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Hip Hop Stroke: Statewide Dissemination and Implementation of an Evidence-based Stroke Preparedness Intervention

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Abstract

Regulatory requirements governing Stroke Center accreditation include community stroke education; however, these efforts are often suboptimal and lacking evidence-based approaches. The goal of this trial is to disseminate an evidence-based stroke preparedness program targeting elementary school children, Hip Hop Stroke (HHS), to New York State's Stroke Systems of Care. Using a Hybrid-Effectiveness Implementation Type 3 design, and guided by Consolidated Framework for Implementation Research (CFIR), we aim to disseminate HHS to a heterogeneous (urban, suburban, and rural) population of schools via 47 New York State Stroke Centers through a partnership with the New York State Department of Health (NYSDOH). We will: 1) identify contextual factors, such as barriers and facilitators, which influence uptake of the program at the Stroke Center and local school levels, 2) determine whether Stroke Center implementation of the HHS program leads to increased stroke preparedness of local students; 3) assess the determinants of high performance implementation and effectiveness under real world practice conditions, and 4) evaluate the costs associated with HHS program implementation. Community education is an underdeveloped component of Stroke Systems of Care. This study aims to address this gap by studying contextual factors that impede or facilitate the uptake of an evidence-based community education program across a heterogeneous population.

Keywords: Stroke; Dissemination and implementation; Hip Hop Stroke; Stroke centers; Randomized clinical trial

Abbreviations: HHS: Hip Hop Stroke; t-PA: thrombolysis therapy; RCT: Randomized Clinical Trial; NYC: New York City; NYSDOH: New York State Department of Health; CFIR: Consolidated Framework for Implementation Research; IC: Implementation Champions; RE-AIM: Reach Effectiveness Adoption Implementation Maintenance

Introduction

A mere 7% of ischemic stroke events in the US receive thrombolysis (t-PA) therapy [1] due to delayed hospital arrival, most often related to the failure to recognize stroke symptoms and to call 911 immediately. Efforts to improve the public's stroke preparedness have been driven by mass media stroke education campaigns usually conducted by Stroke Associations and Departments of Health that include public service announcements and print advertising. However, these efforts have failed to have an effect on ambulance use (the major determinant of early hospital arrival) beyond the funding period for the specific media campaign. Stroke Centers may represent more sustainable channels for public stroke education promoting the use of ambulance services. State Departments of Health and accrediting agencies such as the Joint Commission regulate Stroke Center hospitals through a certification process that requires the fulfilment of certain stroke care measures. Notably, one of these regulatory requirements is community stroke education by the hospital; but these are underdeveloped, and typically lack guidelines and evaluation metrics. Consequently, the majority of stroke education efforts by Stroke Centers do not use evidence-based approaches [2].

Analysis of mass media campaigns have shown: (a) poor penetration within Black and ethnic minority populations [3], (b) an effect on the general population that is not sustained beyond the media campaign period [4], and (c) may have no effect when using "donated" advertising media due to inadequate exposure [5]. Starting in 2005, our group has focused on these limitations in an effort to improve the effectiveness, uptake, and dissemination of community education interventions addressing stroke.

Hip Hop is the most popular American musical genre [6] and appeals to a large youth population, including White youth who purchase 60-80% of all hip hop music [7], making it a good vehicle for broadly distributed public health communications [8].

Drawing on this background, we developed a school-based stroke preparedness intervention for Blacks and ethnic minorities called Hip Hop Stroke (HHS), which has been built through pilot studies [9-13] and a randomized trial [14] to improve community stroke knowledge.

These programs were developed iteratively using community engagement techniques by a transdisciplinary team that included target-age students, an Emmy award winning children's media producer, a well-known rapper, a hip hop producer-songwriter, a behavioral scientist, teachers, and neurologists. These programs, which demonstrated efficacy [9-13] and later effectiveness [15,16], included interactive, multimedia programming delivered live in local schools. The programs comprised three 1-hour modules containing culturally tailored stroke messaging embedded in narrative cartoons, hip-hop music, and an interactive stroke video game, which can be played at home with parents and family caregivers.

A recent cluster randomized clinical trial (RCT) involving 3070 fourth through sixth graders and 1144 parents from 22 schools located in economically disadvantaged ethnic minority communities of New York City (NYC)[15] demonstrated the effectiveness of HHS in improving stroke preparedness as measured by a validated stroke knowledge instrument [16]. This instrument utilized hypothetical stroke scenarios to measure behavioral intent to call 911 for suspected stroke. Moreover, several participating children during the course of the trial appropriately called 911 for real life stroke occurring in family members [16].

In addition to the effects on stroke preparedness and 911 behaviors, we found high levels of program acceptance by school administrators. Hip Hop Stroke modules likely have broad appeal because they also include primordial prevention strategies focused on teaching healthy lifestyle behaviors (e.g., diet and exercise), and all program content has been aligned with health education standards that help schools fulfil health education requirements.

The current trial aims to disseminate a modified, computer and classroom-based version of HHS now called Hip Hop Stroke 2.0 – see Figure 1 across an entire state by leveraging the infrastructure of stroke systems as an alternative to traditional mass media approaches. This approach may help sustain the practice of evidence-based community stroke education, which is the least developed component of stroke systems. Unlike the more advanced in-hospital stroke processes and guidelines from regulatory bodies, the metric used by Stroke Center accrediting agencies with regards to community education is "to provide at least two stroke education activities per year to the public." No further details or guidelines are provided for this regulation, although recently, an evaluation component has been added to these activities as a requirement by some accrediting agencies.

New York State has one of the largest stroke systems of care in the US, with 120 hospitals designated as primary Stroke Centers. The New York State Department of Health (NYSDOH) application for Stroke Center designation is a voluntary process, although most (two-thirds) NYS hospitals are currently designated as Stroke Centers. Under NYS law, ambulances carrying suspected stroke patients by-pass non-stroke certified hospitals in favor of the nearest certified Stroke Center, which they pre- notify, alerting the receiving hospital that a stroke patient is en route. Despite this, low rates of ambulance use and correspondingly low rates of thrombolysis (7- 8.7%) persist [17,18], leaving a knowledge gap regarding best practices for improving 911 activation for suspected stroke at the community level.

Therefore, our primary aims are:

Aim 1: To identify contextual factors, such as barriers and facilitators that influence the uptake of the HHS 2.0 program in a heterogeneous sample of Stroke Centers and schools across New York State

Aim 2: To determine whether Stroke Center implementation of the HHS 2.0 program leads to increased stroke preparedness of local students by cross-validating outcomes with the results of our RCT.

Aim 3: To assess the determinants of high performance implementation and effectiveness of HHS 2.0 under real world practice conditions

Aim 4: To evaluate the costs associated with HHS 2.0 program implementation

Figure 1: Two elementary school children in action on the Hip Hop Stroke online portal in a public school computer lab.

Methods

Trial design

The overarching framework governing Hip Hop Stroke is the social-ecological model (Figure 2) [19]. At the intrapersonal/individual level, HHS targets knowledge, attitudes, and beliefs of children regarding stroke. At the interpersonal level, HHS utilizes child-mediated communication to improve stroke preparedness, attitudes and beliefs of parents and relatives of the children. At the organizational level, HHS improves awareness of stroke and calling 911 in local schools through children and the teacher involved in the program, and also engages hospitals as mediators of this process. At the community level, HHS seeks to change social norms regarding 911 behaviors for stroke by making the 911 call for suspected stroke the default decision, and at the policy level, HHS leverages regulations requiring Stroke Centers to conduct public stroke education in the communities they serve. The current trial uses a Hybrid Effectiveness-Implementation Type 3 design informed by Consolidated Framework for Implementation Research (CFIR) to engage the NYSDOH, Stroke Centers, schools and students. This hybrid design tests our implementation strategy in a new setting with a more heterogeneous sample, while enabling analyses of the impact on stroke preparedness.

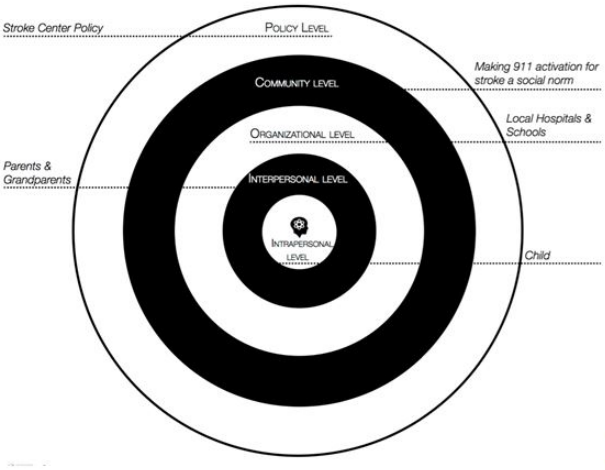

Figure 2: Social Ecological Model of Hip Hop Stroke showing the different levels of influence impacted by the intervention. These include the policy level, community level, organizational level (hospitals, schools), interpersonal level (parents), and intrapersonal level (child).

Role of the New York State Department of Health (NYSDOH)

To encourage successful adoption and implementation of HHS 2.0 across NYS, we have established a strong partnership with the NYSDOH. Given their longstanding regulatory relationships with hospitals and experience with quality improvement initiatives, the NYSDOH is in a unique position to facilitate statewide adoption of HHS. A Public Health Specialist within the NYSDOH was assigned to work with the state's Coverdell Stroke Centers to help implement the HHS program in elementary schools located in each hospital's catchment area. The responsibilities of the Public Health Specialist include: (1) working with the research team to promote and market the Hip Hop Stroke program, (2) performing hospital recruitment activities and monitoring participation, (3) utilizing the NYSDOH Coverdell Learning Collaborative to increase uptake of the program by Stroke Centers, (4) facilitating webinar training of stroke coordinators on implementation procedures, (5) assessing fidelity to implementation procedures at the Stroke Center level, and (6) facilitating program sustainability at the NYSDOH through processes independent from the research.

Participants

The research team will recruit 47 NYS designated Stroke Centers from diverse geographical locations (urban, suburban, rural). Each Stroke Center will be responsible for disseminating the HHS program to a minimum of two elementary/middle schools within their local catchment area.

Recruitment

Stroke centers: An introductory letter was sent out by the NYSDOH to all NYS designated Stroke Centers including the 47 Coverdell stroke directors to solicit participation. Stroke Centers who express interest are approached by the research team and enrolled in the program. Due to the critical role Stroke Center coordinators play in ensuring compliance with regulatory requirements, including community education, these individuals will serve as the HHS 2.0 implementation champions (IC) at their respective hospitals. Implementation champions will subsequently undergo a web-based training module that is facilitated by the HHS team, and engage their community health departments where available. The training module reviews all aspects of program implementation including local school recruitment.

Following the training, stroke coordinators in each Stroke Center will recruit a minimum of two local schools for program implementation, consistent with the biannual community stroke education requirement for NYSDOH Stroke Center certification. Importantly, through existing relationships and experience with school systems, the HHS team will provide school recruitment support beyond just training to stroke coordinators who require additional support. The biannual community education Stroke Center designation requirement will be fulfilled through the implementation of the HHS 2.0 program in at least two separate schools each year. The target month for program implementation by hospitals is May, which is National Stroke Month – a time when many hospitals, stroke associations, and public health departments are engaged in stroke awareness activities. Recruited schools are required to have 4th and/or 5th grade classes, which are the target grades for HHS. Schools signing on to the program will be asked to identify a school champion at the administration level who will work with classroom facilitators (e.g. teachers, computer lab supervisor, wellness instructors) on implementation procedures.

Inclusion/exclusion criteria: All NYSDOH designated Stroke Centers are eligible for recruitment into this study. Regarding local schools, eligibility criteria include: availability of 4th and/or 5th graders, presence of adequate computer and internet access for students, and not a special education school with a student body comprised of those with learning disabilities. We have evaluated project- relevant characteristics of school systems in each of the 47 NYS hospitals participating in the Coverdell stroke program and have ascertained the following: (1) a sufficient number of local schools (at least two) are available for recruitment, (2) schools with 4th and/or 5th grade student bodies have at least 50 students in each of these grades, (3) the range of schools reflect diverse socio-demographic NYS communities, and (4) a majority of schools have the computer and internet resources required to access the HHS online portal.

Formative evaluation

Guided by the Consolidated Framework for Implementation Research, we will conduct semi-structured interviews with Stroke Center leadership from a representative sample of Coverdell hospitals by telephone, videoconferencing, or in-person. We will include at least 24 hospitals (~50% of the total sample). All 3 rural hospitals in our Coverdell cohort will be included and the remainder will be comprised of an even distribution of urban/suburban and academic/non-academic institutions. These interviews will be designed to identify factors that may influence program uptake including: (1) barriers and facilitators to adoption, (2) the best way to meet Stroke Center certification needs, and (3) potential costs associated with adoption and implementation. Data from these interviews will be used to refine implementation procedures incorporated into the Stroke Center webinar training and procedures manual. Each Stroke Center coordinator from recruited hospitals will then complete the training

webinar that will include school recruitment strategies, implementation support for the HHS curriculum, and a biannual school program fidelity check process.

Summary of the Hip Hop Stroke dissemination model

The HHS state wide dissemination model involves a partnership with the NYSDOH, which is responsible for accrediting Stroke Centers. Dissemination will include the following broad steps: 1) Engagement of NYS designated Stroke Centers by the NYSDOH and introduction of HHS 2.0; 2) Web-based training of stroke coordinators and key members of the stroke teams at hospitals who will serve as IC; 3) Engagement of local schools in the stroke hospital's catchment area by ICs; 4) Adoption of HHS 2.0 by local schools; 5) Web-based training of local school champions; and 6) Implementation of HHS 2.0 by classroom facilitators at local schools.

Implementation outcomes

We will include the following implementation outcomes: (1) Stroke Center adoption, implementation, and maintenance, and (2) local school adoption, implementation, and maintenance. We will use the CFIR to evaluate implementation, including determinants of high performance implementation (i.e., successful implementation with high fidelity and maintenance), effectiveness (assessed by student scores), and costs associated with implementation. Our evaluation, which is based on the RE-AIM approach (Table 1) [20], will support the translation of research findings into practice and evaluate the public health impact of the program. RE-AIM constructs will assess the HHS program impact at the organizational (i.e., Stroke Center and school), and at the individual (student) levels. Specifically, we will assess "effectiveness", which refers to the outcomes of the program, by examining the Stroke Centers' community education goals, the teachers' training and competency assessments, and the students' pre-post stroke preparedness scores. Student stroke preparedness scores will be assessed via a pre- and post-test validated questionnaire [21] embedded in the online program. Data from these questionnaires populate a centralized Redcap database linked to the HHS portal. Adoption refers to the agreement (percentage) of Stroke Centers to disseminate to schools, schools to disseminate to students, and students' participation. Implementation is the extent to which the Stroke Centers delivered the HHS program to schools, and the schools to the students, as intended (fidelity), as well as the respective implementation costs (through the creation of level-specific accounts). Characteristics of successful schools will be documented, as well as implementation barriers. At the organizational level, maintenance (i.e., the sustainability of the HHS program) will be appraised by the continued contact between Stroke Centers and schools to ensure continued implementation and fidelity of the program at the school and student levels.

Adoption and implementation

Implementation champions (stroke coordinators) will recruit at least two schools from their local community and facilitate at least two HHS programs a year – one program at each school. We will include all students from 4th and/or 5th grade classrooms at each school. Grade teachers or other school staff overseeing the computer-based implementation in the classroom (classroom facilitators) will be directed to the HHS 2.0 portal by the school administration program liaison (school champion) and asked to take a 15 minute training webinar. Implementation champions at participating Stroke Centers will be given an electronic program introduction package containing the web link for school program registration and the online curriculum. This electronic package will be used to recruit and enroll local schools, along with digital versions that can be downloaded and printed. To foster relationship building, ICs will be encouraged to recruit schools in-person, motivate school champions to promote the program within their schools, and monitor completion of classroom facilitator training. ICs will assess fidelity of classroom implementation by: (1) reviewing the online activity of students and assessing whether each module is fully completed, and (2) quantifying the amount of time spent on program tasks by school champions and classroom facilitators via phone or in-person interviews.

Re-aim constructs	Stroke center	School	Student
Effectiveness	Achieve community education goals	Achieve health education goals	Pre-Post Test Stroke preparedness scores using S.L.A.M instrument
Adoption	Agree to disseminate to school	Agree to disseminate to students	Agree to participate
Implementation	Implementation champion Training school Recruitment Fidelity checks	Creation of school account. Classroom Facilitator Training	Create personal student account. Complete modules
Maintenance	Continued school contact to ensure at least 2 years of implementation	Implementation for at least 2 years	Continue engaging website for at least 2 years

Table 1: RE-AIM evaluation of Hip Hop Stroke

Post-evaluation maintenance and dissemination activities

We will ask Stroke Centers who adopt the program to promote continued yearly implementation of HHS 2.0 in recruited schools and/or recruit new schools (with 4th and/or 5th graders) using similar procedures. If the program is implemented in the same schools, implementation champions will remind the school champions to refer classroom facilitators to a brief online training refresher course and track: (1) teacher turnover, (2) which elements of the program were repeated, and (3) whether the program was modified over the year (administered to lower/higher grades, time interval between modules, etc.). Finally, in the year following the completion of the initial wave of implementation of HHS 2.0 in local schools and completion of effectiveness outcome data collection, ICs will receive downloadable digital copies of the HHS cartoons from the HHS team. These cartoons will be accompanied by specific recommendations for their usage; for example, showing them on hospital flat screen televisions in waiting

rooms and lobby areas, as part of programming on patient bedside televisions, or as part of community lectures and professional lectures to providers during National Stroke month.

Sample size calculation

The second aim of this study is to determine whether Stroke Center implementation of the HHS leads to increased stroke preparedness of local students by cross-validating outcomes with the results of our RCT.

The design is a pre-post evaluation of students who receive the training intervention. We will randomly select a minimum of 18 of the 47 Stroke Centers. There will be two schools (each with Nc=2 classrooms of 4th and/or 5th graders and an average of Ns=25 students per class) with 50 children each for a total of 36 schools and 1800 children. We have three levels of clustering: children nested within classrooms, nested within schools. Although schools are also nested within regions, because we are selecting Stroke Centers at random and accounting for the clustering within schools, we will treat region as a fixed effect. Based on previous research, we specify the intracluster correlation coefficient (ICC) for class as 0.03. We posit a lower ICC at the school level (0.015). We assume that knowledge is measured with error (reliability=0.95). We assume that the values for ρ (the correlation between pre- and post-tests) will be 0.4 and 0.5.

Power for examination of 3-level cluster sampling and evaluation of pre- and post-intervention scores, treating preparedness as binary (assuming examination of effects within intervention subjects).

Using the canonical link (Logit), the generalized linear model (GLIMMIX): $\eta=\log(pijk/(1-pijk))=\beta0+\beta1\ Tijk+FUjk$, with i students, j classes and k schools where FUjk is the random effect associated with school and class, T=0 is the pre-test and T=1 is the post-test, with variance inflation factor (VIF).

Table 2 assumes α=0.05, power (1-β=80%), adjusted for reliability (R=0.95) and clustering: VIF=2.095 (with ns=25, ICCclass=0.03, Nc=2, ICCschool=0.015). The proportion passing the test (operationalized as getting all the items correct) is assumed to be 2% at pre-test and as high as 55% at post-test: p0=2% and p1=55%. Sample sizes were calculated for the McNemar test statistic examining change from pre- to post-test. As shown, with power of 80%, ρ=0.4, sample sizes as low as 24 will permit detection of relatively large effect sizes. However, more conservative differences in proportions were also used for some scenarios. Assuming smaller effect sizes, the sample sizes required are larger (500 to 600 students). If lower reliability is observed, larger sample sizes will be needed. The sample size posited (around 1800) will permit subgroup analyses, e.g., ethnic/racial composition, with inclusion of contextual variables, e.g., stroke hospital characteristics such as staffing, Stroke Center and school resources.

Statistical analysis for effectiveness

A generalized linear model with a canonical (logit) link will be modeled using GLIMMIX. McNemar's test statistic for change from pre- to post-test will be examined for significance. Sensitivity analyses will be performed with GEE. Subgroup analyses will be conducted by inclusion of interaction terms for moderator variables.

Power Analyses					**McNemar's Method**	**Generalized Estimating Equation (GEE) Method**
Pre-test rate	Post-test	Effect size (Pre-post)	M (total number of children) (ρ=0.4)	M (ρ=0.5)	M (ρ=0.4)	M (ρ=0.5)
2%	55%	53%	5	24	46	43
5%	40%	35%	41	38	48	43
10%	30%	20%	95	83	96	82
10%	20%	10%	279	238	282	238
10%	15%	5%	925	777	930	779
5%	10%	5%	603	512	618	523

Table 2: Power Analyses Literacy (passing) rate P(y=1)

Comparison of outcomes to prior study

The initial study was an RCT with 1,414 predominantly Black and Hispanic students in the control arm and 1,656 in the intervention. In that study it was observed that while the control and intervention groups both started out with stroke preparedness scores of about 1 to 2%, the intervention group improved to 57%. Because we have access to these data we will be able to compare intervention effects from that study to those observed in the proposed study. For the proposed project there are 3 levels of clustering and 1,800 subjects. The generalized linear model will be: $\eta=\log(pijk/(1-pijk))=\beta0+\beta1\ Xijk+FUjk+\beta CO\ XCO$, where FUjk is the random effect term associated with school and class and Xco is the covariate set. The analysis of the difference between the original RCT and this intervention will be performed using SAS Proc GLIMMIX, with adjustment for pre-test differences and for unreliability and clustering. The binary outcome is passing the stroke preparedness test.

Assessing the determinants of high performance implementation and effectiveness under real world practice conditions

Using data from Aim 1 and Aim 2, we will analyze contextual data from each Stroke Center in relation to the data generated from implementation variables in Table 1. Multivariate models such as logistic regressions and Poisson regressions (analyses to model count

data) will be used to assess how and which factors/elements influenced the adoption, implementation, and maintenance of the intervention at the Stroke Center and the local school levels. At the most elemental level, counts of the number of schools that have implemented the program, the number of students who complete the program, and counts of teacher training will be examined. Mediating (control) variables for these analyses will consist of influential factors for these outcomes, i.e., intervention characteristics, outer setting, inner setting, characteristics of the individuals involved, and the process of implementation as outlined in the Consolidated Framework for Implementation Research.

Data collection and management

HHS is comprised of three 45-minute, self-administered modules that can be conducted in a school computer lab (Figure 1). Schools will receive the link to the online curriculum and teacher training webinar from their local Stroke Centers with instructions on how to access and implement the content. Upon completion of the HHS modules by students, the implementation champion will receive an email alert and a link to access student test results containing de-identified data collected from each school. These data will provide information about the number of schools that have implemented the program, the number of students that complete the program, as well as raw pre/post-test data. Furthermore, data for developing cost estimates will be obtained through a combination of Stroke Centers' and schools' administrative records, information collected as part of the Stroke Center leadership interviews, and time-use data.

Evaluating the costs associated with HHS program implementation

Determination of organizational and system-wide costs associated with implementing HHS is a complex task. A comprehensive approach would require consideration of overall use of medical and non-medical resources, taking into account the opportunity costs and possible constraints on availability of these resources. Given the many sources of uncertainty, and our desire to obtain cost estimates that may be readily used by different stakeholders, we will conduct cost analyses from two complementary perspectives: 1) implementing agencies (primary cost analysis) and 2) society as a whole. We will first estimate costs, and variations therein, based on the experience of participating Stroke Centers and schools (implementing agencies). Estimates of the total cost of the HHS program, by its key components and activities, and costs per participant will be calculated using the resource cost method. A secondary cost analysis will take broader societal interests into account by including, in addition to program's costs, estimates of the opportunity cost for facilities', students' and teachers' time (e.g., foregone alternative uses of health class time and resources) and potential cost savings associated with the program (e.g., simulated estimates of reduced disability and mortality secondary to stroke based on assumptions about the relationship between improved stroke literacy and stroke morbidity and mortality rates of family members). These analyses will provide a useful framework for evaluating HHS 2.0 and place it in the context of similar interventions as long-term data on educational interventions with a health component become more plentiful.

Estimating costs

Data for developing cost estimates will be obtained through a combination of Stroke Centers' and schools' administrative records, information collected as part of the Stroke Center leadership interviews, and time-use data.

The principal measures of cost pertain to: (a) personnel or labor resources associated with implementing the program, (b) non-personnel operating resources, (e.g., equipment, supplies and facilities), and (c) indirect costs. Personnel resources will include direct service staff time and the proportion of management and administrative staff time allocated to the HHS program at the Stroke Centers and schools. For example, based on FTE proportion assigned to the program, the cost associated with each Stroke Center program director or coordinator in charge of training, supervising and supporting school recruitment and retention or the costs associated with each school's representatives in charge of championing HHS and supervising its classroom-based implementation. Non-personnel resources include supplies and materials, equipment, office/computer lab space, and transportation. The value of personnel and non-personnel resources will be categorized into direct and indirect costs, with indirect costs estimated using each agency's established indirect cost rate and applying it to direct costs, following the same procedure used by each agency. A similar approach will be used to assess the value of alternative uses of facilities', teachers' and students' time in order to calculate the opportunity cost of these resources for the societal-perspective cost analysis (Evaluation costs, such as those incurred with data collection and development of analytical databases, will not be included in the cost estimates).

Sensitivity analyses will be conducted to estimate the extent to which our cost estimates change with adjustments in assumptions or cost parameters. Given the relatively high costs of medical and non-medical resources in New York, for example, personnel and non-personnel resources will be valued at their actual sites as well as using national averages for comparable unit item or service (e.g., national average hourly salary/benefits for a program manager based on the Bureau of Labor Statistics).

Variation in total and average per participant costs, from both implementing agencies' and societal perspectives, will be examined across the multiple sites with respect to several stroke hospital characteristics, including academic versus community hospital, socioeconomic and demographic characteristics of the hospital's catchment area, extent of time allotment for community education, and related Stroke Center resources (e.g., available transportation to schools, presence of a community outreach department). We will further examine how the proportions of specific types of costs (e.g., personnel, indirect costs) vary across sites.

Discussion

The stroke system of care serves three critical functions: (1) to ensure effective interaction and collaboration among those involved in the provision of stroke-related prevention, community education, transportation, treatment, and rehabilitation services in the region, (2) to promote the use of an organized and standardized approach in each facility and component of the system, and (3) to identify process and outcome performance measures and an evaluation mechanism [22]. The impact of stroke systems on the quality of care provided to stroke patients has been substantial. Stroke patients evaluated at certified Stroke Centers are more likely to receive t-PA and less likely to die than those evaluated at non-certified hospitals [23-25]. Nevertheless, major challenges remain, specifically those related to community stroke education and 911 activation to the extent that no significant change

has occurred in the proportion of patients who arrive within the time window for thrombolysis with t-PA [1]. This is despite the fact that patients are more likely to be treated when they arrive within the time window due to improved intra-hospital processes.

The importance of community education is further highlighted by studies demonstrating that interventions designed to educate the public to seek treatment for stroke sooner may increase thrombolysis rates. Indeed one study projected that thrombolysis rates would increase to 57% if emergency medical system response times and in-hospital response times are optimized, while another found that if all patients with known stroke symptom onset times had called 911 immediately, 24% more patients would have received thrombolysis [26].

The overall goal of the current study is to increase the uptake of an evidence-based community stroke education program by NYS designated Stroke Centers. If successful, this approach may represent a more sustainable and cost effective method than is currently offered by mass media campaigns, and lead to improvement in community stroke preparedness and related treatment outcomes.

Declarations

Ethics approval and consent to participate

The protocol and informed consent forms were approved by the Institutional Review Board of Columbia University. Consent for participation in the study will be obtained from all parents of participating students using an opt-out mechanism, and assent will be obtained from each participating child.

Consent for publication

Consent for publication will be obtained from all participating authors.

Competing interests

All the authors disclose that there are no conflicts of interest relevant to this trial.

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Authors' Contributions:

Daudet Ilunga Tshiswaka and Olajide Williams: drafted the entire manuscript, Jeanne Teresi: drafted the analytical section and edited the manuscript. James Noble, Luisa Gomez-Chan, Janhavi Mallaiah, Joseph P. Eimicke, Jian Kong, Stephanie Silver, Ian Brissette, Krystal Parrigan, Liliana E. Pezzin, and Gbenga Ogedegbe: reviewed the manuscript and made revisions and further edits.

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