HHS Public Access

Author manuscript

Ethn Health. Author manuscript; available in PMC 2024 April 01.

Published in final edited form as:

Ethn Health. 2023 April ; 28(3): 413–430. doi:10.1080/13557858.2022.2059451.

Mobile health technology for hypertension management with Hmong and Latino adults: mixed-methods community-based participatory research

Kathleen A Culhane-Pera, MD MA,
SoLaHmo Partnership for Health and Wellness, Minnesota Community Care, St Paul MN, USA

Ka Bao Vang, MD,
Hennepin Healthcare, Minneapolis MN, USA

Luis Martin Ortega, MD,
Hennepin Healthcare, Minneapolis MN, USA

Txia Xiong, Pharm D,
SoLaHmo Partnership for Health and Wellness, Minnesota Community Care, St Paul MN, USA

Carin A Northuis, MPH,
Division of Epidemiology & Community Health, School of Public Health, University of Minnesota, Minneapolis, MN, USA

Pilar de la Parra, MPH,
SoLaHmo Partnership for Health and Wellness, Minnesota Community Care, St Paul MN, USA

Kamakshi Lakshminarayan, MD PhD MS
Division of Epidemiology & Community Health, School of Public Health, University of Minnesota, Minneapolis, MN, USA

Abstract

Objective: To identify Hmong and Latino adults' perspectives about a mHealth-based care model for hypertension (HTN) management involving blood pressure (BP) self-monitoring, electronic transmission of BP readings, and responsive HTN medication adjustment by a provider team.

Design: We conducted a mixed-methods formative study with 25 Hmong and 25 Latino participants with HTN at an urban federally-qualified health center. We used a tool to assess HTN

Correspondence author: Kathleen A Culhane-Pera, MD MA, Minnesota Community Care, 895 E 7th Street, Saint Paul MN, USA 55106, Phone: 651-602-7500, kpera@mncare.org.

Biographical notes on all authors:
Designed study: KL, KACP, KBV, LMO, TX, PdlP
Collected data: KBV, LMO, TX, PdlP
Analyzed qualitative data: KACP, KBV, LMO, with input from TX, PdlP, KL
Analyzed quantitative data: KL, CAN
Drafted manuscript: KACP, KBV, LMO
Critiqued manuscript: KL, CAN, TX, PdlP
All authors gave final approval for the manuscript

Conflicts of Interest- Authors declare they have no financial conflicts of interest.

knowledge and conducted open-ended interviews to identify perspectives about mHealth-based care model.

Results: While most participants agreed that lowering high blood pressure decreased the risk of strokes, heart attacks, and kidney failure, there were gaps in medical knowledge. Three major themes emerged about the mHealth-based care model: 1) Using mHealth technology could be useful, especially if assistance was available to patients with technological challenges; 2) Knowing blood pressures could be helpful, especially to patients who agreed with doctors' medical diagnosis and prescribed treatment; 3) Transmitting blood pressures to the clinic and their responsive actions could feel empowering, and the sense of increased surveillance could feel entrapping. Some people may feel empowered since it could increase patient-provider communication without burden of clinic visits and could increase involvement in BP control for those who agree with the medical model of HTN. However, some people may feel entrapped as it could breach patient privacy, interfere with patients' lifestyle choices, and curtail patient autonomy.

Conclusions: In general, Hmong and Latino adults responded positively to the empowering aspects of the mHealth-based care model, but expressed caution for those who had limited technological knowledge, who did not agree with the medical model and who may feel entrapped. In a shared decision-making approach with patients and possibly their family members, health care systems and clinicians should explore barriers and potential issues of empowerment and entrapment when offering a mHealth care model in practice.

Keywords

mHealth; hypertension; blood pressure monitoring; Hmong; Latino; community-based participatory action research; mixed-methods

Introduction

Hypertension (HTN) is a major risk factor for strokes and heart attacks (Chobanian et al. 2003), and is a significant comorbidity in severe COVID-19 infections (Richardson et al. 2020; Guan et al. 2020). It is estimated to affect almost half of the United States (US) adult population (Virani et al. 2020) when using blood pressure (BP) thresholds based on the 2017 Hypertension Clinical Practice Guidelines (Whelton et al. 2018). In individuals with the diagnosis, only 43.7% of all adults have controlled HTN (Muntner et al. 2020). The problem of uncontrolled HTN disproportionally affects marginalized groups (Muntner et al. 2020; Cruz-Flores et al. 2011; Howard et al. 2006). Many factors have been associated with suboptimal HTN control, including gaps in health services (Wong et al. 2005), low socioeconomic status (Leng et al. 2015), and limited self-care (Gee et al. 2012). Self-measured blood pressure monitoring (SMBP), an aspect of self-care, has been shown to be effective in lowering BP and improved HTN control (Uhlig et al. 2013). It is recommended in guidelines on the care of patients with HTN including the Eighth Joint National Committee (James et al. 2014) and the American Heart Association and American Medical Association (AHA/ASA) (Kernan et al. 2014; Meschia et al. 2014). SMBP was endorsed in a joint policy statement by AHA/ASA as a result of increasing utilization of telehealth visits in the COVID-19 pandemic (Shimbo et al. 2020).

Mobile health (mHealth) has emerged as an innovative way to facilitate SMBP (Ciemins et al. 2018). Our previous mHealth research study found that SMBP utilizing mHealth can improve HTN self-management (Lakshminarayan et al. 2018). In a randomized controlled trial of 50 stroke survivors, we compared SMBP with usual care versus an mHealth model that included automated wireless transmission of BP data to the provider team who could make responsive medication adjustments. The mHealth care model was significantly more effective: 89% of participants in the mHealth group versus 58% in the enhanced usual care group (p=0.015) had their BP controlled at 3 months post-randomization. We found that the mHealth model of HTN care was feasible and acceptable to participants. However, the generalizability of this study is limited as the majority of participants were English-speaking Whites, which is true of other published studies (Burke et al. 2015). To the best of our knowledge, no studies have been done to evaluate technology-mediated HTN management with Hmong patients. One RCT study with 54 Latino patients found that SMBP with motivation messages and an electronic medicine tray versus usual care with healthy lifestyle text messages resulted in improved HTN control and medication adherence at 9 months (Chandler et al. 2019).

Our goal with this mixed-methods formative study was to identify Hmong and Latino participants' perspectives about the mHealth-based HTN care model in a health system serving low income and minority populations. We aim to use the information in a randomized control trial (RCT) to evaluate the effectiveness of a mHealth care model for HTN management in these populations.

Background of Location and Communities

We conducted the study at Minnesota Community Care (MCC), a federally-qualified health center located in Saint Paul, Minnesota. In 2019, MCC served over 36,000 patients annually, including 52% Latino and 15% Asian (mostly Hmong) patients, most of whom prefer to speak in their native language and were born outside of the US.

The Hmong people are refugees from Laos after the Vietnam War and the Secret War in Laos; they were resettled in the US as refugees from 1975–1989 and 2004–2006. Minnesota is home to the second largest Hmong community in the US, numbering 66,181 in 2010 (Pfeifer ME 2012). While national data regarding HTN control among Hmong adults does not exist, a 2006 study showed that 16.5% of adults had HTN (SBP ≥140mmHg) and 36.2% had pre-HTN (SBP 120–139mmHg) on arrival from a Thailand refuge area (Culhane-Pera et al. 2009). A 2005 study of 323 Hmong adults with HTN showed that HTN control was 27% (Wong et al. 2005). Traditionally, Hmong believed that illness can stem from one of four sources: supernatural, natural, social and personal causes (Culhane-Pera and Xiong 2003). According to this system, diseases attributed to spirits require a shaman or soul caller to cure the disease; diseases of natural causes could be cured by herbal medicines; social causes by ritual healing; and personal causes by lifestyle changes. The biomedical concept of chronic illness that is asymptomatic and requires taking prescription medicines (such as HTN) is relatively new and not well understood in the Hmong community (Wong et al. 2005; Culhane-Pera and Xiong 2003; Thalacker 2011). A 2005 study (Wong et al. 2005) of 323 Hmong adults with HTN found that 83% thought that HTN was caused by "bad

blood", 80% thought it was caused by pesticides in foods, and 15% thought that HTN was a punishment by spirits for doing something bad. Also, 37% believed that traditional Hmong practices and herbal medicines were more effective and safer for HTN, 71% believed that prescribed medicines were too strong for Hmong people, and 54% were not adhering to their prescribed anti-hypertensive medications all or most the time. Wong *et al*. concluded that respondents who were 50 years of age or older, had no physical illness, did not know that hypertension was preventable, or believed that American medicine was too strong, were more likely to report nonadherence with proper medication consumption.

The Latino community is a heterogenous group of peoples defined as having ancestral roots in Central America, South America or the Caribbean, while the Hispanic community is defined as peoples who have ancestral roots in Spanish-language predominant cultures. By the 2019 American Community Survey, there were almost 315,000 Latinos living in Minnesota, with the majority of Mexican origin (66%)(Bureau 2019). According to the 2017–2018 National Health and Nutrition Exam Survey (NHANES), rates of controlled HTN in Hispanic adults (36.8%) was substantially lower than in non-Hispanic White adults (45.2%) (Muntner et al. 2020). Researchers have suggested that acculturation and health literacy play important roles in illness perceptions around hypertension (Perez 2015), however cross-sectional studies examining further covariates such as depression, anxiety, sleep disturbances, education level, birth country, age and sex found that health literacy's unique contribution in predicting medication adherence was minimal (Lor et al. 2019). Others have posited that fatalism – the belief that health is predetermined by fate – is associated with poorer adoption of risk reducing health behaviors that could reduce HTN; however, it has been found that the non-significant association of fatalism with HTN awareness/treatment/control was largely due to its association with socioeconomic status, acculturation or other related health conditions (Gutierrez et al. 2017).

Methods

Partnership

Following community-based participatory principles (CBPR) (Israel 2005), our partnership consisted of two academic researchers from the University of Minnesota and five community members from *SoLaHmo Partnership for Health and Wellness* (SoLaHmo), a community-driven research program from Minnesota Community Care (MCC). The University of Minnesota members included a physician-researcher (KL) and doctoral research assistant (CAN). The community researchers included the community clinician and qualitative researcher (KACP), two bilingual-bicultural Hmong community researchers (KV, female M.D. student and TX, female Pharm.D. student) and two bilingual-bicultural Latino community researchers (LMO, male M.D. student and PdlP, female M.P.H. patient educator). As a CBPR partnership team, we identified the research objectives, designed the research methods, prepared the data collection materials, translated the materials into Hmong and Spanish, created an educational video about HTN, conducted the study, and analyzed the results. We obtained approval from MCC and the University of Minnesota's Institutional Review Board (STUDY00002701).

Study Design, Study Setting, Participant Recruitment

We conducted a cross-sectional mixed-methods formative study with 25 Hmong and 25 Latino adults in March-April 2018. Participants were recruited from two MCC clinic locations. The community clinician (KACP) reviewed clinic schedules and patient charts to identify scheduled patients who met the inclusion criteria: adults (18 years and older) with HTN (as medical diagnosis) who could have been either Hmong or Latino (i.e., Hmong and Latino surnames, Asian race, Hispanic ethnicity, and/or Hmong or Spanish preferred languages). The clinic intake staff informed the identified patients about the study and referred interested patients to the appropriate Hmong or Latino community researcher. In addition, some clinic staff who met the inclusion criteria expressed a desire to participate. One community researcher (KV, TX, MLO, or PdlP) met with each interested person, obtained written informed consent, and collected the data in English, Hmong, or Spanish. Most interviews lasted 45 (range 30–60) minutes.

Data Collection

The Hmong (KV, TX) and Latino (LMO, PdlP) community researchers interacted with participants in the participants' desired language and entered data into Qualtrics. Participants replied to questions about their demographics, access to smartphones, and knowledge regarding HTN using an assessment tool that was adapted from Oliviera (Oliveria et al. 2005) and Wong (Wong et al. 2005). The community researchers explained the mHealth-based HTN care model involving self-monitoring of blood pressure at home to the participants (Lakshminarayan et al. 2018), demonstrated the wireless blood pressure monitor and showed them a video on how to measure blood pressure using the wireless monitor and a mobile device (a Withings Wireless BP Monitor). Community researchers then conducted interviews following a semi-structured question guide of open-ended questions to elicit participants' reactions to medications and perspectives about the device (Table #1). Community researchers typed participants' verbatim replies into Qualtrics, either directly typing the English responses, or directly typing the Spanish responses and then later translating into English, or simultaneously translating Hmong or Spanish responses into English and typing the English translation, based on each interviewer's language translation skills. Finally, they showed participants an educational video about HTN in their preferred language. No chart data was obtained. Individuals received a $50 gift card for their participation in the study.

Analysis

We used descriptive statistics (RStudio Version 3.1.1) to describe participants' demographic characteristics and responses to HTN knowledge questions. The qualitative analysis team consisted of the Hmong (KV, TX) and Latino (LMO, PdlP) community researchers who conducted the interviews, and the qualitative researcher (KACP). We conducted thematic qualitative analysis of the interviews using a template analysis approach (Crabtree and Miller 1999). Initially, each community team inductively coded their interview transcripts by interview questions. Subsequently, the full qualitative analysis team discussed the initial inductive list of codes to identify the final codes for the codebook template. The next stage entailed iterative discussions among each community researcher team, where they used the

coding template to re-organize their transcript data. Finally, the team jointly identified the themes and patterns from both communities' transcripts. Analysis revealed that we had reached data saturation.

Results

Demographics

A total of 50 Latino (n=25) and Hmong (n=25) adults completed the study (Table #2). The majority of participants were women (56%), were born outside of the US (88%), and most of these (94%) had lived in the US for 10 years or more. Most participations were patients (N=45, 90%) and some were staff members (N=5, 10%, with two Hmong and three Latino). More Latino participants had completed high school or had higher levels of formal education (84%) than Hmong participants (40%). None of the Hmong participants had completed college, compared to 32% of Latino participants who had completed four-year college or gone beyond to post-graduate education. Furthermore, 44% of Hmong participants had no formal education, although eight of these participants (32%) had English Language Learner (ELL) training after arrival to the US. Of the Latino participants, 64% spoke and read English compared to 40% of Hmong participants. We found that 96% of all participants (100% Latino and 92% Hmong) either owned or had reliable access to a smartphone device.

Multiple comorbid conditions were common among these participants (mean number of co-morbid conditions 3.3), with 48% having diabetes and 54% having high cholesterol. A substantial number of participants (26%) reported a history of cardiovascular disease, including heart disease or stroke. Depression and anxiety were frequent with 48% of participants reporting depression and/or anxiety. More Hmong participants (48%) reported history of depression than Latino participants (24%), while more Latino participants (36%) reported history of anxiety than Hmong participants (16%).

Hypertension Knowledge

Participants' knowledge about hypertension was variable (Table #3). Most participants (90%) identified high BP as being dangerous to health and 88% identified it as playing a role in the risk for stroke, heart attacks and kidney failure. Participants also reported that lowering BP can improve health and lower the risk for stroke, heart disease and kidney failure (98%). However, 58% of participants (80% Hmong and 36% Latino) did not know the meaning of the top and bottom numbers in BP measurement and 20% of participants (36% Hmong and 4% Latino) did not know normal systolic BP thresholds.

Medication Use: Barriers and Facilitators

Participants identified several issues that prevent them from taking their anti-hypertensive medications as prescribed. Most acknowledged that they have trouble taking daily medications, with many revealing that they were too busy to remember to take their medicines or forgot to transport their medications when not at home. Participants also cited that their state of health (i.e. feeling ill or feeling healthy) had an influence on their decision to take medicines. Additional barriers listed by Latino participants included

cost and medication side effects. Hmong participants also listed fear of potential side effects, polypharmacy, and too much reliance on chronic disease medications. (We included illustrative quotes for each of the qualitative content areas in the text and placed additional quotes in Table #4.)

- It can be very expensive to have so many prescriptions and have to go to the clinic so often. I'm usually good about managing my conditions and reaching out to my doctor but I sometimes have to balance that with work and home life.

  (56-year-old Latina woman)

- I get worried sometimes about side effects from medications. I feel less confident about my dosing regimen when my blood pressures are still high. I would rather not have to take my medicines if I can help it.

  (55-year-old Latino man)

- Sometimes I feel like I am taking too many medicines, so instead of taking two a day, I take one a day.

  (51-year-old Hmong man)

- Sometimes I wonder why I take medicines for so long… is it just to keep giving doctors a job? Why isn't there a medicine that I can just take for a few years and be rid of my high blood pressure?

  (58-year-old Hmong man)

Some participants said that they did not have difficulty taking their medications. Factors involved in medication adherence among Latino participants included prioritizing medications despite a busy schedule. A few Hmong participants attributed their medication adherence to having assistance from family members and to utilizing a pillbox with a timer.

Reactions to mHealth Care Model

From interview data, three major themes emanated from participants' reactions to the mHealth-based hypertension care model: 1) Reactions to the technology: *Could be useful, especially if people have help*; 2) Reactions to availability of blood pressure information to participants due to self-monitoring: *Could be useful, especially for people who agree with doctors*; 3) Reactions to healthcare providers receiving participant blood pressure information: *Could be empowerment, could be entrapment*.

1. Reactions to technology: *Could be useful, especially if people have help*

—The majority of Latino and Hmong participants had positive reactions to the mHealth technology. Among the positive aspects, participants mentioned that it was light, portable and easy to use anywhere. Participants specifically mentioned "no wires/tubes" as a positive aspect. They felt that it was convenient since they did not have to go to their clinic or drug store to measure their blood pressure. Participants mentioned that it was helpful that the measured BPs were saved on an app and hence they did not have to write them down manually. Participants also appreciated the similarity between the manual cuff and

the wireless monitor and therefore felt they could manage the device. Some participants mentioned it was analogous to home blood glucose monitoring.

- "If it's that easy, people with high BP can use it, it doesn't take a lot of time and they can still go to work."

  (52-year-old Hmong woman)

Participants from both groups expressed concerns and challenges with the technology. Since there is only one cuff size, participants were concerned that it could be too small for them or other people. There were concerns about access to a smartphone and the cost of a phone and internet service. Participants felt that this would be easier for young people, as older patients may struggle with using the smartphone and app technology because they were not English literate, educated and/or technologically savvy. One Hmong person wondered about the veracity of data in case other people in their household used the meter.

- If you know how to use a smartphone, then it's easy (to use). If you don't, then it's harder than the original cuff. It looks easy for the younger educated people, but not for the older people. Some people have never gone to school before and never even seen an airplane or car before coming to the US. How can they use a smartphone? I don't even know how to answer an incoming call when I'm already on the phone talking to someone else. It's better for me to write down my own numbers so I can look back and see what my numbers were before. Some people are welcoming to the new technology and new knowledge, but some people are still very old fashioned and they won't be able to.

  (79-year-old Hmong man)

- Logging into the app and getting it configured could be difficult for some in the Latino community. Financing the device could be difficult for some too.

  (43-year-old Latina woman)

Those who were concerned about not being able to use the technology on their own said that they would be able to if they had help from healthcare professionals or family members to learn how to use it. However, some mentioned that they do not always have access to their family members.

2. Reactions to increased awareness of blood pressures due to self-monitoring: *Could be useful, especially for patients who agree with doctors*

—Participants were divided on whether or not having increased self-monitoring capacity from the technology would improve BP control. Some people thought that it could promote self-motivation, medication compliance and lifestyle changes. However, a few reported that increased monitoring could make them become too focused on their BP measurements, causing anxiety and therefore worsen HTN control. Overall, many people said this model could be most useful for patients who agree with their healthcare clinician about the importance of taking medicine for high blood pressure.

- It would help maintain awareness of hypertension and would be a nice reminder to take medications as well.

  (66-year-old Latina woman)

- The device could be a cause for anxiety or obsession for some people in that they could focus too much on their BP readings to the point it stresses them more.

  (60-year-old Latina woman)

- The most important thing is the person and if they care about their health and blood pressure. If they have this machine but don't care about their health, then this wouldn't help.

  (59-year-old Hmong woman)

3. Reactions to clinicians receiving blood pressure results: *Could be empowerment, could be entrapment—*The majority of participants cited positive elements to the sharing of BP results with clinicians. Some liked the idea of the increased and timely attention from providers. They felt that this approach could help in communicating with their physicians regarding their BP. They liked that their doctor could have access to and could monitor their blood pressure. They felt it could save time by requiring fewer clinic visits and could improve patient-clinician relationships because it shows their clinician cares for them outside of the clinic. Some thought that the mHealth model could improve blood pressure control and health outcomes.

- It's like having a doctor at home and they're seeing things in real time. It would be relieving for patients.

  (43-year-old Latina woman)

- The doctor can adjust your medications or other things to lower your blood pressure. Helps that you don't have to come to the clinic too often.

  (52-year-old Hmong woman)

Participants also voiced concerns. Some were worried that the technology could lead to less face-time with their clinicians and ultimately lead to poorer health outcomes. A minority of participants worried about privacy, confidentiality and accuracy. Some participants were uncomfortable with their providers' access to BP readings because it may reveal when they were noncompliant with medications or dietary recommendations or had mis-reported their BP readings. There was a concern that healthcare providers might call patients at home when their BP readings were high, resulting in an interference to their privacy, personal lives, and autonomy. Lastly, some people were concerned that providers may intensify medication regimens, perhaps against their desires, due to the increased access to BP data.

- I think older people might prefer physical visits with their doctor, the old-fashioned way.

  (60-year-old Latino man)

- (I'm) worried that doctors will know when my pressures are high, such as when I eat good food, and they will make me eat too much medicine.

  (79-year-old Hmong man)

- I think others might not like it because they can't lie about their pressure.

  (58-year-old Hmong man)

Discussion

This formative study found that both Hmong and Latino adults with HTN who were interviewed generally have favorable responses to the mHealth-based care model that electronically transmits home BP readings to their healthcare team. This has the potential to improve BP control, especially during the COVID-19 pandemic. Participants described benefits and challenges of the mHealth model. First, some people can use the technology easily while others will need help to manage the technology. Second, this technology may assist those who agree with their healthcare team about the importance of BP monitoring and control more than those who disagree. Third, while many people will welcome the technological connection with their clinicians as empowering, some people will feel that intensive health monitoring could infringe on their privacy, impair their self-agency and lead to feelings of entrapment.

Technology

The study participants noted numerous positive aspects of mHealth technology including saving time, saving money, avoiding clinic visits and receiving effective care to improve BP control. Participants also identified challenges for some members of their communities including variable access to and proficiency with technology, English literacy, numeracy and cost that would have to be addressed by healthcare professionals or family members. Other studies, which have explored mHealth engagement among diverse populations, have identified that patient characteristics such as language, culture, age, limited literacy and lack of familiarity with technology are important factors to be acknowledged and considered in designing mHealth interventions (Chandler et al. 2019; Nelissen et al. 2018; O'Connor et al. 2016; Albrecht et al. 2018; Cimperman, Makovec Brencic, and Trkman 2016; Fang et al. 2019).

Hypertension Knowledge and Belief

HTN knowledge has been shown to be important for BP control (Oliveria et al. 2005). HTN knowledge was variable in our participants; most of our participants knew that HTN could cause serious morbidities, but many had little knowledge about the meanings of BP numbers. However, participants referred to beliefs, rather than to knowledge, as being relevant for people's using and responding to SMBP. Participants thought that the mHealth model would not promote behavior change in individuals who do not agree with their clinicians' assessments, recommendations, and the biomedical model of HTN. When analyzing these responses through a cultural lens, we interpreted these responses to mean that the mHealth model may not benefit those who have different beliefs regarding HTN.

Belief, in this setting, has previously been described as the "understandings of the causes, mechanisms or pathophysiology, course of illness, symptoms and effects of treatment" (Bokhour et al. 2012). In prior studies, patient beliefs have been found to play a critical role in HTN disease self-management behavior and overall BP control (Bokhour et al. 2012; Cohn et al. 2012; Kressin et al. 2019). Prior studies with Hmong (Wong et al. 2005; Thalacker 2011) and Latino (Perez 2015; Lor et al. 2019; Gutierrez et al. 2017; Karliner S 1998) communities highlight the role of cultural beliefs in BP control. As communities are not homogenous in their beliefs about HTN, patients' responses to SMBP are not homogenous but are influenced by their knowledge and beliefs of HTN. Our assessment is that the HTN cultural beliefs go beyond HTN knowledge, into a deeper response to healthcare providers' messages about BP control. Our study emphasizes the need for clinicians and health care systems to work with patients about their understandings and beliefs about BP and HTN before implementing a mHealth SMBP care delivery model.

Elements for Empowerment and Entrapment

mHealth has gained popularity for empowering users to play an active role in their health and wellness. For patients who embrace the technology, mHealth promotes self-determination by increasing awareness and control of their health (O'Connor et al. 2016; Birkhoff and Smeltzer 2017), thereby improving motivation for lifestyle changes (O'Connor et al. 2016; Arnett et al. 2019) and strengthening medication adherence (Kang and Park 2016). While our participants echoed these advantages, they also expressed concerns that sharing information about their home BP measurements outside of the clinic setting could be excessive and intrusive, contributing to a feeling of entrapment. Research in this area is limited. One study found that increased blood pressure surveillance can make patients feel like they are being too strictly monitored (Nelissen et al. 2018). In another study that implemented a mHealth application for HTN management, data transmission was the feature that scored the lowest in user satisfaction compared to other features such as ease of blood pressure recording, medication recording, alerts, recommendations and education about medication (Kang and Park 2016). One theme in our study, especially with the Hmong cohort, was that participants were worried about aggressive medication management and consequences related to medications, such as side effects, reliance on chronic medications and polypharmacy. Successful implementation of a mHealth-based care model for HTN management will have to address patient concerns about medication use.

Results from a pilot study by Lakshminarayan and team (Lakshminarayan et al. 2018) in predominantly White stroke survivors in Minnesota present an interesting comparison. The stroke survivors were overwhelmingly positive about the mHealth-based HTN management and identified self-empowerment, convenience and increased medical attention as key drivers of their positive attitudes. A small minority felt daily BP measurement was inconvenient and also felt that knowing their BP was anxiety provoking. The participants in that pilot were enrolled in the immediate aftermath of their stroke. Hence, it is likely that they were more attuned to the importance of BP control and interested in self-care.

Implementation: Patient-centered Care and Shared Decision-Making

Patient-specific issues need to be incorporated into BP control efforts (Arnett et al. 2019) and mHealth implementation strategies (AlDossary et al. 2017; Bradbury et al. 2018; Yardley et al. 2015) to support patients feeling empowered and not feeling entrapped. Interventions should prioritize understanding patients' responses to and preferences for mHealth by utilizing shared decision-making (SDM) approaches (Quality 2017; Abbasgholizadeh Rahimi et al. 2017) when introducing patients to SMBP. Since SDM involves active participation from both parties, a traditional SDM approach may not be suitable for patients from all cultural backgrounds. A systematic review evaluating SDM in racial minorities identified how patient differences in communication style, amount and type of information desired, and preferred decision roles impacted SDM (Mead et al. 2013). The authors highlighted that some patients from marginalized communities want to include people outside of the traditional patient-physician relationship in SDM. Our findings support this process, since patients already turn to knowledgeable people in their social network for help with technology, disease management, and medications.

While it is important for clinicians to avoid cultural stereotypes/biases when communicating with patients from marginalized communities, there may be general cultural differences that are relevant in predicting if a patient prefers family members to be involved in medical decision-making. An international SDM study identified how people from cultures that value relational-interdependence and social hierarchy desired more family involvement in medical decision-making than people from cultures that value independence (Alden et al. 2018). Indeed, many of our Hmong and Latino participants relied on family members for assistance with chronic disease management including the mHealth model. Taken together, these studies indicated that innovative approaches that use technology may need to take advantage of relational networks including caregivers and other family members to help patients negotiate and navigate mHealth services.

Limitations

The study's limitations include a small sample size of adults recruited through convenience sampling, which is not unusual for formative studies. Inherent to qualitative design, these participants may not represent all Hmong and Latino individuals with HTN in Minnesota. And since our participants were recruited from a community clinic that serves patients from lower socio-economic backgrounds, they may not represent Hmong and Latinos from other socio-economic strata. Most of our participants were older, female, born outside the US, had limited education and had a high burden of comorbidities including depression and anxiety. Nonetheless, participants had a range of important characteristics (age, gender, years in US, education, English literacy, religion, co-morbidities), and this diversity could strengthen our findings. As we recruited people who sought medical care at a community clinic, these participants may be more accepting of a biomedical model of health than others. We did not recruit Hmong and Latino community members outside the clinic setting to expand our sample. Hence, we may have not included people who place more reliance on traditional/cultural systems of healing and are less likely to share the biomedical model of health. Nevertheless, by inquiring about broader opinions in their community, and not just their own perspectives, we obtained additional information beyond their personal preferences.

While we had diverse participants, the sample size was not large enough to analyze our findings by subgroups, such as age, sex and educational level categories. Contrary to ideal CBPR processes, we did not return to participants to obtain their insights into our analyses and implications for mHealth implementation. We acknowledge that we did not collect additional data which may have been useful including technological literacy, BP control, BP medications, and prior use of SMBP. Both Hmong and Latino participants expressed ideas in the three themes, with some differences as explained above; to further describe differences between the communities, or by various characteristics, would require a quantitative study. Our limitations open the door for future studies accounting for these variables.

Conclusion

Hmong and Latino study participants with HTN viewed a mHealth-based care model as a form of empowerment because it could facilitate communication with their doctor, could free people from the time and money constraints of clinic visits and could provide information that supports their lifestyle changes and medication adherence. Nevertheless, some participants expressed concern about mHealth as a potential form of entrapment since intensive health monitoring could infringe on their privacy, interfere with their lifestyle choices, impose the biomedical view of hypertension upon them and curtail their autonomy. We recommend that clinicians evaluate patients' technological challenges and utilize relational networks to overcome the challenges, elicit understanding of patients' beliefs regarding the biomedical model of HTN, and use shared decision-making approaches to explore issues of empowerment and entrapment prior to implementing mHealth-based programs for patients of marginalized communities.

Acknowledgements –

We want to thank our 50 participants who graciously shared their thoughts and experiences with us, our federally-qualified health center partner Minnesota Community Care, and Shannon L Pergament MPH MSW.

Funding-

This work was supported by NIH grant R01 HL138332 to KL and a J.B. Hawley Award from the University of Minnesota, Division of Epidemiology and Community Health to KL. CAN was supported by the National Heart, Lung, and Blood Institute of the National Institutes of Health under award number T32HL007779.

Data Availability Statement –

Our qualitative data is not available.

Abbreviations

HTN	hypertension
BP	blood pressure
SMBP	Self-measured blood pressure monitoring
mHealth	mobile health
MCC	Minnesota Community Care

FQHC	federally qualified health care center
SDM	shared decision-making
US	United States
SD	Standard Deviation
ELL	English language learners
ESL	English as a second language

References

Abbasgholizadeh Rahimi S, Menear M, Robitaille H, and Legare F. 2017. “Are mobile health applications useful for supporting shared decision making in diagnostic and treatment decisions?” Glob Health Action 10 (sup3):1332259. doi: 10.1080/16549716.2017.1332259. [PubMed: 28838306]

Albrecht L, Wood PW, Fradette M, McAlister FA, Rabi D, Boulanger P, and Padwal R. 2018. “Usability and Acceptability of a Home Blood Pressure Telemonitoring Device Among Community-Dwelling Senior Citizens With Hypertension: Qualitative Study.” JMIR Aging 1 (2):e10975. doi: 10.2196/10975. [PubMed: 31518242]

Alden DL, Friend J, Lee PY, Lee YK, Trevena L, Ng CJ, Kiatpongsan S, Lim Abdullah K, Tanaka M, and Limpongsanurak S. 2018. “Who Decides: Me or We? Family Involvement in Medical Decision Making in Eastern and Western Countries.” Med Decis Making 38 (1):14–25. doi: 10.1177/0272989X17715628. [PubMed: 28691551]

AlDossary S, Martin-Khan MG, Bradford NK, Armfield NR, and Smith AC. 2017. “The Development of a Telemedicine Planning Framework Based on Needs Assessment.” J Med Syst 41 (5):74. doi: 10.1007/s10916-017-0709-4. [PubMed: 28321589]

Arnett DK, Blumenthal RS, Albert MA, Buroker AB, Goldberger ZD, Hahn EJ, Himmelfarb CD, et al. 2019. “2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines.” Circulation 140 (11):e596–e646. doi: 10.1161/CIR.0000000000000678. [PubMed: 30879355]

Birkhoff SD, and Smeltzer SC. 2017. “Perceptions of Smartphone User-Centered Mobile Health Tracking Apps Across Various Chronic Illness Populations: An Integrative Review.” J Nurs Scholarsh 49 (4):371–8. doi: 10.1111/jnu.12298. [PubMed: 28605151]

Bokhour BG, Cohn ES, Cortes DE, Solomon JL, Fix GM, Elwy AR, Mueller N, et al. 2012. “The role of patients’ explanatory models and daily-lived experience in hypertension self-management.” J Gen Intern Med 27 (12):1626–34. doi: 10.1007/s11606-012-2141-2. [PubMed: 22821569]

Bradbury K, Morton K, Band R, van Woezik A, Grist R, McManus RJ, Little P, and Yardley L. 2018. “Using the Person-Based Approach to optimise a digital intervention for the management of hypertension.” PLoS One 13 (5):e0196868. doi: 10.1371/journal.pone.0196868. [PubMed: 29723262]

Bureau, United States Census. 2019. “American Community Survey Demographic and Housing Estimates.” In.

Burke LE, Ma J, Azar KM, Bennett GG, Peterson ED, Zheng Y, Riley W, et al. 2015. “Current Science on Consumer Use of Mobile Health for Cardiovascular Disease Prevention: A Scientific Statement From the American Heart Association.” Circulation 132 (12):1157–213. doi: 10.1161/CIR.0000000000000232. [PubMed: 26271892]

Chandler J, Sox L, Kellam K, Feder L, Nemeth L, and Treiber F. 2019. “Impact of a Culturally Tailored mHealth Medication Regimen Self-Management Program upon Blood Pressure among Hypertensive Hispanic Adults.” Int J Environ Res Public Health 16 (7). doi: 10.3390/ijerph16071226.

Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr., Jones DW, et al. 2003. "Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure." Hypertension 42 (6):1206–52. doi: 10.1161/01.HYP.0000107251.49515.c2. [PubMed: 14656957]

Ciemins EL, Arora A, Coombs NC, Holloway B, Mullette EJ, Garland R, Walsh Bishop-Green S, Penso J, and Coon PJ. 2018. "Improving Blood Pressure Control Using Smart Technology." Telemed J E Health 24 (3):222–8. doi: 10.1089/tmj.2017.0028. [PubMed: 28930497]

Cimperman M, Makovec Brencic M, and Trkman P. 2016. "Analyzing older users' home telehealth services acceptance behavior-applying an Extended UTAUT model." Int J Med Inform 90:22–31. doi: 10.1016/j.ijmedinf.2016.03.002. [PubMed: 27103194]

Cohn ES, Cortes DE, Fix G, Mueller N, Solomon JL, and Bokhour BG. 2012. "Habits and routines in the daily management of hypertension." J Health Psychol 17 (6):845–55. doi: 10.1177/1359105311424471. [PubMed: 22108291]

Crabtree Benjamin F., and Miller William L.. 1999. Doing qualitative research. 2nd ed. Thousand Oaks, Calif.: Sage Publications.

Cruz-Flores S, Rabinstein A, Biller J, Elkind MS, Griffith P, Gorelick PB, Howard G, et al. 2011. "Racial-ethnic disparities in stroke care: the American experience: a statement for healthcare professionals from the American Heart Association/American Stroke Association." Stroke 42 (7):2091–116. doi: 10.1161/STR.0b013e3182213e24. [PubMed: 21617147]

Culhane-Pera KA, Moua M, DeFor TA, and Desai J. 2009. "Cardiovascular disease risks in Hmong refugees from Wat Tham Krabok, Thailand." J Immigr Minor Health 11 (5):372–9. doi: 10.1007/s10903-008-9211-x. [PubMed: 19101803]

Culhane-Pera KA, and Xiong P. 2003. "Hmong Culture: Tradition and Change." In Healing by Heart: Clinical and Ethical Case Stories of Hmong Families and Western Providers, edited by Vawter DE Culhane-Pera KA, Xiong P, Babbitt B, Solberg MM, 11–68. Nashville: Vanderbilt Press.

Fang J, Huang B, Xu D, Li J, and Au WW. 2019. "Innovative Application of a Home-Based and Remote Sensing Cardiac Rehabilitation Protocol in Chinese Patients After Percutaneous Coronary Intervention." Telemed J E Health 25 (4):288–93. doi: 10.1089/tmj.2018.0064. [PubMed: 30192210]

Gee ME, Bienek A, Campbell NR, Bancej CM, Robitaille C, Kaczorowski J, Joffres M, Dai S, Gwadry-Sridar F, and Nolan RP. 2012. "Prevalence of, and barriers to, preventive lifestyle behaviors in hypertension (from a national survey of Canadians with hypertension)." Am J Cardiol 109 (4):570–5. doi: 10.1016/j.amjcard.2011.09.051. [PubMed: 22154320]

Guan WJ, Liang WH, Zhao Y, Liang HR, Chen ZS, Li YM, Liu XQ, et al. 2020. "Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis." Eur Respir J 55 (5). doi: 10.1183/13993003.00547-2020.

Gutierrez AP, McCurley JL, Roesch SC, Gonzalez P, Castaneda SF, Penedo FJ, and Gallo LC. 2017. "Fatalism and hypertension prevalence, awareness, treatment and control in US Hispanics/Latinos: results from HCHS/SOL Sociocultural Ancillary Study." J Behav Med 40 (2):271–80. doi: 10.1007/s10865-016-9779-x. [PubMed: 27501734]

Howard G, Prineas R, Moy C, Cushman M, Kellum M, Temple E, Graham A, and Howard V. 2006. "Racial and geographic differences in awareness, treatment, and control of hypertension: the REasons for Geographic And Racial Differences in Stroke study." Stroke 37 (5):1171–8. doi: 10.1161/01.STR.0000217222.09978.ce. [PubMed: 16556884]

Israel Barbara A. 2005. Methods in community-based participatory research for health. 1st ed. San Francisco, CA: Jossey-Bass.

James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, Lackland DT, et al. 2014. "2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8)." JAMA 311 (5):507–20. doi: 10.1001/jama.2013.284427. [PubMed: 24352797]

Kang H, and Park HA. 2016. "A Mobile App for Hypertension Management Based on Clinical Practice Guidelines: Development and Deployment." JMIR Mhealth Uhealth 4 (1):e12. doi: 10.2196/mhealth.4966. [PubMed: 26839283]

Karliner S, Crewe SE, Pacheco H, Gonzalez YC. 1998. “Latino Health Beliefs: A guide for health care professionals.” In. Washington, DC: National Council of La Raza.

Kernan WN, Ovbiagele B, Black HR, Bravata DM, Chimowitz MI, Ezekowitz MD, Fang MC, et al. 2014. “Guidelines for the prevention of stroke in patients with stroke and transient ischemic attack: a guideline for healthcare professionals from the American Heart Association/American Stroke Association.” Stroke 45 (7):2160–236. doi: 10.1161/STR.0000000000000024. [PubMed: 24788967]

Kressin NR, Elwy AR, Glickman M, Orner MB, Fix GM, Borzecki AM, Katz LA, et al. 2019. “Beyond Medication Adherence: The Role of Patients’ Beliefs and Life Context in Blood Pressure Control.” Ethn Dis 29 (4):567–76. doi: 10.18865/ed.29.4.567. [PubMed: 31641324]

Lakshminarayan K, Westberg S, Northuis C, Fuller CC, Ikramuddin F, Ezzeddine M, Scherber J, and Speedie S. 2018. “A mHealth-based care model for improving hypertension control in stroke survivors: Pilot RCT.” Contemp Clin Trials 70:24–34. doi: 10.1016/j.cct.2018.05.005. [PubMed: 29763657]

Leng B, Jin Y, Li G, Chen L, and Jin N. 2015. “Socioeconomic status and hypertension: a meta-analysis.” J Hypertens 33 (2):221–9. doi: 10.1097/HJH.0000000000000428. [PubMed: 25479029]

Lor M, Koleck TA, Bakken S, Yoon S, and Dunn Navarra AM. 2019. “Association Between Health Literacy and Medication Adherence Among Hispanics with Hypertension.” J Racial Ethn Health Disparities 6 (3):517–24. doi: 10.1007/s40615-018-00550-z. [PubMed: 30607576]

Mead EL, Doorenbos AZ, Javid SH, Haozous EA, Alvord LA, Flum DR, and Morris AM. 2013. “Shared decision-making for cancer care among racial and ethnic minorities: a systematic review.” Am J Public Health 103 (12):e15–29. doi: 10.2105/AJPH.2013.301631.

Meschia JF, Bushnell C, Boden-Albala B, Braun LT, Bravata DM, Chaturvedi S, Creager MA, et al. 2014. “Guidelines for the primary prevention of stroke: a statement for healthcare professionals from the American Heart Association/American Stroke Association.” Stroke 45 (12):3754–832. doi: 10.1161/STR.0000000000000046. [PubMed: 25355838]

Muntner P, Hardy ST, Fine LJ, Jaeger BC, Wozniak G, Levitan EB, and Colantonio LD. 2020. “Trends in Blood Pressure Control Among US Adults With Hypertension, 1999–2000 to 2017–2018.” JAMA 324 (12):1190–200. doi: 10.1001/jama.2020.14545. [PubMed: 32902588]

Nelissen HE, Cremers AL, Okwor TJ, Kool S, van Leth F, Brewster L, Makinde O, et al. 2018. “Pharmacy-based hypertension care employing mHealth in Lagos, Nigeria - a mixed methods feasibility study.” BMC Health Serv Res 18 (1):934. doi: 10.1186/s12913-018-3740-3. [PubMed: 30514376]

O’Connor S, Hanlon P, O’Donnell CA, Garcia S, Glanville J, and Mair FS. 2016. “Understanding factors affecting patient and public engagement and recruitment to digital health interventions: a systematic review of qualitative studies.” BMC Med Inform Decis Mak 16 (1):120. doi: 10.1186/s12911-016-0359-3. [PubMed: 27630020]

Oliveria SA, Chen RS, McCarthy BD, Davis CC, and Hill MN. 2005. “Hypertension knowledge, awareness, and attitudes in a hypertensive population.” J Gen Intern Med 20 (3):219–25. doi: 10.1111/j.1525-1497.2005.30353.x. [PubMed: 15836524]

Perez A 2015. “Acculturation, Health Literacy, and Illness Perceptions of Hypertension among Hispanic Adults.” J Transcult Nurs 26 (4):386–94. doi: 10.1177/1043659614524785. [PubMed: 24810516]

Pfeifer ME, Sullivan J, Yang K, Yang W. 2012. “Hmong population and demographic trends in the 2010 Census and 2010 American Community Survey.” Hmong Studies Journal 13 (2):1–31.

Quality, Agency for Healthcare Research and. 2017. “The CAPHS Ambulatory Care Improvement Guide: Practical Strategies for Improving Patient Experience.” In Section 6: Strategies for Improving Patient Experience with Ambulatory Care. Rockville, MD.

Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, Covid-Research Consortium the Northwell, et al. 2020. “Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area.” JAMA 323 (20):2052–9. doi: 10.1001/jama.2020.6775. [PubMed: 32320003]

Shimbo D, Artinian NT, Basile JN, Krakoff LR, Margolis KL, Rakotz MK, Wozniak G, Association American Heart, and Association the American Medical. 2020. “Self-Measured

Blood Pressure Monitoring at Home: A Joint Policy Statement From the American Heart Association and American Medical Association." Circulation 142 (4):e42–e63. doi: 10.1161/CIR.0000000000000803. [PubMed: 32567342]

Thalacker KM 2011. "Hypertension and the Hmong community: using the health belief model for health promotion." Health Promot Pract 12 (4):538–43. doi: 10.1177/1524839909353735. [PubMed: 21051326]

Uhlig K, Patel K, Ip S, Kitsios GD, and Balk EM. 2013. "Self-measured blood pressure monitoring in the management of hypertension: a systematic review and meta-analysis." Ann Intern Med 159 (3):185–94. doi: 10.7326/0003-4819-159-3-201308060-00008. [PubMed: 23922064]

Virani SS, Alonso A, Benjamin EJ, Bittencourt MS, Callaway CW, Carson AP, Chamberlain AM, et al. 2020. "Heart Disease and Stroke Statistics-2020 Update: A Report From the American Heart Association." Circulation 141 (9):e139–e596. doi: 10.1161/CIR.0000000000000757. [PubMed: 31992061]

Whelton PK, Carey RM, Aronow WS, Casey DE Jr., Collins KJ, Dennison Himmelfarb C, DePalma SM, et al. 2018. "2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines." Hypertension 71 (6):e13–e115. doi: 10.1161/HYP.0000000000000065. [PubMed: 29133356]

Wong CC, Mouanoutoua V, Chen MJ, Gray K, and Tseng W. 2005. "Adherence with hypertension care among Hmong Americans." J Community Health Nurs 22 (3):143–56. doi: 10.1207/s15327655jchn2203_2. [PubMed: 16083402]

Yardley L, Morrison L, Bradbury K, and Muller I. 2015. "The person-based approach to intervention development: application to digital health-related behavior change interventions." J Med Internet Res 17 (1):e30. doi: 10.2196/jmir.4055. [PubMed: 25639757]

Table #1:

Interview questions

1	What, if anything, prevents you from taking your medicines for high blood pressure?
2	Now that you have seen the mobile technology-based blood pressure system:
	a. What do you think?
	b. What do you like about this system?
	c. What do you not like about this system?
	d. What might make it easier for you (or others) to use this system at home?
3	When we use it, people like you can see their blood pressure on their phone.
	a. What do you think about this idea?
	b. What do you think others will think about this idea?
	c. Will this idea help you (or others) control their blood pressure? Why or why not?
4	When we use it, doctors and pharmacists will also be able to see people's blood pressures. The doctors and pharmacists can call people when the blood pressure is too high or too low.
	a. What do you think about this idea?
	b. What do you think others will think about this idea?
	c. Will this idea help you (or others) control their blood pressure? Why or why not?

Table #2.

Participants' demographics and baseline characteristics

	Total (N=50)	**Hmong (N=25)**	**Latino (N=25)**
Age in years Mean (±SD*; range)	55.5 (±15.4; 28–86)	57.9 (±17.6; 29–86)	53.2 (±12.8; 28–76)
Gender Female N(%):Male N(%)	28 (56%):22 (44%)	14 (56%):11 (44%)	14 (56%):11 (44%)
Clinic Role Patients N(%):Staff N(%)	45 (90%):5 (10%)	23 (92%):2 (8%)	22 (88%):3 (12%)
Education, N (%)			
None or ESL/ELL**	11 (22%)	11 (44%)	0 (0%)
< High School Graduate	8 (16%)	4 (16%)	4 (16%)
= High School Graduate	9 (18%)	3 (12%)	6 (24%)
> High School Graduate	22 (44%)	7 (28%)	15 (60%)
Religion, N (%)			
Christian	28 (56%)	9 (36%)	19 (76%)
Animist	13 (26%)	13 (52%)	0 (0%)
None/Other/No Answer	9 (18%)	3 (12%)	6 (24%)
Country Born, N (%)			
USA	6 (12%)	3 (12%)	3 (12%)
Non-USA	44 (88%)	22 (88%)	22 (88%)
Time in US for non-US born, N (%)			
<10 years, N (%)	2 (5%)	1 (5%)	1 (5%)
≥10 years, N (%)	42 (95%)	21 (95%)	21 (95%)
Languages Spoken, N (%)***			
English	26 (52%)	10 (40%)	16 (64%)
Hmong	25 (50%)	25 (100%)	0 (0%)
Spanish	26 (52%)	1 (4%)	25 (100%)
Other	8 (16%)	7 (28%)	1 (4%)
Languages Read, N (%)***			

	Total (N=50)	Hmong (N=25)	Latino (N=25)
English	26 (52%)	10 (40%)	16 (64%)
Hmong	19 (38%)	19 (76%)	0 (0%)
Spanish	26 (52%)	1 (4%)	25 (100%)
Other	6 (12%)	6 (24%)	0 (0%)
Ownership of Smartphone, N (%)			
Yes	41 (82%)	18 (72%)	23 (92%)
No, but access to smartphone	7 (14%)	5 (20%)	2 (8%)
No and no access to smartphone	2 (4%)	2 (8%)	0 (0%)
Comorbidities Mean (±SD *; range)	3.3 (±1.6; 1–6)	3.4 (±1.6; 1–6)	3.3 (±1.6; 1–6)
Diabetes	24 (48%)	13 (52%)	11 (44%)
High Cholesterol	27 (54%)	12 (48%)	15 (60%)
Heart Disease	8 (16%)	3 (12%)	5 (20%)
Stroke	5 (10%)	3 (12%)	2 (8%)
Heart Disease and/or Stroke	13 (26%)	6 (24%)	7 (28%)
Depression	18 (36%)	12 (48%)	6 (24%)
Anxiety	13 (26%)	4 (16%)	9 (36%)
Depression and/or Anxiety	24 (48%)	13 (52%)	11 (44%)

*SD: Standard Deviation

**ESL/ELL= English as a Second Language/English Language Learner

***Numbers and percentages are >100% due to multiple languages spoken/read

Table #3.

Hypertension knowledge

Question	Answer	Total N=50 (%)	Hmong N=25 (%)	Latino N=25 (%)
What does the word “hypertension” mean?	High Blood Pressure	29 (58%)	8 (32%)	21 (84%)
	Stress/Tension	4 (8%)	2 (8%)	2 (8%)
	I don’t know	17 (34%)	15 (60%)	2 (8%)
How dangerous is high blood pressure to people’s health?	Extremely dangerous	38 (76%)	17 (68%)	21 (84%)
	Somewhat dangerous	7 (14%)	3 (12%)	4 (16%)
	Not at all dangerous	2 (4%)	2 (8%)	0 (0%)
	I do not know	3 (6%)	3 (12%)	0 (0%)
Why is high blood pressure dangerous to people?	Causes heart attacks	3 (6%)	0 (0%)	3 (12%)
	Causes strokes	3 (6%)	1 (4%)	2 (8%)
	Causes strokes, heart attacks, and kidney failure	44 (88%)	24 (96%)	20 (80%)
What do the two numbers in the blood pressure readings mean?	Correct response	15 (30%)	2 (8%)	13 (52%)
	Incorrect responses	6 (12%)	3 (12%)	3 (12%)
	I do not know	29 (58%)	20 (80%)	9 (36%)
What is the normal blood pressure level for the top number?	≤120 mmHg	32 (64%)	12 (48%)	20 (80%)
	≤130 mmHg	8 (16%)	4 (16%)	4 (16%)
	I don’t know	10 (20%)	9 (36%)	1 (4%)
What is the normal blood pressure level for the bottom number?	≤80 mmHg	38 (76%)	14 (56%)	24 (96%)
	≤100 mmHg	1 (2%)	0 (0%)	1 (4%)
	I don’t know	11 (22%)	11 (44%)	0 (0%)
Do you think there are things that people can do to lower their blood pressure?	Yes	47 (94%)	23 (92%)	24 (96%)
	No	1 (2%)	0 (0%)	1 (4%)
	I don’t know	2 (4%)	2 (8%)	0 (0%)
Can lowering blood pressure, even a little bit, improve health?	Yes	49 (98%)	24 (96%)	25 (100%)
	No	1 (2%)	1 (4%)	0 (0%)
	I don’t know	0 (0%)	0 (0%)	0 (0%)
Can lowering blood pressure decrease risk for strokes, heart attacks, and kidney failure?	Yes	49 (98%)	25 (100%)	24 (96%)

Question	Answer	Total N=50 (%)	Hmong N=25 (%)	Latino N=25 (%)
	No	1 (2%)	0 (0%)	1 (4%)
	I don't know	0 (0%)	0 (0%)	0 (0%)

Table #4:

Participants' additional quotes

Category	Quotes
Medication Use: Barriers and Facilitators	When I have a cold or when I feel nausea, then I don't take my medicines for 3–4 days. When I feel better, I will continue taking the medicine. (Hmong) When my body is feeling better or healthier, then I don't take medications. (Hmong) I'm very mindful of when and where to take my medicines, even on busy days. (Latino) My children help me out a lot and set up pill boxes. They take care of me very well. (Hmong)
Theme 1. Reactions to technology *Could be useful, especially if people have help*	I think it might be a bit difficult for some people who only know the basics about smartphones, but younger family members would usually be able to help. I think it would be relatively easier to use than some other phone apps. (Latino) I don't think that I am smart enough to use the cuff and the smartphone. I think that my kids can help me use it, but they are very busy. (Hmong)
Theme 2: Reactions to increased awareness of blood pressures due to self-monitoring *Could be useful, especially for patients who agree with doctors*	If you can see your blood pressure readings everyday with this device, it will help you control it by managing your medications and diet better. (Hmong) The device could be a cause for anxiety or obsession for some people in that they could focus too much on their BP readings to the point it stresses them more. (Latino) I think it will be able to help control blood pressure because I can think about what I did or ate yesterday to cause high blood pressure and I look at today to see if my changes made a difference. (Hmong)
Theme 3: Reactions to clinicians receiving blood pressure results *Could be empowerment, could be entrapment*	I can measure it and send my numbers to my doctor. He will monitor my blood pressure and we can avoid visits to the clinic and, worse, to the ER! (Latino) It's nice because they will help you and remind you what you need to do to control your blood pressure. It makes you feel like someone cares. (Hmong) I think older people might prefer physical visits with their doctor, the old-fashioned way. (Latino) I think it would be a nuisance because they will be calling me. I would not feel like wanting to (check) my blood pressure. (Hmong) (I'm) worried that doctors will know when my pressures are high, such as when I eat good food, and they will make me eat too much medicine. (Hmong)