Using Mobile Video-Teleconferencing to Deliver Secondary Stroke Prevention Interventions: A Pilot Study

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Abstract

Objectives: Patient self-management support (SMS) interventions help stroke survivors control stroke risk factors and assist with secondary prevention. We examined utility and preliminary effectiveness of mobile video-teleconferencing (VT) to deliver SMS to stroke survivors in rural and low-income urban Texas communities.

Methods: We applied a within-subjects design to assess improvement in self-management behaviors and stroke risk factors among stroke survivors receiving SMS intervention through mobile VT. Adults with stroke and two or more uncontrolled stroke risk factors were eligible. The SMS program, Video-teleconference-Self-management TO Prevent stroke (V-STOP) was delivered over 6 weeks by trained health coaches through VT. We applied Generalized Estimating Equations with site and time in intervention as covariates to evaluate psychological, social, physiological outcomes, self-management behaviors, and quality of life.

Results: Mean age of 106 participants was 59.3 (±10.9); most were White, Hispanic men, living with someone, with low income. Approximately 69% completed all measures at 6 weeks. Median number of sessions attended was 5 (interquartile range 3) potentially avoiding 210 km of travel per person. Satisfaction with V-STOP and VT delivery was high, at (4.8 [±0.5]) and (4.7 [±0.5]), respectively. Stroke knowledge was improved from 8.8 (±1.0) at baseline to 9.6 (±0.7) at 12 weeks, (p < 0.0001). Improvements were observed in self-efficacy, exercise behaviors, depression and anxiety, disability, and quality of life.

Conclusion: Implementation of SMS is feasible and shows good utility and preliminary effectiveness of using mobile VT to provide stroke follow-up care to stroke survivors. Participants improved self-management behaviors and stroke risk factors.
Introduction

In the United States, ~800,000 people have a stroke each year, resulting in tremendous personal and financial burden. For decades stroke has remained the leading cause of long-term disability worldwide.1,2 Unfortunately, 30% of strokes that occur each year are second strokes, which have poorer outcomes and are costlier than first strokes. Most strokes are preventable through management of controllable vascular risk factors.3–5 Prevention of second stroke and other vascular events requires secondary prevention interventions that target stroke etiology and incorporate individualized risk-factor management plans. Self-management support (SMS) interventions have been developed to help stroke survivors meet the difficulties and challenges of stroke recovery and secondary prevention.6–10 However, evidence-based delivery methods for SMS within the poststroke care continuum and under less structured clinical conditions remain undetermined. Some previous studies indirectly address the principal questions being asked in this study.11–13

We believe that no studies have been conducted to address the best delivery method for SMS using programs like Video-teleconferencing Self-management TO Prevent stroke (V-STOP) using mobile video teleconferencing (VT), as the V-STOP program was designed for secondary stroke prevention specifically related to the self-management of controllable stroke risk factors. However, recently a few more studies have been published that synthesize the evidence of the effectiveness of SMS in improving health-related outcomes for stroke survivors using telehealth. These reviews discovered a positive effect on various self-management outcomes for poststroke patients. However, the authors recognized that the tailored interventions with well-defined content and mode of telehealth delivery with targeted outcomes and quality measures should further be explored.14–16

Therefore, with recent exponential growth in telehealth, effective delivery of SMS using mobile VT applications needs to be examined.17–21 Mobile VT has great potential to improve access to secondary stroke prevention and SMS for stroke survivors living in rural and low-income urban communities.22

Methods

Multiple methods were applied to establish utility and preliminary effectiveness of using mobile VT to provide stroke follow-up care and SMS to stroke survivors living in rural and low-income urban communities in Texas.23 The investigators applied a within-subjects pilot design to assess improvement in self-management behaviors and stroke risk factors among stroke survivors receiving a stroke SMS intervention while at home through a VT application. We used a VT application that was accessible on mobile devices and personal computers. However, all participants in the study used a mobile device such as a smartphone or tablet computer to participate in the intervention.

Setting and sample selection

The study was implemented within the Lone Star Stroke Consortium (LSSC; https://lonestarstroke.com), a research network of academic medical centers (hub sites) linked to affiliate community hospitals and clinics (spokesites) across Texas. Institutional Review Board approval was obtained from the LSSC academic hub site and coordinating center. Convenience sampling was applied, using an electronic medical record (EMR) algorithm in five LSSC affiliate spoke sites that serve higher numbers of stroke survivors from rural and low-income urban communities.

Criteria for participation

Patients >18 years of age receiving care in an LSSC facility were screened for participation, based on the following criteria: a history of ischemic stroke within 12 months and two or more uncontrolled stroke risk factors; the ability to read and speak English or Spanish; and access to a smartphone, tablet, or computer with capability to load a mobile VT application. Patients with severe cognitive deficits, aphasia, medical record documentation of being medically or mentally unstable, or inability to follow-up (homelessness or incarceration) were excluded.

Participant enrollment

Screening and recruitment were conducted between March 2017 and June 2019. A sampling pool of 1900 patients aged 18 years or older, with a diagnosis of ischemic stroke within the past 12 months, was identified, using an EMR algorithm. Prescreening through EMR chart review was completed on all patients. A total of 715 patients were excluded from the sampling pool, leaving 1185 patients identified for
screening. Initial contact to introduce the study was established during hospital admission or during a follow-up clinic visit. Patients indicating interest in the study were contacted through telephone to complete the screening questionnaire.

Among the 1185 patients identified for screening, 365 (31%) patients were identified for recruitment. Of those, 193 (53%) signed informed consent and enrolled in the study. Of patients enrolled, 154 (78%) completed the baseline assessment and 106 (55%) initiated the study by completing at least one V-STOP intervention session through mobile VT (Fig. 1).

Study procedures
The SMS intervention was V-STOP—a stroke SMS program developed by the investigators and adapted for telehealth delivery in the Veterans Health Administration.6–8 The intervention was delivered using a centralized telehealth delivery model. Five trained health coaches at the LSSC hub site used a point-to-point mobile VT application to deliver V-STOP to stroke survivors at home through their personal smartphone, tablet, or computer. All coaches had graduate degrees that focused on health prevention and promotion, such as public health and nursing. Each of the three coaches carried out exactly 19 group sessions. Of the two coaches conducting individual sessions, Coach 1 carried out 38, and Coach 2, 19 sessions.

The V-STOP intervention is a 6-week SMS program that consists of three group education sessions and three individualized coaching sessions. Group sessions were delivered simultaneously over the 6 consecutive weeks to up to 10 participants per session, who were invited to attend by clicking on a mobile VT meeting link sent through e-mail. Sessions were for 90 min and focused on development of self-management skills and strategies for addressing the specific and unique needs of stroke survivors. All sessions were provided using a scripted format to ensure implementation fidelity.

Individualized coaching sessions were delivered one-on-one to each participant. A trained health coach met individually with each participant, using a mobile VT meeting link sent through e-mail. Each coaching session was 30 min. Participants were coached in identification and management of their personal stroke risk-factor profile and guided in developing personalized self-management goals to reduce stroke risk. A secondary stroke-prevention and self-management protocol was used to guide each coaching session.

Data collection
Multiple repeated measures were collected at baseline, 6, 12, and 18 weeks to determine the utility and preliminary effectiveness of using mobile VT for secondary stroke prevention and SMS. Study data were collected and managed using Research Electronic Data Capture (REDCap; Vanderbilt University, Nashville, TN, USA), hosted by the LSSC hub site. REDCap is a secure web-based software platform designed to support data capture for research studies.

Measures
A baseline questionnaire was used to collect participants’ sociodemographic characteristics and personal health history. Utility was measured as access and acceptability of the V-STOP intervention. Access was determined as intervention attendance and completion rates. Acceptance was assessed using the V-STOP satisfaction survey and the Telemedicine Satisfaction Questionnaire. Multiple validated self-reported measures were used to determine preliminary effectiveness of the V-STOP intervention on participants’ self-management behaviors, stroke risk knowledge, psychological and physiological outcomes, and quality of life24–26 (Table 1).
Table 1. Assessment Measures

| Outcome                        | Assessment measure                                      |
|--------------------------------|--------------------------------------------------------|
| Self-management skills         | SES27, GAM-s28                                         |
| Stroke risk knowledge          | Stroke risk questionnaire29                            |
| Psychosocial health outcomes   | General Anxiety Disorders (GAD-7)30                     |
| Physiological health outcomes  | Depression scale (PHQ-8)31                              |
|                                | Disability HAQ-8 scale32                                |
|                                | BMI                                                     |
|                                | SF-1233                                                 |

BMI, body mass index; BP, blood pressure; EBS, Exercise Behavior Scale; GAD-7, 7-item Generalized Anxiety Disorder; GAM-s, goal attainment measure-stroke; HAQ-8, Health Assessment Questionnaire for Depression; PHQ-8, 8-item Patient Health Questionnaire for depression; QOL, quality of life; SES, Self-Efficacy Scale; SF-12, 12-item Short Form Survey.

Analysis plan

Participants’ sociodemographic characteristics, access, and acceptability measures were analyzed descriptively. Stroke risk knowledge was assessed with paired t-test. Means and medians were calculated for continuous variables and frequency for categorical variables. Longitudinal analysis was conducted for SMS effectiveness, using the Generalized Estimating Equations with site and time in intervention as covariates, using SAS® 9.4 software (SAS Institute, Cary, NC, USA). Outcomes evaluated were psychological (anxiety and depression), social (community integration), physiological (body mass index [BMI], blood pressure [BP], and disability), self-management behaviors (exercise behavior, self-efficacy, and goal attainment), and health-related quality of life.

Results

Sociodemographic characteristics

V-STOP was successfully delivered using mobile VT to 106 participants for 2 years. Mean age was 59.3 (±10.9), most were White, Hispanic, men, not living alone, and married, with low annual income, and lacking insurance. Demographic characteristics are presented in Table 2.

Utility: access and acceptability of mobile VT delivery

Approximately 54% of baseline participants completed all study questionnaire measures at 18 weeks, with 60% completing all measures at 12 weeks, and 69% completing all measures at 6 weeks. Of the study initiators (n = 106), 52 (49.1%) completed all six V-STOP intervention sessions; and 17 (16.0%) completed five sessions. Median (interquartile range [IQR]) number of sessions attended were 5 (IQR 3). Delivery of V-STOP using mobile VT eliminated 131 miles of travel per person over the 6-week intervention. Overall satisfaction with V-STOP and VT delivery was high at (4.8 [±0.5]) and (4.7 [±0.5]), respectively. Participants’ stroke knowledge was improved from 8.8 (±1.0) at baseline to 9.6 (±0.7) at 12 weeks, p-value <0.0001. Longitudinal analyses data for study outcomes are shown in Table 3.

Table 2. Participant Characteristics at Baseline (N = 106)

| Characteristics                                      | Frequency (%) n = 106 |
|------------------------------------------------------|-----------------------|
| Age years (mean±SD)                                  | 59.3 ± 10.9           |
| Gender                                               |                       |
| Male                                                 | 58 (54.7)             |
| Female                                               | 48 (45.3)             |
| Race                                                 |                       |
| White                                                | 87 (82.1)             |
| Black/African American                               | 18 (17.0)             |
| Native American/Alaska Native                        | 1 (0.9)               |
| Ethnicity                                            |                       |
| Hispanic/Latino                                      | 66 (62.3)             |
| Non-Hispanic/Latino                                  | 40 (37.7)             |
| Education                                            |                       |
| Less than high school                                | 23 (21.7)             |
| High school                                          | 41 (38.7)             |
| Some college                                         | 26 (24.5)             |
| College graduate or higher                           | 16 (15.1)             |
| Living status                                        |                       |
| Alone                                                | 15 (14.2)             |
| With someone                                         | 91 (85.9)             |
| Marital status                                       |                       |
| Single                                               | 50 (47.2)             |
| Married                                              | 56 (52.8)             |
| Employment                                           |                       |
| Not employed                                         | 26 (24.5)             |
| Employed/self employed                               | 29 (27.4)             |
| Disabled                                             | 23 (21.7)             |
| Retired                                              | 27 (25.5)             |
| Unknown/missing                                      | 1 (0.9)               |
| Annual income                                        |                       |
| <$25,000                                             | 62 (58.5)             |
| $25,000–$49,999                                      | 25 (23.6)             |
| $50,000–$74,999                                      | 11 (10.4)             |
| $75,000–$99,999                                      | 3 (2.8)               |
| Unknown                                              | 5 (4.7)               |
| Insurance coverage                                   |                       |
| Yes                                                  | 63 (59.4)             |
| No                                                   | 43 (40.6)             |
| Rurality                                             |                       |
| Urban                                                | 69 (65.1)             |
| Rural                                                | 30 (28.3)             |
| Missing/unknown                                      | 7 (6.6)               |
| Comorbidities                                        |                       |
| Arthritis                                            | 26 (24.8)             |
| Asthma                                               | 16 (15.2)             |
| Atrial fibrillation                                  | 11 (10.5)             |
| Heart failure                                        | 28 (26.7)             |
| Hypertension                                         | 92 (87.6)             |
| Diabetes                                             | 63 (60.0)             |
| Depression                                           | 22 (21.0)             |
| Baseline PHQ-8 ≥ 10                                  | 32 (30.5)             |
| Baseline GAD-7 ≥ 10                                  | 32 (30.5)             |

SD, standard deviation.
Table 3. Longitudinal Analyses for Study Outcomes

| Domain | Outcome | Time point (weeks) | $\beta$ estimate | 95% confidence limits | $p$  |
|--------|---------|-------------------|------------------|-----------------------|-------|
|        |         | BL (ref)          |                  |                       |       |
|        |         | 6                 | 0.6386           | 0.5316–0.7670         | <0.0001* |
|        |         | 12                | 0.6789           | 0.5289–0.8815         | 0.0024* |
|        |         | 18                | 0.6612           | 0.4973–0.8791         | 0.0044* |
| Psychosocial outcomes | Psychological Depression (PHQ-8) | | |
|        |         | 6                 | 0.6639           | 0.5483–0.8040         | <0.0001* |
|        |         | 12                | 0.6067           | 0.4784–0.7693         | <0.0001* |
|        |         | 18                | 0.6561           | 0.5096–0.8447         | 0.0011* |
|        |         | BL (ref)          |                  |                       |       |
|        |         | 6                 | 1.0627           | 0.9803–1.1522         | 0.0285* |
|        |         | 12                | 1.0118           | 0.9407–1.0883         | 0.7525 |
|        |         | 18                | 1.0810           | 1.0082–1.1590         | 0.1399 |
|        | Psychological Anxiety (GAD-7) | | |
|        |         | BL (ref)          |                  |                       |       |
|        |         | 6                 | 1.0254           | 0.9455–1.1119         | 0.5450 |
|        |         | 12                | 1.0071           | 0.8978–1.1297         | 0.9036 |
|        |         | 18                | 0.9412           | 0.8823–1.0040         | 0.0661 |
|        | Social Community integration (CIQ) | | |
|        |         | BL (ref)          |                  |                       |       |
|        |         | 6                 | 1.0581           | 1.0175–1.1003         | 0.0047* |
|        |         | 12                | 0.9880           | 0.9418–1.0364         | 0.6206 |
|        |         | 18                | 1.0068           | 0.9557–1.0607         | 0.7978 |
| Physiological outcomes | Physiological BMI | | |
|        |         | BL (ref)          |                  |                       |       |
|        |         | 6                 | 0.9783           | 0.9265–1.0331         | 0.4306 |
|        |         | 12                | 0.8311           | 0.6413–1.0772         | 0.1621 |
|        |         | 18                | 0.6492           | 0.5112–0.8244         | 0.0004* |
|        | Physiological BP (diastolic) | | |
|        |         | BL (ref)          |                  |                       |       |
|        |         | 6                 | 1.0123           | 0.9650–1.0618         | 0.6169 |
|        |         | 12                | 0.9883           | 0.9451–1.0335         | 0.6069 |
|        |         | 18                | 0.9783           | 0.9265–1.0331         | 0.4306 |
|        | Physiological BP (systolic) | | |
|        |         | BL (ref)          |                  |                       |       |
|        |         | 6                 | 1.0179           | 1.0547–1.2061         | 0.0004* |
|        |         | 12                | 1.1279           | 1.0716–1.2527         | <0.0001* |
|        |         | 18                | 1.1779           | 1.0765–1.2957         | <0.0001* |
|        | Physiological Disability and function (HAQ disability) | | |
|        |         | BL (ref)          |                  |                       |       |
|        |         | 6                 | 0.8956           | 0.8294–1.0317         | 0.2645 |
|        |         | 12                | 0.8878           | 0.8222–0.9587         | 0.0024* |
|        |         | 18                | 0.9154           | 0.8444–0.9925         | 0.0321* |
| Self-management | Self-management Exercise behavior (time in minutes) | | |
|        |         | BL (ref)          |                  |                       |       |
|        |         | 12                | 1.4881           | 1.1743–1.8856         | 0.0010* |
|        |         | 18                | 1.7670           | 1.4248–2.1915         | <0.0001* |
|        | Self-management Self-efficacy for managing chronic disease (SE) | | |
|        |         | BL (ref)          |                  |                       |       |
|        |         | 12                | 1.1279           | 1.0547–1.2061         | 0.0004* |
|        |         | 18                | 1.1779           | 1.1076–1.2527         | <0.0001* |
|        | Self-management GAM-s | | |
|        |         | 3 (ref)           |                  |                       |       |
|        |         | 6                 | 0.9596           | 0.8924–1.0317         | 0.2645 |
|        |         | 12                | 0.8878           | 0.8222–0.9587         | 0.0024* |
|        |         | 18                | 0.9154           | 0.8444–0.9925         | 0.0321* |
| QOL | PCS QOL (SF-12) | BL (ref) | | | |
|        |         | 12                | 1.0296           | 0.9689–1.0940         | 0.3469 |
|        |         | 18                | 1.1114           | 1.0450–1.1820         | 0.0008* |
|        | MCS QOL (SF-12) | | |
|        |         | BL (ref)          |                  |                       |       |
|        |         | 12                | 1.1017           | 1.0441–1.1625         | 0.0004* |
|        |         | 18                | 1.1075           | 1.0550–1.1625         | <0.0001* |

Note: All longitudinal models are adjusted for study site and time in intervention.
*Represents significant p values.
BL, baseline; CIQ, Community Integration; MCS, mental component score; PCS, physical component score.
Self-management behaviors

Self-efficacy. Self-efficacy for managing chronic disease was measured using a 10-point level of confidence ranging from not at all, 0, to totally confident, with higher scores indicating higher levels of confidence. Mean (± standard deviation) and median (IQR) for self-efficacy (SE) was 7.0 (±2.0) and 7 (IQR 2.5) at baseline, 7.7 (±1.8) and (IQR 3.2) at 12 weeks, and 8.1 (±1.7) and 8.2 (IQR 2.8) at 18 weeks. SE increased from baseline to 12 weeks ($\beta=1.1, 95\% \text{ CI } 1.05$ to 1.21) and from baseline to 18 weeks ($\beta=1.2, 95\% \text{ CI } 1.11$ to 1.25).

Exercise behavior. Exercise behavior was measured as total time (in minutes) spent exercising per week. Mean number of minutes spent exercising was 117.5 (±128.0) at baseline, 191.5 (±128.1) at 12 weeks, and 207.4 (±144.7) at 18 weeks. Exercise behavior improved with more time spent exercising from baseline to 12 weeks ($\beta=1.49, 95\% \text{ CI } 1.17$ to 1.19) and baseline to 18 weeks ($\beta=1.77, 95\% \text{ CI } 1.43$ to 2.19). There was no change from 12 to 18 weeks ($p=0.07$).

Goal attainment measure. Goal attainment was measured beginning at 3 weeks as ability to complete assigned task, with higher score indicating better ability. Total participants at 3 and 12 weeks was $n=60$ (100%) but dropped to $n=58$ (96.8%) at 18 weeks. Mean goal attainment was 7.0 (±1.9) at 3 weeks, 7.0 (±2.0) at 4 weeks, 7.4 (±1.4) at 5 weeks, 7.1 (±1.6) at 6 weeks, 6.4 (±2.0) at 12 weeks, and 6.2 (±2.4) at 18 weeks. Goal attainment was lower at 12 weeks ($\beta=0.89, 95\% \text{ CI } 0.82$ to 0.96), as well as at 18 weeks when compared with 3 weeks ($\beta=0.91, 95\% \text{ CI } 0.84$ to 0.99) but did not change at 4 or 5 weeks when compared with score at 3 weeks ($p>0.05$).

Psychological health outcomes

Depression. Depression was measured using the 8-item Patient Health Questionnaire for depression (PHQ-8), with higher score indicating higher depression. Mean PHQ-8 score at baseline was 6.5 (±5.9), 6-week mean score was down to 3.9 (±4.1), 12-week score was 4.1 (±4.5), and 18-week score was 3.5 (±4.1). Depression scores improved ($p<0.05$) from baseline to 6 weeks ($\beta=0.62, 95\% \text{ CI } 0.51$ to 0.75), baseline to 12 weeks ($\beta=0.66, 95\% \text{ CI } -0.52$ to 0.85), and baseline to 18 weeks ($\beta=0.64, 95\% \text{ CI } 0.49$ to 0.84). The improvement at 6 weeks was maintained for 12 and 18 weeks.

Anxiety. Anxiety was measured using the 7-item Generalized Anxiety Disorder (GAD-7) assessment tool, with higher score indicating higher anxiety. Mean GAD-7 score at baseline was 6.4 (±6.9), 6-week mean score was 4.1 (±4.6), 12-week score was 3.4 (±4.7), and 18-week score was 3.3 (±4.7). Anxiety scores improved ($p<0.05$) from baseline to 6 weeks ($\beta=0.66, 95\% \text{ CI } 0.54$ to 0.80), baseline to 12 weeks ($\beta=0.61, 95\% \text{ CI } -0.48$ to 0.77), and baseline to 18 weeks ($\beta=0.66, 95\% \text{ CI } 0.51$ to 0.85). The improvement at 6 weeks was maintained for 12 and 18 weeks.

Physiological health outcomes

Body mass index. Attrition from baseline for physiological health outcomes was very high in this study sample. BMI assessment (self-reported) was 15% at 6 weeks, 12% at 12 weeks, and 14% at 18 weeks. BMI mean was 32.7 (±8.0) at baseline, 34.8 (±9.9) at 6 weeks, 35.5 (±9.0) at 12 weeks, and 30.8 (±7.4) at 18 weeks. Longitudinal analysis did not indicate any change in BMI.

Blood pressure. Attrition for self-reported BP measurement was also very high, with only 44% completing BP measure at 6 weeks, 12% at 12 weeks, and 22.6% at 18 weeks. Mean systolic and diastolic BP at baseline was 134.2 (±23.9) and 77.3 (±11.1), respectively; at 6 weeks was 134.5 (±22.3) and 81.8 (±10.5), respectively; at 12 weeks was 130.7 (±16.2) and 76 (±11.7), respectively; and at 18 weeks was 129 (±16.8), and 77.3 (±9.4), respectively. Diastolic BP increased from baseline to 6 weeks ($\beta=1.1, 95\% \text{ CI } 1.02$ to 1.10) but did not indicate any change between other time points ($p>0.05$). Systolic BP also did not show any change between any two time points ($p>0.05$).

Disability. Disability was measured using the Stanford Health Assessment Questionnaire, with higher score indicating higher perceived difficulty with daily activities. Mean score was 0.42 (±0.55) at baseline, 0.34 (±0.48) at 12 weeks, and 0.20 (±0.33) at 18 weeks. Perceived difficulty was reduced from baseline to 18 weeks ($\beta=0.65, 95\% \text{ CI } 0.51$ to 0.82), but no change was observed from baseline to 12 weeks ($p=0.16$).

Quality of life

Quality of life was measured using the 12-item Short Form Survey questionnaire with two component scores, physical and mental. Higher score indicates higher...
quality of life. Mean physical component score (PCS) and mental component scores (MCS) were, respectively, 41.8 (±10.6) and 47.5 (±11.0) at baseline, 42.7 (±10.0) and 51.7 (±11.4) at 12 weeks, and 46.8 (±8.6) and 52.3 (±8.9) at 18 weeks. PCS improved from baseline to 18 weeks (β = 1.1, 95% CI 1.05 to 1.18). However, no change was observed from baseline to 12 weeks (p = 0.35). The improvement in PCS was seen from 12 to 18 weeks (β = 1.1, 95% CI 1.03 to 1.14). Similar to PCS, the MCS improved from baseline to 18 weeks (β = 1.1, 95% CI 1.06 to 1.16). Improvement in MCS was also seen from baseline to 12 weeks (β = 1.1, 95% CI 1.04 to 1.16).

Longitudinal analyses for study outcomes are presented in Table 3.

**Discussion**

Expansion of telehealth services may be an important strategy to mitigate challenging social determinants of health and health vulnerability.17,34,35 In this pilot study we examined the utility and effectiveness of using a mobile VT application to deliver secondary stroke prevention and SMS to a sample of stroke survivors challenged by low income and other social determinants of health. It has already been mentioned that health interventions delivered through mobile VT have strong empirical support from research studies. However, their implementation and effectiveness under less structured clinical conditions have not been well demonstrated.

Results indicate mobile VT is feasible for delivery of secondary stroke prevention and SMS among stroke survivors with health vulnerability. Mobile VT delivery showed good utility as an alternative to traditional in-person clinic follow-up. Attendance and completion rates for VT-STOP were comparable with traditional in-person SMS programs.36,37 Moreover, high satisfaction scores for the SMS program and mobile VT delivery showed VT to be highly acceptable among participants. Finally, access to SMS and secondary stroke prevention was improved by eliminating 131 miles of in-person travel for participants over the 6-week intervention, thus supporting telehealth modalities as a strategy to improve access to stroke follow-up care.

Study findings indicate SMS delivered using mobile VT is effective for managing depression and anxiety and supports community integration after stroke. During the study, participants were encouraged to set risk-reduction goals using goal setting and action planning methodology.38 Our results parallel existing evidence from the systematic review reporting positive effects of the telemedicine SMS interventions on all self-efficacy outcomes.16 However, it is important to point out that the telehealth delivery type most used in selected studies was messaging.

Participants also demonstrated significant improvement in stroke risk knowledge and confidence for managing stroke risk factors. Upon completion of V-STOP, participants showed significant improvement in perceived disability and overall quality of life.

More research is needed to determine how best to incorporate telehealth modalities into routine clinical practice for delivery of stroke follow-up care.16 Our research raises several important questions that require further investigation. We experienced challenges with recruitment and retention. Many patients were excluded due to being medically unstable at the time of recruitment. A primary reason may be related to having a sampling pool that included currently hospitalized stroke survivors. Participants’ attrition and visit compliance were an issue.

Similar problems were reported by Kendall et al39 and Cadilhack et al.40 In addition, self-reported data contributed to a response bias, hence creating problems with accurate measures to model health outcomes. To control response bias, part of the group educational sessions was devoted to educating participants in self-reported data collection. We provided trainings on the correct way to measure BP and factors that affect BP readings. For additional information we provided relevant links to the American Stroke Association and Centers for Disease Control websites.

The organizational structure in which the program was delivered, staff turnover, and a lack of deeper understanding of the individual health challenges of medically underserved stroke survivors need to be addressed in future studies.

Overall, this pilot study was successful in establishing the feasibility, utility, and preliminary effectiveness of using mobile VT to provide stroke follow-up care and SMS to stroke survivors in medically underserved communities in Texas. The study showed improvement in self-efficacy and exercise behavior receiving a stroke SMS intervention while at home through mobile VT.

Although this is encouraging, this observational pilot study has limited generalizability, as there was no randomization; and we targeted a small sample of medically underserved stroke survivors in Texas. This was intentional as a first step in evaluating mobile VT as a strategy to provide secondary stroke prevention and
SMS to health-vulnerable communities in Texas. A future study with a large sample size and inclusion of a comparison group is planned.

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Conceptualization, data curation, formal analysis, funding acquisition, investigation, and methodology by J.A.A., B.K., C.P.V.R., and T.A.K. Project management and administration, resources, software, and supervision by B.K., A.O., and C.C.-S. Statistical analysis, validation, and visualization by J.A.A., B.K., and S.S. Writing—original draft by J.A.A., S.S., and B.K. Review and editing by all authors.

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References
1. Benjamin EJ, Muntner P, Alonso A, et al. Heart disease and stroke statistics—2019 update: A report from the American Heart Association. Circulation 2019;139(10):e56–e528; doi: 10.1161/CIR.0000000000006599
2. Virani SS, Alonso A, Aparicio HI, et al. Heart disease and stroke statistics—2021 update: A report from the American Heart Association. Circulation 2021;143(8):e254–e743; doi: 10.1161/CIR.0000000000000950
3. Feigin VL, Krishnamurthi R, Pamar P, et al. Update on the global burden of ischemic and hemorrhagic stroke in 1990–2013: The GBD 2013 Study. Neuroepidemiology 2015;45(3):161–176; doi: 10.1159/000441085
4. Esmwa C, Gutierrez J. Secondary stroke prevention: Challenges and solutions. Vasc Health Risk Manag 2015;11:437–450; doi: 10.2147/VHRM.S63791
5. Feigin VL, Roth GA, Naghavi M, et al. Global burden of stroke and risk factors in 188 countries, during 1990–2013: A systematic analysis for the Global Burden of Disease Study 2013. Lancet Neurol 2016;15(9):913–924; doi: 10.1016/S1474-4422(16)30073-4
6. Anderson J, Godwin KM, Petersen NJ, et al. A pilot test of videoconferencing to improve access to a stroke risk-reduction programme for Veterans. J Telemed Telecare 2013;19(3):153–159; doi: 10.1177/1357633X13479073
7. Anderson JA, Willson P, Godwin KM, et al. Use of a clinical video teleconference (CVT) technology model to implement patient self-management to prevent stroke. Internet J Adv Nurs Pract 2014;13(1).
8. Anderson JA, Godwin KM, SALEEM J, et al. Accessibility, usability, and usefulness of a Web-based clinical decision support tool to enhance provider–patient communication around Self-management TO Prevent (STOP) Stroke. Health Informatics J 2013;20(4):261–274; doi: 10.1177/1460458213493195
9. Warner J, Packer T, Villeteneuve M, et al. A systematic review of the effectiveness of stroke self-management programs for improving function and participation outcomes: Self-management programs for stroke survivors. Disabil Rehabil 2015;37(23):2141–2163; doi: 10.3109/09638288.2014.996674
10. Sakakibara BM, Kim AJ, Eng JJ. A systematic review and meta-analysis on self-management for improving risk factor control in stroke patients. Int J Behav Med 2017;24(1):42–53; doi: 10.1007/s12480-016-9582-7
11. Harrison CE. Using telehealth in the management of hypertension. Nurs Stand 2017;31(48):44–49; doi: 10.7748/nst.31.48.44.s59
12. Laver KE, Adey-Wakeling Z, Crotty M, et al. Telehabilitation services for stroke. Cochrane Database Syst Rev 2020;1:CD010255; doi: 10.1002/14651858.CD010255.pub3
13. Litchman ML, Kwan BM, Zittleman L, et al. A telehealth diabetes intervention for rural populations: Protocol for a randomized controlled trial. JMIR Res Protoc 2022;11(6):e34255; doi: 10.2196/34255
14. Oh HX, De Silva DA, TohZA, et al. The effectiveness of self-management interventions with action-taking components in improving health-related outcomes for adult stroke survivors: A systematic review and meta-analysis. Disabil Rehabil 2021;1–16; doi: 10.1080/09638288.2021.2001057
15. Sakakibara BM, Lear &A, Barr SI, et al. Telehealth coaching to improve self-management for secondary prevention after stroke: A randomized controlled trial of Stroke Coach. Int J Stroke 2022;17(4):455–464; doi: 10.1177/17474930211017699
16. Hwang NK, Park JS, Chang MY. Telehealth interventions to support self-management in stroke survivors: A systematic review. Healthcare 2021;9(4):472; doi: 10.3390/healthcare9040472
17. Bagchi AD. Expansion of telehealth across the rural–urban continuum. State Local Gov Rev 2019;51(4):230–258; doi: 10.1177/0160323X20929053
18. Dorsey ER, Topol EJ. State of telehealth. New Engl J Med 2016;375:154–161; doi: 10.1056/NEJMra1601705
19. HealthIT.gov. Telemedicine and telehealth. 2017. Available from: https://www.healthit.gov/topic/health-it-health-care-settings/telemedicine-and-telehealth [Last accessed: September 9, 2022].
20. HealthIT.gov. Social determinants of health. 2021 update: A report from the American Health Association. J Telemed Telecare 2013;19(3):153–159; doi: 10.1177/1460458213493195
21. HealthIT.gov. Social determinants of health. 2021. Available from: www.healthit.gov/topic/health-it-health-care-settings/social-determinants-health [Last accessed: May 3, 2020].
22. Health IT.gov. Federal Health IT Strategic Plan | HealthIT.gov. Available from: www.healthit.gov/topic/health-it-health-care-settings/social-determinants-health [Last accessed: March 29, 2022].
23. Kapral MK, Austin PC, Jeyakumar G, et al. Rural-urban differences in stroke risk factors, incidence, and mortality in people with and without prior stroke. Circulation 2019;12(2):e004973; doi: 10.1161/CIRCOUTCOMES.118.004973
24. Myers MG. Reporting bias in self-measurement of blood pressure. Blood Press Monit 2001;6(4):181–183; doi: 10.1016/S0126-0097/00018000-00003
25. Ng CD. Biases in self-reported height and weight measurements and their effects on modeling health outcomes. SSM Popul Health 2019;7:100405; doi: 10.1016/j.sspm.2019.100405
26. Halanych J, Andreue S, Cherrington A, et al. Blood pressure measurement biases in clinical settings. J Gen Intern Med 2021;26:5113–5114.
27. Lorig K, Stewart A, Ritter P, et al. Outcome Measures for Health Education and Other Health Care Interventions. Thousand Oaks, CA: Sage; 1996.
28. Kimmel B. Measuring goal attainment in chronic disease self-management within clinical and research contexts: Development and initial testing of the goal attainment outcome measure for stroke (GAM-S). University of Texas School of Public Health Dissertations (Open
Access); 2019, 108. Available from: https://digitalcommons.library.tmc.edu/uthsph_dissertsopen/108 [Last accessed: September 9, 2022].

29. National Stroke Association. National Stroke Association Stroke Risk Scorecard. 2011. Available from: https://www.hoag.org/documents/Neurosciences/StrokeRiskScorecard.pdf [Last accessed: September 9, 2022].

30. Spitzer RL, Kroenke K, Williams JB, et al. A brief measure for assessing generalized anxiety disorder: The GAD-7. Arch Intern Med 2006;166(10):1092–1097; doi: 10.1001/archinte.166.10.1092

31. Kroenke K, Strine TW, Spitzer RL, et al. The PHQ-8 as a measure of current depression in the general population. J Affect Disord 2009;114(1–3):163–173; doi: 10.1016/j.jad.2008.06.026

32. Lorig KR, Sobel DS, Ritter PL, et al. Effect of a self-management program on patients with chronic disease. Effect Clin Pract 2001;4:256–262.

33. Ware JE Jr, Kosinski M, Keller SD. A 12-item Short-Form Health Survey: Construction of scales and preliminary tests of reliability and validity. Med Care 1996;34(3):220–233; doi: 10.1097/00005650-199603000-00003

34. Short Se, Mollborn S. Social determinants and health behaviors: Conceptual frames and empirical advances. Curr Opin Psychol 2015;5:78–84; doi: 10.1016/j.copsyc.2015.05.002

35. Bhatnagar A. Environmental determinants of cardiovascular disease. Circ Res 2017;121(2):162–180; doi: 10.1161/CIRCRESAHA.117.306458

36. Lennon S, McKenna S, Jones F. Self-management programmes for people post stroke: A systematic review. Clin Rehabil 2013;27(10):867–878; doi: 10.1177/0269215513481045

37. Jaglal SB, Haroun VA, Salbach NM, et al. Increasing access to chronic disease self-management programs in rural and remote communities using telehealth. Telemed eHealth 2013;19(6):467–473; doi: 10.1089/tmj.2012.0197

38. Lorig KR, Ritter P, Stewart AL, et al. Chronic disease self-management program: 2-Year health status and health care utilization outcomes. Med Care 2003;41(11):1217–1223; doi: 10.1097/00005650-200111000-00008

39. Kendall E, Catalano T, Kuipers P, et al. Recovery following stroke: The role of self-management education. Soc Serv Med 2007;64(3):735–746; doi: 10.1016/j.soscimed.2006.09.012

40. Cadilhac DA, Hoffmann S, Kilkenney M, et al. A phase II multicentered, singleblind, randomized, controlled trial of the stroke self-management program. Stroke 2011;42(6):1673–1679; doi: 10.1161/STROKEAHA.110.601997

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Abbreviations Used

| Abbreviation | Definition |
|--------------|------------|
| BMI | body mass index |
| BP | blood pressure |
| CI | confidence interval |
| EBS | Exercise Behavior Scale |
| EMR | electronic medical record |
| GAD-7 | 7-item Generalized Anxiety Disorder |
| GAM-s | goal attainment measure-stroke |
| IQR | interquartile range |
| LSSC | Lone Star Stroke Consortium |
| MCS | mental component score |
| PCS | physical component score |
| PHQ-8 | 8-item Patient Health Questionnaire for depression |
| QOL | quality of life |
| REDCap | Research Electronic Data Capture |
| SD | standard deviation |
| SES | Self-Efficacy Scale |
| SF-12 | 12-item Short Form Survey |
| SMS | self-management support |
| V-STOP | Video-teleconferencing Self-management TO Prevent stroke |
| VT | video teleconferencing |

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