Feasibility Study for Wearable Appointment Reminders: Decreasing the Rate of Missed

Appointments in Primary Care Clinics for Homeless Patients

Andrea Jackson

In partial fulfillment of the requirements for the Doctor of Nursing Practice

University of Utah

Executive Summary

Missed appointments in primary care clinics have a negative impact on patient health, provider productivity, and clinic revenue. Typical ways of reducing missed appointments via email, texts, and phone calls are more difficult when serving homeless patients due to lack of access to telephones and mobile devices. Patients who frequently miss appointments have more emergency department visits and decreased preventative screening. Though deprivation ethnicity, substance use, and mental health problems are associated with missed appointments, there is little evidence regarding reminder systems tailored to meet their needs.

The overarching purpose of this project was to design and create a wearable appointment reminder device for homeless patients to improve appointment attendance in primary care. More specifically, this project was a feasibility study to improve upon the design of the wearable appointment reminder prototype. The objectives of this study were to:

1) Develop an effective way to integrate wearable appointment reminders into clinic workflow. Then, distribute wearable appointment reminders to medical assistants to deliver to patients;

2) Gain information via surveys from medical assistants and homeless patients regarding the feasibility and usability of the device;

3) Present results to the university and homeless clinic's stakeholders so they can incorporate this information in their efforts of improving appointment attendance and health outcomes for homeless patients; and

4) Submit results for publication in appropriate peer-reviewed journals in order to disseminate information to a larger audience of stakeholders who serve the homeless population.

Detailed notes regarding potential use of the prototype were taken throughout this project. After a full prototype was created, feedback about the device was solicited from clinic staff (n=4), and by a convenience sample of non-homeless volunteers (n=3). Semi-structured interviews were used to get feedback on the device itself and potential implementation barriers, and the information was disseminated to university stakeholders in order to improve upon the prototype.

Delays in creating the device and program required that the initial project methods be altered. In lieu of patients themselves being able to test the device, feedback was solicited at the earliest possible phase of production and, doing so, allowed for identification of implementation barriers including patient comfort, and difficulty for staff to program during busy clinic workflow. Finally, the reliability of the device's program needs to be improved upon before a clinical trial can take place.

In sum, the purpose of this project was to evaluate the feasibility of using a wearable appointment reminder in a homeless clinic. Results of this preliminary study will be used to improve upon the prototype in order to successfully develop a low-cost, effective, wearable appointment reminder.

Table of Contents

Acknowledgements

Feasibility Study for Wearable Appointment Reminders: Decreasing the Rate of Missed

Appointments in a Primary Care Clinic for Homeless Patients

Problem Statement

Missed appointment rates in primary care clinics serving homeless patients are high

(McInnes et al., 2014). Typical ways of reducing missed appointments via email, texts, and

phone calls prove more difficult in the homeless population due to these individuals' lack of

access to computers and phones (McInnes et al., 2014). In a systematic review, a reported 40-

54% of homeless patients owned a cell phone at one time, in contrast to 84% of homed

individuals (McInnes, Li, & Hogan, 2013). Also, those at risk for missing appointments due to

ineffective appointment reminders are those in less stable housing who frequently change

addresses or telephone numbers (McLean et al., 2016) such as homeless patients. These missed

appointments are significant because this leads to less continuity of care, worse health outcomes,

and decreased clinic revenue (Keogh, O'Brien, Hoban, O'Carroll, & Fahey, 2015; Lebrun-Harris

et al, 2013; Keogh; Wang et al., 2015).

Clinical Significance

Missed appointment rates in the United States range from 5%-55% in community health

clinics treating low-income individuals (DuMontier, Rindfleisch, Pruszynski, & Frey, 2013). No

show rates increase three-fold with patients who live in deprived areas (DuMontier, Rindfleisch,

Pruszynski, & Frey, 2013). Specifically, McInnes et al. (2014) found there was 31% no show

rate for homeless veterans in primary care clinics. Patients are the most affected from missed

appointments, as increased missed appointments compromise continuity and quality of care

(Wang et al., 2015). Missed appointments also affect those patients who could have been

scheduled during those missed appointments (Chrystal et al., 2015). The clinic also loses

possible revenue and productivity. Finally, the funding for most homeless clinic comes from

federal grants, so all taxpayers are stakeholders in the success of this clinic (Zlotnick, Zerger, &

Wolfe, 2013).

If high rate of missed appointments persists in homeless clinics, clinic revenue can

remain suppressed and poor patient care could persist. When patients consistently miss

appointments, providers cannot give good follow up care to evaluate patients' health. Also,

missed appointments will decrease the effectiveness of government funds to a community health

clinic and decrease the effectiveness of clinic employee's time (McInnes et al., 2014).

Decreasing the no-show rate of homeless patients will maximize clinic and government

resources. Also, more consistent appointment attendance will improve consistency of care and

health outcomes for homeless individuals (Lebrun-Harris et al., 2013).

Objectives

The purpose of this project was to perform a feasibility study for utilizing wearable

appointment reminders in a suburban primary care clinic that treats homeless patients into the

current clinic workflow. The objectives of this project were to:

1) Develop an effective way to integrate wearable appointment reminders into clinic

workflow. Then, distribute wearable appointment reminders to medical assistants to deliver to

patients;

2) Gain information via surveys from medical assistants and homeless patients regarding

the feasibility and usability of the device;

3) Present results to the university and homeless clinic's stakeholders so they can incorporate this information in their efforts of improving appointment attendance and health outcomes for homeless patients; and

4) Submit results for publication in appropriate peer-reviewed journals in order to disseminate information to a larger audience of stakeholders who serve the homeless population.

Literature Review

In order to collect information regarding homelessness and appointment reminders, several searches were used. The PubMed database was used to search: "homelessness", "homelessness AND health AND disparities", "homelessness AND primary AND care", "appointment AND reminders", and "missed AND appointments". When articles which were relevant were found, at times the search was expanded to include related articles.

Definition of Homelessness

Researchers, government officials, and other stakeholders struggle to agree upon the definition of homelessness. The department of Health and Human Service defines homelessness as those in emergency shelters or who are sharing housing "due to a loss of housing, economic hardship, or a similar reason." (Grant, Gracy, Goldsmith, Shapiro, & Redlener, 2013, p. e3). However, other governing bodies define families in doubled up situations as precariously housed instead of homeless (Grant et al., 2013). Some agencies do not include children who are living in shared housing as homeless (Grant et al., 2013).

Prevalence

Living situation. According to the U.S. Department of House and Urban Development (2015), 36.5% of homeless individuals are in families and 63.5% are individuals. Approximately 23% of homeless individuals are under 18, nine percent were between the ages of 18 and 24, and

68% were 25 and older. It's estimated that in 2015, there were 564,708 people homeless on a given night with 61% in residential programs and 31% in unsheltered situations.

Prevalence comparison. There is an estimated 2,025 homeless individuals in Utah (Henry et al., 2015). Of those, 1,798 individuals were not living in a family and 1,216 were living in families (Henry et al., 2015).

Population Characteristics

Demographics. Individuals seen in homeless health centers were approximately 57% male compared to 37% of housed individuals (Lebrun-Harris et al., 2013). Only 6% of homeless individuals report being employed (Lebrun-Harris et al., 2013). Hispanics or Latinos were 20% of the homeless population, with most homeless people being white (49%) or black (40%) (Henry et al., 2015).

Health status. Homelessness is associated with an increase in many physical and mental health conditions. Yin, Leung, Chan, Lam, & Lim (2015) estimate that the prevalence of mental illness for homeless individuals is 56% with a 71% lifetime prevalence of mental illness. Also, approximately 78% of school-age homeless children have a psychiatric, behavioral, or academic problem (Grant et al., 2013). Compared with low-income children, there are four times as many under immunized homeless children (Grant et al., 2013). Homeless children also have a higher asthma and obesity rates compared to the national average (Grant et al., 2013). Homeless families bring their children to the emergency department two to three times more often than other pediatric populations (Grant et al., 2013). In homeless individuals, 59% report currently smoking, 40% report binge drinking in the past year, 12% report being alcohol dependent, and 15% report being drug dependent (Lebrun-Harris et al., 2013).

Treating Homeless Patients in Primary Care

Primary Care Needs. A medical home model that incorporates physical health, mental health, and social determinants of health best meets the needs of homeless individuals (Grant et al., 2013). Unfortunately, primary care providers treating homeless individuals, especially mental health providers, are in even shorter supply than for the general population (Grant et al., 2013). Homeless patients report worse health status, worse mental health problems, a higher burden of chronic disease, and substance used problems compared to homed individuals (Lebrun-Harris et al., 2013). Though homeless individuals report a high incidence of substance use, only 31% report in the last year receiving treatment for drug and alcohol use (Lebrun-Harris et al., 2013). Homeless health center patients report needing medical care (66%) and mental health care (48%) in the last year, but many homeless individuals report unmet health needs (43%) (Lebrun-Harris et al., 2013).

Effect of Primary Care. When individuals are facing housing instability, providing health services, including primary and preventative care, can improve health status. When provided primary care, homeless individuals have reduced hospital stays and emergency room visits (Grant et al., 2013). From a public health standpoint, this means reduced ED crowding that causes delay in care. By providing preventative care, such as immunizations, population health will increase. For example, the 2011 Minnesota measles outbreak has been attributed to beginning in homeless shelters with low vaccine rates (Grant et al., 2013).

Barriers To Accessing primary care: Socio-Ecological Model

Health status. Homelessness is associated with an increase in many physical and mental health conditions. Yin, Leung, Chan, Lam, & Lim (2015) estimate that the prevalence of mental illness for homeless individuals is 56% with a 71% lifetime prevalence of mental illness. Also, approximately 78% of school-age homeless children have a psychiatric, behavioral, or academic

problem (Grant et al., 2013). Compared with low-income children, there are four times as many

under immunized homeless children (Grant et al., 2013). Homeless children also have a higher

asthma and obesity rates compared to the national average (Grant et al., 2013). Homeless

families bring their children to the emergency department two to three times more often than

other pediatric populations (Grant et al., 2013). In homeless individuals, 59% report currently

smoking, 40% report binge drinking in the past year, 12% report being alcohol dependent, and

15% report being drug dependent (Lebrun-Harris et al., 2013).

      System level barriers. Often overlooked environmental factors contribute to barriers to

care for homeless individuals at a system level. Researchers have also found that addressing

health disparities in low-income communities does not translate to better care for homeless

individuals and families (Grant et al., 2013). Homeless individuals report difficulty going to

clinics because the clinics are far from their dwellings (Campbell et al., 2015). Another barrier

that can be overlooked includes homeless individuals' lack of identification. Homeless

individuals often have their identification cards stolen or they misplace them, and they struggle

replacing these (Campbell et al., 2015). Clinic hours sometimes present a problem because

many homeless are considered working poor (Campbell et al., 2015). Therefor, homeless

patients already have many barriers to entry in receiving health care. The goal of this study is to

begin creating support, via an effective appointment reminder system, to counter some of these

barriers.

Missed Appointments in Primary Care

      Causes of missed appointments. Barriers to effective appointment reminders often

occurs when patient records, of either homed or homeless patients, are not accurately updated

(McLean et al., 2016). Often patients' contact information is incorrect or out-of-date, and

inaccurate patient records is most likely to occur in populations at greater risk for missed appointments. Those at risk for receiving effective appointment reminders are those in less stable housing who frequently change addresses or telephone numbers (McLean et al., 2016).

Mallow et al. (2014) found that young adults are less likely to attend health education programs and healthcare visits compared to older adults. Also, these young adults were less likely to meet health goals such as HgA1c or LDL levels (Mallow et al., 2014). Patients' perceptions, such as their perceived threat of chronic disease and perceived burden of chronic diseases, causes more adherence to medical appointments (Mallow et al., 2014). Missed appointments by 15-35 year olds in primary care were strongly associated with mental health problems (Moscrop, Siskind, & Stevens, 2012). The individuals who missed appointments were more likely to have presented in the past with mental health complaints and were more likely to present in the next 12 months with mental health complaints (Moscrop, Siskind, & Stevens, 2012).

Effect of missed appointments. The average cost per encounter billed by clinics is $167 (Kheirkhah, Feng, Travis, Tavakoli-Tabasi, & Sharafkhaneh, 2016). By using cost per encounter and number of no shows, Kheirkhah et al. (2016) estimated that the cost of no-show rates for 10 clinics studied was $14.58 million in 2008. This was for a no show rate of 18.8% on average between the 10 clinics (Kheirkhah et al., 2016).

Health effect to the individual of missed appointments. Patients who frequently miss appointments have more frequent emergency department visits, have less preventative screening performed, and have more poorly controlled blood pressure and diabetes (Nguyen, Dejesus, & Wieland, 2011).

Interventions to Reduce Missed Appointments

McLean et al. (2016) performed a systematic review and found 30 out of the 31 randomized control trials studied showed significant reduction in missed appointments through various interventions. These were not specific for homeless patients, but provide a good reference for the qualities of effective appointment reminder systems. For effectiveness, McLean et al. (2016) found that simple reminders should include the date, time, and location of the appointment. Further, there was no statistical difference in effectiveness between different reminders such as text message, phone call reminders, and other reminders. Between the days of one and seven, there is no difference in attendance behavior, however sending reminders earlier gives patients more time to reschedule appointments. Some technology systems, such as text message reminders, are not as effective at allowing patients to reschedule or cancel appointments. There is only weak evidence that indicate patients' age does not impact reminder effectiveness, indicating that these reminder tools can be implemented through various age groups (McLean et al., 2016). Evidence consistently showed that "deprivation, minority ethnicity, substance abuse, mental health problems, and comorbidities", all situations and conditions which are high in homeless patients, are associated with missed appointments. Unfortunately, there is little evidence for tailored reminder systems designed to meet their needs (McLean et al., 2016).

Theoretical Framework: Bullock and Batten Planned Change Model

Bullock and Batten's (1985) model distinguishes stages of system changes in an organization. In the exploration phase, a need for change is explored as well as identify resources required. The planning phase involves creating goals and plan for implementation as well as acquiring resources and stakeholders for support. In the action phase, the change is

implemented, monitored, and the process and goals are adjusted as necessary. Finally, in the integration phase, results are communicated and changes are reinforced to become standard.

This theoretical framework asserts that organizational change can be planned, but it requires the buy in and support from all the stakeholders. Only in this way can the change be embraced and sustained. The change agent, whether an outside entity or team in the organization, must focus on gathering data, analyzing it, and providing feedback. This constant analysis and re-planning is necessary for effective integration of change into an organization.

The exploration phase, which was the primary focus of this project, includes acquiring any resources necessary for change to go forward (Bullock & Batten, 1985). These resources include expertise from individuals. In order for these wearable appointment reminders to be integrated into a clinic, feedback from homeless patients, as the key stakeholders, will prove essential. Clinic staff represent other stakeholders whose involvement is critical in order for their critique to affect the device creation and integration moving forward.

The interdisciplinary team at the university is already in the planning stage of the project, and more planning will continue as the research team collaborates with the homeless clinic. The planning phase must include key decision makers as well as technical experts (Bullock & Batton, 1985). Clinic decision makers were necessary to incorporate in this step as they will shape the planned designs of the wearable appointment reminder. In the planning stage, the expertise and feedback gained from the exploration phase will be and made into concrete goals. As the project is one step in a bigger goal to mass produce this product, a large part of the project focused on planning and preparing for this larger purpose. In the near future, re-planning will occur to improve the wearable appointment reminder before a pilot study takes place. This will lead to

further development, studies, and integration of this wearable appointment reminder in the

future.

Implementation and Evaluation
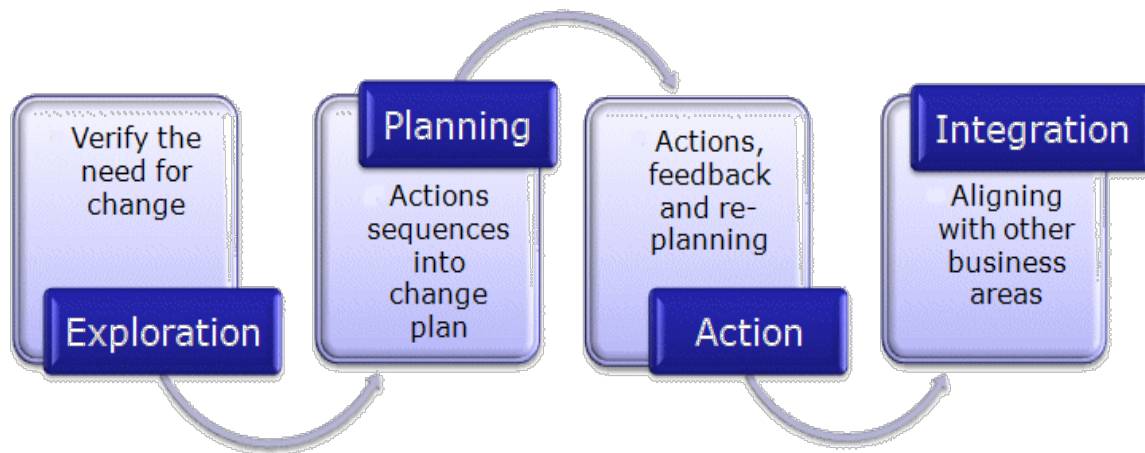
The purpose of this scholarly project was to pilot a prototype of a wearable appointment

reminder bracelet in an effort to reduce the rates of missed appointments in clinics that treat

homeless individuals. In order to complete this project, four objectives were delineated.

The first objective was to develop, with clinic staff, an effective way to integrate wearable

appointment reminders into clinic workflow. Then, we would distribute wearable appointment

reminders to medical assistants to deliver to patients. In order to meet this objective,

implementation strategies were discussed with the clinic administration and clinic staff. Medical

assistants (MAs) were to be educated on how to program the device, and how to incorporate

distribution into workflow and collect all the bracelets after distribution. Successful completion

of this objective was to be measured when an agreed upon workflow created by the staff and the

MAs who received the bracelets successfully taught back how to use the bracelets. Finally, MAs

were to report when patients return and bracelets are successfully re-obtained.

Next, information was to be gathered via surveys from medical assistants (MAs) and homeless patients regarding the feasibility and usability of the device. To do this, the project team created a questionnaire for the MAs regarding the usability and programmability of the bracelets. There was also a questionnaire for the patients regarding the bracelet's wearability and usefulness as an appointment reminder. The survey was reviewed by the project chair and programming team and adjustments of the survey were made. Then, study participants were to fill out surveys provided during the project. The goal was to have an 85% response rate from the MA and patient participants. Data from the survey was to be synthesized by creating an Excel spreadsheet for quantitative data and group qualitative data into themes.

After data were compiled, the principle investigator was to present the feedback obtained from the feasibility study to the university and homeless clinic's stakeholders so they can incorporate this information in their efforts of improving the wearable appointment reminder, appointment attendance in general, and health outcomes for homeless patients. For a successful presentation, a PowerPoint was to be designed that provided information on the project and the results found. Stakeholders were to participate in an open dialog about the implementations for further pilot studies and producing this for a wider clinic use. Feedback and themes from the meeting with stakeholder were to be compiled to further incorporate this into the discussion. Successful completion of this objective was to be met when the presentation was successfully presented and themes from the meeting compiled and incorporated into the discussion of this paper.

The project's outcomes were then to be submitted for publication in an appropriate peer-reviewed journal in order to disseminate information to a larger audience of stakeholders who serve the homeless population. The paper was first compiled and a draft completed. The paper

was submitted to the project chair and content expert for review and appropriate edits

incorporated for submission to an appropriate, peer-reviewed journal.

Implementation

Unfortunately, designing the software program and the actual device took much longer

than anticipated. While the software program's code is entirely written, there are still disruptions

in communicating with the appointment reminder.   Because of this, the original objective of

distributing a programmed appointment reminder to homeless patients to return at their next

appointment was modified. First, the DNP Project Presentation was given and passed (see

Appendix A) and the project was able to move forward. In the development stage, the principle

investigator's role included advising device creators on the functionality this device should have

to integrate well into clinic workflow. The research team met nearly weekly going over the

laboring process of slowly building this device. The principle investigator acted as a patient

advocate in voicing what the needs of the patient would most likely be for the device. These

recommendations included what the screen would display during a notification, when the

notifications should alarm to remind patients of their appointment, and other design elements that

would make the device more comfortable and feasible when used by homeless patients.

When it came to the computer program to set the notification on the device, the principle

investigator was the link to clinical knowledge and experience. The principle investigator gave

feedback regarding the needs of the medical assistant who would be programming the device in

the clinic. What began as a more complicated program was turned into a simple program that

could program the device with only two to three prompts. Within a minute, a medical assistant

could have the appointment programmed, thus reducing the burden of care on the medical

assistant.

The principle investigator also wrote the initial questionnaires that were to be taken by the medical assistants and homeless patients regarding the feasibility of the device. The programmers gave a list of feedback they wanted from participants to take the initial prototype of the appointment reminder to a finished product. This included how easy the device was to program, the comfort of the wristband, and how likely the medical assistants and patients would be to use this device if it was available. The principle investigator took that input from the device designers, and created a questionnaire that would be at an appropriate reading level for the medical assistants as well as the homeless patients.

The principle investigator also worked with the device creators in designing the study necessary that would provide feedback on how to improve the prototype of the device to a finished, marketable, product. The principle investigator was responsible to contact administration of a homeless clinic and continually update them on the progress of the device. Also, an IRB application was created by the principle investigator, which took much longer to return than suspected. Due to potential financial conflicts possible from creating a clinic device, additional applications to the university's tracking of clinical research (uTRAC) had to also be submitted before IRB approval. The approval process took five months total from September 2016 to February 2017 (see Appendix B).

Instead, appointment reminder devices were distributed to a convenience sample of homed individuals in the community (n=3) to wear for a week. These consumer participants were instructed to wear it as often as they could (informing them that it was not waterproof). Also, they were instructed to press, several times a day, the button on the wearable appointment that brings up the date and time on the display (see Appendix C). Then after a week, a semi-structured interview was used to gain qualitative data regarding their experience. Though these

consumer participants were not homeless, the purpose was gaining feedback on how comfortable

the device was and if the screen of the device continued to function throughout the week. The

feedback was less around the socioeconomic culture around wearing the device, but the

wearability and functionality of the device. Therefore, these data should translate to creating a

device that is comfortable for any person to wear regardless of socioeconomic status.

Finally, as the objective of designing a workflow for clinic education and implementation

proved still premature, two interviews were held with clinic stakeholders to discuss the

feasibility of the appointment reminder devices. The purpose of these interviews was to obtain

feedback from clinic staff who would directly manage and implement the appointment reminder

device into the workflow. These informants, due to their experience in the clinic, have input

regarding issues that may occur in implementing the device into clinic workflow. Because these

staff members work closely with homeless patients, they also could provide secondary

knowledge regarding the homeless population. Also, the clinic staff were to provide input on

barriers that may occur in distributing these devices to homeless patients. The first interview,

utilizing a semi-structured format, was held with the clinic IT department head (n=1). The

second interview, again utilizing a semi-structured format, was with medical assistants (n=2) and

a physician assistant (n=1) who work in the homeless clinic.

Evaluation

Results of the interviews were compiled based on themes that were commonly noted

throughout the interviews. Information synthesized into topics included, "wearability and

comfort", "costs and liability", and "functionality".

Results

Wearability and Comfort

Consumer participants voiced concern over the size and fit of the appointment reminder over any other concern. This concern will be somewhat negated by the fact that the device will go through a major design change for the final design. However, the consumer participants expressed extreme discomfort. One wearer of the device, who reported wearing the device approximately 5% over the course of the week, stated, "Initially, the device wasn't too bad. However, after a couple of hours, the Velcro and wristband material started to rub at my skin and cause irritation/itchiness. It was hard to keep on my wrist after some time. I would usually take a break from wearing it or I would switch to my other wrist." Another consumer participant, who claimed wearing the device approximately 20% of the time, reported, "The device was not comfortable. The only way that I could wear it for more than half the day was to wear it over my jacket or pant leg. I think it broke skin once after wearing it for a few hours. That was without any clothing underneath it."

Participants also expressed concern over the appearance of the device. Both clinic staff and consumer participants stated the device looked like a "parole ankle bracelet." One participant actually chose to wear it on the ankle, in order to increase comfort, but commented, "It felt very conspicuous and a little silly. It was most noticeable to others when I wore it on my arm. I felt like I was on parole when I would wear it around my ankle. So yeah, it was distracting to me and to others. What made it cool was that I was able to tell people it was for science. If all I could say that is was to remind me of my doctors appointments, then I would have felt lame." However, some clinic staff commented that they worried the final product would appear too polished. The comment from several staff was that if the device looked like any popular fitness tracker, homeless patients may try to sell the item or will not feel safe wearing it due to concerns of theft.

One clinic staff participant stated, "Unfortunately, we get things stolen from the clinic on a regular basis. Things that you would not think would be valuable go missing."

The consumer participants had many recommendations on how to improve the final appointment reminder. One suggestion included, "I think most of the issues would be resolved if the watch were made out of more comfortable and durable material. If there were any way you could shrink the size down, that'd be good." Echoing those thoughts was another participant, "I think if the electronic device were smaller I would be more likely to wear it. Also, if it looked less bulky or obvious I might feel more comfortable wearing it. Maybe increased durability-like waterproof- might be helpful, especially for people with less shelter."

Functionality

Finally, the consumer participants reported that two out of the three devices stopped working after several days into the study. In the lab, the devices were projected to function between 40 days to three months depending on how often the screen is turned on. However, one individual stated, "Also, starting last week [sic] the screen did not light up. I thought it died so we plugged it in and it worked again. However, after a few days the screen would not turn on again? I'm not sure what happened." One other consumer participant said that the device stopped working after about six days. So there was concern about how well the program on the appointment reminder device functions.

Costs and Liability

The administrator interviewed voiced a strong concern over the cost of the device and liability of the company. He commented, "Bottom line, if I were going to invest in these devices for my clinic, I would need clear evidence that these will actually reduce the rate of missed appointments instead of losing the clinic a lot of money." He stated he would want data

from pilot studies indicating how many devices returned and the overall cost analysis to a clinic.

He also said, "I would also want to know these devices were reliable and would not run out of

batteries or stop functioning while patients had them." The last concern the administrator voiced

was protecting the company's network from malware and data theft. The administrator cited the

experience they had of recently incorporating tablet devices for patient intake. He described the

process "scrubbing the devices", and stated that the information technology department would

have to, and could easily, check each appointment reminder device as well.

Workflow implementation barriers

One unexpected theme noted from clinic staff participants is what the investigator labeled

"program fatigue". Clinic staff commented that, because they are a community health clinic,

they are often approached by government entities and university researchers to incorporate new

initiatives into their workflow. These include many public health programs such as smoking

cessation programs, specialty and community service referrals, and mammogram or colonoscopy

screenings. All of the clinic staff participants asked questions such as, "How long would it take

to program these?", or "How would we track them and get them back from patients?", or, "What

would we do with them if they stop working?" The general concern was summed up by the

physician assistant participant who stated, "If these devices really help homeless patients, we

would love to use them. We just have had a lot of programs start and then stop, or seem like

they only add more work for us."

<div align="center">

Recommendations

</div>

The purpose of this project, ultimately, involves synthesizing the study results to make

recommendations to move the wearable appointment device prototype to a finished product.

From the information collected, several adjustments seems appropriate. The first suggestion

includes a unique and comfortable design. The consumer participants' feedback confirmed the appropriateness of the original designers' plan of a single piece of silicone, flexible material for the wristband. This should maximize comfort for patients.

One idea that should bear some serious consideration, which was offered by several participants, was making the device into a keychain. An individual who wore the device offered, "I would suggest it being smaller and less conspicuous. I would also suggest having it be a key chain, a dongle, or something else that could clip onto a backpack or something." This was echoed by a clinic staff member who stated, "many of our homeless patients wear backpacks that they could clip something like a keychain too. That way it would be less obvious." In this scenario, adding an alarm sound may be appropriate. A keychain device may improve the compliance because it would eliminate the concerns of the wristband being uncomfortable and conspicuous.

The last recommendation would be to improve the reliability and function of the device. Obviously, with two of the three devices malfunctioning within a week, there remains work in the program. The reliability of the device is paramount, as the purpose of the device is rendered useless if the device shuts off or runs out of batteries before the patient returns to the clinic. One other recommendation provided by the administrator participant, perhaps for future versions of the device, is to have the device communicate with an EHR. In this way, when front desk staff or medical assistants input an appointment in the EHR, it can sync to a connected appointment reminder device. This can improve workflow time for staff and accuracy in programming.

DNP Essentials

This study incorporated DNP essentials II, IV, and VI (American Association of Colleges of Nursing (AACN), 2006). DNP essential II is "organizational and systems leadership for

quality improvement and systems thinking" (AACN, 2006, p. 2). This project focused on quality improvement of a clinic workflow, a systems based approach, in order to improve individual patients' health. Implementing wearable appointment reminders to a clinic required attention to business, clinic, and financial functions of an outpatient system.

Because the focus of this study was on technology design, the DNP essential IV, "Information systems/technology and patient care technology for the improvement and transformation of health care" (AACN, 2006, p. 5) applied directly to this project. The research team's goal of a feasibility study included successful implementation of new clinic technology that actually improves patient outcomes and clinic workflow instead of becoming another technologic burden on employees and patients.

The last DNP essential addressed, essential VI, was "Interprofessional collaboration for improving patient and population health outcomes" (AACN, 2006, p. 7). The project team included individuals from design, engineering, public health, and clinic administration. The vision of the team was to use wearable appointment reminders to enhance the health of a population who are often forgotten when it comes to technological innovation.

Conclusion

In conclusion, rates of missed appointments are highest in some of the most vulnerable populations of society, but there is little research or initiative aimed at tackling this issue. The research is clear that rates of missed appointments have a negative impact on patients' health and increases the public health burden. What is not clear is why homeless patients fail to attend follow up appointments. Suggested further research includes qualitative data from homeless patients who frequently miss appointments regarding their perceived barriers to attending clinic visits. Before the wearable appointment reminders created en mass, pilot studies providing

homeless patients with generic countdown timer key chains or pocket size calendars can provide

data on the effectiveness of appointment reminders in reducing missed appointments. In sum,

further data should be supplied regarding the specific needs of the homeless population who miss

clinic appointments before assuming a solution.

      Though this project did not succeed in meeting all of the planned objectives, ample

feedback was gathered to improve the function of this appointment reminder device. Forward

thinking researchers and clinicians can remain open to creating and implementing new research

aimed at tackling such an important problem. Though there are many improvements to be made

on this device, this and other creative, technological advancements should be further explored to

improve the health of homeless individuals.

References

American Association of Colleges of Nursing (2006). *The Essentials of Doctoral Education for Advanced Nursing Practice.* Washington, DC.

Bullock, R. J. & Batten, D. (1985) "It's just a phase we're going through: A review and synthesis of OD phase analysis", *Group and Organization Studies*, December Vol. 10 (4), p. 383-412

Campbell, D. J., O'Neill, B. G., Gibson, K., & Thurston, W. E. (2015). Primary healthcare needs and barriers to care among Calgary's homeless populations. *BMC Family Practice, 16*, 139. doi:10.1186/s12875-015-0361-3

Chrystal, J. G., Glover, D. L., Young, A. S., Whelan, F., Austin, E. L., Johnson, N. K., . . . Kertesz, S. G. (2015). Experience of primary care among homeless individuals with mental health conditions. *PLoS One, 10*(2), e0117395. doi:10.1371/journal.pone.0117395

DuMontier, C., Rindfleisch, K., Pruszynski, J., & Frey, J. J., 3rd. (2013). A multi-method intervention to reduce no-shows in an urban residency clinic. *Fam Med, 45*(9), 634-641.

Grant, R., Gracy, D., Goldsmith, G., Shapiro, A., & Redlener, I. E. (2013). Twenty-five years of child and family homelessness: where are we now? *American Journal of Public Health, 103 Suppl 2*, e1-10. doi:10.2105/AJPH.2013.301618

Henry, M., Shivji, A., de Sousa, T., Cohen, R., & Abt Associates Inc. (2015) The 2015 annual homeless assessment report (AHAR) to congress. https://www.hudexchange.info/resource/4832/2015-ahar-part-1-pit-estimates-of-homelessness/

Keogh, C., O'Brien, K. K., Hoban, A., O'Carroll, A., & Fahey, T. (2015). Health and use of health services of people who are homeless and at risk of homelessness who receive free

primary health care in Dublin. *BMC Health Services Research, 15*, 58.

doi:10.1186/s12913-015-0716-4

Kheirkhah, P., Feng, Q., Travis, L. M., Tavakoli-Tabasi, S., & Sharafkhaneh, A. (2016).

Prevalence, predictors and economic consequences of no-shows. *BMC Health Services

Research, 16*, 13. doi:10.1186/s12913-015-1243-z

Lebrun-Harris, L. A., Baggett, T. P., Jenkins, D. M., Sripipatana, A., Sharma, R., Hayashi, A. S.,

. . . Ngo-Metzger, Q. (2013). Health status and health care experiences among homeless

patients in federally supported health centers: findings from the 2009 patient survey.

Health Services Research, 48(3), 992-1017. doi:10.1111/1475-6773.12009

Mallow, J. A., Theeke, L. A., Barnes, E. R., Whetsel, T., & Mallow, B. K. (2014). Free Care Is

Not Enough: Barriers to Attending Free Clinic Visits in a Sample of Uninsured

Individuals with Diabetes. *Open Journal of Nursing, 4*(13), 912-919.

doi:10.4236/ojn.2014.413097

McInnes, D. K., Li, A. E., & Hogan, T. P. (2013). Opportunities for engaging low-income,

vulnerable populations in health care: a systematic review of homeless persons' access to

and use of information technologies. *Am J Public Health, 103 Suppl 2*, e11-24.

doi:10.2105/AJPH.2013.301623

McInnes, D. K., Petrakis, B. A., Gifford, A. L., Rao, S. R., Houston, T. K., Asch, S. M., &

O'Toole, T. P. (2014). Retaining homeless veterans in outpatient care: a pilot study of

mobile phone text message appointment reminders. *American Journal of Public Health,

104 Suppl 4*, S588-594. doi:10.2105/AJPH.2014.302061

McLean, S. M., Booth, A., Gee, M., Salway, S., Cobb, M., Bhanbhro, S., & Nancarrow, S. A.

(2016). Appointment reminder systems are effective but not optimal: results of a

systematic review and evidence synthesis employing realist principles. *Journal of Patient Preference and Adherence, 10*, 479-499. doi:10.2147/PPA.S93046

Moscrop, A., Siskind, D., & Stevens, R. (2012). Mental health of young adult patients who do not attend appointments in primary care: a retrospective cohort study. *Family Practice, 29*(1), 24-29. doi:10.1093/fampra/cmr053

Nguyen, D. L., Dejesus, R. S., & Wieland, M. L. (2011). Missed appointments in resident continuity clinic: patient characteristics and health care outcomes. *Journal of Graduate Medical Education, 3*(3), 350-355. doi:10.4300/JGME-D-10-00199.1

van den Berk-Clark, C., & McGuire, J. (2014). Trust in health care providers: factors predicting trust among homeless veterans over time. *Journal of Health Care for the Poor Underserved, 25*(3), 1278-1290. doi:10.1353/hpu.2014.0115

Wang, H., Nejtek, V. A., Zieger, D., Robinson, R. D., Schrader, C. D., Phariss, C., . . . Zenarosa, N. R. (2015). The role of charity care and primary care physician assignment on ED use in homeless patients. *American Journal of Emergency Medicine, 33*(8), 1006-1011. doi:10.1016/j.ajem.2015.04.026

Yim, L. C., Leung, H. C., Chan, W. C., Lam, M. H., & Lim, V. W. (2015). Prevalence of Mental Illness among Homeless People in Hong Kong. *PLoS One, 10*(10), e0140940. doi:10.1371/journal.pone.0140940

Zlotnick, C., Zerger, S., & Wolfe, P. B. (2013). Health care for the homeless: what we have learned in the past 30 years and what's next. *American Journal of Public Health, 103 Suppl 2*, S199-205. doi:10.2105/AJPH.2013.301586

Appendix A

FEASIBILITY STUDY FOR WEARABLE APPOINTMENT REMINDERS: DECREASING THE RATE OF MISSED APPOINTMENTS IN PRIMARY CARE CLINICS FOR HOMELESS PATIENTS

Andrea Jackson, BS, RN, DNPc
University of Utah College of Nursing
In partial fulfillment of the requirements for the Doctor of Nursing Practice

Background

- Last year, an interdisciplinary group of University of Utah faculty and students partnered with Veristride, a mechanical engineering startup company.
- The goal was to design a wearable appointment reminder that can be utilized in clinics where individuals lack the access to traditional communication (i.e. cell phones, computers)
- Last year, a psychiatric DNP student assessed patient's preferences in designing this device for his project.
- The first target population to test the effectiveness of this wearable appointment reminder will be homeless patients.

Problem Statement

- Missed appointments in primary care clinics serving homeless patients are high. (McInnes et al., 2014)
- Typical ways of reducing missed appointments via email, text, and phone calls are more difficult in homeless populations due to lack of access. (McInnes et al., 2014)
- These Missed appointments lead to less continuity of care, worse health outcomes, and decreased clinic revenue. (Keogh, O'Brien, Hoban, O'Carroll, & Fahey, 2015; Lebrun-Harris et al, 2013; Wang et al., 2015)
- The purpose of this project is to perform a feasibility study for utilizing wearable appointment reminders in a suburban primary care clinic which treats homeless patients.

Significance & Policy Implications

- Missed appointment rates in the United States range from 5-55%. (DuMontier, Rindfleisch, Pruszynski, & Frey, 2013)
- The average cost per encounter billed by clinics is $167, making each appointment missed a severe loss to clinic revenue. (Kheirkhah, Feng, Travis, Tavakoli-Tabasi, and Sharafkhaneh, 2016)
- Negative health impacts for patients who miss appointments include increased ED visits, higher HgA1c and LDL levels, and poorer blood pressure control (Mallow, Theeke, Barnes, Whetsel, & Mallow, 2014; Nguyen, Dejesus, & Wieland, 2011).
- As most primary care clinics serving homeless patients are federally funded, rates of missed appointments is a concern for the individual, the institution, and the community as a whole (Zlotnick, Zerger, & Wolfe, 2013).
- Improving rates of missed appointments will maximize patient health, clinic resources, and government funding (Lebrun-Harris et al., 2013)

Objectives

- Develop, with clinic staff, an effective way to integrate wearable appointment reminders into clinic workflow. Then, distribute wearable appointment reminders to medical assistants to deliver to patients.
- Gain information via surveys from medical assistants and homeless patients regarding the feasibility and usability of the device.
- Present feedback obtained from the feasibility study to the university and homeless clinic's stakeholders so they can incorporate this information in their efforts of improving appointment attendance and health outcomes for homeless patients.
- The project's outcomes will then be submitted for publication in appropriate peer-reviewed journals in order to disseminate information to a larger audience of stakeholders who serve the homeless population.

Conceptual Framework: Bullock and Batten Planned Change Model

- Organizational change can be planned, but requires buy in and support from all stakeholders. In this, change can be embraced and sustained.
- The change agent is focused on gathering data, analyzing it, and providing feedback

Bullock and Batten Planned Change Model

- Exploration
  - This process will begin by assessing the homeless clinic employees' perceptions on the need for change.
- Planning
  - All stakeholders from the university and clinic will provide input on how the wearable devices will be utilized from the distribution to re-obtainment. Re-planning will occur before a pilot study to better improve the wearable devices.
- Action
  - In this step, medical assistants will distribute wearable appointment reminders. Then, the researchers will obtain feedback from the employees and the patients regarding barriers to integrating this device into practice.
- Integration
  - In presenting to stakeholders, suggestions will be provided into how this device can be improved to better integrate into the clinic. Further feedback will be obtained from stakeholders in order to prepare for further dissemination.

Literature Review

- Need for Primary Care for Homeless
  - Homeless patients report worse health status, worse mental health problems, and a higher burden of chronic disease compared to homed individuals (Lebrun-Harris et al., 2013).
  - Homeless patients report needing medical care (66%) and mental health care (48%), but many homeless individuals report unmet health needs (43%). (Lebrun-Harris et al., 2013)
  - When provided primary care, homeless individuals have reduced hospital stays and emergency room visits (Grant et al., 2013)
- Barriers to Meeting Appointments
  - Patients are at more risk for missing appointments when they are in less stable housing or who lack reliable telecommunication (McLean et al., 2016)
  - Young adults have a lower appointment adherence than older adults. (Mallow, Theeke, Barnes, Whetsel, & Mallow, 2014)
  - Patients with mental health conditions have higher rates of missed appointments (Moscrop, Siskind, & Stevens, 2012

Literature Review

- Effects of Missed Appointments
  - Those who frequently miss appointments have more emergency department visits and have less preventative screening (Nguyen, Dejesus, & Wieland, 2011).
  - Patients who miss appointments are less likely to achieve health goals such as HgA1c or LDL levels (Mallow, Theeke, Barnes, Whetsel, & Mallow, 2014).
  - Kheirkhah et al. (2016) found that the cost of missed appointments for 10 clinics studied was $14.58 million in 2008 for these clinics alone.
- Ways to Reduce Missed Appointments
  - McLean et al. (2016) in a systematic review, discovered that simple reminders are just as effective as more complicated reminders. These simple reminders should include date, time, and location of the appointment McLean et al., 2016).
  - There was no statistical significance in effectiveness between different reminders such as text messages, phone calls, or other reminders (McLean et al., 2016)
  - Though McLean et al. (2016) state that deprivation, ethnicity, substance use, and mental health problems are associated with missed appointments, there is little evidence regarding systems tailored to meet their needs.

Implementation and Evaluation

Objective #1	Implementation	Evaluation
Develop, with clinic staff, an effective way to integrate wearable appointment reminders into clinic workflow. Then, distribute wearable appointment reminders to medical assistants to deliver to patients.	–Obtain bracelets and learn how to use them –Meet with clinic staff and create a workflow for implementing wearable appointment reminders –Teach MAs how to program device and educate them on how this process will be implemented –Monitor when patients are returning and MAs will re-obtain the bracelets	–Agreed upon workflow created with staff –MAs successfully teach back how to use the wearable devices –Patients who receive bracelets teach back how to use bracelets –MAs report what patients received bracelets and bracelets are successfully re-obtained
Objective #2	**Implementation**	**Evaluation**
Gain information via surveys from medical assistants and homeless patients regarding the feasibility and usability of the device.	Create a paper questionnaire for MAs regarding usability of bracelets –Create a paper questionnaire for patients regarding wear-ability and usefulness of bracelets –Distribute paper questionnaires and have them returned –Data compiled	Both questionnaires approved by project chair and content expert and printed off –Paper questionnaires will be distributed and successfully returned with an 85% response rate from participants –Compile quantitative data in an Excel spreadsheet –Group any qualitative data into themes

Implementation and Evaluation

Objective #3	Implementation	Evaluation
Present feedback obtained from the feasibility study to the university and homeless clinic's stakeholders so they can incorporate this information in their efforts of improving appointment attendance and health outcomes for homeless patients.	Create a PowerPoint of data compiled -Organize a time to present information -Compile feedback and themes from the discussion	-PowerPoint reviewed by project chair and content expert -Successfully find a time and deliver presentation on information -Incorporate results into discussion of my paper
Objective #4	**Implementation**	**Evaluation**
The project's outcomes will then be submitted for publication in appropriate peer-reviewed journal in order to disseminate information to a larger audience of stakeholders who serve the homeless population.	-Compile data to finish scholarly paper -Educate myself on journal's application process -Submit paper to an appropriate peer reviewed journal	-Finished paper is submitted to an editor, project chair, and content expert for review -Feedback from individuals included -Successful application sent to an appropriate journal

Summary

- Missed appointments negatively affect patients and clinics
- Patients who are disadvantaged, such the homeless, are at greater risk for missed appointments and poor health outcomes
- More interventions to encourage appointment attendance need to be tailored to this high risk population
- A wearable appointment reminder prototype will be studied to see if it could feasibly be used in a primary care clinic serving homeless patients
- The feedback from medical care personnel, patients, and stakeholders will be synthesized and used to improve the device before performing a pilot study

Acknowledgements

References

- DuMontier, C., Rindfleisch, K., Pruszynski, J., & Frey, J. J., 3rd. (2013). A multi-method intervention to reduce no-shows in an urban residency clinic. *Family Medicine, 45*(9), 634-641.
- Grant, R., Gracy, D., Goldsmith, G., Shapiro, A., & Redlener, I. E. (2013). Twenty-five years of child and family homelessness: where are we now? *American Journal of Public Health, 103 Suppl 2*, e1-10. doi:10.2105/AJPH.2013.301618
- Keogh, C., O'Brien, K. K., Hoban, A., O'Carroll, A., & Fahey, T. (2015). Health and use of health services of people who are homeless and at risk of homelessness who receive free primary health care in Dublin. *BMC Health Services Research, 15*, 58. doi:10.1186/s12913-015-0716-4
- Kheirkhah, P., Feng, Q., Travis, L. M., Tavakoli-Tabasi, S., & Sharafkhaneh, A. (2016). Prevalence, predictors and economic consequences of no-shows. *BMC Health Services Research, 16*, 13. doi: 10.1186/s12913-015-1243-z
- Lebrun-Harris, L. A., Baggett, T. P., Jenkins, D. M., Sripipatana, A., Sharma, R., Hayashi, A. S., . . . Ngo-Metzger, Q. (2013). Health status and health care experiences among homeless patients in federally supported health centers: findings from the 2009 patient survey. *Health Services Research, 48*(3), 992-1017. doi:10.1111/1475-6773.12009
- Mallow, J. A., Theeke, L. A., Barnes, E. R., Whetsel, T., & Mallow, B. K. (2014). Free Care Is Not Enough: Barriers to Attending Free Clinic Visits in a Sample of Uninsured Individuals with Diabetes. *Open Journal of Nursing, 4*(13), 912-919. doi:10.4236/ojn.2014.413097

References

- McInnes, D. K., Petrakis, B. A., Gifford, A. L., Rao, S. R., Houston, T. K., Asch, S. M., & O'Toole, T. P. (2014). Retaining homeless veterans in outpatient care: a pilot study of mobile phone text message appointment reminders. *American Journal of Public Health, 104 Suppl 4*, S588-594. doi:10.2105/AJPH. 2014.302061

- McLean, S. M., Booth, A., Gee, M., Salway, S., Cobb, M., Bhanbhro, S., & Nancarrow, S. A. (2016). Appointment reminder systems are effective but not optimal: results of a systematic review and evidence synthesis employing realist principles. *Journal of Patient Preference and Adherence, 10*, 479-499. doi: 10.2147/PPA.S93046

- Moscrop, A., Siskind, D., & Stevens, R. (2012). Mental health of young adult patients who do not attend appointments in primary care: a retrospective cohort study. *Family Practice, 29*(1), 24-29. doi:10.1093/ fampra/cmr053

- Nguyen, D. L., Dejesus, R. S., & Wieland, M. L. (2011). Missed appointments in resident continuity clinic: patient characteristics and health care outcomes. *Journal of Graduate Medical Education, 3*(3), 350-355. doi:10.4300/JGME-D-10-00199.1

- Wang, H., Nejtek, V. A., Zieger, D., Robinson, R. D., Schrader, C. D., Phariss, C., . . . Zenarosa, N. R. (2015). The role of charity care and primary care physician assignment on ED use in homeless patients. *American Journal of Emergency Medicine, 33*(8), 1006-1011. doi:10.1016/j.ajem.2015.04.026

- Zlotnick, C., Zerger, S., & Wolfe, P. B. (2013). Health care for the homeless: what we have learned in the past 30 years and what's next. *American Journal of Public Health, 103 Suppl 2*, S199-205. doi:10.2105/ AJPH.2013.301586

Appendix B

INSTITUTIONAL REVIEW BOARD
THE UNIVERSITY OF UTAH

75 South 2000 East Salt Lake City, UT 84112 | 801.581.3655 | IRB@utah.edu

IRB: IRB_00096247

PI: Andrea Jackson

Title: Feasibility Study for Wearable Appointment Reminders

Date: 2/13/2017

Effective 2/13/2017, the above-referenced protocol is approved to begin the research procedures outlined in the University of Utah IRB-approved application and documents.

APPROVAL DOCUMENTATION

Review Type: Expedited Review, as described in 45 CFR 46.110 and/or 21 CFR 56.110
Expedited Category(ies): Category 6, Category 7
Risk Level: Minimal
Approval Date: 2/12/2017
Expiration Date: 2/11/2019 11:59 PM

DETERMINATIONS

- **Waiver/Alteration Determination:** The IRB has determined that the request for the **alteration of authorization** as described in this application is approved for this research under 45 CFR 164.512(ii).
- **Waiver/Alteration Determination:** The IRB has determined that the request for **waiver of documentation of informed consent** as described in this application is approved for this research under 45 CFR 46.117(c).

APPROVED DOCUMENTS

Informed Consent Document
JacksonAndrea_Employee_ConsentCoverLetter.doc
JacksonAndrea_Patient_ConsentCoverLetter_device_questionnaire.doc

Surveys, etc.
Patient and Employee Questionnaires

Literature Cited/References
AJackson_References_IRB.docx

ONGOING SUBMISSIONS FOR APPROVED PROJECTS

- **Continuing Review:** The research protocol must be re-reviewed and re-approved prior to the expiration date via the continuing review application: http://irb.utah.edu/submit-application/reviews/index.php
- **Amendment Applications:** All changes to the research application, protocol, or approved documents must be submitted and approved prior to initiation: http://irb.utah.edu/submit-application/amendments.php
- **Report Forms:** The research must adhere to the University of Utah IRB reporting requirements for unanticipated problems and deviations: http://irb.utah.edu/submit-application/forms/index.php

Appendix C

Appendix D

Feasibility Study for Wearable Appointment Reminders:
DECREASING THE RATE OF MISSED APPOINTMENTS IN PRIMARY CARE CLINICS FOR HOMELESS PATIENTS

UNIVERSITY OF UTAH COLLEGE OF NURSING
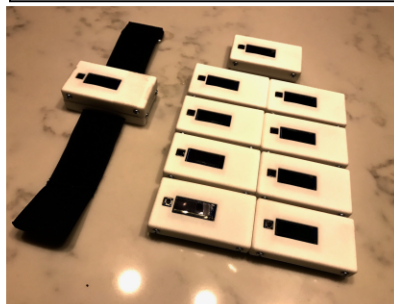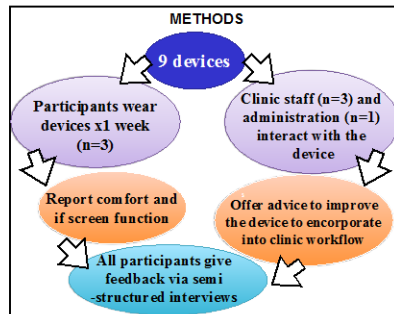
Andrea Jackson, BSN, RN, DNP-Student, University of Utah College of Nursing

PURPOSE
- Missed appointments in primary care clinics serving homeless patients are high
- Typical ways of reducing missed appointments via email, text, and phone calls are more difficult in homeless populations due to lack of access
- Missed appointments lead to less continuity of care, worse health outcomes, and decreased clinic revenue.
- The purpose of this project was to distribute wearable appointment reminders to medical assistants to deliver to patients who would take these home until their follow up appointment, then get the medical assistant's and patient's feedback via surveys.

BACKGROUND
- Deprivation, ethnicity, substance use, and mental health problems increase missed appointments
- There is little evidence for systems tailored to meet the needs of underserved patient populations.
- Last year, an interdisciplinary group of University of Utah faculty and students began to design a wearable appointment reminder
- The goal is to help individuals who lack the access to traditional communication (i.e. cell phones, computers) remember appointments
- The first target population to test the effectiveness of this wearable appointment reminder was be homeless patients.

METHODS

9 devices

Participants wear devices x1 week (n=3)

Clinic staff (n=3) and administration (n=1) interact with the device

Report comfort and if screen function

Offer advice to improve the device to encorporate into clinic workflow

All participants give feedback via semi-structured interviews

RESULTS
- The velcro and plastic of the device were irritating, even causing skin breakdown.
- The participants wore the device 5-20% of the week
- The size and bulky appearance of the device was a concern for all participants
- Clinic staff stated the final device should not look too polished.
- Clinic staff expressed concerns that this device would only add more to their workflow without much benefit to the patient.
- Clinic administration stated they would want to see clinical trials and cost analyses before investment
- The device malfunctioned in two of the three devices worn by participants within a week

RECOMENDATIONS
- A flexible, silicone encasing for the device to improve comfort.
- A unique design that is not unappealing but does not look like popular fitness tracking devices
- Consider changing the device into a keychain.
- Improvement of the device's reliability
- Further clinical trials to study the effectiveness of the device

CONCLUSION
- Rates of missed appointments are high in a very vulnerable population in society.
- There remains skepticism regarding interventions to improve these missed appointment rates.
- Though there are many improvements to be made on this device, creative, technological advancements should be further explored to improve the health of homeless individuals