Feasibility of Cell Phone Surveys in People with Mental Illness Experiencing Homelessness During COVID-19

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Cover Page Footnote

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Introduction

Homelessness remains an intractable public health problem in the United States. People experiencing homelessness (PEH) represent an underserved and diverse population at increased risk for serious mental illness (SMI) or co-occurring substance use disorders (COD). Prevalence rates are estimated to range from 24 to 67% for SMIs including schizophrenia, bipolar disorder, or major depression, [1-9] and from 20 to 50% for COD [6,10-12]. PEH experience poor physical and mental health outcomes, as well as emotional and psychological trauma; this risk is increased in the context of COVID-19 [13,14]. Further, a dearth of homeless shelter beds, the closure of homeless day programs due to social distancing requirements, lack of availability of direct care providers, and spread of disease in homeless shelters compounds the adverse experiences this population is experiencing during the pandemic [15]. While PEH are at risk for higher infection rates and poorer COVID-19–related outcomes, they may experience barriers accessing primary care and/or adhering to public health directives related to physical distancing, isolation and quarantine because of shelter conditions and other challenges [15,16]. Hence, consumer-reported information is needed to elucidate health-related knowledge, experiences, and practices among PEH during the pandemic to improve public health planning and healthcare service delivery.

Mobile phone technology (mHealth) can be leveraged to administer surveys to collect, store and monitor self-reported health information in real time, potentially improving the efficiency of data collection (Carter et al., 2015). General population data regarding cell phone ownership shows 97% of the US population is reported to own a cell phone and 85% own a smartphone [17]. In contrast, cell phone ownership among the homeless population has been shown to range between 44% [18] to 72-94% [19,20]. Higher percentages of phone access tend to be reported among those transitioning to supportive housing (PSH) and among youth experiencing homelessness [20,21]. However, studies prior to the pandemic on feasibility of using mobile phones as a means of administering surveys or delivering care [19,20,22] found homelessness is associated with lower survey completion and non-reporting.

For example, one study suggested that despite possessing the ability to access care via a phone, homeless veterans over the age of 45 were less likely to use video care perhaps due to technological or internet barriers as well as service delivery preference [23]. Feasibility of phone use for surveys or service delivery could be affected by findings such as a 3-month turnover of phone numbers and phones among this population [20]. Additionally, approximately half of PEH who have had a phone report not having a smartphone and not ever accessing the internet, and only one third report having used the internet in the last 3 months [19,20]. PEH are less likely to have a cell phone service contract and older males, in particular, have been found to experience barriers to texting due to limited technological literacy and poor eyesight [22]. Additional problems reported include keeping the phone charged, being victims of theft, lost phones, or exceeding data limits.

However, in prior studies, most subjects reported satisfaction with participation in cell phone research as well as reasonable levels of engagement [24-26]. Additionally, the PEH in these studies welcomed use of cell phones to receive reminders for preventive care and medical appointments; as well as improve treatment adherence and receive health education. Evidently, there are

potential benefits, as well as barriers to leveraging mHealth to address health disparities among PEH.

The shift to virtual care during the pandemic has highlighted the concern for disparity in access to care among PEH. While telemedicine has expanded considerably as a primary means of service provision with an increase from 43% of healthcare centers providing telemedicine pre-pandemic, to 95% by Nov 2020 [27], underserved populations such as PEH may still experience inaccessibility of care due to factors as described above. In addition, existing COVID-19 population surveys have been conducted online [28,29], thereby excluding those who do not have internet access, exposing a gap in data collection from PEH.

Since the start of the pandemic, there has been some limited data on the use of cell phones to increase healthcare access among PEH. One study in Canada has to date given out 180 phones from an Emergency Department to vulnerable populations without a phone, though not limited to PEH. The phones have been used to access medical care, including suicide hotlines, as well as social care such as shelter beds [16]. With regards to data collection pertaining to COVID-19, there was a 66% retention rate of participants at 3 months using a mobile survey platform to examine attitudes towards COVID-19 threat and the vaccine [30].

This study expands on previous research examining the feasibility of data collection via mobile phones, in PEH during the Covid-19 pandemic. The goal includes gaining a better understanding of the experiences of PEH during a critical time when increasing need for remote access to this hard-to-engage population is important. This study is unique in its duration and its focus on patients with mental health issues, including all ages above 18. The aim of this manuscript is to describe the process, lessons learned, barriers and facilitators to gathering electronic mobile survey data from this vulnerable population. Specifically, implications for future research with this population are discussed.

Methods

A pilot sample of PEH, or at risk of homelessness who were enrolled in the University of Texas Health Homeless Outpatient Mental Health Expansion Services (UTHealth HOMES) project (a Substance Abuse and Mental Health Services (SAMHSA) funded grant providing therapy to PEH) were provided with mobile phones. The current study was funded by the American Psychiatric Association Foundation as a residency-research training pilot project and underwent human subjects review and approval by the University of Texas Health Science Center Houston (UTHealth) Institutional Review Board (IRB) (IRB#: HSC-MS-20-0776). This study partnered with a faith-based organization already working with PEH, the SAMHSA-funded UTHealth HOMES project and a telecommunications company, Beast Mobile Phones.

A single group cohort study design (n= 30) was employed to examine feasibility of monthly data collection over 6 months, using mobile phone surveys delivered via a text message link. Eligible and willing participants signed the informed consent, agreeing to three parts of the project: 1) an interviewer administered mental illness screening tool (the modified mini international neuropsychiatric interview), provide demographic data, and self-complete five baseline mobile phone surveys: Patient Health Questionnaire – 9 (PHQ9), PTSD Checklist for DSM-5 (PCL5), Generalized Anxiety Disorder Screener (GAD7), Exposure knowledge, attitudes and practice (EKAP), and health and social services access; 2) completion of the same five

mobile phone surveys on a monthly basis for 6 months; and 3) complete surveys on acceptability and usability at month 6. Participants were given a free smartphone that included a year's worth of cell service along with a $10 loading on their study-given debit card for every month of completed surveys. Additionally, participants were provided with the opportunity to engage in free cognitive behavioral therapy (CBT) with a licensed mental health provider and social service assistance via the UTHealth HOMES program.

Enrollment and recruitment

UTHealth HOMES provides integrated, trauma-informed behavioral health treatment for adults with SMI who are experiencing homelessness. Preliminary UTHealth HOMES data found that approximately 70% of program participants did not possess mobile phones, which was a primary barrier to participation in CBT and social services case management during the onset of the COVID-19 pandemic when social distancing restrictions were implemented.

Study participants were recruited via convenience sampling from homeless encampments, streets, and PSH for the formerly chronically homeless in proximity to a church providing food for PEH in the heart of Houston, Texas. Researchers and UTHealth HOMES staff (masters level social workers and community health workers) conducted outreach and enrolled all persons who met criteria and were willing to participate until maximum enrollment was reached. Study eligibility was established through verbal verification of no regular access to a smartphone, the modified mini to establish a mental health diagnosis and were deemed to meet the criteria for homelessness or at risk of homelessness due to their current living situations. Exclusion criteria included not meeting any of these eligibility requirements and being younger than 18 years of age. During the enrollment process, participants were introduced to the smartphone and oriented to its use. The baseline surveys served to teach participants how to access the survey links, to assess digital literacy and provide technological support. Upon completion of the surveys, participants were given a Mastercard which was loaded with $10 and informed that this card would be reloaded 24-48 hours after completion of every month's worth of surveys.

Survey link design

The surveys were sent directly to participants from Research Electronic Data Capture (REDCap) providing a Health Insurance Portability and Accountability Act (HIPPA) compliant method of storage of responses on the UTHealth Clinical Data Warehouse administered by the UTHealth Biomedical Informatics Group - the Analytics Research Center. The surveys were sent as text messages via email by sending them directly from REDCap to the phone number with the carrier gateway e.g.,number@mms.att.net. This allowed the use of REDCap directly without the need to purchase an additional texting service, making the study more cost-effective. The text included a URL link which the participants clicked on and were then directed to the survey on REDCap. The surveys were automated such that after the participant completed the first one which was the informed consent (S1), all the baseline surveys were sent immediately. Subsequent monthly surveys were automated to be started at 30, 60, 90, 120 and 150 days after S1. The individual 5 surveys for each month (PHQ9, GAD7, PCL5, EKAP, Healthcare access) were sent on sequential days for 5 days to reduce participant burden. If the survey was not completed, an automated reminder link was sent for 3 days.

Data analysis

In total, there were two surveys conducted at baseline, five survey items monthly for a period of 5 months as well as at baseline, and a feasibility survey included in the analyses. Two different statistical models were included in the study. The first model analyzed participant factors associated with Survey *Completion*, which was coded as a binary (yes/no) variable. Survey completion was defined as completing all 6 months of the protocol. Within this model, demographic, social, and substance use data were mostly coded as binary (yes/no) variables and included: *Hispanic/Latino* (ethnicity), *Black or African American* (race), *White* (race), *Male* (gender), *Heterosexual* (sexuality), *Employed, Hospitalization for Mental Health Reasons in the Last 30 Days*, *Jailed in the Last 30 Days*, *Tobacco Use in the Last 30 Days, Alcohol Use in the Last 30 Days,* and *Drug Use in the Last 30 Days*. The variable *Unsheltered* was coded as "yes" if the participant was "truly homeless" and recruited from a homeless day program or encampment site.

Other factors analyzed as binary variables included clinical diagnoses (*Mood Disorder*, *Anxiety Disorder/Post Traumatic Stress Disorder (PTSD)*, *Psychotic Disorder*, and *Substance Use Disorder*) as well as the variable *Probable PTSD*, which was coded as "yes" if the participant's PCL-5 score was 33 or higher. Clinical diagnoses were made by trained, licensed mental health professionals who assigned participants psychiatric diagnoses according to Diagnostic and Statistical Manual of Mental Disorders (DSM) V criteria. These were then categorized into the four diagnosis groups specified above.

Depression Severity was analyzed as an ordinal variable with the levels: "Minimally Depressed", "Mild Depression", "Moderate Depression", and "Moderately Severe to Severe Depression". These cut-offs were derived from PHQ-9 scores of 0-4, 5-9, 10-14, and 15-27. (https://www.hiv.uw.edu/page/mental-health-screening/phq-9)

Education was a categorical variable coded as: "Less than 12th Grade", "12th Grade/High School Diploma/Equivalent (GED)", "Vocational/Technical Diploma", "Some College or University", or "Bachelor's Degree (BA, BS)".
The variables *Age* (in years), *PHQ-9 score*, *PCL-5 score*, and *GAD-7* score were analyzed as continuous variables.

In the preliminary analyses, tests of independence were utilized to examine the association between the categorical/binary variables and *Survey Completion*. For analysis in which all cells in the contingency table had a sample greater than five, Chi-Square testing was used. However, due to the small sample size in this study (n=30), most of the contingency tables had cells with a sample less than five, so Fisher's Exact testing was utilized in its place. For the continuous variables, independent *t* testing was utilized to examine the association of *Age* and *Survey Completion* while Mann-Whitney U testing was used to examine the association of *PHQ-9 score*, *PCL-5 score*, and *GAD-7 score* and *Survey Completion*. Differences between the "complete" and "not complete" survey groups were regarded as statistically significant for p values less than 0.05. Independence of observations was assumed. Further, descriptive statistics of feasibility were reported using proportions to outline the participants ratings of the acceptability and usability of this study. All analyses were conducted using IBM® SPSS® Statistics Version 28.

Results

Thirty people were enrolled from January 2021 to June 2021. On average 1-2 people were enrolled a week from the recruitment areas. Nine of the participants were unsheltered, recruited either from the streets near the church or from an area encampment. The rest were from a PSH building with single room occupancies administered by the church. Out of 31 participants who completed signed consent, 30 went on to enroll and complete all the initial surveys. Enrollment required time to walk the streets, visit encampments and the PSH location to approach and recruit homeless participants. Approximately 40% of those approached refused participation. Reasons for refusal included the requirement to complete ongoing surveys, engage in therapy (as part of the UTHealth HOMES project), concern expressed about being potentially tracked by the phones, and reports that more immediate needs for food and money took precedence. Notably, word-of-mouth referrals from enrolled participants generated interest in the project resulting in potential participants visiting the church and requesting to be enrolled.

Table I shows that the sample population (n=30) was predominately male (86.7%), either African American (70%) or White (30%), non-Hispanic (93.3%), and heterosexual (90%). The average age of the sample was 49.4 years (sd = 9.8 years). Thirty percent of the sample reported having less than a 12th grade education while 36.7% and 33.3% reported completing 12th grade (or received a GED) or having some secondary education, respectively. At the time of enrollment, 93.3% of the participants were unemployed.

At baseline, the median and interquartile range (IQR) values for participants' PHQ-9, PCL-5, and GAD-7 scores were 9 (IQR = 3-14), 32 (IQR = 14-45), and 8 (IQR = 3-14), respectively. With respect to severity of depression as classified by PHQ-9 scores, 26.7% of the sample were classified as "minimally depressed" while 30.0%, 20.0%, and 23.3% met criteria for mild, moderate, and moderately severe to severe depression, respectively (see Table I). Based on PCL-5 scores, 50% of the sample met criteria for PTSD. When interviewed by clinically trained team members, 50% were diagnosed with a mood disorder, 70% with an anxiety disorder (including PTSD), 13.3% with a psychotic disorder, and 53.3% with a substance use disorder. In our sample, 30% of participants were unsheltered, and 23.3% and 16.7% of the population reported being in a hospital for mental health reasons or in jail in the last 30 days, respectively. Finally, 43.3%, 23.3%, and 20.0% of our sample reported using tobacco, alcohol, or drugs in the last 30 days, respectively.

Table II compares the psychosocial characteristics of participants who completed the study versus those who did not complete the study. As shown in the tables, the only variable found to have a statistically significant association with *Survey Completion* was *Unsheltered*.

Table I: Demographic characteristics based on completion of the study

	Completed study (n=11) (N, %)	Did not complete (n=19) (N, %)	*p*-value
Age (mean, SD)	51.18 (9)	48.4 (10)	0.466
Male Gender	11 (100)	15 (79)	0.141[b]
Heterosexual	9 (82)	18 (95)	0.298[b]
Race			
White	2 (18)	7 (37)	0.258[b]
Black	9 (82)	12 (63)	0.258[b]
Other	0 (0)	3 (16)	0.239[b]
Hispanic/Latino Ethnicity	1 (9)	1 (5)	0.607[b]
Employed	1 (9)	1 (5)	0.607[b]
Education			0.125[b]
Less than 12th grade	3 (27)	6 (32)	
High school diploma/GED	4 (36)	7 (37)	
VOC/Tech Diploma	0 (0)	1 (5)	
Some college	4 (36)	4 (21)	
Bachelor's degree	0 (0)	1 (5)	

a = T-value from independent samples *t*-test
b = *p*-value taken from Fisher's exact (no test statistic)

Table II: Psychosocial characteristics at baseline

	Completed study (n=11) (N, %)	Did not complete (n=19) (N, %)	*p*-value
PHQ9	10 (10)	9 (8)	0.703
PCL	20 (39)	40 (32)	0.700
GAD7	8 (18)	8 (8)	0.800
Probable PTSD	3 (27)	12 (63)	0.058
Depression Severity			0.700[c]
Minimally Depressed	5 (46)	3 (16)	

Mild	0 (0)	9 (47)	
Moderate	4 (36)	2 (11)	
Moderately severe to severe	2 (18)	5 (26)	
Hospitalization (past 30 days)	4 (36)	3 (16)	0.200[c]
Jail (past 30 days)	2 (18)	3 (16)	0.619[c]
Drug use (past 30 days)	2 (18)	4 (21)	0.620[c]
Alcohol use (past 30 days)	2 (18)	5 (26)	0.485[c]
Tobacco use (past 30 days)	4 (36)	9 (47)	0.421[c]
Unsheltered*	0 (0)	9 (47)	**0.006*[c]**

* = statistically significant
a = U-value from Mann-Whitney U testing
b = χ^2 value from Chi-Square testing
c = p-value taken from Fisher's exact testing (no test statistic)

Survey responsiveness

At the end of the study length which ran in total from January to November 2021, 11 (36.7%) participants completed the full 6 months of the surveys while 19 (63.3%) partially completed the study. For each of the five months that surveys were sent after the baseline encounter, 18 (60%) participants completed at least one of the month 1 surveys, 15 (50%) completed at least one of the month 2 surveys, 14 (46.7%) completed at least one of the month 3 surveys, 12 (40%) completed at least one of the month 4 surveys, and 12 (40%) completed at least one of the month 5 surveys (Figure I). The project purchased an extra 4 phones to give out in the case of lost/stolen phones and these were given out on a first come-first served basis to participants who were engaged in the project at the time their phone was lost/stolen. By June when all 30 participants were enrolled, 8 phones (27%) were reported lost or stolen; July, 10 phones (33%) and from August through to the end of the study period a total of 12 phones (40%) were reported lost or stolen.

Figure I: Survey completion each month

Completion of monthly surveys
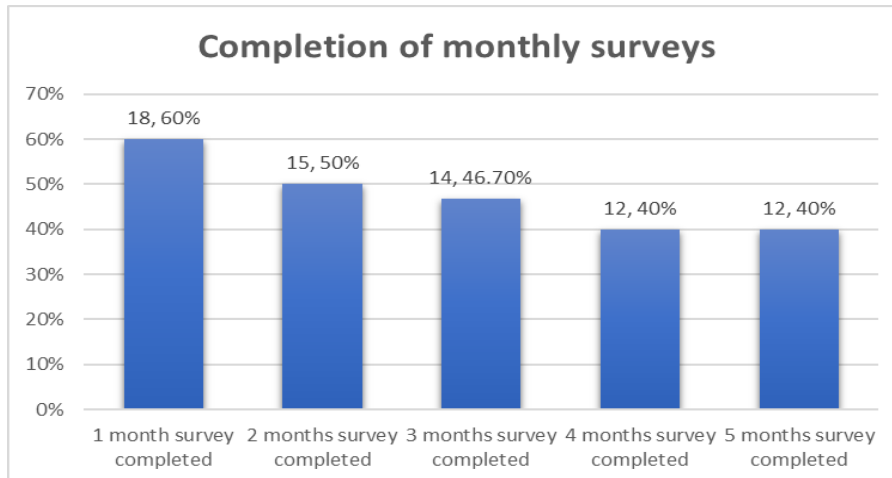
Sheltered vs Unsheltered

Twenty-one participants resided in PSH for formerly chronically homeless persons and these participants had a higher rate of completion of the full survey protocol (52%) as compared to unsheltered PEH (0%). Nine of the participants in PSH reported lost or stolen phones at some point in the study. However, despite losing their phones, 2 participants in PSH requested to complete their final survey in person and received their incentive for completion. The Mastercard incentives were found to positively influence participants willingness to complete the surveys.

   Of the nine participants who were unsheltered, three were known to have lost their phones soon after completing the initial assessments, and therefore could not complete subsequent surveys. Of the remaining six unsheltered, only three (33%) participants completed any subsequent surveys during the study period; (two [22%] completed a single month's set of 5 surveys, and 1 [11%] completed one single survey). Mobile phone usage for these unsheltered non-responding participants showed that two participants were still using the phones and the rest had low usage such as only 1 text message sent. The number of sheltered participants who completed at least one set of the follow-up surveys was 16 (76%); there was also one sheltered participant (5%) that completed a single follow-up survey. Therefore, in comparison to the 33% of unsheltered participants who responded to at least one of the surveys after baseline, there were 81% of sheltered participants who did the same.

Acceptability and usability

The following table (Table III) shows the results from the final survey completed by the 11 participants who finished the 6-month protocol. Of the 11 participants who completed the 6-month protocol, a large majority reported positive experiences with the study. Regarding acceptability of the phone-administered surveys, most of these participants agreed that the surveys were the ideal length (73.7%), frequency (81.8%), and relevance (81.8%) and that the study distributed the appropriate number of total surveys (72.7%). Participants also agreed that the monthly $10 incentivized them to complete the surveys (81.8%). They responded positively regarding experiences with using the provided phones to access teletherapy (72.7%) or for other

healthcare and social services needs (90.9%). Ten of the final participants (90.9%) reported that they enjoyed being part of the study. None of the participants reported privacy concerns, and only one individual disagreed that they would continue using the phone after the study.

Table III: Acceptability and usability survey results

Acceptability (n=11)	Agree	Neither agree or disagree	Disagree
The surveys took just the right amount of time to complete (not too long or too short)	8 (72.7%)	3 (27.3%)	0 (0%)
The $10 incentive made me want to complete the surveys for the month	9 (81.8%)	2 (18.2%)	0 (0%)
There were just the right amount of surveys (not too many or too few)	8 (72.7%)	3 (27.3%)	0 (0%)
The surveys were given at just the right frequency (not too often, not too far apart)	9 (81.8%)	2 (18.2%)	0 (0%)
I enjoyed being part of this study	10 (90.9%)	1 (9.1%)	0 (0%)
I like using the phone to access teletherapy	8 (72.7%)	3 (27.3%)	0 (0%)
I like using the phone for other health/social service- related needs such as making appointments	10 (90.9%)	1 (9.1%)	0 (0%)
I found using the phone was private enough	9 (81.8%)	2 (18.2%)	0 (0%)
The survey questions were relevant to how I was feeling	9 (81.8%)	2 (18.2%)	0 (0%)
I will keep using the phone after the study ends	8 (72.7%)	2 (18.2%)	1 (9.1%)

Usability (n=11)	Agree	Neither agree or disagree	Disagree
The mobile phones were not easy to use to answer the surveys	3 (27.2%)	2 (18.2%)	6 (54.5%)
There were problems using the phone itself	3 (27.2%)	1 (9.1%)	7 (63.6%)
I had problems with the phone network e.g dropped calls, not connecting to wifi	2 (18.2%)	3 (27.2%)	6 (54.5%)
It was hard to access the survey links and questions	1 (9.1%)	3 (27.2%)	7 (63.6%)
I wasn't able to use the phone for the whole study because it was lost/stolen/borrowed by someone else	3 (27.2%)	0 (0%)	8 (72.7%)
I would have liked help to complete the surveys	4 (36.3%)	3 (27.2%)	4 (36.3%)
The survey questions were too difficult to answer	0 (0%)	1 (9.1%)	10 (81.8%)

In terms of usability, a minority of participants who finished the protocol did report difficulties using the phone to access surveys (27.2%), using the survey links (9.1%), or with general phone service (18.2%). None reported difficulty with the survey questions themselves. It is worth noting that only 4 participants (36.3%) disagreed that they would have liked help to complete the surveys.

Discussion

This study afforded a clearer understanding of the feasibility of engaging PEH in mobile phone survey data collection. The study feasibility can be evaluated in 3 broad categories: the barriers and facilitators experienced in each stage of the study implementation; the survey completion rates and participants' reported views on acceptability and usability. The following table (Table IV) summarizes the findings in the first category.

Table IV: Feasibility of each stage of implementation: barriers and facilitators

Implementation stage	Facilitators	Barriers	Lessons Learned
Recruitment	Central location close to PSH and encampments. Team willing and able to engage and develop rapport, build trust and actively recruit. Free phone and offer of $10 incentives. Word of mouth generating interest.	Requirement for ongoing involvement. Fears surrounding monitoring via phones. Not having all parts of project working simultaneously e.g mastercards awaiting delivery, delays in getting phones Staff turnover, natural disasters e.g ice storm, social distancing and masking during face-to-face engagement.	Central location with ease of access to and trust with the population is key to success.
Screening	Simple eligibility criteria that required minimal screening.	Participants not admitting to already having a phone.	Stricter screening to be balanced against difficulty in recruitment.
Technology	Cost-effective phones and data. Use of smart phones with ongoing service for a year. Newer phones more user-friendly. Brief run through on how to use the phones at enrollment.	Older phones more difficult to use. Digital literacy variable. Data overage stopped surveys coming in. Broken phones/chargers. Lost/stolen/traded phones. Malware downloaded.	Having facilitators available at the church twice a week to address technology issues. Technology help-line would also be helpful.
Survey links	Simple set up directly from REDCap. Interface easy to see on the phones.	Surveys not coming in due to data overage. Two steps to access survey confusing to some participants. Survey links/reminders remaining in text message after survey completed cluttered text messages so difficult to see new surveys coming in.	Facilitators at the church to assist participants with surveys. Put helpline number in the phone for participants to contact team for assistance.
Incentives	Mastercards an effective incentive. Ability to track usage via phone company.	Lost mastercards. Manual system of loading. Frustrations with delays in loading.	Proactive, upfront communication with participants to warn them of possible loading delays. Consider an automated system.
On-going engagement	Rapport with therapist and UTHOMES team. Availability of a site to charge phone.	Lost phones. Unsheltered participants had more immediate needs.	Active outreach to the participants via the phone to offer support. Ability to replace phones.

	Ability to locate participant e.g in PSH for face to face support. Higher functioning participants in PSH.	Difficult to follow-up with patients who were not in vicinity of church (no alternate contact info due to nature of eligibility criteria.)	

There are some important lessons learned from the barriers and facilitators that would benefit future studies. One key lesson was the importance of a centralized location known to and trusted by the population as a study base which was near (within one to two blocks) where many of the PEH were located to facilitate recruitment, ongoing engagement, and troubleshoot technology issues. PEH who were mostly located near this central location, whether in PSH or the nearby encampment were among those who engaged the most. This study established the viability of partnering with a faith-based organization to enable engagement with PEH who are hard-to-reach traditionally.

Secondly, technological issues were unavoidable and certain factors should be considered for future studies including use of newer phones, the monthly data limit on the cellular plans and advising participants on what to do if they exceed that limit, such as use of WIFI where possible [26]. A dedicated phone number direct to the technology company was provided to address these issues but providing a list of common issues and their resolution could be another option (e.g., how to manually reset the phone or how to remove malware). The highly manual process of loading the Mastercards, which involved checking survey completion on REDCap and emailing the mobile phone company who then loaded cards, was inefficient and at times led to delays in delivering the incentives. Where possible, future studies could engage automated processes to minimize delays. On the other hand, because the surveys were checked manually on a regular basis, it was possible to reach out to participants and engage them actively or troubleshoot.

One aspect that affected the assessment of feasibility from an implementation point of view was the amount of maintenance and engagement required by the team. This peaked during a portion of the study when participants were being enrolled, close to maximum enrollment. During this phase, team members had to recruit, trouble-shoot technology issues, monitor survey completion to provide the incentives, and provide active outreach to aid engagement. This level of involvement would decrease the feasibility of this design in a larger study unless more aspects could be automated e.g with a helpline, automatic loading of mastercards or more team members were available. It was necessary to add additional members to our team to facilitate this work.

Survey completion feasibility

Overall, the full protocol completion rate of 36.7% and partial completion of 63.3% is in keeping with prior studies where response rates have ranged from 24-65% in samples not specific for PEH [24,31-33]. However, this is the longest survey study of PEH that we are aware of. It is encouraging to see that the majority of participants were able to complete month one, and half could complete month 2. Two main factors appeared to affect survey completion. Firstly, response rate was inversely proportional to time in the study suggesting that maximum engagement happens with shorter studies. This is relevant to finding the optimum length of a study protocol to ensure maximum engagement while still gathering sufficient data. It may be that multiple data points collected over a shorter overall time-period will increase engagement

yet provide adequate data. This was the case in a study by Mayo-Wilson et al (2020) where surveys were sent weekly for 5 weeks and response rates in any given week ranged from 64 - 82%.

Secondly, being completely unsheltered and recruited from encampments as opposed to PSH was associated with much lower levels of survey completion and inability to complete the 6-month protocol. This has feasibility implications for future studies since it is evident that truly unsheltered PEH face significant barriers to completing online surveys and using or maintaining ownership of phones that are given to them. On the other hand, while PEH living in PSH are at risk of homelessness, more than half completed the full protocol and 12 (57%) completed 3 months. The fact that there was little statistical difference between the sheltered and unsheltered participants in terms of other psychosocial characteristics, suggests that both groups face similar psychosocial challenges, but the key difference to engagement is being sheltered or not. This has implications for public policy in terms of the primacy that should be given to addressing sheltering the homeless as a means of engagement, especially during the pandemic.

Some of the barriers to survey completion that were evident are similar to those cited in prior studies including lost or stolen phones, more pressing needs such as for food or shelter, data overage, inability to charge the phone and limited digital literacy. Future studies with unsheltered PEH may need to consider options to mitigate these issues such as a free outdoor charging station, training in digital literacy and creative ways to pair the meeting of basic needs with survey completion such as at locations where participants receive free food. The participants who completed the surveys were motivated by the incentives showing that for some PEH, this is an aid to improve engagement.

Survey response rates in our small sample did not appear to be significantly associated with any demographic differences or mental health diagnosis, except possibly PTSD with more participants in the non-completion group having PTSD, though not quite a statistically significant difference. There was also no difference based on drug and alcohol use or being in jail or hospital in the last 30 days. This may be due to the small sample size which was appropriate for the main purpose of the study, i.e., as a sample to pilot the feasibility, usability and acceptability of the methods used to engage PEH in phone surveys. However, it can be noted that half of participants reported symptoms consistent with probable PTSD and 70% met criteria for an anxiety disorder, while depression and psychosis appeared to be less common. This is consistent with existing data on mental health diagnoses among PEH in previous studies [34-36].

Acceptability and usability

The high acceptability and satisfaction ratings collected in our final survey are corroborated by existing feasibility studies of mobile phone surveys among PEH [25,26]. Several components of our study's design may have contributed to these acceptability ratings. Participants were recruited from existing UTHOMES patients with whom several members of the research team had existing rapport. Additionally, the team partnered with an established faith-based organization working with PEH for the intake interview and as a centralized location for continued outreach and contact. This partnership may have added to the study's perceived credibility among participants. Furthermore, this centralized location facilitated word-of-mouth discussion about

and awareness of the study among PEH in the surrounding community. The cash incentives offered in the study were also reported to be sufficiently motivating (Table III). Monthly monetary compensation throughout the 6-month protocol (as opposed to incentives being given at study completion, as adopted by some other feasibility studies) may have been beneficial [24]. Study participants may also have felt more comfortable honestly answering sensitive questions about mental health symptoms over the anonymity of a mobile phone survey than with an in-person interview. This is supported by positive responses about adequate phone privacy (Table III) and was also observed by Mayo-Wilson [24]. Finally, study participants being able to keep their smartphone after the conclusion of the investigation may have contributed to reported positive experiences, as a large majority indicated that they found the phone useful and would continue to use it (Table III).

Although the data collected on usability was overall positive, some participants did endorse difficulties with survey links or with the phones themselves and reported that assistance would have been helpful (Table III). These results are in line with prior discussion that on-site facilitators, consistent communication with participants, and a provided helpline number played a key role in alleviating engagement barriers and should be further implemented in future investigations. Our overall positive usability ratings and the types of barriers encountered were similar to that of previous feasibility studies [24-26]. Another important component of our protocol design that may have enabled high usability was the in-person baseline encounter during which study staff could walk through the survey process with participants and provide initial technical assistance. Furthermore, the study utilized user-friendly smartphones with largely reliable phone service and streamlined survey interfaces.

It is also worth noting that individuals who were able to complete the full 6-month protocol might be more likely to report favorable acceptability and usability in their final survey of this pilot study. From the investigators point of view, there were technological issues, but this was not reflected in participants' ratings of phone usability, suggesting that those who did complete the protocol experienced minimal technology problems. However, this could be a factor among those who did not complete. The number of participants who completed this final survey was just over a third of the total and a relatively small number which limits interpretation. However, the significant majority of positive reported experiences are encouraging and demonstrate that mobile phones are a promising tool in healthcare data collection and delivery among PEH.

Limitations

As primarily a pilot feasibility study, the sample size was fairly small though consistent with other feasibility studies [24,26]. It was not therefore designed to identify differences between the sheltered and unsheltered groups, though this is of interest for future studies. Furthermore, the sample was recruited from a relatively small geographic area of Houston, Texas and so may not necessarily represent PEH in other areas. PEH who were currently sheltered were primarily the participants who were able to remain in the study which still leaves the unsheltered PEH as a more difficult group to engage and limits generalizability of the results to the truly unsheltered.

Conclusion

This study found that PEH who are truly unsheltered and provided with a phone, monetary incentives and the options for no cost mental health treatment, social services and active outreach may be more difficult to engage in a mHealth research project. This is a concerning finding and reflects the truly difficult nature of pursuing inclusivity in research, especially during the pandemic, for this vulnerable group. However, we did find that longitudinal phone surveys among a subset of PEH or at risk of homelessness, namely those who are formally chronically homeless and living in PSH, is feasible, acceptable and offers the potential as a means of data collection in this population. This study offers valuable insight as it is the longest study on mobile phone surveys in the homeless that we are aware of, and the only one that targeted mental health, healthcare access and COVID-19 measures in a population that was not mainly youth. Future studies could compare sheltered and unsheltered groups in more detail and focus on increasing numbers of participants to enable adequate power for more statistical analysis.

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