Leveraging Technology-Based Interventions to Improve Social Determinants of Health in Housing Insecure Populations: Evidence from the Samaritan Intervention

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Abstract

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COVID-19 has exacerbated the issue of housing insecurity in the United States, putting significantly more people at risk of becoming unhoused. Housing insecure populations have unique health-related social needs that could potentially be addressed through innovative technology-based interventions (TBIs). Organizations developing TBIs usually have divergent approaches to addressing social determinants of health in their user base and as a result include a wide diversity of components and features. However, minimal literature exists on best practices regarding the design of TBIs. This thesis aims to fill this gap by developing a set of guiding principles and important considerations for TBIs delivered to housing insecure populations using a mixed-methods evaluation of the Samaritan TBI and comparative analysis of alternative TBIs.

Keywords

Technology-based interventions, housing insecurity, employment insecurity, homelessness, social determinants of health, health related social needs, social service provision, social capital, application design, case management, care coordination

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1. INTRODUCTION

The 2020 Annual Homeless Assessment Report from the U.S. Department of Housing and Urban Development (HUD) found that 580,466 people were experiencing homelessness on a given night in 2020. Of this number, 110,528 were experiencing chronic homelessness (HUD, 2021). The National Homelessness Law Center estimates that between 2.5 million and 3.5 million people will experience homelessness in any given year (National Homelessness Law Center, 2015). The U.S expends significant financial resources in efforts to alleviate homelessness. For example, cities like Los Angeles (CA) and New York (NY) have budgeted $950 million and $2.2 B respectively to address homelessness in 2022 (Scott, 2021) (The Council of the City of New York, 2021), and the National Alliance to End Homelessness estimates that a person experiencing homelessness (PEH) costs taxpayers roughly $36,000 per year (National Alliance to End Homelessness, 2017).

COVID-19 has further exacerbated the issue of housing insecurity in the United States, putting significantly more people at risk of becoming unhoused. Despite some economic recovery from the COVID-19-induced recession during 2021, a recent survey found that 12 million American adults are behind rent payments by at least one month, representing 16% of all renters nationally (Center on Budget and Policy Priorities (CBPP), 2021). Unemployment and job loss are key drivers, with 24.1 million Americans living in a family with one or more unemployed adults due to the pandemic and the 5.3% loss in low-wage jobs between February 2020 and September 2021 (CBPP, 2021). While the federal government has attempted to alleviate the impact of COVID-19 on low-income families through rental assistance programs and a national moratorium on eviction, the Supreme Court ruled that evictions could continue at

the end of August 2021. As a result, the U.S. Census Bureau estimates that approximately 3.7 million Americans currently face eviction (U.S. Census Bureau, 2021).

However, crucial challenges prevent the effective delivery of resources, services, and support to the subpopulations experiencing housing insecurity. Resource scarcity, organizational capacity, and fragmentation of services represent just a few of the barriers organizations face when delivering services to housing insecure populations. Additional systemic barriers present in municipalities across the U.S. include restrictive zoning laws that prevent the development of affordable housing units, driving up housing costs, and further contributing to widespread housing insecurity. Individual factors like mental illness and other behavioral health disorders, distrust in government and other service providers, and difficulty navigating services pose further barriers in service provision. Thus, there is a clear need to reconceptualize how housing insecure populations are able to access resources and services to mitigate the existing frictions and issues to improve outcomes in this population.

The ensuing chapters will focus on the experience of Samaritan - a Seattle-based company that works to provide financial and social resources to PEH while facilitating access to case management in support of individual PEH goals. Ultimately, this thesis will explore important considerations, features, and stakeholders to incorporate into the delivery of services to PEH, specifically technology-based interventions (TBIs) targeted at housing insecure populations. To this end, this thesis seeks to:

1. Evaluate outcomes achieved through a social determinant of health-focused TBI delivered to a housing insecure population in Greater King County.
2. Compare and contrast the design and function of TBIs delivered to housing insecure populations.

3. Determine important factors that contribute to initial homelessness, prevent successful exit from housing insecurity, and cause friction in providing social services.
4. To highlight important design considerations for future TBIs delivered to homeless populations.

2. BACKGROUND

2.1 Health-Related Social Needs in Housing Insecure Populations

Housing and health have a unique bi-directional relationship in which poor health can lead to homelessness, and homelessness can precipitate poor health outcomes (Swope & Hernández, 2019). Prolonged health conditions can drain accrued sick leave, cause absences from work, and prevent regular attendance at a job entirely, all of which may lead to a layoff or permanent firing (Beatty & Joffe, 2006). Without reliable income, an individual no longer has sufficient financial capital to devote to healthcare expenditures, impeding their ability to fully heal and rejoin the workforce (National Health Care for the Homeless Council, 2019). In exhausting their financial resources to pay for medical care, individuals may become unable to pay for rent or their mortgage and become housing insecure as a result. A similar pattern may occur for an individual with a chronic mental health condition or substance use disorder that causes extended absences from jobs; excessive absences can lead to dismissal from work, loss of income, and subsequent housing insecurity (Thorpe et al., 2017).

Becoming homeless precipitates a variety of poor health outcomes. PEH exert significant energy on immediate needs like looking for reliable sources of food and shelter, often forcing the deprioritization of essential needs like healthcare, social services (Wiecha et al., 1991). Food insecurity in PEH can lead to outcomes like malnutrition and obesity due to overconsumption of unhealthy processed foods (Seligman et al., 2020). PEH face an increased risk of communicable disease transmission due to increased exposure to environmental factors and other potentially sick individuals, paired with the inaccessibility of hygiene and healthcare facilities (Liu et al., 2020). Individuals with pre-existing health conditions who become homeless might lose access to healthcare providers, medications, wound care, and other treatment healthcare services, all of

which can exacerbate their conditions (National Health Care for the Homeless Council, 2019). These factors are all independent stressors, but the accumulation of multiple stressors increases the risk of behavioral health issues like mental illness and substance misuse, both of which present an additional barrier to PEH seeking permanent housing.

The causal pathways connecting housing insecurity and health are clear, but they offer little value in designing interventions for populations experiencing homelessness. Individual persons have unique circumstances, including risks for becoming housing insecure, resource availability, knowledge of existing social services, and capacity to work towards improved personal outcomes. Thus, there exists a clear need for a mechanism that allows PEH to set individual goals, facilitates support in attaining those goals, and ultimately works towards permanent housing and improved outcomes. With these differences in mind, interventions must be tailored to individual PEH goals and must be flexible enough to adapt to changing priorities, while also providing sufficient support towards the accomplishment of such goals.

2.2 Strategies for Addressing Unmet Social Determinant of Health Needs

2.2.1 Case Management

One strategy to address health and social determinant of health needs is through intensive case management, which seeks to improve outcomes by connecting individuals with complex needs to relevant supportive services (Fink-Samnick, 2018). Case managers can assist PEH with obtaining temporary and permanent housing, accessing the healthcare system, and connecting them to other auxiliary services that may be useful given their circumstances (Vanderplasschen, 2019). Case managers also help PEH prioritize issue response, helping them navigate the complicated system of programs, services, and organizations available for PEH.

Academic literature also highlights the efficacy of case management for populations experiencing homelessness, specifically. One systematic review of intensive case management interventions found that heightened case management was associated with a reduced number of days homeless, decreased substance and alcohol use, and fewer hospital readmissions among PEH (Ponka et al., 2020). Another study on integrated service delivery noted that a PEH cohort with dedicated care coordination teams and additional social service support had 70% lower emergency department use (Schick et al., 2018).

2.2.2 Technology-Based Interventions for People Experiencing Homelessness

Technology-Based Interventions (TBIs) have the potential to improve care delivery by offering uninterrupted accessibility, promoting communications between care providers and patients, and allowing for greater patient engagement, all at a lower cost compared to traditional office visits (Tofighi et al., 2018) (Sugarman et al., 2017). Examples of TBIs include software, smartphone apps, text messaging, electronic health records, and telemedicine platforms (Sugarman et al., 2017). Evidence suggests that TBIs may be a valuable tool to complement inpatient substance use disorder (SUD) treatment as TBIs for SUD treatment has been linked to increased opioid (Kim et al., 2016), cocaine (Kim et al., 2016), and alcohol abstinence in SUD treatment patients (Ramsey et al., 2018). However, other research has found that TBIs for SUD treatment may be just as effective as in-person, clinician-led treatment, especially for individuals with comorbid SUD and mental illness diagnoses (Sugarman et al., 2017).

TBIs are also an important tool in care coordination efforts, with improvements in screening, scheduling, patient information accessibility, treatment adherence, and communications between various care providers (Falconer et al., 2018). Furthermore, individual TBIs can also be designed with input from patients, care provider teams, healthcare facilities,

social service organizations, and relevant community organizations, encompassing a broad range of applications to meet care coordination needs.While TBIs may increase treatment accessibility and affordability for patients in some situations, it is worth noting that TBIs can also potentially disrupt care coordination if certain features are not included in the platform's design. A systematic review of technology-based care coordination documented that the lack of funding for health information technology, poor electronic health record design, limited access to technology for some patients, and cultural barriers all limited the effectiveness of care coordination for some TBI platforms (Falconer et al., 2018).

The extensive body of evidence suggests an opportunity to improve SUD treatment outcomes in PEH by delivering TBIs focused on alleviating social determinant of health (SDOH) needs and promoting care coordination. This intersection generates potentially unique partnerships between social services, the healthcare system, and community organizations. Ultimately, these relationships may be leveraged to increase social support for a vulnerable population and translate to improved health and wellbeing outcomes.

2.3 Local Experience: Samaritan

Samaritan is a platform through which PEH can access financial and social resources needed to accomplish a wide variety of individual goals, regardless of what those may be (Samaritan, 2021). Samaritan's platform has three primary user groups: clients (PEH), supporters, and case managers. Clients are enrolled into the Samaritan platform through case managers, who choose to enroll users based on their assessment of whether Samaritan can facilitate improved outcomes for the client. Both housing insecure and homeless individuals qualify for participation in Samaritan as the platform has the ability to address immediate needs in both subpopulations. Clients work with case managers to establish individual goals to work

towards, which are uploaded to the Samaritan network and are viewable for users, supporters, and case managers on the platform. Supporters donate money through two primary channels: 1) the Samaritan Action Fund, a pool of financial resources from which users receive a monthly allowance and 2) directly to users, through which supporters can set financial incentives for users in attaining their goals. Supporters can also send messages of encouragement to users as motivation to continue working towards their goals, which helps establish a social home for users who may lack social support. Samaritan does not directly provide services to PEH. Instead, they provide a platform through which PEH can obtain the financial and social capital needed to access other services.

Samaritan collects user data and has several available datasets that offer important insights on client SDOH improvements achieved through this platform. This data is useful for the evaluation of the Samaritan platform and for more general considerations in designing TBIs for PEH. Specifically, analysis of this data emphasizes the facilitators, barriers, features, stakeholders, and design components of concern in developing similar TBI platforms.

3. METHODS

This thesis employs a mixed-methods design leveraging qualitative and quantitative data to evaluate Samaritan's Seattle Pilot program. Samaritan collected various sociodemographic data points from clients using their platform, including age, gender, race, level of education, and time spent homeless. Samaritan also collected data on metrics such as platform use, including time spent using the app, number of support team members, messages of encouragement received, and dollars received through the platform. All datasets were de-identified to ensure Samaritan clients' anonymity and to respect the sensitivity of their lived experiences.

A subset of Samaritan members provided additional information on SDOH improvements achieved through Samaritan platform participation. SDOH topics included health, housing, social support, income, feelings of hopefulness, access to transportation, access to professional support, access to nutrition, and utilities. SDOH improvements are measured on a binary scale, where zero indicates no improvement to that social determinant, and one indicates any improvement of a given social determinant. Descriptive statistics were calculated for demographics, utilization, and SDOH improvements.

T-tests were conducted to assess whether differences in SDOH outcomes were statistically significant across race, gender, and age groups. The variables included total SDOH improvements, nutrition, utilities, housing, and income, which were the most frequently reported outcome improvements. T-tests to investigate differences in outcomes by race compared White SDOH outcomes to Black, Indigenous, and People of Color SDOH outcomes, while T-tests to examine differences in outcomes by gender compared male SDOH outcomes to female SDOH outcomes. Age was captured as a categorical variable with three levels; T-tests were used to compare outcomes among the age groups 18-34 years, 35-64 years, and 65+ years.

In addition to compiling administrative and sociodemographic information, Samaritan also prepared one paragraph write-ups on the experiences of Samaritan members, describing both the factors precipitating their homelessness and the outcomes achieved through the use of Samaritan's platform. These paragraphs were developed by case managers working with users. Paragraph text was uploaded to the qualitative data analysis software Dedoose. Once uploaded to Dedoose, inductive coding was employed to develop a preliminary codebook. Next, the codebook was revised and re-applied to the paragraph write-ups to ensure higher precision in code application. Parent and child codes predominantly focused on factors contributing to housing insecurity, factors preventing exit from homelessness, and specific features of the Samaritan platform that facilitated success.

Finally, key informant interviews were conducted with three Samaritan executives with intimate knowledge of Samaritan's platform. Interview questions were developed following the literature review on technology-based interventions providing SDOH support, focusing on the domains of platform design, working with populations experiencing homelessness, stakeholder engagement, and best practices for designing SDOH-focused TBIs delivered to housing insecure populations.

4. SAMARITAN PILOT RESULTS

4.1 Samaritan Seattle Pilot User Demographics

Samaritan deployed their Seattle Pilot program over 24 months, during which time 500 housing insecure individuals were able to use the platform to connect to financial and social resources (Samaritan, 2021). Samaritan users self-identified as 59.2% White, 27.8% Black, 5.4% Hispanic, and 7.6% Other Mixed Race. 66.2% of Samaritan users were Male, compared to 33.0% Female, with 0.8% preferring not to disclose their gender. Finally, Samaritan users were categorized into 18-34, 35-64, and 65+ age groups, making 30.8%, 56.8%, and 10.4% of users, respectively. The population distributions of the race, gender, age, and education variables are displayed below in *Figure 1*.

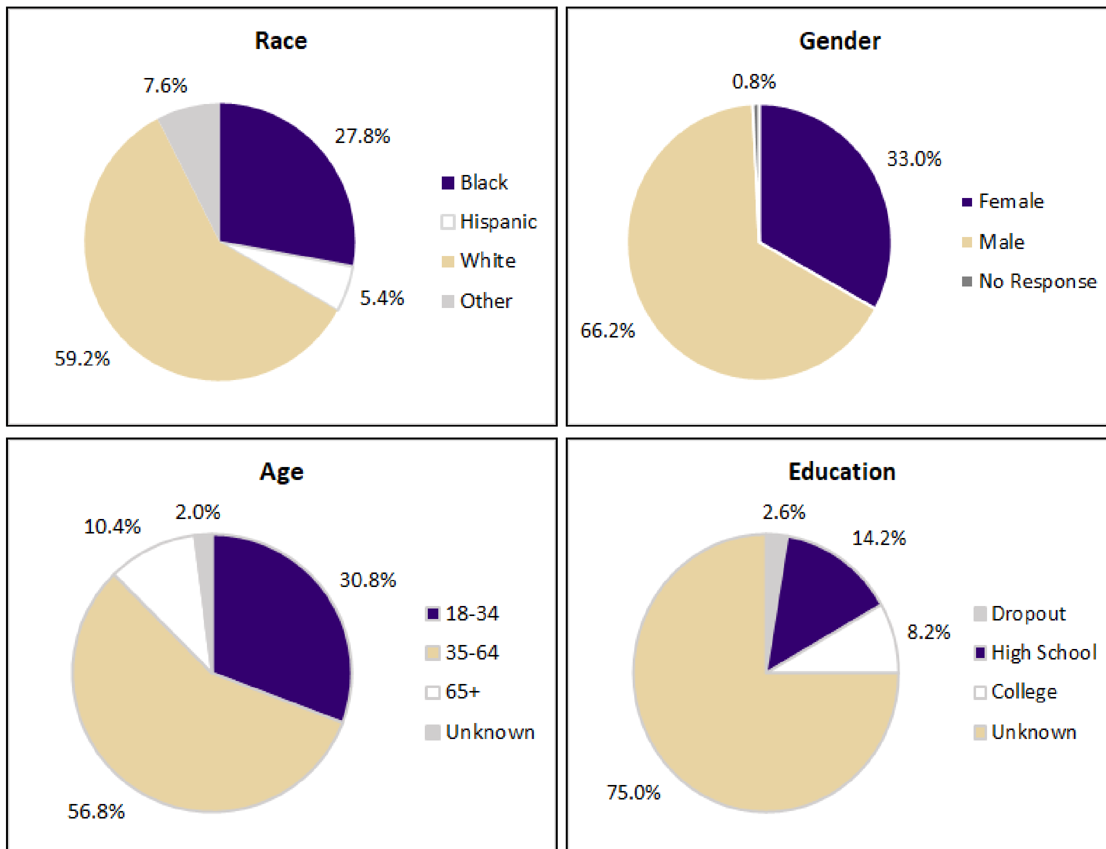

Figure 1: Population distribution of demographic variables among Samaritan's user base.

4.2 Samaritan Beacon Use Metrics

User data metrics were available for 491 of the 500 total users. The length of Samaritan membership by user ranged from 1 day to 41 days with a mean of 10.17 days (s = ±8.6 days). The number of supporters per user ranged from 0 to 151 with a mean of 13.3 supporters (s = ± 15.8 supporters). Users received an average of 34.4 messages of encouragement (s = ±51.2 messages), though this varied from 0 messages to 540 messages by individual users. Users received $228.40 on average through the Samaritan platform (s = ± $383.32), though this ranged from $1 to $4,934 per user. On a per week basis, users received an average of $22.61 ($s$ = ± $36.32), ranging from $1 per week to $575 per week. Histograms depicting the population distribution of these four variables can be found in *Figures 2-6*. The corresponding box and whisker plots can be found in *Appendix I.* These visualizations all skew right, indicating that outlying data points greatly influence the population mean values.

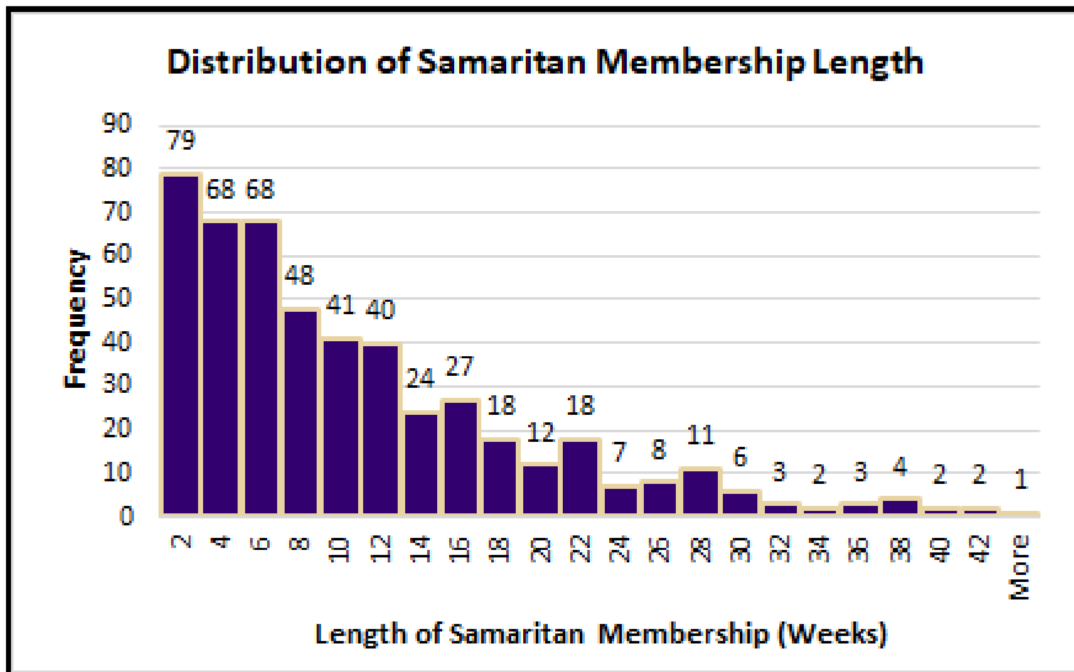

Figure 2: Length of Samaritan membership in weeks.

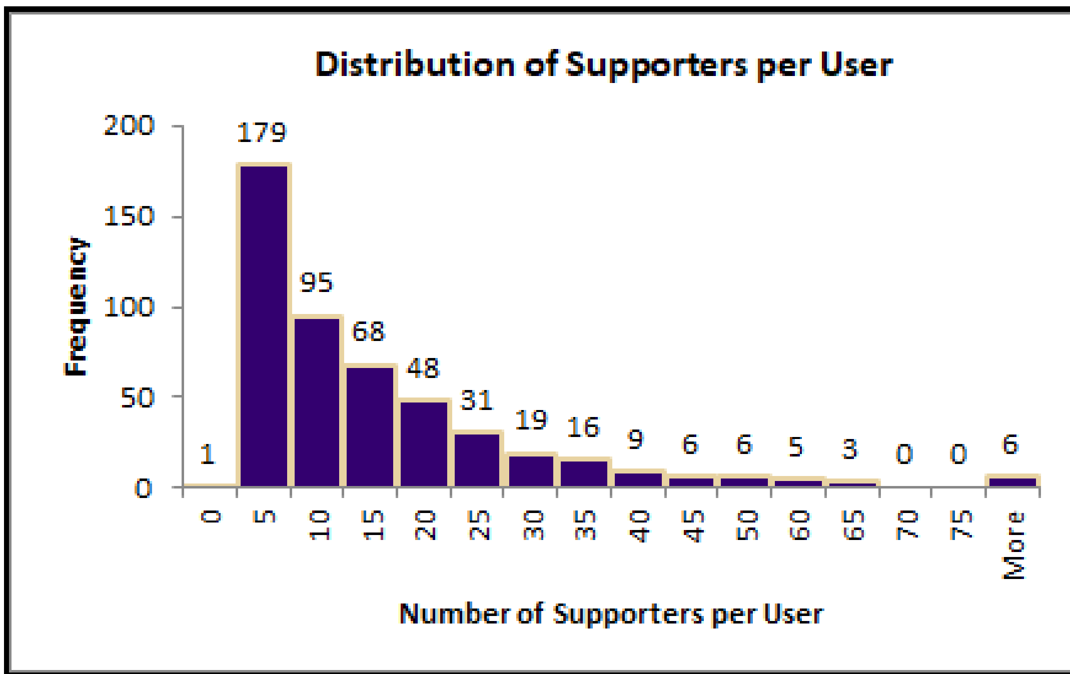

Figure 3: Number of supporters per Samaritan user.

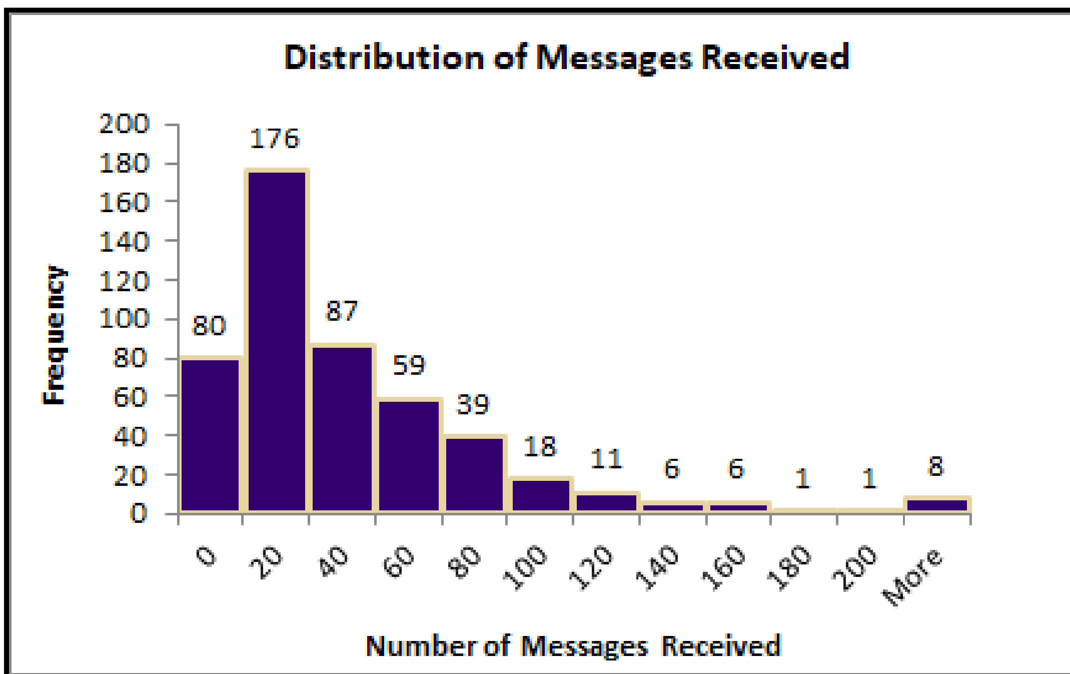

Figure 4: Number of encouraging messages received from supporters by each Samaritan user.

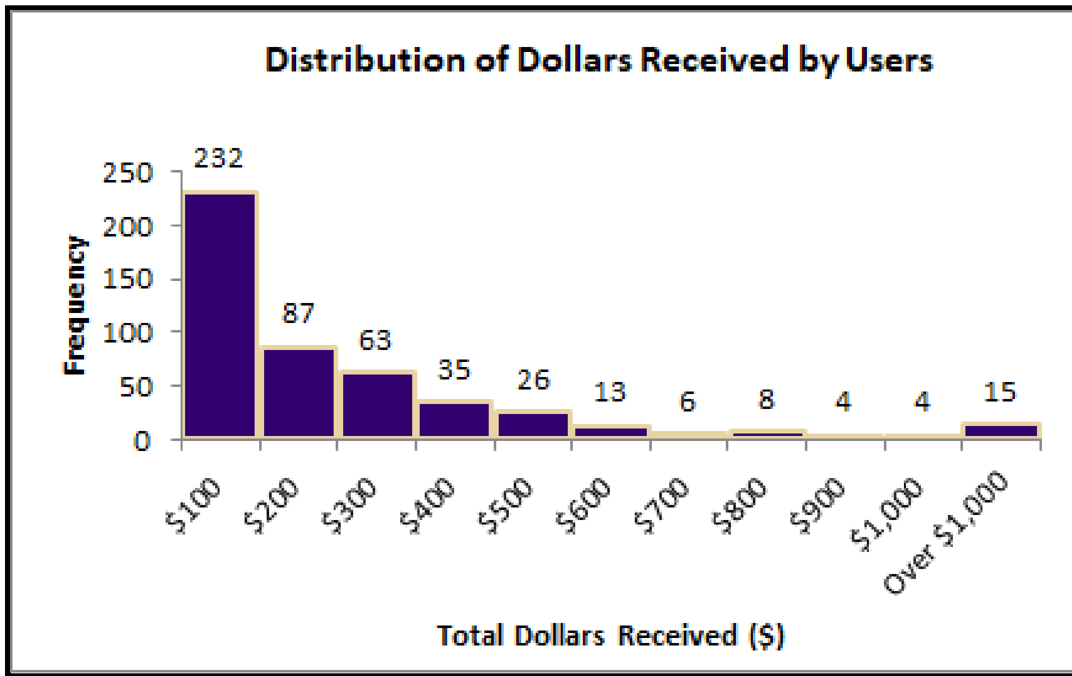

Figure 5: Total dollars received by users during participation in the Seattle Pilot.

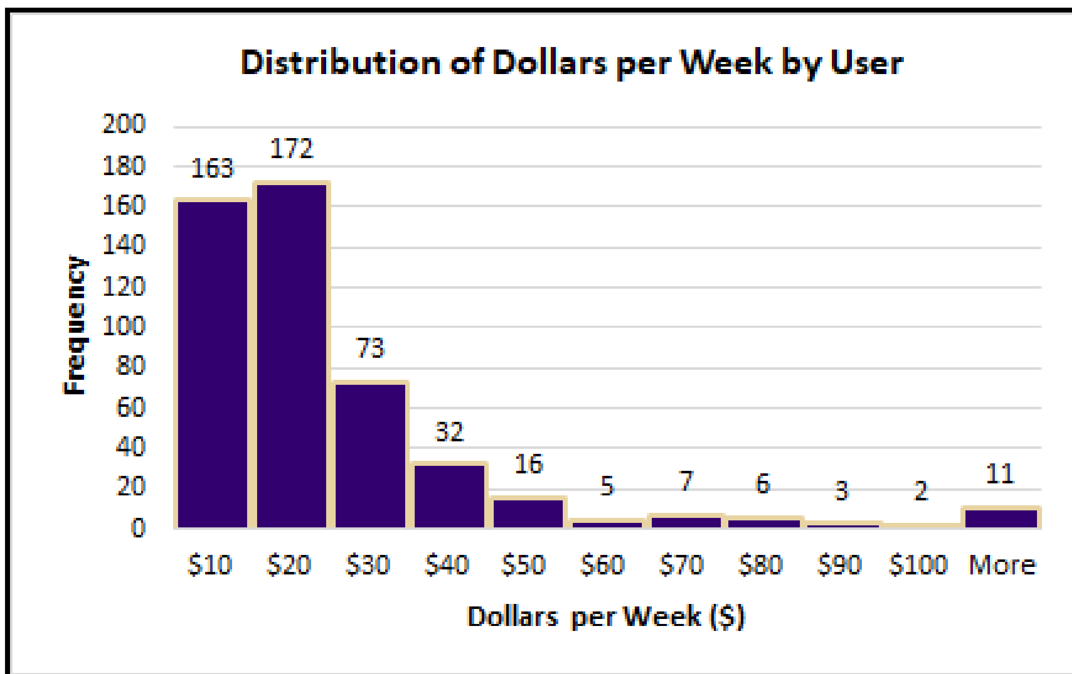

Figure 6: Average dollars received each week by Samaritan users.

4.3 Social Determinant of Health Improvements

Of the 500 total users from Samaritan's Seattle Pilot, 297 indicated that they experienced any improvements to social determinants of health areas while using the platform. 38.4% reported improvement in 1 determinant, 19.4% reported improvement in 2 determinants, and 1.6% reported improvement in 3 determinants, while the other 40.6% (203 users) indicated that they did not experience any SDOH improvements (*Fig. 7*)

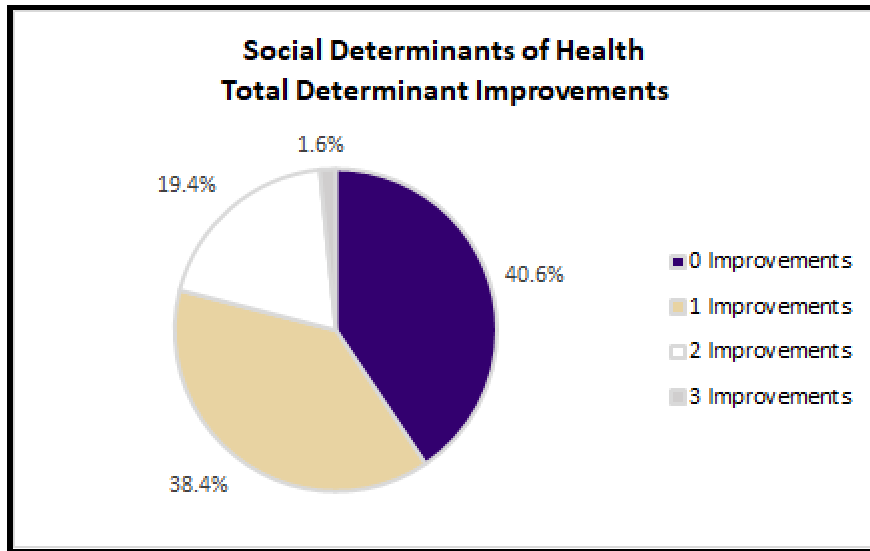

Figure 7: Proportion of Samaritan clients reporting improvements in 0, 1, 2, or 3 social determinants of health areas.

Of the 297 individuals reporting any improvements to social determinants of health, the most frequently reported improvements fell in the areas of Nutrition and Utilities, followed by Housing, Income, and Hopefulness. 68.7% of participants reported improved Nutrition, 39.4% reported improved Utilities, 9.6% improved Housing, 8.4% improved Income, 6.4% improved Hopefulness, 2.7% improved Access to Social Support, 1.7% improved Health, 0.7% improved Transportation, and 0.3% improved Access to Professional Support (*Fig. 8*).

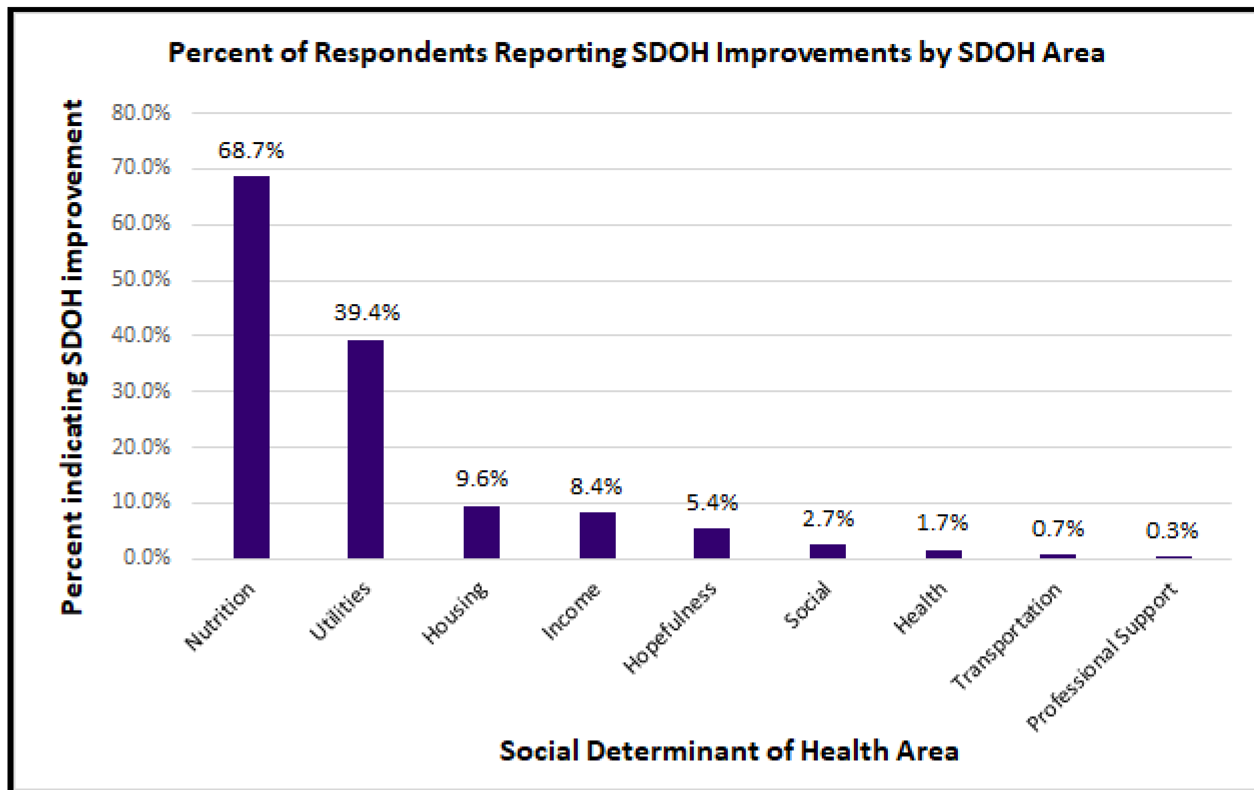

Figure 8: Percentage of Samaritan members reporting social determinant improvements in individual determinant areas.

4.4 Differences in SDOH Improvements by Race, Gender, and Age

4.4.1 Race

There was no statistically significant difference in total SDOH improvements by race, $t(279) = 0.21$, $p = 0.83$. However, White Samaritan users had a mean of 1.386 SDOH improvements compared to BIPOC users with a mean of 1.372 SDOH improvements. In terms of specific SDOH improvements, there was also no statistically significant difference in utilities improvements, $t(439) = 0.158$, $p = .87$, housing improvements, $t(403) = -0.707$, $p = .480$, or income improvements, $t(462) = 0.509$, $p = .611$.

However, there was a statistically significant difference in nutritional improvements by race, $t(271) = -6.21$, $p < .001$, wherein BIPOC users had a higher proportion of individuals experiencing nutritional improvements (0.698) compared to White users (0.373).

4.4.2 Gender

There was no statistically significant difference in total SDOH improvements by gender, $t(243) = 1.02$, $p = 0.31$, though female Samaritan users had a mean of 1.42 SDOH improvements compared to male users with a mean of 1.35 SDOH improvements. Similarly, there was no statistically significant difference in utility improvements, $t(303) = -1.72$, $p = .086$, or income improvements, $t(400) = 1.098$, $p = .273$.

Conversely, there were statistically significant differences in both nutritional improvements, $t(239) = -4.29$, $p < .001$, and housing improvements, $t(245) = -2.176$, $p = 0.03$. In both instances, a higher proportion of female users observed improved nutrition (0.485 vs. 0.269) and improved housing (0.102 vs. 0.045) than male users.

4.4.3 Age

There was no statistically significant difference in total social determinants of health improvements between 18-34 year old and 35-64 year old users [$t(151) = -1.15$, $p = 0.25$], 35-64 year old and 65+ year old users [$t(167) = 1.72$, $p = 0.09$], and 18-34 year old and 65+ year old users [$t(88) = 0.63$, $p = 0.53$]. Similarly, there was no significant difference in housing improvements between 18-34 year old and 35-64 year old users [$t(401) = -1.727$, $p = 0.085$], 35-64 year old and 65+ year old users [$t(91) = 1.247$, $p = 0.215$], and 18-34 year old and 65+ year old users [$t(88) = 0.016$, $p = 0.99$], or income improvements between 18-34 year old and 35-64 year old users [$t(281) = 0.659$, $p = 0.501$], 35-64 year old and 65+ year old users [$t(103) = 1.299$, $p = 0.197$], and 18-34 year old and 65+ year old users [$t(158) = 1.651$, $p = 0.101$].

Different patterns arose for nutrition improvements and utility improvements, however. There was a statistically significant difference in the proportion of the Samaritan population experiencing nutrition improvements between 18-34 year old and 35-64 year old users [$t(297) =$

-3.03, $p = 0.003$], but not between 35-64 year old and 65+ users [$t(68) = 0.67$, $p = 0.51$], or between 18-34 year old and 65+ year old users [$t(76) = -1.24$, $p = 0.22$].There was no statistically significant difference in utilities improvements between 18-34 year old and 35-64 year old users [$t(343) = -1.52$, $p = 0.130$], and 35-64 year old and 65+ year old users [$t(66) = -1.698$, $p = 0.094$], but there was a statistically significant difference in utility improvements 18-34 year old and 65+ year old users [$t(74) = -2.47$, $p = 0.016$].

5. THEMATIC ANALYSIS OF COMPILED PARAGRAPHS

The compiled qualitative write-ups from Samaritan users offer information on factors contributing to initial homelessness, factors preventing exit from homelessness, and key outcomes achieved using the Samaritan platform. As outcomes improvements were captured by collecting SDOH outcomes data, paragraph write-ups are especially important for identifying factors contributing to initial and prolonged homelessness. A thematic analysis of the compiled paragraphs is a critical component of this thesis, as it will help improve our understanding of the features and components of support services that should be incorporated into the design of tech-based interventions to maximize the potential for meeting individual needs.

It is important to note that the categorization of themes in this thesis focused on more distal causes of homelessness instead of more proximal variables in the causal pathway. Furthermore, there was a fair amount of crossover in themes between factors contributing to homelessness and preventing exit from homelessness, but it is the timing of these needs which is crucial for informing the design and delivery of services to PEH. The codebook applied to the paragraph write-ups and the distribution of code application can be found in *Appendix II.*

5.1 Factors Contributing to Homelessness

5.1.1 Loss of Self-Sufficiency

On the topic of factors contributing to homelessness, one theme was "Loss of Self-Sufficiency", which included the child codes "Lost Job," "Inability to Find Job," "Financial Hardship," and "Eviction / Lost Housing." Self-sufficiency refers to the concept of being able to address one's own basic needs without any outside assistance. Many of the paragraph write-ups explained circumstances wherein an individual would lose stable employment, leading to a loss of reliable income, which subsequently forced them out of housing due to lack of affordability.

Many individuals shared that they first came to Seattle seeking employment, but fell into homelessness after not securing a job. Other issues mentioned included conflicts with landlords, which resulted in eviction from their homes and housing insecurity. The following quotations depict specific situations contributing to this loss of self-sufficiency:

- "*Member 001 lost his home after his wife passed and he was laid off in the same month. After moving to Seattle to try to find fishing work, Member 001 ended up homeless.*"
- *"Member 002 was evicted after reporting safety hazards in her apartment building."*
- *"Member 003 moved to Seattle to find work in construction, ending up homeless during his search."*
- *"Member 004 and his father, Member 005, moved to Seattle for work but their plans did not work out and they became homeless."*

5.1.2 Health Issues

Another theme in factors contributing to homelessness was the presence of health issues that caused individuals to become homeless. Like the theme "Loss of Self-Sufficiency," health issues frequently led to the loss of employment and reliable income and subsequently, homelessness. The key distinction between the two themes is the explicit mention of health issues as a root cause for eventual homelessness. The "Health Issues" theme comprised a number of child codes, including "Mental Health Issues," "Physical Health Issues," "Substance Use Disorder," and "Inaccessibility of Healthcare." Many of the Samaritan users shared that health issues had cascading impacts that resulted in homelessness:

- *"Member 006 ended up on the street after medical conditions made it hard to hold a job."*
- *"Member 007 struggled with mental health and addiction after serving in Vietnam and ended up homeless."*
- *"Member 008 was evicted after being laid-off from a construction job due to injury. The injury in his foot made it incredibly painful to walk short distances, which made finding new work difficult."*

- *"Member 009 was working 60-70 hours a week when he eventually collapsed and underwent a major medical treatment, leading to his homelessness.*

5.1.3 Deterioration of Interpersonal Relationships

The "Deterioration of Interpersonal Relationships" theme focuses on the loss or absence of a support network and social capital, a core focus of Samaritan's platform. This theme encompasses the child codes "Family Issues," "Loss of a Family Member," "Divorce / End of a Relationship," and "Domestic Violence / Abuse." An interpersonal support network may serve as a final line of defense before a person becomes homeless, often allowing individuals to solicit family or friends for temporary assistance while re-establishing self-sufficiency. The stories of individuals who did not have sufficient social capital to call on close contacts for support before entering homelessness are especially important for a company like Samaritan, who focuses on providing social support on top of financial resources as a means to achieve better outcomes:

- *"Member 010 became homeless due to family circumstances."*
- *"Member 011 ended up on the street after a divorce, loss of child custody, and subsequent addiction."*
- *"Member 012 became homeless after his stepdad kicked him out of his home."*
- *"Member 013 ended up on the street after she ran away from domestic violence."*

5.2 Factors Preventing Exit from Homelessness

5.2.1 Health Issues

"Health Issues" include the child codes "Mental Health," "Substance Use Disorder," "Physical Health," "Access to Care," and "Access to Medications." Mental health, substance misuse, and other health conditions were significant barriers for individuals in receiving and maintaining employment, most notably contributing to limited mobility that restricted job opportunities in several sectors. Access to healthcare and medications also posed issues for Samaritan users as pressing needs like housing or food took precedence over management of

health conditions, exacerbating poor health outcomes that reinforced health-related barriers to employment.

- *“Member 014 had a traumatic brain injury and felt unable to hold a steady job.”*
- *“Chronic medical issues made it hard for Member 015 to keep a job.”*
- *“Member 016 ended up on the street after medical conditions made it hard to hold a job.”*
- *“Member 017 ended up on the street. In a short time, Member 017 developed a mental illness that made him unable to hold conversations or be in confined spaces.”*

5.2.2 Lack of Support

Another issue for individuals seeking to exit homelessness was the lack of support and interpersonal relationships that could be relied upon to address immediate needs. The theme “Lack of Support” focuses on these important stakeholders, including family, friends, case managers, counselors, and legal support, which are represented through child codes such as “Lack of Family + Friend Support,” “Non-Contact with Case Manager / Counselor,” “Legal Needs,” and “Social Support Networks.”

- *“Through his beacon, Member 018 formed relationships with Samaritans who have given him critical items and have invited him into their community, providing the hope and support needed to eventually find work again.”*
- *After Member 019 received his beacon, he began having Lifecare visits and created a game plan of steps to get where he wants to be with his case manager”*

5.2.3 Intermediate Barriers

The “Intermediate Barriers” theme includes an array of barriers that prevent individuals from making meaningful advancements towards their eventual goals. This theme covers the child codes “Transportation,” “Clothes / Equipment,” “Phone / Phone Plan,” “Criminal Record / Legal Issues,” and “Other Logistical Issues,” all of which posed some barrier for Samaritan users in attaining either employment or housing. Lack of transportation prevented users from attending work or job interviews, accessing medical care, and addressing other related social needs.

Clothes were most often needed for employment opportunities (i.e., personal protective equipment, job interview, rain jacket). Phones were necessary for communication with potential employers, as well as finding shelter, food, and other supportive services. Having a criminal record or past legal issues and missing crucial administrative documents like driver's licenses, birth certificates, and passports pose further hurdles for PEH looking to exit homelessness.

- *"Member 020 moved to Seattle to find work, but work permit issues prevented her from getting a job."*
- *"Member 021 ended up on the street after she ran away from domestic violence. Member 021 eventually found housing, but outstanding traffic tickets and penalties prevented her from getting to a job she had received where she needed to drive."*
- *"Member 022 used the beacon to get a new passport so he could apply for housing."*
- *"Member 023 used the hundreds of dollars she received on her beacon to pay for [...] her overdue storage unit, which contained documents she'd need for housing and employment."*

5.2.4 Employment-Related Issues

The "Employment-Related Issues" theme describes employment-related barriers that prevent PEH from exiting homelessness This theme consequently encompasses child codes like "Inability to Find Employment," "Inability to Maintain Employment," and "Lack of Income." Whether or not employment was an end goal or some intermediary priority, the lack of employment and income prevented the accumulation of financial resources needed to accomplish other tasks required to become housing secure. Many users also shared that they lacked the self-confidence needed to apply to jobs and attend job interviews, which they attained through case management support and messages of encouragement from Samaritan supporters.

- *"Member 026 was ready to work. But he was sleeping outside or in shelter, constantly threatened by the elements, illness and abuse."*
- *"Over time, Member 027 built up enough confidence to finally apply for a job again."*

- *"Member 028 was able to use the funds on her beacon to get a wig, so she could have the confidence to go to court hearings in her fight for her daughter and attend job interviews to find employment."*

6. KEY INFORMANT INTERVIEW RESULTS

Facilitators, barriers, and key features of Samaritan's platform were central focuses in key informant interview questions and are crucial for determining best practices in designing and implementing TBIs for PEH. Conversations with three Samaritan staff members highlighted numerous themes within these three topics, with each staff member providing different perspectives on Samaritan's Seattle Pilot. Additionally, one of the key informant interviews discussed incorporating healthcare providers into Samaritan's platform to encourage cross-sectoral partnerships between community stakeholders and improve health outcomes among users.

6.1 Facilitators for Success

Two interviewees expressed that one of the driving forces behind Samaritan's success as a platform was the magnitude of impact that small dollar values could have on SDOH outcomes. Though financial resources varied between users, the resources received were used to achieve specific, immediate goals that stood to have the greatest effect on their current circumstances. For example, one user needed money to purchase a rain jacket so that they could continue working as a bike courier when the Fall and Winter weather hit Seattle. Another user required personal protective equipment so that they could secure employment in the construction industry, while a third user spent funds on storage locker fees so that they would be able to retrieve important documents like their driver's license or passport that was in storage. In all of these instances, smaller amounts of money helped users overcome intermediate, logistical barriers needed to accomplish longer-term, high-level needs like housing or employment.

Interviewees also shared that the accessibility of the platform facilitated its success, as users did not need a phone number, email address, bank account, or credit card to enroll. Users

were able to connect with the platform through a mobile app or via the internet if they had the capabilities, but users could also access Samaritan through the case manager that enrolled them to receive funds, messages, and post personal updates. The platform also utilizes a smart wallet that doesn't need to be connected to a bank account, thus eliminating a common barrier for PEH in receiving and using financial resources.

The flexibility provided to individual users was another contributor to platform success, as users were able to post their goals and needs to the platform. Case managers worked with users to develop long-term goals like securing employment or housing, working backward to identify areas where funds could be targeted to support action towards long-term goals. Individuals can also change their listed needs and goals as their situation changes. Further, while individuals could be potentially unenrolled in the system due to months of inactivity, all users could re-enroll in the platform and receive access to all funds they had left prior to disenrollment. The central focus on individual SDOH needs meets users where they are, ultimately improving platform usability for PEH with unique needs and diverse backgrounds.

Case managers and community-based organizations (CBOs) play a central role in the success of Samaritan's platform and their participation directly facilitates its effectiveness. Case managers at CBOs identify individuals that could benefit from Samaritan, then work with them to prioritize needs, identify goals, and determine how to maximize the impact of funds from supporters. Without their assistance, users may struggle to identify the intermediate barriers blocking them from long-term goals, which poses problems for deciding how to use funds. Additionally, prior to case manager-led enrollment, Samaritan employed a team of volunteers to enroll users in the platform. However, volunteers were not typically available for follow-ups on

problems that arose. These factors constrained initial Samaritan use and expansion, and the company scaled up user recruitment and funding once case managers assumed a greater role.

Throughout the initial Seattle Pilot, the Samaritan team was committed to making iterative improvements to the platform based on stakeholder feedback grounded in the lived experiences of people who would most benefit from the app. The original Samaritan app connected users with private supporters through physical proximity, in which devices would connect over Bluetooth to facilitate interactions. However, users shared that this forced them to walk around crowded places in downtown Seattle to access support through the platform, which caused them to forgo finding shelter or food for the chance to receive potentially larger sums from supporters. Another improvement was the switch from volunteer enrollment to case manager enrollment, improving enrollment pathways, prioritization of needs, and assistance in navigating the complex social services sector. Interviewees also communicated that SDOH outcomes were not initially measured, which prevented the capture of the improvements made through the platform and dissemination of positive findings to potential funders and stakeholder partners to increase capital and support needed to scale up operations sooner. Despite these initial issues, the continued commitment to adapting the platform for improved user experiences has made Samaritan more accessible and useful.

6.2 Barriers to Success

One issue for Samaritan has been privacy concerns associated with their platform. Usually, users would share their background or story on how they became homeless and the goals they were hoping to accomplish through the platform. However, some users may have sensitive pasts that they did not wish to share with strangers, or information that could be used to locate them. While these issues have been alleviated by making personal information and profile

pictures optional in the app, other issues like individuals believing that the app was tracking them were also present in potential users. Samaritan is working to communicate exactly how their information is collected to alleviate such concerns for potential users.

Though user enrollment has improved significantly with case managers taking charge, Samaritan has experienced enrollment issues throughout the Seattle Pilot. Initially, "beacons" had smart wallet functions and connected to supporters via physical proximity, but there were often not enough of these physical beacons to enroll all potential users who expressed an interest in participating. Some issues persisted even with the transition to case manager enrollment, including users being frustrated or confused about the platform's purpose and expectations and some community organization partners having issues with enrollment due to technical problems. Many nonprofits in the Greater Seattle-King County area are already working at maximum capacity and thus had no interest in facilitating access to the platform for their target populations.

While Samaritan did not require a phone number, email address, or bank account to enroll to ensure accessibility, this sometimes made it challenging to contact PEH. These individuals accessed Samaritan primarily through their case manager, but they did not receive financial or social resources from supporters. As mentioned previously, individuals who were inactive for extended periods also did not receive push notifications regarding the potential deactivation of their account, and thus did not know to re-engage with their case manager. This subset of users was also unable to upload progress reports on their activities to the Samaritan platform, which decreased the likelihood of receiving future funding from supporters.

Finally, many stakeholders did not participate in the Seattle Pilot, chiefly the healthcare sector and local government bodies. Samaritan attempted to include Seattle government officials in the initial Seattle Pilot, reporting interest and enthusiasm in the platform's objectives.

However, this was before Samaritan collected data on SDOH outcomes achieved through their platform, meaning there was no data available for presentation to government officials who were hesitant about the project. As for the healthcare system, the Samaritan team shared clear opportunities for mutually beneficial partnership opportunities with healthcare providers, and Samaritan is incorporating them into a new tool being released later this year.

6.3 Key Samaritan Features and Characteristics

Samaritan's core mission to improve hopefulness in PEH through financial and social resources influenced two central design features: 1) disbursement of privately donated money to people experiencing homelessness and 2) facilitation of encouraging communication between users and donors. Financial resources allowed individuals to purchase items or services to address intermediate needs towards eventual housing and employment. Communications between users and donors helped cultivate social capital and develop social homes. These principal features provide a solid foundation for improved self-confidence and self-efficacy that encourages action towards achieving goals.

Samaritan is also effective as a touch-point creator, in which PEH can leverage the platform for further contact with social service agencies, the healthcare sector, and case managers. Interactions with case managers increase the likelihood of future case manager meetings, generally increasing the number of interactions with other potentially-useful social services.

Finally, Samaritan can scale up operations to respond to growing demand for their services. As the platform continues to grow, Samaritan leaders anticipate they will be able to partner with more case managers and CBOs to enroll more Samaritan users, in addition to expanding service offerings through partnerships with healthcare and municipal government

stakeholders. With increased data points and evidence demonstrating the platform's effectiveness, they anticipate recruiting more corporate and private partners to grow the Samaritan Action Fund and increase operational capacity.

6.4 Healthcare Stakeholder Integration

People experiencing homelessness often have unique, comorbid health needs that pose barriers to their attainment of stable housing and employment, thus making the integration of healthcare providers crucial for improving circumstances in housing insecure populations. One of the key informant interviews focused on partnerships between Samaritan and healthcare providers, offering a deeper understanding of how providers can leverage Samaritan for vulnerable patients.

A common theme was the use of Samaritan to stabilize patients' SDOH to facilitate improved health outcomes. When a PEH visits a hospital or emergency department, the care provider can coordinate with a patient navigator or case manager at the healthcare facility to get the PEH enrolled in Samaritan. From there, the patient navigator or hospital case manager can use the Samaritan platform to connect patients experiencing homelessness with important services like prescription fulfillment, SUD treatment, housing and employment resources, and connect them with a case manager at a social service organization to provide continued support as necessary. This serves two primary purposes: to reduce the number of days patients experiencing homelessness spend in vulnerable circumstances and to help navigate resources that will promote improved long-term outcomes.

Another opportunity for partnership with healthcare providers exists in setting care management plans for patients. Doctors and nurses can upload care plan activities for patients, who can then view necessary care activities like medication reminders, prescription refills,

attending appointments, and entering a treatment facility. Care providers can also set bonuses for patients in the platform that allow patients to receive a financial reward for completing specific care activities.

When a PEH enrolls in the Samaritan platform, they take a SDOH survey to provide a baseline understanding of their unique health-related social needs. Interviewees shared that a similar tool might be developed to screen potential users for substance use disorders and connect users with SUD resources to facilitate access to treatment.

Though promising partnerships between Samaritan, healthcare providers, and social service agencies stand to improve PEH circumstances, it is also necessary to consider the workload of these stakeholders and their capacity to incorporate Samaritan into their workflows. Given that many hospitals are working at-or-near maximum capacity, particularly during the COVID-19 pandemic, the interviewee shared potential workflows to mitigate the burden on healthcare providers. These workflows outlined potential enrollment channels for potential users, all of which depended on staffing availability within the care setting. The underlying assumption is that a care provider will identify an individual requiring further support or resources, calling upon a case manager or patient navigator to enroll the patient into Samaritan. From here, there are three potential workflows: 1) If the hospital has an internal team for vulnerable population case management, the patient navigator/case manager will set up continued care appointments for the PEH; 2) If the hospital has a partnership with a local social service agency to provide case management for PEH, the hospital's patient navigator/case manager will set up a meeting between the enrolling user and an external case manager at the partner organization, who is then responsible for further case management and care coordination; 3) If the hospital does not have an internal team or a partnership with an external agency, Samaritan will consult the patient

navigator/case manager/nurse on continued care coordination and Samaritan assumes responsibility for future case management.

7. DISCUSSION

7.1 Social Determinant of Health Improvements from Seattle Pilot Data

Analysis of SDOH improvements achieved through Samaritan revealed that most users experienced just 1 SDOH improvement and a smaller proportion of users reported multiple SDOH improvements. Improved outcomes predominantly fell under the areas of Nutrition (68.7%), Utilities (39.4%), Housing (9.6%), Income (8.4%), and Hopefulness (5.4%). However, there were some improvements in Access to Social Support (2.7%), Health (1.7%), Transportation (0.7%), and Access to Professional Support (0.3%).

The finding that nutrition was the most frequently observed SDOH improvement is not surprising due to the bidirectional relationship between housing and food insecurity (Lee et al., 2020). High costs associated with housing can exhaust financial resources, causing individuals facing housing insecurity to eat cheaper, nutritionally deficient food at less frequent intervals and in smaller amounts (Seale et al., 2016). PEH and housing insecure individuals will often choose between paying for housing or meals and forgoing food to retain shelter (HUD USER, 2018). Granular data on SDOH improvements was not available for the provided data set, but funds received through the Samaritan platform to pursue nutrition-related activities like buying meals, paying for groceries, or using transportation to get to supermarkets where more nutritious food may be more available.

Utility improvements were the second-most common improvement among Samaritan users. Key utilities for this population include electricity, water, gas, internet, and phone bills, all of which entail regular bills that may be difficult to pay for low-income and housing insecure individuals. Energy insecurity occurs when a household spends more than 10% of their income on energy bills, and similar to food insecurity, it can force low-income individuals to choose

between housing or utility expenditures (Hernandez, 2016). Many low-income individuals also live in older housing with energy inefficient lighting, heating, and ventilation systems, as well as inefficient appliances that can drive up utility costs (Shahyd, 2016). The “heat or eat” dilemma also arises from high utility costs for low-income households, in which they must decide between heating their home and purchasing food. Cell phone bills are considered utilities and can be essential tools for housing insecure individuals. A cellular device enables housing insecure and homeless individuals to locate and access necessary resources, communicate with employers and apply to jobs, call emergency services and other interpersonal contacts, and connect with healthcare providers. Prioritization of outstanding utility bills facilitates the continued use of important tools like cellular devices or the internet that allow PEH to access resources needed to improve their circumstances.

Far fewer Samaritan users reported housing or income improvements due to platform use, likely stemming from the relatively high cost of housing compared to food or utility bills and that securing employment is more complex than buying a meal or paying a bill. Roughly 78% of Samaritan users received fewer than $300 while using the platform (and 83% of users received less than $30 per week on average), which may have supplemented rent payments, but alone would not have been sufficient to pay one month’s worth of rent in Seattle. Alternatively, case managers connected users to Section 8 housing vouchers from the King County Housing Authority, allowing low-income individuals to pay between 28% and 40% of their income for rent, improving the affordability of private housing for those users (King County Housing Authority, 2020). Income improvements were likely achieved through employment opportunities made available through case managers, Samaritan supports, and partner organizations involved with Samaritan enrollment. However, Income improvements are potentially underreported; users

who utilized Samaritan funds for equipment needed to work (personal protective equipment, rain jackets, etc.) may not have reported improved Income, despite these items allowing them to continue working and secure reliable income.

Although a core tenet of Samaritan's mission, hopefulness improved for a smaller proportion of users. Among this group, the disbursement of financial resources provides the capital needed to accomplish tasks in pursuit of individual goals, while messages of encouragement help foster a social home and build a support network for users; both features help develop the self-confidence needed to work towards and accomplish personal goals. Several individuals explicitly mention the positive impact the messages of encouragement had on them, giving them the hope and support needed to improve their circumstances.

Interestingly, few users reported access to social support, health, or transportation improvements. Access to social support improvements is likely underreported, which could be due to a vague definition of social support provided during the collection of user feedback or the exclusion of messages of encouragement in the definition of social support. As messages of encouragement were supposed to contribute to users' support networks, and users received an average of 34.4 messages on the platform, it is also possible that Samaritan users simply did not consider the messages to constitute an improvement in access to social support.

The lack of health improvements is perhaps understandable given the lack of participation in the Samaritan platform from stakeholders involved in the healthcare system. Multiple individuals reporting Health improvements could access healthcare through interactions with their case manager, but Samaritan did not directly facilitate access to healthcare providers. Like housing, healthcare costs are usually considerably higher than the amount of funds disbursed through Samaritan, leading users to prioritize other more pressing, lower-cost needs.

Additionally, PEH often have complex, comorbid health conditions that are not easily alleviated with a single visit to a healthcare provider and thus may not be prioritized when using the Samaritan platform.

7.2 Paragraph Write-Up Findings

The subpopulation of Samaritan users with available paragraph write-ups supported SDOH outcome findings and shed light on both the key factors contributing to initial homelessness and the factors preventing exit from homelessness. Contributors to initial homelessness fell under three dominant themes: loss of self-sufficiency, health issues, and deterioration of relationships. Factors that prevented exit from homelessness fell under the themes of health issues, lack of support, logistical issues, and employment-related issues. A more thorough understanding of these variables is useful for conceptualizing the design of technology-based interventions in PEH and housing insecure populations; constructing a TBI to address these specific issues may elicit a more rapid transition into permanent housing or prevent homelessness from occurring in the first place.

Many of the paragraphs discussed issues at the intersection of employment, income, and housing, where unemployment preceded the loss of housing, which hindered their ability to remain employed. Several participants came to Seattle hoping to secure employment upon arrival, only to become homeless after failing to find work. Due to the cascading effects that loss of housing or employment can have, interventions targeted at people at risk of becoming homeless should fixate on rapid connection to housing and employment support as a means to reestablish self-sufficiency and prevent homelessness. Primary prevention of homelessness would include increasing the stock of affordable housing units or ensuring livable wages for all workers. Unfortunately, these strategies are resource intensive and require systemic changes,

which are considerably less useful for someone on the verge of becoming homeless. A more reasonable intervention would be a TBI that offers immediate cash assistance, rent subsidies or housing vouchers, or access to a database of in-demand employment opportunities through the platform. Such resources can rapidly improve an individual's self-sufficiency and prevent immediate homelessness and could be paired with continued support services for rapid rehousing.

Health issues were another common contributor to homelessness and were diverse among Samaritan users with paragraph writeups. Two causal pathways were most prevalent: 1) Individuals with health issues were unable to work and without income, subsequently became homeless, and 2) Individuals that were employed developed a health issue that limited their ability to work, causing them to lose their job and become homeless. Samaritan did not initially endeavor to facilitate access to medical care for their users, but the link between health, ability to work, and housing security suggests that improved healthcare access would improve outcomes for users with medical needs (NHCHC, 2019). While Samaritan itself does not have the capacity, nor the desire, to directly provide healthcare to its users, there exists an opportunity to expand their role and connect users with healthcare resources, in conjunction with connecting users to financial and social resources. Several tools may be added to the platform to improve healthcare accessibility for users and would be supported by case managers. One component could assist individuals with health conditions at risk of becoming homeless with enrolling in Medicaid or Medicare to ease the cost burden of healthcare for low-income individuals. By intervening before homelessness, individuals would have the insurance needed to cover potentially exorbitant healthcare costs, receive needed care, and regain the ability to work. In a related vein, a TBI could also consider assistance with scheduling appointments with healthcare providers, offering

information on appointment slots and sending notifications for appointment reminders, reducing potential issues with care access associated with difficulties in navigating the healthcare system.

Several users reported that their homelessness was preceded by a deterioration in interpersonal relationships, including family issues, loss of a family member, divorce or end of a relationship, and domestic violence. Such interpersonal relationships may be crucial support networks for PEH to fall back on when they lose housing insecure, in many cases providing temporary shelter and resources while a person works to regain self-sufficiency. Without them, PEH may be forced to seek temporary shelter or live outside sooner than if they had social support, which poses additional barriers for obtaining medical care, employment, and other supportive services. A TBI like Samaritan that catches individuals in these circumstances before they become homeless could help foster interpersonal relationships with case managers and Samaritan supporters, growing feelings of hopefulness and self-confidence needed to accomplish their immediate goal of remaining housing secure.

Similar to people at risk of becoming homeless, people looking to exit homelessness also reported the negative impacts that health issues had on their ability to become housing secure. Once homeless, more time-sensitive needs like shelter and food may take priority over managing health conditions. Additional barriers associated with homelessness can hinder access to care and prescription medications, further preventing appropriate health condition management. The aforementioned health-related TBI components of Medicaid enrollment and appointment scheduling assistance also benefit individuals looking to exit homelessness. Additional features that facilitate prescription medication renewal would help further reduce barriers to medical interventions. For Samaritan, features like financial resources and messages of encouragement may be leveraged in PEH to incentivize the achievement of care plan activities. On top of

uploading individual goals, Samaritan users could self-report care plan targets and Samaritan supporters could provide financial incentives when users meet specific goals within their care plan. With healthcare sector integration into a platform that improves SDOH needs and care coordination activities, PEH stand to benefit immensely through improved health, housing, and other SDOH outcomes necessary for regaining housing.

Another interesting theme in the barriers in exit from homelessness was the logistical issues present among Samaritan users, which usually prevented the accomplishment of long-term goals like housing or employment. For example, individuals needed phones to apply to jobs, communicate with employers, or contact shelters. These intermediate needs were prevalent among Samaritan users and were usually eliminated with the financial resources made available through the platform. While other TBIs focus on general connection to supportive services, few, if any, address these intermediate needs and the barriers they pose in obtaining housing and employment. These logistical issues emphasize the utility of many characteristics built into Samaritan's platform, including the effectiveness of small dollar amounts, providing flexibility in what funds can be used for, and giving users the self-confidence and hopefulness needed to continue working on their goals.

7.3 Key Informant Interview Takeaways

Interviews with Samaritan executives elicited multiple important takeaways from the Seattle Pilot, all of which are important for developing a set of best practices in designing technology-based interventions for populations experiencing housing insecurity. Several different features of Samaritan, strengthened by Samaritan's guiding principles, facilitated the improved outcomes observed by its users. While some initial issues impeded Samaritan's early progress, an attitude of iterative improvement guided by user feedback has resolved many of these problems

and allowed the platform to expand its scope, most notably developing strategic partnerships with healthcare providers.

The disbursement of financial resources and development of a social home through messages of encouragement are two features unique to Samaritan, both of which were important for their user population. Financial support, especially smaller donation amounts, could have a massive impact on users because it allows them to make purchases necessary to improve their immediate situations, like groceries or utilities. Messages of encouragement fostered self-confidence and self-efficacy needed to take steps towards larger goals like securing employment or housing. Samaritan executives emphasized the role of these features in improving the SDOH status of users, while also highlighting that aspects like case manager participation and granting users flexibility on the platform further supported the effectiveness of these features. Case managers were essential for user recruitment and platform enrollment, not to mention their willingness to incorporate Samaritan into their existing, often substantial, caseload. Once users were enrolled in the platform, case managers also assisted users in setting short- and long-term goals and budgets to help support the achievement of goals. Simultaneously, Samaritan users were granted substantial flexibility in setting goals and financial needs and barriers to participation like phone number, email address, or bank account were eliminated. Finally, Samaritan executives reported a commitment to being responsive to user feedback and transforming the platform as necessary to meet user needs, allowing the platform to grow rapidly.

The improvements made to Samaritan thus far have focused on initial problems identified by users and case managers. While these issues have been alleviated on the Samaritan platform, the lessons learned through these growing pains offer helpful considerations for other similar TBIs. Most notably, Samaritan has moved away from geographic proximity for connections

between users and supporters and volunteer enrollment, but has also begun to capture SDOH outcomes through an initial survey and reporting of SDOH improvements. Other key advancements have been the integration of healthcare providers into the Samaritan ecosystem, who can then employ Samaritan as a tool to improve patient stability through supportive services and resources. Samaritan executives noted that the healthcare sector could best use Samaritan as a tool to improve their housing insecure patient's immediate needs and stabilize them enough to fulfill care activities. Healthcare providers can also use the financial resources available through the Samaritan Action Fund to incentivize care activities like prescription fulfillment or appointment attendance. In addition to the enhanced relationship with healthcare providers, Samaritan envisions using the platform to screen for SUDs, offering another useful tool for healthcare providers caring for housing insecure populations.

7.4 Case Study Comparisons

The following three case studies depict three technology-based interventions targeted at people experiencing homelessness and offer opportunities for comparison between platform features and characteristics. These case studies portray an array of services and resources that may be incorporated in the platform design, thus offering valuable considerations for constructing and deploying TBIs for housing insecure users to eliminate frictions in their ability to access support.

7.5 Case Study 1: Kanndoo

7.5.1 Design

Kanndoo is a U.K.-based company that has developed an entire ecosystem of technology-based interventions for people experiencing homelessness (Kanndoo, 2021). Their primary app is named CARA and targets PEH, providing them with the location of donation

drop-points (primarily warm clothes, tents, sanitary products, and sleeping bags), work opportunities offered exclusively to CARA users, sites of emergency and temporary shelters, and local services like soup kitchens, food banks, and free legal services. CARA users can also use the app to share their location, health issues, medications, legal issues, and leave ratings for social service providers.

The CARA app connects to a second app called AIDA, intended for social support agencies to promote care coordination and reduce overlap of service provision. All participating organizations have access to information that a PEH has chosen to share and can see what other organizations have responded to PEH needs to prevent people from falling through the cracks and from duplicating service provision. CARA users can also activate an SOS function, which alerts AIDA users of a PEH in distress to ensure timely response to the crisis.

Kanndoo has developed a handful of other apps that both housing insecure and secure individuals can use, but the most relevant of their TBIs are JOBA and DON8TA (targeted at social services providers), and GRAFTA and NEEDA (targeted at PEH); JOBA allows companies to post short-term work opportunities on both CARA and GRAFTA for housing insecure persons. DON8TA allows anyone to post items they are looking to give away and a corresponding drop-off location, both of which are visible to NEEDA users.

7.5.2 Outcomes Achieved

Despite a collection of over 35 launched or in-development applications, little data exists about the demonstrable impacts that the Kanndoo ecosystem has been able to produce.

7.5.3 Takeaways

Kanndoo takes a multifaceted approach to address housing insecurity by developing numerous tech-based interventions. PEH can share their needs with the platforms and connect

with key stakeholders to improve their current circumstances. The apps work in pairs - one for supplying services and one for requesting services. Through coordinating platforms, the system can channel support to those in need while preventing duplication of services and ensuring that no one falls through the cracks. Kanndoo apps focus on some of the important issues that both contribute to and prevent exit from homelessness, including shelter, employment and income, and social support, and legal services. Despite addressing other crucial SDOH, none of the applications in Kanndoo' ecosystem facilitate access to the healthcare sector.

Kanndoo apps are similar to Samaritan in that they facilitate access to services and support from stakeholders, but few similarities exist between the platforms. While Samaritan distributes financial resources from private donors to users, Kanndoo directly pays PEH to promote their platforms, generating more app downloads and advertising income to develop more apps and support the organizations that have partnered with Kanndoo. Samaritan also emphasizes developing social homes and support networks to foster the hopefulness and self-confidence needed to achieve goals like housing or employment. In contrast, Kanndoo attempts to facilitate direct access to those necessities.

7.6 Case Study 2: Shelter App

7.6.1 Design

Shelter App is a non-profit that aims to help housing insecure and low-income families access services and resources through their platforms (Shelter App, 2021). Their services are available in many metropolitan areas, including King County, Portland, San Francisco and Oakland, Los Angeles, San Diego, Denver, El Paso, the Twin Cities, and more. The platform lists details of relevant community services like affordable housing communities, food banks, homeless & runaway youth shelters, youth drop-in centers, LGBT advocacy and support groups,

and crisis lines. These resources are available through filterable lists and an interactive map, allowing PEH to see the number of beds available at a location, hours of operation, access directions to the services location, and the ability to contact that location directly. All data is self-reported by the service organizations and vetted by Shelter App staff. Like Kanndoo, PEH can rate the services they use through the platform.

7.6.2 Outcomes Achieved

Since its founding in 2019, Shelter App has amassed 221,000 downloads across Google Play, the App Store, and web apps. Similar to Kanndoo, little data exists describing the outcomes that Shelter App has achieved, likely due in part to their relatively recent founding.

7.6.3 Takeaways

Shelter App has a core focus on connecting PEH to various support services and allows them to filter through services based on their individual needs. The platform also offers more in-depth information on those services, like the number of beds available at a given shelter or directions to get to that service provider location. Opposite Samaritan, Shelter App does not place any emphasis on access to financial or social resources, focusing instead on access to supportive services.

7.7 Case Study 3: StreetLight Chicago

7.7.1 Design

Street Light Chicago was developed by the Chicago Coalition for the Homeless and Young Invincibles in 2017. The platform is intended for housing insecure young adults between the ages of 16 and 24, and provides a plethora of resources including location of food kitchens, shelter bed reservations, medical care, counseling and mental health support, rent subsidy and

housing voucher information, cooling and warming centers, employment opportunities, and locations of lockers for people to store personal items. The two organizations spearheading this work found that most housing insecure young adults had phones but that the information on many of these services was not up to date. Thus, their main goal is to provide up-to-date, timely information for their users.

7.7.2 Outcomes Achieved

The app has been downloaded over 5,000 times since 2019 and has expanded partnerships with Chicago Public Schools to ensure that housing insecure students have the resources they need.

7.7.3 Takeaways

The central focus of Street Light Chicago is to provide up-to-date information on a comprehensive variety of services that may be of use to housing insecure populations (Street Light Chicago, 2021). This allows PEH and people at risk of becoming homeless to access services precisely when they need them so that they can respond to their rapidly changing circumstances.

Regarding services provided, rental assistance resources are one area in which Street Light Chicago differs from other tech-based interventions. Individuals at risk of becoming homeless can access resources through the Illinois Rental Repayment Program, the Illinois Court-Based Rental Assistance Program, and the Short-Term Homelessness Prevention program offered through Chicago’s 311 hotline. In contrast to other TBIs targeted at housing insecure populations, these resources are for individuals who may be at risk of becoming homeless as opposed to individuals who are already homeless, intervening at a key point prior to homelessness.

Chicago Street Light also offers mental health resources, including crisis hotlines, a list of mental health providers, and drop-in mental health services. The mental health providers are all displayed on a map with information like address, hours of operation, contact number, payment options, and walk-in and regular appointment availability. As mental illness is more prevalent in housing insecure populations, both as a contributor to homelessness and as PEH have a higher likelihood of developing a mental illness, these resources help facilitate access to needed healthcare services.

7.8 Synthesis: Optimizing Tech-Based Interventions for People Experiencing Homelessness

Widespread job loss during COVID-19 contributed to a loss of income that caused many tenants to fall behind on rent payments throughout the pandemic. With the recent end of Washington State's eviction moratorium on October 31st, tens of thousands of residents are at risk of being evicted and becoming housing insecure or homeless. In response to the magnitude of the issue, there is a clear need to prevent individuals from becoming homeless and support their rapid exit from homelessness by facilitating access to appropriate and timely resources.

To this end, technology-based interventions offer promising solutions for encouraging access to available social services, both for the influx of tenants at risk of becoming homeless and for the population of individuals in Greater King County already experiencing homelessness. TBIs do not usually provide direct services to populations in need, instead they help PEH navigate the complex, potentially overwhelming social services system, acting as a central node that connects populations in need to organizations willing to assist them. However, TBIs targeted at PEH have a variety of purposes, features, target populations, and partner organizations, translating to diverse outcomes and variable effectiveness. As individual TBIs are usually siloed in their approach to improving the livelihood of housing insecure populations, there exists no

collection of guiding principles or best practices to inform the work of developers in the social services sphere.

Thus, with the increase in tenants at risk of becoming housing insecure, the population of people already experiencing homelessness, the demonstrated utility of TBIs, the fragmented approach to developing TBIs, and the lack of recommendations for developing such interventions, this thesis aims to provide a comprehensive list of considerations for the design of TBIs intended for housing insecure populations and illustrates an “optimal” TBI based on these recommendations.

7.8.1 Guiding Principles

Evidence from the Samaritan intervention offers important insight on core principles of designing TBIs for housing insecure populations. Key informant interviews focused on fundamental priorities in the overarching design of a TBI, predominantly granting broad flexibility to PEH in setting goals and sharing needs. Meanwhile, a culture of responsiveness to user feedback and iterative improvement at Samaritan enabled the team to significantly improve the platform’s design, delivery, and data collection capabilities, all of which facilitated improved SDOH outcomes for users. Interviews also emphasized the importance of low-barrier enrollment for users, clear communication about Samaritan features and user responsibilities, and the need for case manager participation as key facilitators to maximize the accessibility and effectiveness of the platform.

The paragraph write-ups revealed themes spanning the two topics of factors contributing to initial housing insecurity and factors preventing exit from homelessness. Factors contributing to housing insecurity included loss of self-sufficiency, health issues, and deterioration of interpersonal relationships; TBIs aimed at housing insecure user bases must assume the

viewpoint that addressing these issues offers an opportunity to prevent users from becoming homeless. Within these themes, child codes like inability to find a job, eviction, mental health issues, substance use disorder, lack of contact with a case manager, and lack of a support network highlighted specific service needs that had the potential to improve an individual's immediate circumstances.

Similarly, analysis of factors preventing exit from homelessness entailed comparable themes such as health issues, lack of social support, employment issues, and intermediate barriers. While factors contributing to housing insecurity identify areas where services can prevent homelessness from happening in the first place, factors preventing exit from homelessness are the intermediate barriers and logistical issues standing between an individual experiencing homelessness and housing security. Providing services to alleviate these problems fosters the momentum needed for PEH to continue working towards short- and long-term goals and eventually obtain permanent housing.

7.8.2 Recommendations on Guiding Principles

- Allow users the flexibility to set and work towards unique individual goals. Individuals experiencing homelessness have the most comprehensive understanding of their circumstances and should have the capability to pursue any resources or services they feel stand to have the greatest impact on their situation.
- Leverage case managers to recruit and enroll potential participants while also allowing them to collaborate with users to prioritize service and resource needs.

- Ensure that the platform addresses a demonstrated need for individuals experiencing housing insecurity or homelessness. Individual user needs signal services and resources that are valuable to users, and thus bear consideration for inclusion into the platform.
- Collect user feedback on the platform's design, features, and characteristics and make improvements to better support the needs of a housing insecure user base.
- Prioritize clear communication with all stakeholders to avoid confusion regarding different roles, responsibilities, and opportunities inherent to the platform's ecosystem. This is particularly important for users, who may miss out on improved outcomes due to a misunderstanding of how the platform can best support them.
- There should be minimal requirements for participation in the platform to ensure equitable access for all potential users. For TBIs specifically, users experiencing homelessness can lack a phone number or phone, email address, or bank account. Eliminating these prerequisite needs allows for increased user participation and corresponding outcome improvements.

7.8.3 Key Stakeholders

Key informant interviews and comparison of Samaritan to other TBIs delivered to housing insecure populations highlighted a diverse array of stakeholders whose involvement in a TBI could help support improved user outcomes. Samaritan highlighted the utility of case managers and non-profit organizations, individual and corporate supporters, and healthcare providers. Case studies on Kanndoo, Shelter App, and StreetLight Chicago highlighted areas where additional stakeholders may be recruited for participation in a TBI. For example, Kanndoo incorporates potential employers into their platform to allow users experiencing homelessness to

access job opportunities exclusively available to users. Other potential stakeholders include SUD treatment providers, fire departments and emergency medical services, and municipal governments leaders.

7.8.4 Recommended Stakeholder Involvement

- Local kitchens offering meals for people experiencing homelessness
- Temporary and permanent shelters
- Case managers and local nonprofits
- Fire Departments and Emergency Medical Services
- Local housing authorities
- Local Federally Qualified Health Centers
- Other healthcare providers
- SUD treatment providers
- Municipal, state, and federal government

7.8.5 Core Features

Data from the Samaritan intervention, in addition to key informant interviews and case study comparisons, highlight several features, components, services, and resources that may be delivered through a TBI to adequately meet user needs and improve SDOH outcomes. Incorporation of features should be dependent on user needs, but a baseline set of services and resources offered through the TBI address important factors contributing to homelessness, barriers preventing exit from homelessness, and common needs and goals shared by users.

Samaritan prioritized facilitating access to financial support and building a social home, translating to features that allow the disbursement of money to users and communication with private supporters. Both features were important facilitators of goal attainment, with the financial

capital providing the resources needed to act on immediate needs. At the same time, messages of encouragement aimed to develop a social home that promoted self-efficacy and hopefulness within users. While the SDOH outcomes data did not depict substantial improvements to users' hopefulness through Samaritan use, both the paragraph write-ups and informant interviews suggest that the messages of encouragement had a positive influence for some users. Data suggests that financial resources are useful to a broad user base and might be a central design component, while messages of encouragement may be an additional TBI feature targeting a smaller subset of users who lack social support networks.

While healthcare providers were not directly involved with either the Seattle Pilot or any included case studies, providers have a clear opportunity to participate in TBIs for PEH to elicit improved healthcare service provision and subsequent health outcomes. For example, healthcare providers could use TBIs to facilitate access to supportive services for housing insecure patients to ensure that they can recover from illness or injury. Samaritan executives also discussed the ability of healthcare providers to upload specific care plan activities into the platform and corresponding financial incentives to improve care management. Other opportunities for healthcare sector involvement include Medicaid enrollment, prescription renewal, and appointment scheduling assistance, where healthcare providers could list available appointments on the platform and assist users with signing up for visits with care providers.

Other TBIs like Kanndoo, Shelter App, and StreetLight Chicago had features that provided resources and support in alignment with the factors contributing to homelessness and barriers preventing exit from homelessness found in this study. Kanndoo displayed the geographic locations of temporary and permanent shelters, soup kitchens, free legal services, and item dropoff spots, all of which help satisfy immediate needs so that users can focus on other

long-term goals. Kanndoo and StreetLight Chicago both coordinated with local employers to provide job listings exclusively available to their user base, similarly addressing employment issues that prevent their users from exiting homelessness. Shelter App and StreetLight Chicago both allowed users to view shelter bed availability and offered the possibility to contact shelter staff directly to confirm updated availability. The focus on accurate information was a central aspect of StreetLight Chicago's platform, communicating updated information on resources like housing vouchers and subsidies, medical care for homeless users, and locations of lockers to store personal items. Other features found in case study examples include connection to crisis hotlines and drop-in mental health services.

7.8.6 Recommended Features

- Messages of encouragement help foster a social home, self-efficacy, and hopefulness.
- Financial resources to address intermediate needs (i.e., groceries).
- Uploading care plan activities and corresponding financial incentives, both set by providers, to encourage prioritization of healthcare needs.
- Scheduling assistance and push notifications to remind patients of upcoming appointments.
- Medicaid enrollment through the TBI
- Prescription medication renewal
- Geographic location of partner organizations, soup kitchens, temporary and permanent shelters, item drop-off sites, and free legal services.
- Job board with readily available employment opportunities offered only to TBI user base
- Resources on housing vouchers and rent subsidies that may prevent users from becoming homeless or facilitate rapid exit from homelessness
- Daily availability of shelter beds and ability to contact shelter staff and reserve beds
- Connection to relevant crisis hotlines and drop-in mental health resources

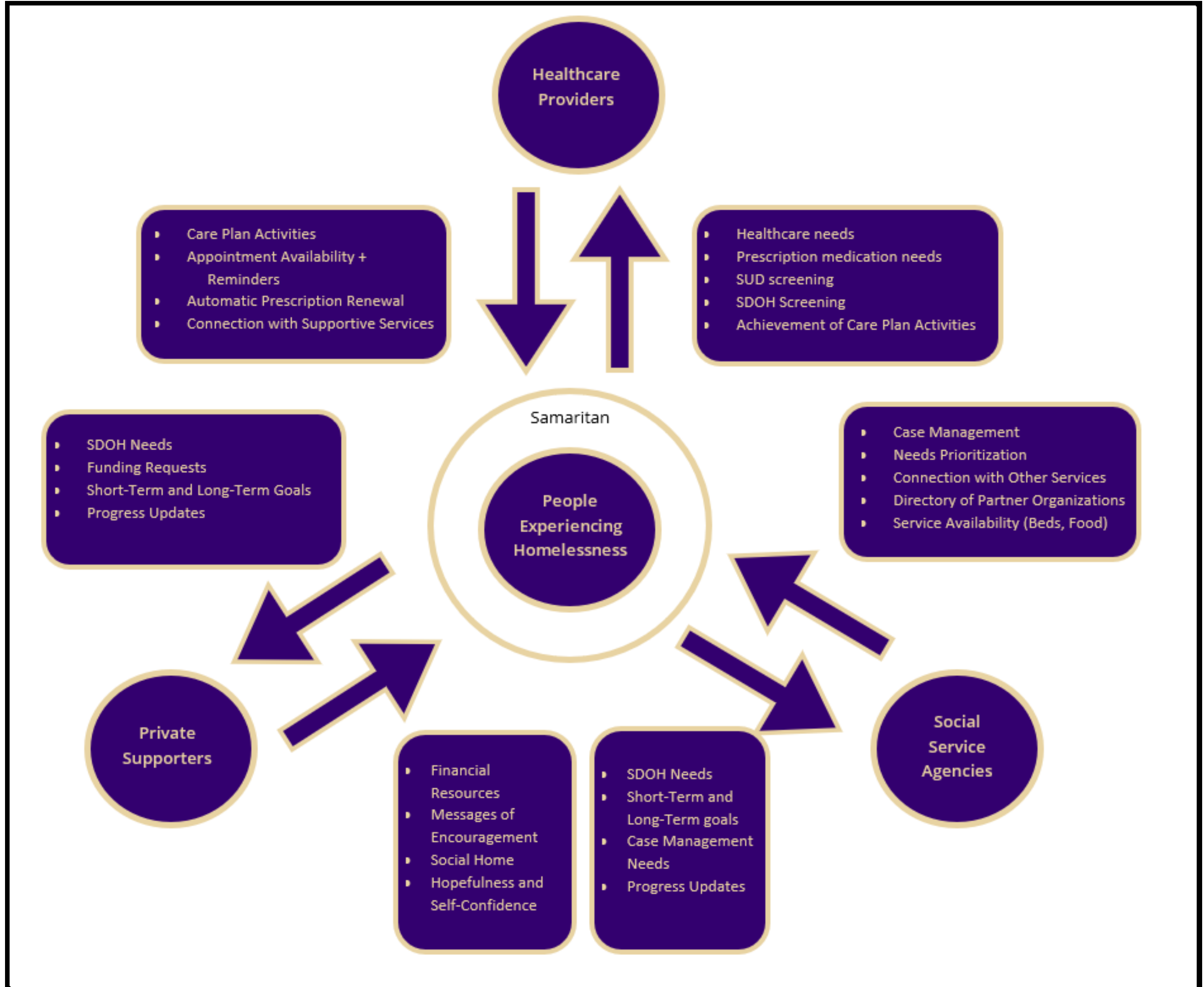

Figure 9: Diagram of Optimal Collaboration Between Stakeholders in Deployment of Technology-Based Interventions for Populations Experiencing Homelessness.

8. CONCLUSION

This thesis sought to accomplish the following four goals through an analysis of Samaritan outcomes data, factors contributing to homelessness and preventing exit from homelessness through paragraph write-ups, key informant interviews with Samaritan executives, and case study comparisons with other TBIs delivered to populations experiencing homelessness.

1. To evaluate outcomes achieved through a social determinant of health-focused technology-based intervention delivered to a housing insecure population in Greater King County.
2. To compare and contrast the design and function of technology-based interventions delivered to populations experiencing homelessness.
3. To determine important factors that contribute to initial homelessness, prevent successful exit from housing insecurity, and cause friction in the provision of social services.
4. To highlight important design considerations for future technology-based interventions delivered to housing insecure populations.

Social determinants of health outcomes data from Samaritan users revealed nutrition, utilities, housing, income, and hopefulness improvements, with most users reporting improvements in just one social determinant of health area. The subpopulation of users with paragraph write-ups offered insight into both factors contributing to homelessness and preventing exit from homelessness, including key themes such as loss of self-sufficiency, health issues, employment issues, and lack of interpersonal support networks. These themes highlight potential inefficiencies in social service delivery, thus indicating areas where interventions could improve accessibility of resources and facilitate improved outcomes. Analysis of key informant interviews provided additional information on facilitators to Samaritan's success, barriers to initial platform success, and core features that supported user outcome improvements. These findings further augment recommendations on potential components and design considerations to include in TBI design, while comparison with other TBIs targeted at housing insecure users provides a comprehensive set of best practices in TBI design and deployment.

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APPENDIX I: SAMARITAN USE STATISTICS

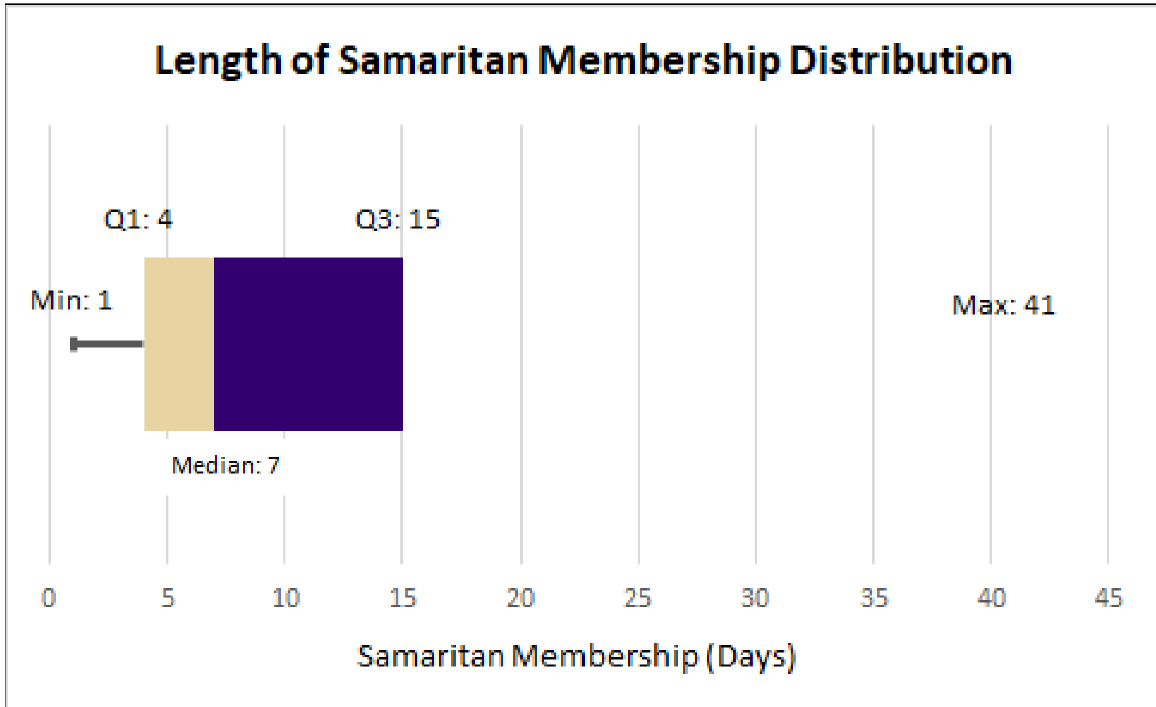

Figure 1: Box and Whisker plot of the Distribution of Samaritan Membership

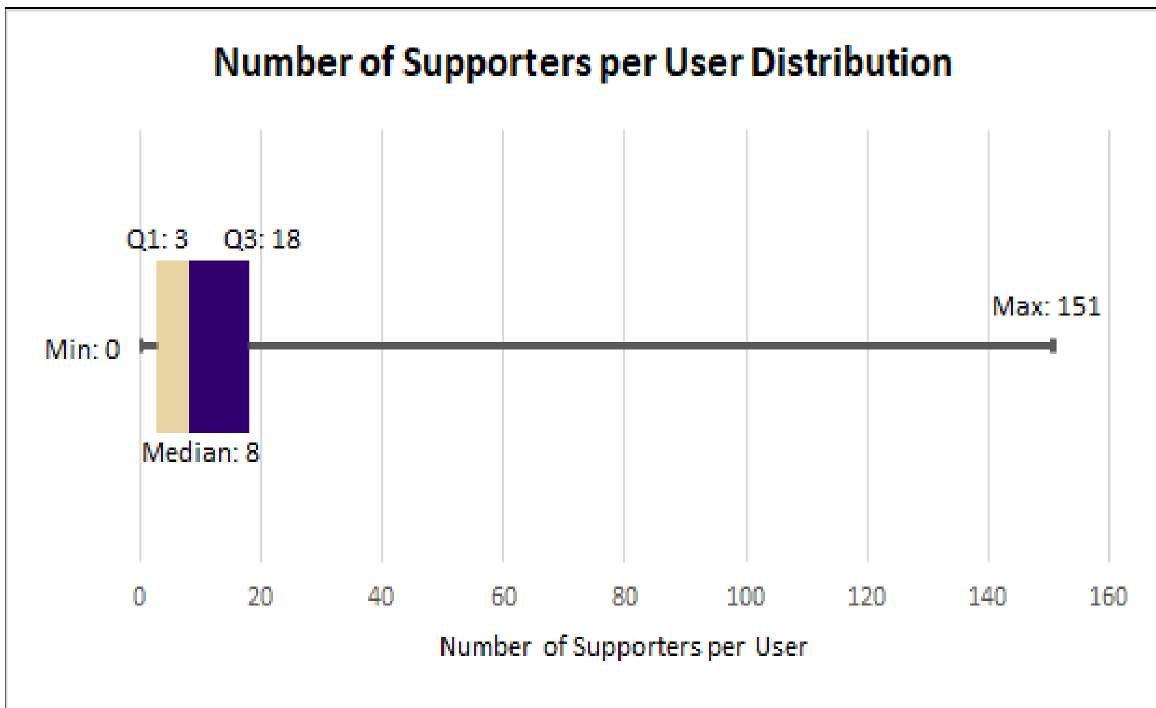

Figure 2: Box and Whisker plot of the Distribution of Supporters Per Users

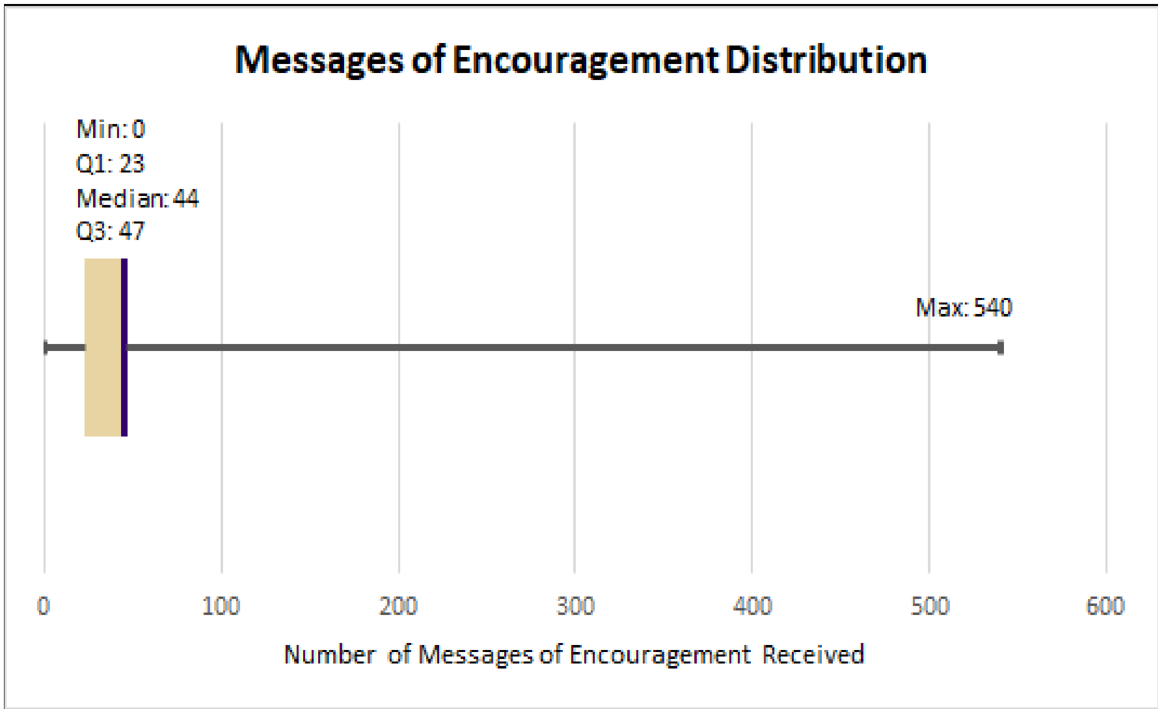

Figure 3: Box and Whisker plot of the Distribution of Messages of Encouragement Received by User

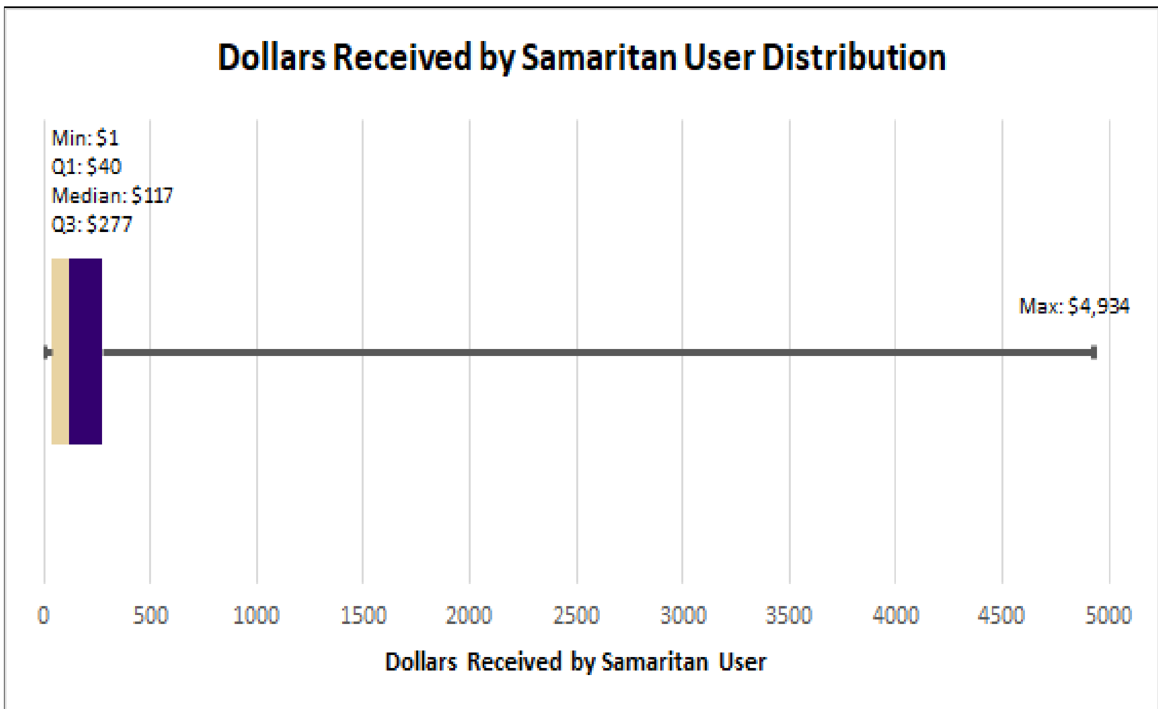

Figure 4: Box and Whisker plot of the Distribution of Dollars Received by Samaritan User

APPENDIX II: PARAGRAPH WRITE-UPS CODEBOOK

A. Codebook

Parent Code	Child Code	Child Code	Description
Factors Contributing to Homelessness	Deterioration of Interpersonal Relationships	Divorce / End of Relationship	Users shared that they became homeless due to a divorce or other end of a relationship.
		Loss of Family Member	Users shared that they became homeless because a family member passed away.
		Domestic Violence / Domestic Abuse	Users shared that they became homeless as a result of either domestic violence or domestic abuse
		Other Family Issues	Users shared that they became homeless due to other family issues not previously mentioned. One example might be the loss of custody of a child had cascading effects eventually leading to homelessness.
	Health Issues	Mental Health Issues	Users shared that they became homeless as a result of mental health issues.
		Physical Health Issues	Users shared that they became homeless due to physical health issues.
		Substance Use Disorder	Users shared that they became homeless as a result of substance use disorder.
		Inaccessibility of Healthcare	Users shared that they became homeless because they could not access healthcare, their condition worsened, and they became homeless as a result.
	Loss of Self-Sufficiency	Eviction / Lost Housing	Users shared that they became homeless due to eviction, disagreements with landlords, or other issues leading to loss of housing.
		Financial Hardship	Users shared that financial hardship prevented them from maintaining housing, causing homelessness.
		Lost Job	Users shared that losing their job directly impacted their housing security and ability to remain housed.

		Inability to Find Job	Users shared that their inability to find a job prevented them from remaining housing secure.
Factors Preventing Exit from Homelessness	Employment Issues	Inability to Find Employment	Users shared that inability to find employment was a major barrier to their exit from homelessness.
		Inability to Maintain Employment	Users shared that inability to maintain employment was a barrier to their exit from homelessness.
		Lack of Income	Users shared that a lack of income prevented them from exiting homelessness.
	Health Issues	Mental Health	Users shared that mental health issues prevented their exit from homelessness.
		Physical Health	Users shared that physical health issues prevented them from exiting homelessness.
		Substance Use Disorder	Users shared that substance use disorder was a barrier to their exit from homelessness.
		Access to Care	Users shared that lack of access to care worsened their health conditions, making it more challenging for them to exit homelessness.
		Access to Medications	Users shared that lack of access to medications exacerbated health conditions and prevented their exit from homelessness.
	Intermediate Barriers	Clothing / Equipment	Users shared that clothing or equipment was an intermediate barrier to their exit from homelessness.
		Criminal Record / Legal Issues	Users shared that criminal records or legal issues prevented them from securing housing or employment and prevented them from exiting homelessness.
		Phone / Phone Plan	Users shared that lack of phone or phone plan access prevented them from applying for jobs, accessing services, and communicating with employers, all of which encumbered their ability to exit homelessness.
		Transportation	Users shared that lack of transportation prevented them from traveling to

			job interviews or accessing services, preventing them from working and subsequently exiting homelessness.
		Other Logistical Issues	Users shared some other logistical issue that posed a barrier to employment or housing and eventual exit from homelessness.
	Lack of Support	Lack of Family + Friend Support	Users shared that a lack of familial or friend support negatively impacted their hopefulness and self-confidence, preventing them from exiting homelessness.
		Non-Contact with Case Manager	Users shared that their lack of contact with case managers was a barrier to their exit from homelessness.
		Legal Support	Users shared that they needed legal support and that their inability to access legal services posed a barrier to employment that prevented exit from homelessness.
		Lack of other Social Network	Users shared they lacked any other social network and thus interpersonal support, which impacted their hopefulness and self-efficacy.

B. Distribution of Codes

Media \ Codes	Factors Contributing to	Deterioration of Interpersonal	Divorce / End of Relationship	Domestic Violence / Domestic	Family Issues	Loss of Family Member	Health Issues	Inaccessibility of Healthcare	Mental Health Issues	Physical Health Issues	Substance Use Disorder	Loss of Self-Sufficiency	Eviction / Lost Housing	Financial Hardship	Inability to Find Job	Lost Job	Factors Preventing Exit from	Employment Issues	Inability to Find Employment	Inability to Maintain	Lack of Income	Health Issues	Access to Care	Access to Medication	Mental Health	Physical Health	Substance Use Disorder	Intermediate Barriers	Clothing / Equipment	Criminal Record / Legal Issues	Other Logistical Issues	Phone / Phone Plan	Transportation	Lack of Support	Lack of Family + Friend	Legal Support	Non-Contact with Case	Social Support Networks	Self-Efficacy	Self-Confidence / Hopefulness	Totals
Paragraph Write Ups.docx			5	6	6	2		1	3	4	5		7	3	11	8			4	3	1		1		2	7	3		15	3	7	3	8		3	1	8	2		11	143
Totals			5	6	6	2		1	3	4	5		7	3	11	8			4	3	1		1		2	7	3		15	3	7	3	8		3	1	8	2		11	