PINGS (Phone-Based Intervention Under Nurse Guidance After Stroke)

Interim Results of a Pilot Randomized Controlled Trial

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Background and Purpose—Stroke exacts an immense toll in sub-Saharan Africa where there are few resources, and stroke prevention research is limited. The aim of this study is to test the feasibility and preliminary efficacy of an m-Health technology–enabled, nurse-guided intervention in improving blood pressure (BP) control among Ghanaian stroke patients within 1 month of symptom onset.

Methods—We conducted a 2-arm cluster pilot randomized controlled trial involving 60 recent stroke survivors encountered within a single tertiary medical system in Ghana. Subjects in the intervention arm (n=30) received a Blue-toothed UA-767Plus BT BP device and smartphone for monitoring and reporting BP measurements and medication intake for 3 months compared with standard of care (n=30). Primary outcome measure was systolic BP <140 mm Hg at month 3; secondary outcomes included medication adherence and autonomous self-regulation. Analysis accounting for clustering was made using generalized linear mixed model by intention to treat.

Results—Mean±SD age was 55±13 years, 65% male. Systolic BP <140 mm Hg at month 3 was found in 20/30 subjects (66.7%) in the intervention arm versus 14/30 subjects (46.7%) in the control arm (P=0.12). Medication possession ratio scores at month 3 were better in the intervention (0.88±0.40) versus control (0.64±0.45) arm (P=0.03). One subject in control arm died from a recurrent hemorrhagic stroke.

Conclusions—It is feasible to conduct an m-Health–based, nurse-guided BP control intervention among recent stroke patients in sub-Saharan Africa. We observed a potential signal of efficacy with the intervention, which will need to be tested in a future large definitive study.

Clinical Trial Registration—URL: https://www.clinicaltrials.gov. Unique identifier: NCT02568137.

(*Stroke*. 2018;49:236-239. DOI: 10.1161/STROKEAHA.117.019591.)

Key Words: blood pressure ■ hypertension ■ medication adherence ■ randomized controlled trial ■ survivors

The stroke burden in sub-Saharan Africa is escalating.[1] Mitigating this burden will require enhanced control of traditional stroke risk factors, especially hypertension.[2] However, insufficient numbers of physicians and transportation cost challenges across the region means that successful intervention will likely require the incorporation of provider task shifting and remote risk factor monitoring.

The objective of this study was to test the feasibility and preliminary signal of efficacy of an m-Health technology–enabled, nurse-led, multi-level integrated approach to improve blood pressure (BP) control among Ghanaian stroke patients within 1 month of symptom onset compared with standard of care.

Methods

Data supporting the findings of this interim analysis are available on request from the corresponding author (F.S.). The study was approved by the Institutional Review Boards of Komfo Anokye Teaching Hospital in Ghana and the Medical University of South Carolina. The trial protocol published elsewhere[3] is summarized below.

Trial Design

This was a 2-arm cluster-randomized controlled trial involving 60 stroke survivors with the physician as unit of randomization and patient as unit of analysis. Eligible subjects included were aged >18 years with a recent computed tomographic scan confirmed stroke of <1 month and uncontrolled hypertension (systolic blood pressure [SBP] ≥140 mm Hg) at screening and/or subsequent enrollment visit.

Received September 30, 2017; final revision received October 23, 2017; accepted November 13, 2017.

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The online-only Data Supplement is available with this article at http://stroke.ahajournals.org/lookup/suppl/doi:10.1161/STROKEAHA.117.019591/-/DC1.

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Study Setting

All subjects were enrolled through the Outpatient Neurology clinic at Komfo Anokye Teaching Hospital in Ghana after obtaining informed consent from patients or proxy.

Intervention

Using a computer-generated sequence, subjects were randomly allocated into 4 clusters of 15 subjects each per physician: 2 clusters in the intervention arm and 2 in the control arm. Subjects in the intervention arm received a Blue-toothed UA-767Plus BT BP device and smartphone for monitoring and reporting BP measurements and medication intake for 3 months. Per the medication intake protocol, if the time stamp medication intake from the app was ±90 minutes of the predesignated time, subjects scored 100%; within ±180 minutes, 50%; and outside of that window a 0%. Tailored motivational text messages were delivered based on the levels of adherence to the medication intake protocol.

Standard of Care

To control for attention exposure, the control arm of the study received SMS messages dealing with healthy lifestyle behaviors but not with medication adherence.

Allocation, Concealment, and Blinding

A computer-generated randomization sequence was used to allocate subjects to the 2 arms. Results were concealed in individually numbered envelopes and opened by the Research Coordinator in the presence of the consenting eligible study participant at enrollment. Office BP was measured thrice by a nurse blinded to patients' group status with the last 2 recorded and averaged for analysis.

Outcome Measures

Primary outcome measure was SBP control defined as SBP <140 mm Hg at month 3. Secondary outcome measures included (1) medication adherence measured using the medication possession ratio at month 3, (2) hypertension management competence using the 18-item perceived confidence scale,[4] and (3) autonomous self-regulation using the 15-item treatment self-regulation questionnaire.[5]

Statistical Analysis

We did both intent-to-treat and per-protocol analysis. We compared medians and means between treatment arms using either the Mann–Whitney *U* test or Student *t* test for continuous variables and using the χ^2 tests for categorical variables. Comparison of the treatment arms on the outcome variables was made using generalized linear mixed models with an identity link for continuous outcomes and logit link for binary outcomes. A random intercept was used to account for correlation among outcomes because of clustering by physician and for missing data in the outcomes assuming missing at random. We also estimated the intracluster correlation coefficient from the generalized linear mixed models. A $P<0.05$ was considered a significant difference between the 2 groups. Statistical analysis was performed using SAS 9.4.

Results

Baseline demographic and clinical characteristics of 60 subjects were comparable as shown in the Table. Follow-up status is shown in Figure 1. One subject in the control arm had and died from a recurrent hemorrhagic stroke within the first month of study.

Primary Outcome Measure

Proportions of intervention versus standard of care groups with SBP <140 mm Hg at month 3 by intention to treat was 20/30

Table. Comparison of Baseline Characteristics and Key Outcome Measures of the Study Participants

Characteristic	Intervention Arm (n=30)	Standard of Care Arm (n=30)	*P* Value	Adjusted *P* Value*
Age, mean±SD	54.3±11.9	55.9±13.7	0.64	…
Male sex, n (%)	18 (60)	21 (70)	0.42	…
Location of residence			0.19	…
Urban	20 (66.7)	15 (50.0)		
Rural/semiurban	10 (33.3)	15 (50.0)		
Educational attainment			0.12	…
None	2 (6.7)	1 (3.3)		
Primary	15 (50.0)	13 (43.3)		
Secondary	11 (36.6)	7 (23.4)		
Tertiary	2 (6.7)	9 (30.0)		
Vascular risk factors				
Diabetes mellitus	7 (23.4)	8 (26.7)	0.77	…
Dyslipidemia	26 (86.7)	25 (83.3)	0.72	…
Stroke type			1.00	…
Ischemic	23 (76.6)	23 (76.6)		
Hemorrhagic	7 (23.4)	7 (23.4)		
No. of antihypertensive medications, median (range)	3 (1–5)	2 (1–4)	0.63	…
Outcomes (per-protocol analysis)				
SBP at month 3, mean±SD	137.5±21.8	142.1±27.8	0.49	0.71
DBP at month 3, mean±SD	89.3±15.2	84.4±14.5	0.26	0.41
SBP<140 mm Hg at month 3, %	65.0	52.0	0.31	0.26
DBP<90 mm Hg at month 3, %	59.0	67.0	0.54	0.87
BP<140/90 mm Hg at month 3, %	55.0	44.0	0.43	0.30
MPR at month 3, mean±SD	0.88±0.40	0.64±0.45	0.03	0.03
Outcomes (intention to treat analysis)				
SBP at month 3, mean±SD	137.3±21.4	142.0±26.5	0.49	0.71
DBP at month 3, mean±SD	89.1±15.0	85.0±14.0	0.26	0.41
SBP<140 mm Hg at month 3, %	67.0	50.0	0.31	0.26
DBP<90 mm Hg at month 3, %	57.0	70.0	0.54	0.87
BP<140/90 mm Hg at month 3,%	53.0	43.0	0.43	0.30

BP indicates blood pressure; DBP, diastolic blood pressure; MPR, medication possession ratio; and SBP, systolic blood pressure.

*Model adjusted for age, baseline BP, and antihypertensives, in GLMM analysis.

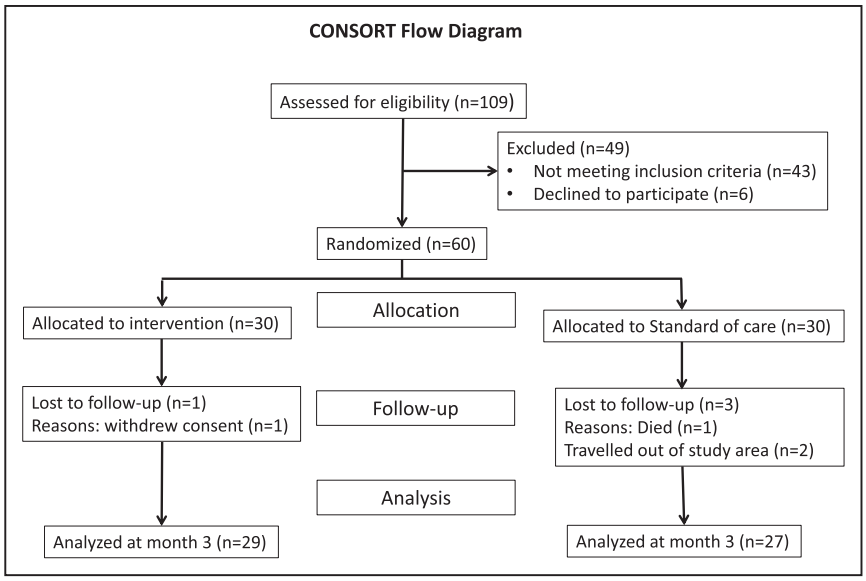

Figure 1. Consort flow diagram.

(66.7%) versus 14/30 (46.7%) (P=0.12). Adjusting for baseline SBP and covariates, the P value was 0.26. The intracluster correlation coefficient for SBP was 0.1005, and the intracluster correlation coefficient for diastolic blood pressure was 0.0452. Other BP outcomes are shown in the Table, Figure 2, and Figures I through III in the online-only Data Supplement.

Secondary Outcome Adherence Measures

Mean medication possession ratio at month 3 for the intervention was 0.88±0.40 versus 0.64±0.45 for control group (P=0.03). Electronically keyed medication adherence scores at months 1 and 3 were 49.0%±31.2 and 39%±31.3. Self autonomous regulation scores improved from 64.7±12.8 at enrollment to 83.7±11.3 at month 3 (P<0.0001) for phone-based intervention under nurse guidance after stroke group and from 68.4±9.3 to 83.9±12.1 (P<0.0001) for control group. Perceived confidence in taking medications as prescribed by physicians improved significantly from 82.2±14.2% to 93.0±8.5% (P=0.005) for intervention and nonsignificantly from 86.3±13.0% to 91.5±10.4% (P=0.08) for control group, respectively. Technology glitches reported among phone-based intervention under nurse guidance after stroke group included challenges with network connectivity, inability for some to login onto the app by themselves for taking BP, and sending medication intake information.

Discussion

We have demonstrated the feasibility of implementing an m-health intervention under nurse guidance aimed at improving BP control after stroke in an under-resourced region. We observed in this interim analysis a nonsignificant trend toward better systolic BP control among patients randomized to the intervention arm compared with the standard of care arm at 3 months, a period broadly recognized as being the period of highest risk for stroke recurrence. It should be noted that our study was not specifically powered to detect significant differences between the 2 groups.

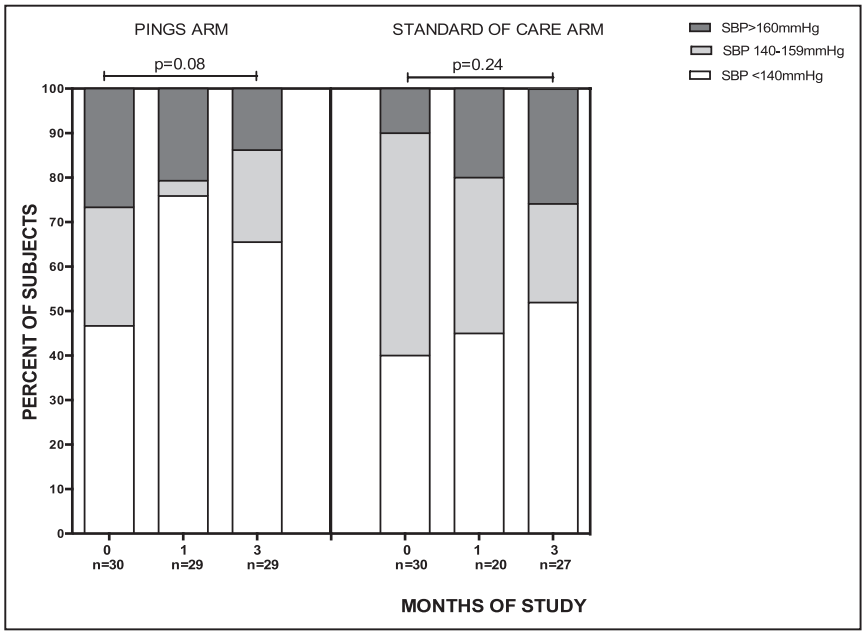

Figure 2. Systolic blood pressure control during follow-up.

Secondary measures assessed showed improvement over time in both arms with significantly better medication adherence in the intervention arm. Our findings indicate that conducting stroke intervention research in sub-Saharan Africa is doable and highlight the importance of providing evidence for task-shifting strategies and culturally tailored m-health interventions aimed at improving poststroke care in sub-Saharan Africa.

We think that the implementation of this trial within a major tertiary medical system in Ghana at a dedicated stroke clinic staffed by the few providers in the country experienced in evidence-based stroke care may have underestimated the impact of the intervention in this pilot trial. On the contrary, challenges encountered in implementation including intermittent internet connectivity issues, dependence on caregivers to help implement the BP and medication-monitoring protocols, who were unable to consistently be present at predesignated protocol times (±3 hours), probably reduced the impact of the intervention. These issues will be addressed in the design of a larger multicenter trial adequately powered to assess outcome measures involving stroke survivors at various cadres of health care in sub-Saharan Africa.

In conclusion, we have demonstrated the feasibility and a preliminary signal of efficacy in 3-month BP control among recent stroke survivors in a resource-limited setting via a nurse-supervised m-health technology–enabled intervention. Longer-term outcomes are currently being evaluated.

Sources of Funding

This study was supported by the National Institutes of Health–National Institute of Neurological Disorders and Stroke (R21 NS094033).

Disclosures

None.

References

1. Feigin VL, Forouzanfar MH, Krishnamurthi R, Mensah GA, Connor M, Bennett DA, et al; Global Burden of Diseases, Injuries, and Risk Factors Study 2010 (GBD 2010) and the GBD Stroke Experts Group. Global and regional burden of stroke during 1990-2010: findings from the Global Burden of Disease Study 2010. *Lancet*. 2014;383:245–254.
2. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, Blaha MJ, et al; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics–2014 update: a report from the American Heart Association. *Circulation*. 2014;129:e28–e292. doi: 10.1161/01.cir.0000441139.02102.80.
3. Sarfo FS, Treiber F, Jenkins C, Patel S, Gebregziabher M, Singh A, et al. Phone-based Intervention under Nurse Guidance after Stroke (PINGS): study protocol for a randomized controlled trial. *Trials*. 2016;17:436. doi: 10.1186/s13063-016-1557-0.
4. Schwarzer. R. Health-Specific Self-Efficacy Scales. http://jpkc.Ujn.Edu.Cn/xljkyj/jxzy/ywlw/15.Pdf.2011. Accessed July 21, 2015.
5. Williams GC, Freedman ZR, Deci EL. Supporting autonomy to motivate patients with diabetes for glucose control. *Diabetes Care*. 1998;21:1644–1651.