

Interventional and New Approaches to Stroke Prevention

Education Strategies for Stroke Prevention

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Stroke is a major public health burden in the United States, with indications that stroke is emerging as a global epidemic. Furthermore, there exists an appreciation that focus on clinical treatment alone will not significantly reduce the burden of stroke, including morbidity and mortality. Emphasis needs to shift to acknowledging the importance of behavioral change science. The focus of this monograph is to provide insight into considerations for the development of theory-based interventions for reduction of stroke through behavioral change.

The Science of Behavioral Change is a complex endeavor, and addressing the lifestyle changes during the life course needed to reduce the burden of stroke remains a significant challenge. Areas of exploration include an understanding of the acquisition of vascular risk behaviors; identifying and testing mechanisms for changing existing behaviors; identifying strategies that optimally support the maintenance of health behaviors; and choosing the appropriate level for behavioral change (ie, individual change versus population level or structural change). Part of understanding behaviors includes making predictions about why people behave the way they do. Behavioral theory used in the design of interventions allows us to assess an individual's readiness to take action toward healthier behaviors. An accompanying theoretical platform, such as the transtheoretical model, provides the framework for the type of strategy or process needed to guide individual or system interventions through the stages of change, including action and maintenance.

An important epidemiological feature of cerebrovascular disease concerns the sharp gradients in morbidity and mortality by race-ethnicity. Indeed, some of the earliest educational materials for stroke prevention have been suboptimal because of the generic nature of information without reference to place or culture. For example, trust is a concern among many African American and Hispanic communities and low-income populations. Effective interventions in minority communities have established trust by building relationships with community members and organizations. Successful community engagement strategies include engaging in conversation with the community to inform about the issues; designing curriculums to focus a dialogue; establishing collaborative leadership models; and sharing use of resources.¹

Other important components of any intervention design include a focus on health-literate materials and cultural

tailoring. Examples of health-literate and cultural tailored educational materials include American Heart/American Stroke Association Power to End Stroke Program and the Massachusetts Department of Health Video.²

For decades, a sense of nihilism permeated stroke research stemming from a clinical frustration about the lack of realistic stroke treatments, poor recovery prognosis, and the inability to change risk behaviors. However, literature exists to suggest individual level behavioral change is possible and that different modalities for change (ie, in-person, Web-based remote delivery) are successful. Even the most intractable behaviors, such as weight loss, have been successfully addressed with individual interventions. Appel et al³ demonstrated a significant decrease of $\geq 5\%$ initial weight loss in 41% of participants randomized to in-person support group, 38% randomized to Web-based support, and 14% in control group ≥ 24 months.

For cerebrovascular disease, further consideration is needed about specific types of behaviors and what types of strategies optimally achieve change. We suggest that interventions need to focus on 2 key areas of behavior modification: stroke preparedness and stroke prevention. With the emergence of tissue-type plasminogen activator in 1996, there has been an emphasis on reducing stroke morbidity and mortality through increased action during acute stroke.⁴ Being prepared to take action requires individuals to be able to recall and recognize stroke warning signs, learn how to call 911, facilitate a dialogue about stroke, and navigate the emergency department so appropriate stroke codes are activated. Preparedness behavior may be best characterized by achieving competency skills that require short-term interventions with reinforcement.⁴

Several interventions have actively addressed preparedness with mixed success in different populations (Table). One study reported that widespread acute stroke education was associated with a 10% decrease in the proportion of stroke patients presenting within 3 hours of symptom onset.⁵ Morgenstern group demonstrated that an aggressive, multilevel stroke educational intervention program can be effective in promoting behavioral change.⁶ They reported an increase in intravenous tissue-type plasminogen activator treatment from 1.38% to 5.75% among all cerebrovascular event patients in the intervention community ($P=0.01$) compared with a change from 0.49% to 0.55% in the comparison community ($P=1.00$).⁶

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Table. Summary of Major Primary, Secondary Prevention, and Preparedness Stroke Interventions

Study	Intervention Strategies	Outcome Measures
Stroke preparedness		
Temple Foundation Stroke Project ⁶	Community level social marketing campaign I	Community level acute stroke parameters
KIDS ⁸	Community engaged Culturally tailored module Dissemination to parents	Prepost 3-dimensional knowledge preparedness, stroke physiology, and risk factors school children and parents
HIP HOP Stroke ⁹⁻¹¹	School based Culturally tailored, Hip Hop Song Cartoons Dissemination to parents	Prepost (3 mo) knowledge in preparedness and risk factors school children and parents
Beauty shop ¹²	Community engaged Train the trainer Focus on African American women	Knowledge of stroke warning signs, preparedness and risk factors
SWIFT ^{13,14,22}	RCT Stroke and TIA patients Culturally tailored Hospital based Multimedia Interactive group sessions Motivational interviewing Patient narratives Bracelets	Measurement of individual acute stroke parameters in recurrent events
SWIFT community	Stroke-free community based Randomized community organizations Free risk factor screening Multimedia Interactive group sessions Motivational interviewing Patient narratives	Prepost (1 y) knowledge in preparedness, and risk factors in multiethnic adults
ASPIRE ¹⁵	City-wide Train the trainer Community engaged Group sessions/health fairs Use of bracelets, magnets Acute stroke messages on buses	Comparison of city-wide prepost intervention acute stroke parameters
Primary stroke prevention		
SHARE ¹⁶	Community engaged Culturally tailored Church-based, video, motivational interview, Partner support	Reduction in vascular risk factors, including BP Change in lifestyle behaviors
Secondary stroke prevention		
PROTECT ¹⁷	Structural integration of care with systematic evidence based, disease management program Nurse focused	Hospital discharge treatment and adherence rates
ICARUSS ¹⁸	RCT systems model Shared care-specialist and general practitioner Nurse coordinator Education and clinical communication	Reduction in vascular risk factors, including BP Change in lifestyle behaviors including physical activity
SUSTAIN ¹⁹	Structural intervention Chronic care model with care manager Poststroke discharge Groups sessions, self -instruction	Measurement of BP at 6 mo after discharge Lifestyle and adherence measures Cost Analysis
PROTECT DC ²⁰	RCT Community health worker hospital-based initiation of secondary prevention strategies	Reduction in vascular risk factors including BP at 1 y Mortality

(Continued)

Table. Continued

Study	Intervention Strategies	Outcome Measures
DESERVE	RCT Mild stroke and TIA patients Discharge strategy Culturally tailored and bilingual staff Community health workers Chronic care model Patient-based educational videos Skill-based focus	Reduction in vascular risk factors including BP at 1 y Change in lifestyle behaviors, including physical activity Lifestyle and adherence measures Difference in recurrent stroke events Cost analysis
PRAISE ²¹	RCT Self-identified stroke Community-based peer education workshops vs. usual care Culturally tailored and bilingual staff Flexible participant scheduling	Reduction in vascular risk factors, including BP at 1 y
FURRTHER	RCT Culturally tailored Family-friendly support networks, family-based counseling	Measurement of BP at 1 y in stroke patients and family networks

BP indicates blood pressure; RCT, randomized controlled trial; and TIA, transient ischemic attack.

Other programs have focused on the basis of theory, educational interventions to improve intent to call 911 for stroke among children.⁷⁻⁹ The Kids Identifying and Defeating Stroke (KIDS) was a pilot, randomized, controlled trial to encourage calling 911 for witnessed stroke among middle-school children and their parents.⁸ A comparison of knowledge change between intervention and control students was $P < 0.001$ for each of the 3 individual domains of stroke pathophysiology, stroke symptom knowledge, and stroke preparedness. Unfortunately, dissemination of this knowledge was suboptimal because of poor parental response.⁸ Similarly, the Hip Hop Stroke intervention, with its timely music and catchy phrases, demonstrated improved stroke knowledge and behavioral capability to activate emergency services at 3-month follow-up.⁹ A larger randomized trial of Hip Hop is ongoing in New York City.^{10,11} The community placed health-literate beauty shop intervention in African American women improved knowledge of stroke warning signs and calling 911, and this knowledge was sustained for ≥ 5 months.¹² Although these studies have focused on increased knowledge and behavioral intent (ie, will call 911), data from the Stroke Warning and Information and Faster Treatment Study (SWIFT) specifically measured preparedness outcomes in a randomized group of 1200 stroke and transient ischemic attack (TIA) patients.¹³ SWIFT found that $\geq 45\%$ of stroke/TIA patients randomized to health-literate educational materials; and 46% of stroke/TIA patients randomized to intensive inpatient intervention returned to the emergency department within 4.5 hours of recurrent stroke onset. This is compared with 18% at baseline and 20% in an urban control group.¹⁴ The data also suggested that after-stroke reinforcement may be as effective as hospital interventions.¹⁴ The Acute Stroke Program of Interventions Addressing Racial and Ethnic Disparities (ASPIRE) study is a multidimensional program aimed at community, hospital, and emergency medical services for acute stroke preparedness targeted to increased intravenous tissue-type plasminogen activator usage in underserved black communities in the DC metro area.¹⁵ A pilot feasibility study of 1 DC ward reported preintervention mean and median time to arrival of 1600 minutes (27.0 hours) and 890 minutes (14.8 hours), respectively. After the intervention, mean and median time to arrival was 1423

minutes (23.7 hours) and 815 minutes (13.6 hours), respectively. In addition to this modest decrease in overall arrival times, an increased proportion of cases arriving in the 4.5-hour group was noted (pre 25% versus post 28%; $P = \text{NS}$).¹⁵

Behavioral strategies focused on both primary and secondary preventions may be more complex. Indeed, prevention requires a different set of skills and actions taken during the life course. Primary prevention programs focused on prevention of hypertension, diabetes mellitus, and increased healthy behaviors are relevant for reduction of all cardiovascular risk and will not be addressed here. The Stroke Health and Risk Education study is an educational intervention study aimed at primary stroke prevention for Mexican Americans and non-Hispanic whites using a community-based participatory research approach.¹⁶ Vascular risk reduction is a critical target in the prevention of secondary stroke, as demonstrated in the evidence-based guidelines. Strategies include modification of lifestyle behaviors and medication adherence targets. Motivation and reinforcement may be 2 key components for successful and sustainable lifelong interventions. With regard to intervention design, 2 distinctly different approaches to secondary prevention of stroke have emerged: (1) community engaged, and (2) structural. Behavioral economics suggest that we can compel action through structure. A focus on structural interventions include the integration of behavioral strategies, such as medication adherence into existing structures or systems allowing for process evaluations and use of quality indicators to test success of implementation.

As a structural intervention, the Preventing Recurrence of Thromboembolic Events through Coordinated Treatment (PROTECT) study included integration of a quality initiative program, which mandated documentation of discharge medications among stroke/TIA patients.¹⁷ This discharge intervention demonstrated success in increasing adherence to stroke discharge medications during the first year after stroke and reported 90-day adherence rates of 100% antithrombotics, 99% statins, 92% angiotensin-converting enzyme, 99% statins, 80% thiazides.¹⁷ The primary aim of the Integrated Care for the Reduction of Secondary Stroke (ICCARUS) study was to promote the management of vascular risk factors through ongoing patient contact and education via the

integrated care reduction of secondary stroke model, involving collaboration between a specialist stroke service, a hospital coordinator, and a patient's general practitioner.¹⁸ At 12 months after stroke, systolic blood pressure decreased in the integrated care group and increased in controls ($P=0.04$).¹⁸ The Families Understanding Risk Reduction through Educational Reinforcement (FURRThER) pilot study uses family and friend networks as a structural platform for vascular risk reduction. The ongoing Systematic Use of Stroke Averting Interventions (SUSTAIN) program seeks to improve the delivery of secondary stroke preventive services after hospital discharge. This care intervention includes group clinics, self-management support, report cards, decision support through care guides and protocols, and coordination of ongoing care.¹⁹

There is an ongoing concern that vascular risk reduction programs have not been widely implemented or successful in reducing risk factors outside of a trial setting because interventions have not included community infrastructure or addressed behavioral barriers to vascular risk factor reduction, including health literacy, patient physician communication, and risk perception. There are numerous ongoing studies that have integrated components of community engagement into secondary stroke prevention. PROTECT DC piloted the use of community health workers as vehicles for reducing disparities in risk control after stroke.²⁰ Prevent Recurrence of All Inner-City Strokes Through Education (PRAISE) a community-based peer education workshop versus usual care among self-identified stroke survivors, demonstrated significant improvements in blood pressure control in intervention versus control groups.²¹ The Discharge Educational Strategies for Reduction of Vascular Events (DESERVE) study of mild stroke and TIA patients, currently underway, incorporates a chronic care model of vascular risk management strategies with emphasis on integration of skills related to risk perception, medication adherence, and patient/physician communication.

This is an exciting time for behavioral interventions in stroke. As indicated above, there are a substantial number of interventions currently underway. Each of these trials will add unique information and ultimately inform optimal strategies for both stroke prevention and stroke preparedness. Key issues surrounding intervention design that still need to be resolved include cost, optimal reinforcement strategies, and the appropriate use of usual care for testing behavioral interventions because even educational brochures systematically distributed can be considered an intervention. Furthermore, given the burden of disparities in stroke, it may be that although these interventions equalize the field, the disparities gradient continues to exist. Indeed, equalizing the playing field is a good first step but not enough, and continued work identifying mechanisms and designing strategies addressing disparities will be critical. Finally, dissemination and implementation of successful intervention strategies must be underwritten so that what is successful in a few communities can be disseminated to all.

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