Mobile health for stroke: a promising concept for research and practice

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The potential for mHealth to revolutionize worldwide healthcare delivery through enhanced patient education/awareness, improved screening procedures, better risk factor control, and sustainable health system cost reductions is tremendous. In particular, the use of mHealth to effectively manage chronic disease, especially for those patients with several co-morbid chronic illnesses, is expected to exponentially soar (1-3) as scientific evidence supporting the benefits of mHealth continues to accrue in published literature.

In their feasibility pilot study, Siegal and colleagues evaluated an institutionally developed app—the personal health assistant (PHA)—for coordinating post-stroke care among a series of 21 acute stroke patients, specifically to help organize medication compliance, comply with follow-up instructions, navigate health insurance issues, conduct appointment scheduling, and communicate patient's questions to health care providers and nurses. Of the 21 patients screened, 18 were ineligible due to no smartphone (n=4), inappropriate disposition (n=4), patient decline (n=3), discharge before enrollment (n=3), and others (n=4) while 3 were eligible but only 2 used the PHA app. Both patients who used the app were very satisfied of which one was re-admitted on account of new stroke (4).

An important finding of the Siegal study was the high proportion of acute stroke patients who were not eligible to use the PHA app, highlighting the profound impact stroke has on dexterity, communication, and cognition which could serve as a barrier to widespread testing of the utility of mHealth for recent stroke survivors. Nonetheless, it is conceivable that perhaps greater participation of caregivers of recent stroke patients in mHealth based strategies, especially as early as possible during the index stroke hospitalization may enhance utilization of mHealth based interventions in the initial post-stroke recovery period (i.e., up to the first 3 months after the stroke). Stroke patients could then increasingly participate to the extent they can as motor, speech, and cognitive deficits resolve. Moreover, careful patient selection and focused interventions targeting key aspects of the post-stroke care continuum, e.g., major risk factor management, may allow for higher enrollment of more recent stroke patients into mHealth studies and enhance participation of caregivers. Expert consensus guidelines recommend that secondary preventive therapies and rehabilitation after stroke should be started soon after onset of symptoms and adhered to persistently to reduce risk of recurrent strokes, as well as facilitate re-integration of stroke survivors back into the society (5). The achievement of these goals relies on a coordinated and multi-disciplinary team effort involving several health professionals and the stroke patient/caregiver, which might best be coordinated using mHealth approaches. A recent systematic review and meta-analysis of randomized control clinical trials that assessed the effect of mHealth on major stroke risk factors found that of 79 studies identified, 13 of them met eligibility criteria (6). The review concluded that mHealth improved

glycemic control and smoking abstinence rates, two factors that may lead to better stroke outcomes, but that there is a need for mHealth to be tested in modifying the premier risk factor for stroke, i.e., hypertension.

The two patients who did utilize the intervention to coordinate their post-stroke care in the Siegal study rated it excellent. While this is based on very small number of respondents, the high rate of satisfaction is consistent with results from a survey of 60 recent stroke survivors about an mHealth based intervention targeting blood pressure control and antihypertensive medication adherence. In that survey conducted at a hospital in South Carolina, 78% of respondents believed that mHealth would help remind them to follow doctor's directions, and 83% were confident that technology could effectively be used to communicate with health care providers for medical needs; the cohort had 93% ownership of cellular phones and 23% ownership of smartphones (7).

The low rate of enrollment in the Siegal study notwithstanding, mHealth has already made great strides in improving stroke knowledge and outcomes in certain aspects. Mobile health apps with educational content on stroke symptoms are being used to help the lay public and healthcare providers to identify stroke, activate emergency responses and facilitate risk assessment for prompt timely recognition and treatment of stroke thus helping overcome delays in health seeking after stroke which is a prime barrier to optimal management of acute stroke (8-10). In acute stroke care, telemedicine based interventions, adapted to an mHealth based platform have been shown to expedite access to safe and efficacious thrombolytic therapy in both resource-replete and rural settings with improved outcomes for ischemic stroke (11-13). Still it should be noted that despite the rapid growth of mobile health applications, there are few culturally-appropriate and sustainable stroke-specific apps (14). Furthermore, there is a paucity of published stroke studies that have rigorously assessed mobile apps for their efficacy, usefulness, and sustainability with regard to patient privacy and regulatory compliance (14).

Perhaps the greatest impact of mHealth for post-stroke care could be harnessed in low and middle income countries (LMIC) were stroke prevalence is escalating at alarming rates (15-17), and profound disparities exist in access to specialized care due to paucity of neurologists and specialist physicians. In these LMIC settings, task-shifting strategies with greater participation by nurses as liaisons between stroke patients and physicians via mHealth technology could be worth exploring, if all the stakeholders were interested and engaged. A soon-to-be-published survey of 200 Ghanaian recent stroke survivors showed very positive acceptance of mHealth for blood pressure control after stroke (96.5%), but found much lower rates (22.5%) of smartphone ownership (personal communication) in this region. The low patronage of smartphones among stroke patients and the requirement of smartphones for functionality of most mHealth apps needs a closer scrutiny in future apps to be developed although the cost of smartphones may decline in the coming years to increase access. It would be important to assess the attitudes and receptivity of stroke patients in diverse settings towards mHealth to gain a better understanding into the modifications that would be necessary for wider acceptance in this population.

The Phone-based Interventions under Nurse Guidance after stroke study (PINGS), a feasibility pilot randomized controlled trial, is an on-going study which seeks to demonstrate that a theoretical-model-based, mHealth technology-centered, multi-level integrated approach is effective in improving sustained BP control among 60 recent Ghanaian stroke patients within one month of symptom onset (18). Of note, patients with severe cognitive impairment/dementia and severe global disability (modified Rankin Scale score ≥ 3) are excluded from PINGS. In PINGS, stroke subjects will be given loaner phones if they do not have personal smartphones, and a caregiver (usually a household relative), along with the patient will be taught how to utilize the app, if the patient is unable to do so (either due to deficits from the index stroke or literacy issues). Blood pressure readings and medication adherence data will be sent remotely to nurses by patients who will receive feedback motivational messages delivered by text messages based on levels of blood pressure control and adherence to therapy with targeted interventions coordinated by the nurse under a physician supervision in the intervention arm. A feasible and preliminarily effective PINGS intervention could lead to a larger more definitive efficacy/effectiveness RCT powered to look at clinical events, with the potential to reduce hypertension-related stroke morbidity, mortality, and associated costs in Africa.

Before mHealth interventions can gain widespread integration and sustained application in routine stroke care, some important issues need to be resolved. For instance, it is not clear which aspects of stroke care that mHealth would produce the most profound benefits for patients/caregivers and healthcare providers. Resolving this key

question will require the conduct of several studies aimed at testing specific components of post-stroke care to derive high-level evidence-based data to inform policy adoption. It is likely that developers of Apps would need to work closely and responsively with stroke patients, healthcare providers, system administrators, public health personnel, and researchers to fine tune programs to (I) be adaptable in various residential settings—rural, semi-urban and urban communities; and (II) be vetted by regulatory bodies to prevent unintended consequences such as incorrect information and medical errors. These approaches would align with the recommendations of a recent scientific statement by the American Heart Association on the use of mobile devices, social media and crowdsourcing as digital strategies to improve care of individuals with vascular disease (19).

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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