

# MOBILE APPLICATIONS FOR STROKE PREVENTION: A SURVEY OF PHYSICIANS' PERSPECTIVES

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**Background:** Little is known about the prevalence and nature of mobile application adoption in clinical practice.

**Aims:** To explore current and potential mobile application use in primary care physicians (PCPs) for stroke prevention. Do PCPs recommend, use, or discuss mobile health applications for stroke preventative measures?

**Methods:** Current PCPs in the New York City area specializing in Internal Medicine, Ob/Gyn, and Family Medicine were surveyed in person. The survey consisted of demographic questions and 11 questions on mobile application use.

**Results:** Of the 86 physicians surveyed (53% female; mean age 37 years, SD 12), 74% (95% CI 65%, 84%) reported using mobile applications in patient care, whether for their own use or in recommending to patients. Experience was the most important determining factor, with 82% of physicians with less than 3 years practice experience using mobile apps, 78% of physicians with 3 to 10 years, 60% of physicians with 11 to 20 years, and 58% of physicians with greater than 20 years experience ( $p=0.045$ ). Physicians reported using mobile applications to manage stroke risk factors 25% (95% CI 16%, 35%) of the time, while 77% (95% CI 68%, 86%) expressed interest in new apps to help their patients manage these risks. Lastly, 41% (95% CI 30%, 51%) of physicians surveyed strongly agreed that mobile applications are useful in providing patient care, while 49% (95% CI 38%, 59%) simply agreed and 0% disagreed.

**Conclusions:** Most urban PCPs we surveyed believe that mobile applications belong in healthcare, with one in four using them to manage stroke risk factors.

**Keywords:** Mobile Technology, Stroke, Prevention, Primary Care Physicians, Patient-Centered

## Introduction

Stroke is the leading cause of preventable disability in the United States<sup>1</sup>. Each year, approximately 795,000 Americans suffer a stroke<sup>1</sup>. Many of these strokes are preventable. According to a case-control study of 6,000 individuals, 90% of strokes can be attributed to just 10 modifiable risk factors, and targeted interventions to reduce blood pressure and cigarette smoking as well as to promote physical activity and healthy diet could substantially reduce the risk of stroke<sup>2</sup>. There are already many mobile applications that individually target each one of these interventions, although not necessarily in the specific context of stroke prevention<sup>3</sup>.

Healthcare related mobile technology has expanded rapidly over the last several years. In 2015, there were 165,000 medical and health related apps for sale in the Google and Apple store<sup>4</sup>, up from 40,000 in 2012<sup>5</sup>. However, little is known about the prevalence and nature of mobile application adoption in patient centered clinical practice, let alone about its effectiveness in changing healthcare outcomes. While there are many mobile applications in fields such as diabetes management, there are still usability and integration issues among almost all of them<sup>6</sup>. A 2014 study found 93 mobile application for iPhone and Android regarding general stroke information, although many of these were lacking scientifically valid information<sup>7</sup>.

There have been relatively few randomized controlled trials involving mobile applications, although some have shown promise. A systematic review of 9 studies assessing mobile application effectiveness in managing cardiovascular disease, lung disease, or diabetes mellitus found 3 studies where a mobile application intervention showed a statistically significant clinical improvement<sup>8</sup>. Additionally, there has been at least one quality improvement project studying mobile technology assistance in blood pressure control for stroke survivors<sup>9</sup>, although there have been no large scale randomized control trials specifically involving stroke prevention. Mobile applications have the potential to change the healthcare landscape, leading to improved outcomes while reducing cost. If mobile technology is going to be implemented in a meaningful way, it is imperative that it be grounded in clinical evidence.

The current study is the first step in examining the role that mobile technology plays in primary care physicians' (PCPs') practices. The purpose of this study is to examine the prevalence of PCPs using

mobile applications in patient care. More specifically, to study if and how PCPs use mobile applications for stroke prevention. Also, we evaluated preferences and attitudes of PCPs toward the use of mobile applications in their practices with specific focus in stroke management, and how these preferences vary over physician and practice demographics. We hypothesize that younger physicians practicing in wealthier areas are more likely to use and recommend mobile applications.

## Methods

Current PCPs in the New York City area specializing in Internal Medicine, Ob/Gyn, and Family Medicine were surveyed in person.

*Participants:* A convenience sample of 86 physicians (46 females) ranging from 25 to 68 years of age participated in this study, which was approved by the SUNY Downstate IRB. Participants were surveyed in person and were identified at SUNY Downstate grand rounds and the annual meeting of the New York Academy of Family Physicians. The mean age was  $37 \pm 12$  SD. Forty one percent of the participants were attendings and the remaining 59% were residents. Sixty (70%) were Family Medicine specialists, 14 (16%) were in Ob/Gyn, and 12 (14%) were in Internal Medicine. These three specialties were selected because they provide the primary care lead in general preventative care, and the study focus is on actually managing stroke risk factors. Neurologists, despite managing patients after stroke, do not generally provide the ongoing lead in preventative care unless a patient has a separate neurological issue, and so were excluded from the study.

*Measures:* The standardized survey consisted of demographic questions and practice characteristics including gender, specialty, resident/attending, type of practice (private independent, private partnership, community or university hospital), years of experience (less than 3, 3 to 10, 11 to 20, greater than 20), patients seen per month (less than 30, 30 to 100, greater than 100), median income of practice zip code as determined by census data (less than \$40,000 or greater than \$40,000), and 11 questions on mobile application use (table 1).

*Data analysis:* Fisher's exact test was used to test for association between demographic variables and whether or not the physicians used mobile applications in any patient care setting. Cochran–Armitage trend test was used to determine if higher levels of

	Percent of Subjects (n)
<b>Gender</b>	
Male	47% (40)
Female	53% (45)
Did not respond	(1)
<b>Specialty</b>	
Family Medicine	71% (60)
Ob/Gyn	16% (14)
Internal Medicine	13% (11)
Did not respond	(1)
<b>Position</b>	
Resident	59% (51)
Attending	41% (35)
<b>Type of Practice</b>	
Private, solo	6% (5)
Private, group/partnership	21% (18)
Community or University	36% (31)
Hospital	
Other	37% (32)
<b>Age</b>	
24-29 years	35% (30)
30-39 years	38% (32)
40-68 years	27% (23)
Did not respond	(1)
<b>Experience</b>	
<1-3 years	53% (45)
3-10 years	21% (18)
10-20 years	12% (10)
>20 years	14% (12)
Did not respond	(1)
<b>Number of Patients Seen Per Month</b>	
0-30	22% (18)
30-100	36% (30)
100+	42% (35)
Did not respond	(3)
<b>Median Income of Practice Zip</b>	
<\$40,000	30% (24)
>\$40,000	70% (55)
Did not respond	(7)

Table 1: Demographic Summary of Study Subjects

the ordinal predictors (age groups, experience and volume of patients) were associated with higher prevalence of mobile technology use. P values less than 0.05 were considered significant. All participants answered the primary question on mobile application use in patient care. Missing data in other, secondary questions were not factored into the analysis as we were not adequately powered for other specific analyses. A sample size of 87 physicians was

determined to have 80% power to detect an odds ratio of 0.4 for the relationship between age and the use of mobile applications using a significance level of 0.05. The odds ratio of 0.4 corresponds to a hypothesized effect of physician age on mobile application use. This odds ratio is based on an expected 30% use of mobile applications by physicians at age 50, compared to 15% for physicians at age 63. The data were analyzed using SAS version 9.4 (SAS Institute Inc., Cary, N.C.)

### Results

Of the 86 physicians surveyed, 74% reported using mobile applications in patient care, whether for their own use or in recommending to patients. Physicians reported using mobile applications to manage stroke risk factors 25% of the time, while 77% expressed interest in new apps to help their patients manage these risks. Forty one percent of physicians surveyed strongly agreed that mobile applications are useful in providing patient care, while 49% simply agreed and 0% disagreed.

Table 2 shows the most important determining factor, with 82% of physicians with less than 3 years practice experience using mobile apps, 78% of physicians with 3 to 10 years, 60% of physicians with 11 to 20 years, and 58% of physicians with greater than 20 years experience ( $p=0.045$ ). Other demographic factors, including median income of practice zip code were not significant.

Age did not have an effect on whether or not physicians agree that mobile applications are useful in providing patient care ( $p=0.27$ ; table 3). Position, type of practice, and volume of patients were not associated with higher use of mobile technology use ( $p=0.80, 0.49, 0.33$ , respectively).

### Discussion

Previous studies have shown that there are a large number of mobile applications available to patients and physicians, particularly to manage stroke risk factors<sup>3,4,6-8</sup>. This study builds on this knowledge in an attempt to determine how physicians view mobile application use in the primary care clinical setting, particularly in stroke prevention. Our data revealed that of a sampling of mostly urban PCPs, 74% are already using mobile applications in clinical practice and an even greater portion, 90%, believe that mobile applications belong in patient care. Although PCPs with more experience were less likely to use mobile applications, the findings suggest a wide acceptance

Question	Percent of All Subjects (n)
Have you ever used any mobile applications for any kind of patient care or intervention?	
Yes	74% (64)
No	26% (22)
Have you ever discussed any mobile applications for any kind of primary stroke prevention (e.g. management of vascular risk factors) with your patients?	
Yes	26% (22)
No	69% (59)
Did not respond	(5)
If yes, for which of the following: (check all that apply)	
Weight management (diet, exercise tracking)	21% (18)
Smoking cessation	9% (8)
Medication adherence	14% (12)
Education (general information about stroke – prevalence, risk factors, prognosis)	12% (10)
Education specific information about patient’s current health status and how it relates to stroke risk, such as blood pressure, lipid profile, and HbA1C	7% (6)
Other	3% (3)
Do you see stroke survivors in your practice?	
Yes	84% (72)
No	9% (8)
Did not respond	(6)
Have you ever discussed any mobile applications for any kind of secondary stroke prevention with your patients?	
Yes	17% (15)
No	70% (60)
Did not respond	(1)
If yes, for which of the following interventions: (check all that apply)	
Medication adherence	15% (13)
Education (general information about stroke recurrence)	13% (11)
Vascular risk factors monitoring	13% (11)
Other	2% (2)
Would you be interested in having a mobile device application for any of the following: (check all that apply)	
Primary stroke prevention	77% (66)
Secondary stroke prevention	60% (52)
Neither	14% (12)
If yes, for which of the following interventions: (check all that apply)	
Weight management (diet, exercise tracking)	57% (49)
Smoking cessation	58% (50)
Medication adherence	59% (51)
Education (general information about stroke – prevalence, vascular risk factors, prognosis)	56% (48)
Other	3% (3)
“Mobile phone applications are useful in helping to provide patient care”	
Strongly agree	41% (35)
Agree	49% (42)
Neither agree nor disagree	10% (9)
Disagree	0% (0)
Strongly disagree	0% (0)

**Table 2 (Continued)**

Question	Percent of All Subjects (n)
If you are not interested in mobile health technology for any kind of patient care, what is your reason? Check all that apply	
Hardware functions and ease of use	8% (7)
Determining which app is best for you in your setting	12% (10)
Integrating app with your EHR	8% (7)
Confidentiality and privacy concerns	8% (7)
Unproven efficacy	3% (3)
Time limitations and using hardware during actual patient visit	10% (9)
Other	3% (3)

**Table 2: Mobile Application Usage Responses**

	Have you ever used any mobile applications for any kind of patient care or intervention?		P Value
	Yes	No	
Position			0.80
Resident	73% (37)	27% (14)	
Attending	77% (27)	23% (8)	
Age			0.27
25-29	80% (24)	20% (6)	
30-39	75% (24)	25% (8)	
40-68	65% (15)	35% (8)	
Type of Practice			0.49
Private, solo	60% (3)	40% (2)	
Private, group/ partnership	78% (14)	22% (4)	
Community or University Hospital	68% (21)	32% (10)	
Other	81% (26)	19% (6)	
Experience			<b>0.05</b>
<1-3 years	82% (37)	18% (8)	
3-10 years	78% (14)	22% (4)	
10-20 years	60% (6)	40% (4)	
>20 years	58% (7)	42% (5)	
Number of Patients Seen Per Month			0.33
0-30	67% (12)	33% (6)	
30-100	73% (22)	27% (8)	
100+	80% (28)	20% (7)	
Median Income of Practice Zip			1.0
<\$40,000	75% (18)	25% (6)	
>\$40,000	75% (41)	25% (14)	

**Table 3: Usage of Mobile Applications in Patient Care by Demographics**

across physician age groups and practice characteristics. Income of practice zip code was not a significant predictor in whether or not PCPs recommend

mobile applications to patients, and neither was PCP age. Physician experience was potentially important, with less experienced PCPs more likely to recommend

mobile applications than their more experienced colleagues. These findings suggest the adoption of mobile application use in clinical practice will likely continue to increase in the coming years.

Some physicians, 34% of the respondents, expressed concerns over mobile technology use in healthcare. These concerns included ease of use, confidentiality, determining which app is best, time limitations, and integration with Electric Health Records (EHR). Some of these concerns, such as determining which apps are best, can be solved with further study. Confidentiality and EHR integration issues are more complex but are also potentially manageable in the future<sup>5</sup>.

There was a major disparity between PCP-expressed interest in mobile applications (76%) compared with their actual use of mobile applications to manage stroke risk factors (25%). This gap between interest and use can be bridged by either the development of new mobile applications specifically tailored to manage stroke risk factors or the development of a tool to assist patients and physicians in selecting from already existing mobile applications. The development of such a tool would likely require a systematic method for determining which mobile applications are effective in the patient care setting. Mobile applications that can assist in managing chronic risk factors for stroke can then be identified, potentially leading to an inexpensive and effective method for reducing one of the largest causes of morbidity and mortality in the United States<sup>1,2</sup>.

There were several limitations to the study. First, the sample size was one under the projected number, as the data were collected from physicians in discrete groups (grand rounds, etc.) rather than from individuals. Second the data were slightly skewed by specialty and position. We recruited a large percentage of Family Medicine attendings because of the ease of recruiting them at their annual meeting. Many of the Ob/Gyn and Internal Medicine respondents were residents because they were more likely to attend grand rounds and stay to fill out a survey. There were few respondents from high income zip codes. We acknowledge the potential lack of generalizability to other specialties, including neurologists who may participate in stroke prevention but generally do not lead and primarily manage this effort in their patients.

## Conclusions

The majority of PCPs have either already adopted mobile applications in their clinical practice or

believe that mobile applications belong in patient care. However, the implementation of mobile applications specifically for stroke prevention purposes is still limited. Concerns about mobile application use were limited to a small number of physicians and a significant number expressed interest in a new application to manage stroke risk factors. There is PCP interest in a mobile application specifically tailored to manage stroke risk factors that patients and physicians can use together and encompasses several aspects of stroke prevention. Since many physicians are already using mobile applications or support their use in patient care, it is likely that mobile applications will have a place in clinical practice in the future, and specifically in stroke prevention.

## Acknowledgements

Supported by a SUNY Alumni fund medical student research scholarship to DH.

## Disclosures

All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author) and declare: DH received support from a SUNY Alumni grant, no other support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous 3 years; no other relationships or activities that could appear to have influenced the submitted work.

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