will be compared using the same method.

In the evaluation of the hospital-based interventions, change in benchmark times for patients within 3 hours of symptom onset before and after the intervention will be measured. To evaluate the EMS interventions, change in response time from 911 call to ED arrival will be measured before and after the intervention phase.

**Preliminary Results**

Between January 2008 and February 2009, coordinators collected demographic and acute stroke parameters on 1256 patients with ischemic stroke. Of the subjects from the pre-intervention period with arrival times <48 hours, the median arrival time to the ED was 9 hours, and 20% presented <3 hours. Coordinators administered 373 structured interviews to patients with acute ischemic stroke arriving within 3 hours of last known well and matched controls arriving >3 hours.

In the pilot feasibility study, 50 education sessions were conducted in church, civic, educational, and work organizations during a 6-month period in DC’s ward 7. Pre-post pilot intervention acute ischemic stroke parameters were compared, and EMS data were integrated into this data set (Table 2).

Before intervention, 142 ischemic strokes were identified in ward 7 (mean age, 63 years; 63% men; and 96% black). Fifty-six percent arrived via EMS, with a mean and median time to arrival of 1600 minutes (27.0 hours) and 890 minutes (14.8 hours). After intervention, 115 ischemic stroke cases were identified (mean age, 66 years; 47% men; and 89% black). Fifty percent arrived via EMS, with a mean and median arrival time of 1423 minutes (23.7 hours) and 815 minutes (13.6 hours). Overall, there was a modest increase in cases arriving in the 4.5-hour group (pre 25% versus post 28%; $P=0.05$).
During the citywide intervention year (2010–2011), 531 community intervention sessions (Figure) were conducted, reaching >10,256 participants. A total of 3289 intervention evaluations were completed, and >19,000 preparedness bracelets and 14,000 stroke warning magnets were distributed. Training in stroke knowledge, community education, research protocols, and cultural competence was conducted for 58 volunteer DC Stroke Educators to assist with ASPIRE’s citywide intervention efforts. DC Stroke Educators included health professionals and a diverse group of community members. Concurrently, and in collaboration with National Institute of Neurological Disorders and Stroke Office of Communications, ASPIRE disseminated stroke preparedness messages through a 1500 bus citywide advertisement campaign. Additional social marketing included articles in local newspapers, interviews for area radio, and social media sites.

Coordinators from ASPIRE and information specialists from the EMS Fire Safety Education office met regularly to exchange information on upcoming outreach opportunities, allowing both parties to maximize community engagement. ASPIRE worked with EMS staff on 12 community sessions, piloting a partnership beneficial to organizations seeking both stroke preparedness education and risk factor measurements.

At the end of the intervention, 4 hospitals were TJC primary stroke centers. Two hospitals were in preparation for TJC review and were recognized as DC Department of Health primary stroke centers in 2011.

**Discussion**

ASPIRE was a multilevel intervention targeting acute stroke preparedness in the community, hospital, and EMS level, with the overall goal of increased IV tPA utilization in underserved black communities in the DC metro area. Several interventions have actively addressed preparedness, with mixed success in different populations including patients with stroke, adult communities, and youth.2,3,9,27 The Temple Foundation Stroke Project increased the tPA treatment rate for all patients with ischemic stroke 4-fold above baseline after intervention (2.2%–8.6%) but was limited in establishing temporal relationships between knowledge and preparedness.28 The ASPIRE project extends this work with specific and measurable preparedness deliverables at the community, hospital, and EMS level to reduce stroke treatment disparities. ASPIRE’s design addresses previously identified variables linked to racial treatment disparities, including limited awareness, access to care, socioeconomic status, patient mistrust, and clinician bias.10–16 The ASPIRE findings to date highlight the complexity underlying racial treatment disparities and emphasize the importance of systemic changes in hospitals where underserved patients are more likely to receive their care. Although the primary objective of this study is to increase the number of stroke patients treated with IV tPA, prespecified secondary outcomes include pre-post intervention assessments of EMS utilization, hospital arrival times, and an evaluation of the health economics of a multilevel citywide intervention.

**Table 2. Pre-Post Acute Stroke Program of Interventions Addressing Racial and Ethnic Disparities Feasibility Study in Ward 7**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Preintervention</th>
<th>Postintervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic strokes</td>
<td>142</td>
<td>115</td>
</tr>
<tr>
<td>Sex (female)</td>
<td>37%</td>
<td>53%</td>
</tr>
<tr>
<td>Mean age</td>
<td>63</td>
<td>66</td>
</tr>
<tr>
<td>Proportion using EMS</td>
<td>56%</td>
<td>50%</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, other</td>
<td>4%</td>
<td>11%</td>
</tr>
<tr>
<td>Black</td>
<td>96%</td>
<td>89%</td>
</tr>
<tr>
<td>Mean time from onset to ED</td>
<td>1600 min (27 h)</td>
<td>1423 min (23.7 h)</td>
</tr>
<tr>
<td>Median time from onset to ED</td>
<td>890 min (14.8 h)</td>
<td>815 min (13.6 h)</td>
</tr>
<tr>
<td>Arriving &lt;4.5 h</td>
<td>25%</td>
<td>28%</td>
</tr>
</tbody>
</table>

ED indicates emergency department; and EMS, emergency medical services.

**Figure.** Distribution of types of community organizations for Acute Stroke Program of Interventions Addressing Racial and Ethnic Disparities intervention.
The methodology applied to the ASPIRE project demonstrates numerous strategies needed to approach acute stroke preparedness at key levels of impact (EMS, hospital, community). Using a community-engaged approach to establish trust, we identified key barriers to preparedness and designed educational materials to address these issues.

The intensive hospital baseline data collection demonstrated race disparities in treatment with tPA within DC. Furthermore, in the ASPIRE feasibility pilot, there was a trend toward early acute stroke presentation after intervention, suggesting that multidimensional community efforts toward stroke preparedness may be successful. Implementation of citywide interventions can be a moving target, and we learned that flexibility is the key to sustaining relationships. EMS had great interest in outreach collaboration, and our ongoing partnership in educating communities speaks to the potential sustainably for this program beyond ASPIRE research funding.

Implementing processes to ensure sustainability is a key component of multilevel interventions. ASPIRE was designed to promote sustainability through (1) overall increase in awareness of stroke preparedness through enhanced education of EMS and hospitals, (2) stroke center certification of all DC hospitals that provide systems for ongoing delivery of acute stroke care, (3) education of lay and medical communities through train-the-trainer sessions of key stakeholders and identification of medical stroke champions, and (4) development of accessible materials that can be adapted nationwide. A key component to sustainability of ASPIRE was a change in DC EMS policy that required diversion of patients with stroke to primary stroke- certified centers. The hospitals that participated in ASPIRE were engaged to varying degrees in the process of stroke center certification, and part of this process included a financial commitment, which was enhanced by DC EMS policy. ASPIRE leveraged this opportunity to provide support to these hospitals through shared resources. If a hospital had no interest in treating patients with stroke, they would not have been involved in ASPIRE.

The ASPIRE intervention results will inform optimal strategies for stroke preparedness at individual and citywide levels. Furthermore, given the burden of disparities in stroke, it will be of critical interest whether ASPIRE will be a model for reducing disparities in acute stroke treatment among black urban populations.

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Disclosures
None.

References
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