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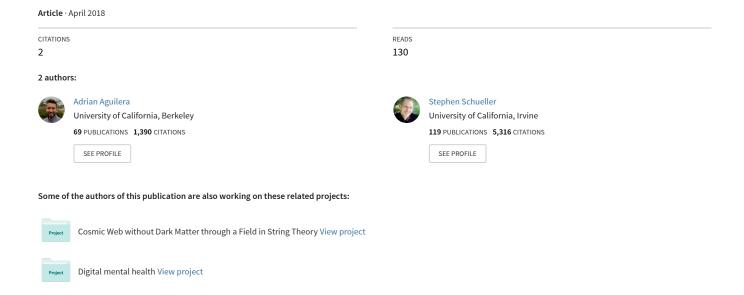
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Leveraging Mobile Technologies to Improve Mental Health in Underserved Populations: Lessons Learned From Latino Immigrants and Homeless Populations

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MOBILE PHONES and Internet connectivity have become a necessity in modern society. Although in the early days of the Internet, high-priced entry points such as computers and broadband connections contributed to a "digital divide" between those with and without access, the development of low-cost Internet connected devices such as smartphones has led to more pervasive availability. When the Pew Research Center started tracking Internet usage in early 2000, only half of American adults were online. Since then that number has grown to over 90% (Pew Research Center, 2017). However, groups access the Internet in different ways. While most people have broadband access at home, racial minorities, older adults, rural residents, and those with lower levels of education and income are more likely to use smartphones as their primary, and often only, access point to the Internet (Smith, 2015). Beyond Internet connectivity, mobile phones adoption is driven by their usefulness for a variety of tasks. They are used for communicating with others (phone, email, messaging, social networks), and accessing financial information, jobs, and health resources. Because these technologies connect people to invaluable information, they can be leveraged to intervene for improving mental health (Aguilera, Bruehlman-Senecal, Liu, & Bravin, 2017). This article will review some ways that mobile phones can be used to improve mental health with an emphasis on two underserved populations: Latino immigrants and homeless youth.

Recent years have demonstrated the potential of mobile phone technologies to provide mental health services more broadly. From text messaging interventions (Aguilera et al., 2017) to mobile apps (Pratap et al., 2017) to artificial intelligence–powered chatbots (Fitzpatrick, Darcy, & Vierhile, 2017), we have seen considerable innovation in new modes of intervention delivery and new types of interventions powered by technology. Technology has also demonstrated potential to improve identification and assessment of mental health. Google and the National Alliance on Mental Illness (NAMI) recently collaborated on efforts to provide depression and posttraumatic stress disorder screening to individuals

entering related terms into Google searches. Research demonstrates that passive assessment of mental health issues is possible through social media (e.g., Instagram—Reece & Danforth, 2017; Facebook—Schwartz et al., 2014) or smartphone sensors (Mohr, Zhang, & Schueller, 2017).

However, despite all the potential of technology to overcome issues present in our current mental health service system, issues such as stigma and limited access to underserved populations with high need still present problems. Stigma associated with mental health diagnoses and interventions is well documented, especially toward mental health treatment. This stigma can be higher among immigrant and low-income populations (Corrigan, 2004). The personal, private, and convenient nature of mobile phones make those mediums an ideal way to introduce mental health information and intervention. For example, Price, Davidson, Andrews, and Ruggiero (2013) found that underserved populations that are less likely to access in-person services were equally likely to engage in online interventions. Leveraging ubiquitous mobile devices to deliver mental health may reduce barriers such as stigma (Price et al., 2013), inflexible work schedules, transportation, childcare issues (Alvidrez & Azocar, 1999), and other factors that contribute to disparities in mental health service utilization.

Technology alone will not solve barriers to receiving quality mental health care. Instead, if mobile health technologies are to provide useful mental health resources for underserved populations, then they need to be designed to address their needs and preferences and be responsive or useful to the contexts where they are interested to receive care. We review some considerations of mobile health technologies generally to address mental health needs of underserved populations and discuss two particular underserved populations—Latino immigrants and homeless individuals—as illustrations intended to highlight considerations in the development, evaluation, and implementation of interventions using mobile health technologies.

mHealth for Spanish-Speaking Latinos With Depression

Although mobile health intervention development has exploded in recent years, development of mobile health tools does not always occur with diverse communities. According to the U.S. Census, there are 40 million Spanish speakers in the U.S. Latinos in the U.S. report significantly lower utilization of mental health services relative to need compared to their White counterparts, with those disparities increasing in recent years (Cook, Trinh, Li, Hou, & Progovac, 2016). When services are received, engagement (attendance and homework completion) tends to be low (Aguilera, Bruehlman-Senecal, Liu, & Bravin, 2017). Latino adults also report the very high utilization (94%) of mobile devices for accessing the Internet with younger and more educated subsegments utilizing mobile Internet at the highest rates (Brown, López, & Lopez, 2016). Despite the large population and high engagement with mobile phones, there are very few mHealth apps targeting mental health in Spanish. Only one study that we found has tested the feasibility of a mobile app for depression among Spanish speakers (Pratap et al., 2017) and another reported on the willingness of women to utilize apps for perinatal depression (Osma, Barrera, & Ramphos, 2016). There is a tremendous need to develop mHealth tools for mental health in Spanish.

Our group has utilized text messaging to improve the reach and quality of mental health interventions for Latino immigrants from low-income backgrounds and with low levels of educational attainment. HealthySMS is a text messaging platform that was developed with and for low-income populations (mostly Spanish speakers) to deliver a text-messaging-based adjunct to group cognitive behavioral therapy (GCBT) for the treatment of depression in a public sector primary-care clinic. The text-messaging-based adjunct was designed to enhance patients' mood-state awareness, improve CBT skill practice, increase therapy attendance, and help clinicians better track patient progress. Patients receiving this adjunct were sent daily text messages prompting them to report their mood on a 1 (*worst mood*) to 9 (*best mood*) scale, as well as daily psychoeducational messages that reinforced the concepts taught in GCBT. Patients were also sent weekly text-based reminders to attend therapy, and could opt in to receive daily reminders to take prescribed medications. Clinicians reviewed graphical representations of patients' daily mood data with patients during weekly GCBT sessions, allowing clinicians to assess patients' mood over the prior week, and talk with patients about how they could apply the strategies taught in therapy to cope with low mood.

Early feasibility and acceptability pilot research of the HealthySMS system demonstrates that patients reported overall positive experiences using texting as an adjunct to GCBT for depression (Aguilera & Berridge, 2014; Aguilera & Muñoz, 2011). In responding to open-ended questions regarding what they found helpful about the text messages, over half of patients spontaneously reported that the messages prompted self-reflection and mood-state awareness. For example, one English-speaking patient wrote: "They (the messages) made me stop and think for a moment about how I was feeling and why I was having those feelings. My life is so crazy, I need a reminder to think about how I feel." Similarly, a majority of patients also reported that the messages made them feel cared for, and closer to their therapist and the therapy group. For example, one Spanish-speaking patient indicated that the texting program "makes you feel like someone is concerned about you" (Aguilera & Berridge). In an earlier, smaller pilot, most patients (80%) also reported that the text messages encouraged them to attend therapy (Aguilera & Muñoz). Patients in this study respond to the text messages at an acceptably high rate, responding on average to 65% of the messages received over a 2–4 month period (Aguilera & Muñoz).

A recent clinical trial provides evidence that this text-messaging adjunct to GCBT increases psychotherapy attendance and reduces therapy dropout relative to stand-alone GCBT (Aguilera, Bruehlman-Senecal, Demasi, & Avila, 2017). Patients in this trial were low-income Spanish-speaking Latinos who were assigned to receive either standard GCBT for depression (control condition; *n* = 40) or the same treatment with the addition of the text-messaging adjunct described above (*n* = 45). Intent-to-treat analyses demonstrated that patients assigned to the text-messaging adjunct condition stayed in therapy significantly longer (median of 13.5 weeks before dropping out) than patients assigned to the control condition (median of 3 weeks before dropping out). Patients assigned to the text-messaging adjunct also generally attended a greater number of therapy sessions (median = 6 session) than patients assigned to the control (median = 2.5 sessions). The text-messaging adjunct did not lead to significantly higher reductions in depressive symptoms as both conditions experienced significant decreases in depressive symptom severity over the course of treatment. A larger sample would likely be needed to detect a potential condi-

tion difference in depressive symptoms or a longer study could investigate if the text-messaging adjunct might lead to more sustained benefits. Including text messaging might better reinforce how activities outside of the sessions can aid recovery and could potentially encourage people to engage in positive self-management behaviors in the period after treatment. Despite the shortcomings of the study, these findings provide promising evidence that text-based adjuncts to psychotherapy may promote sustained engagement with efficacious treatments for depression among Latino immigrants.

Data collected through HealthySMS has also proved useful in predicting clinically meaningful outcomes, including depressive symptom severity and weekly GCBT attendance. Average weekly mood ratings, measured via text, were found to reliably predict depressive symptom severity as assessed by the Patient Health Questionnaire (PHQ-9) within a sample of 33 depressed patients (Aguilera, Schueller, & Leykin, 2015). This finding suggests that text-based mood ratings may serve as an efficient proxy measure for depressive symptom severity, potentially reducing the need to administer the full PHQ-9 during therapy, a measure that can be clinically burdensome to administer and difficult to comprehend for patients with low literacy. Daily mood ratings have also been found to prospectively predict patients' likelihood of attending upcoming therapy sessions (Bruehlman-Senecal, Aguilera, & Schueller, 2017). In a sample of 56 depressed patients, patients who reported a more positive mood the day before a scheduled therapy session were significantly more likely to attend therapy the next day, even after controlling for their prior attendance history. These findings indicate that daily mood ratings can be used to predict and potentially prevent costly therapy appointment no-shows, allowing clinics to strategically time outreach to patients who need additional support to stay engaged. Given the benefits of regular therapy attendance, and the costs associated with early termination, this finding has high clinical utility. Taken together, these results underscore the value of the text messaging adjunct and the development with and for underserved and Spanish speaking populations.

Mobile Mental Health for Homeless Young Adults

Individuals experiencing homelessness are a high-need yet low-availability population when it comes to mental health services. Estimates consistently find that homeless individuals have rates of mental disorders 2 to 3 times higher than their housed peers (Quimby et al., 2002). Mental health issues are both a cause and consequence of homelessness, especially in young adults where homelessness often results from "aging out" of child welfare services (Fowler, Toro, & Miles, 2011). Indeed, nearly a quarter of children who leave the foster care system will experience homelessness within 2 years (Fowler, Toro, & Miles, 2009).

Unfortunately, homeless individuals receive mental health resources at extremely low rates, with estimates below 10% in most instances (De Rosa et al., 1999). Given the insufficiency of access to care, the most common setting for treatment tends to be emergency rooms when health needs can no longer be ignored (Ensign & Bell, 2004). This often results in treatment for acute issues such as substance use or serious mental illness but less care for common mental health problems, such as depression and anxiety. Just like their housed peers, however, common mental health issues are the primary mental health complaints among homeless individuals (Rohde, Noell, Ochs, & Seeley, 2001; Whitbeck, 2011).

Fortunately, evidence-based practices validated in other settings appear to be useful for homeless individuals. For example, a few studies have demonstrated that cognitive-behavioral therapy delivered in shelters can lead to significant decreases in depression and other mental health problems and improvements in self-efficacy (Hyun, Chung, & Lee, 2005; Taylor, Stuttaford, & Vostanis, 2007). However, although the treatments themselves are effective, there are considerable barriers to engagement. In one study, only treatment completers displayed significant benefits, and over half of the young adults who began treatment discontinued after the first session (Taylor et al., 2007). Thus, evidence-based practices must be provided in ways that are appropriate and acceptable for this population and the settings in which they come into contact with health resources.

While access to health care services is much lower than the general population, homeless individuals have a level of access to mobile technologies comparable to the general population. The adoption of specific technologies (e.g., feature phones as opposed to smartphones) are sometimes below current rates in some specific contexts, but the overall rates of ownership and use of devices is quite comparable. One-fourth of homeless individuals report using the Internet for more than an hour a day (most often accessed via smartphone devices; Rice & Barman-Adhikari, 2014; Rice, Monro, Barman-Adhikari, & Young, 2010). Estimates of smartphone ownership among homeless individuals ranges from 44% to 62% (McInnes, Li, & Hogan, 2013; Post et al., 2013), and individuals ages 18 to 29 account for the top end of that range (Rice, Lee, & Taitt, 2011).

Despite the high potential of mobile mental health interventions to be useful for homeless individuals, few attempts have been made to develop programs specifically for this population, and the research literature is completely lacking. In a system requiring low-cost interventions that can be used on-the-go without trained mental health specialists, mobile health interventions could promote a standard of care that could significantly advance mental health treatment in this population and setting.

In Chicago, we have been trying to leverage the affordances of technologies to develop a novel form of mental health services specifically designed for the needs of homeless young adults (Karnik, Glover, Boley, Schueller, & Zalta, 2017). The program was developed with stakeholder input from homeless young adults (Adkins et al., 2017), as well as close collaboration with the shelter system in which it would be deployed. Through focus groups we learned that homeless individuals, especially young adults, have frequently had negative experiences with mental health care and thus have low levels of trust in mental health professionals. Furthermore, depression, anxiety, and "stress" were indicated as chief concerns among different mental health issues. A major issue that emerged for these young adults was wanting to feel a sense of autonomy in their lives generally and, as a result, in the mental health treatment as well. We heard repeated stories of people feeling like their voices were not heard, which resulted in prescriptions of medications or treatment plans that did not address their needs. Additionally, logistical problems emerged. For example, travel to therapy appointments when even bus fare was a significant financial strain made it practical impossible to engage in traditional services.

Based on this input, we created a smartphone-delivered mental health program tailored to the needs of homeless young adults. The program consists of a combination of mental health apps and telephone

and text message support provided by a clinical psychologists. The apps leverage some products already developed and evaluated through Northwestern's Center for Behavioral Intervention Technologies such as the IntelliCare suite (Lattie et al., 2016; Mohr et al., 2017), as well as an app specifically designed for this population and project, Pocket Helper. Pocket Helper provides a daily tip supporting coping skills, which are the focus of the program, and a daily survey that feeds information back to the supporting clinical psychologist. The human support is based on concepts of "remote hovering" (Ben-Zeev, Kaiser, & Krzos, 2014) as well as the Efficiency Model of Support for Behavioral Intervention Technologies that emphasizes the importance of addressing goals of one's interaction with the technology (Schueller, Tomasino, & Mohr, 2017). Although the pilot program is still ongoing, several lessons have emerged from this early work.

First, the participants are accepting of this form of services and willing to engage with the program. We have had high rates of engagement with over half of the participants completing all of their telephone sessions. However, the highest rated aspect of the program is not the telephone support, ability to text message a provider, or the interactive mobile apps, but the simple tips that people receive on a daily basis. Last, although the participants enjoy the ability to connect with a provider via technology, they still would prefer to establish the connection through a face-to-face meeting. This suggests that "blended care" models that have become increasingly popular ways to integrate digital resources into mental health treatment abroad require further consideration in the United States. The idea that technologies might come to "replace" mental health providers is probably less likely in the near term than better learning how technologies can support providers. As such, technology might help create a form of market segmentation or fit into stepped-care models (i.e., some people receiving low-intensity treatments), but we should be thinking more deeply about technology plus humans rather than technology only serving as a stand-alone product.

Conclusions and Recommendations

It is crucial to identify populations with the highest need relative to available resources when developing and testing mental health interventions to achieve the maximum public health impact. Mobile

health interventions often do not reach the populations that are most affected by mental health problems. Nor are they developed with and for those least able to access care within the current system. In the U.S., vulnerable populations (e.g., economically disadvantaged, racial and ethnic minorities, uninsured, low-income children, elderly, homeless, etc.) frequently receive their care in safety net or nontraditional settings, where cutting-edge interventions such as new mobile technologies are not likely to be designed or developed, and are only available many years after use within higher-resourced systems (Regenstein, Huang, & Cummings, 2005). This significant translational gap presents problems in achieving health equity and increases the likelihood that these interventions, when actually implemented in underserved settings, will ultimately fail with respect to sustained patient engagement because they were not built with these types of systems and populations in mind. It is more likely that mobile interventions will be widely accessible and easy to use if they are designed and tested with diverse patients from the outset (Mohr, Weingardt, et al., 2017; Sarkar et al., 2016).

Designing technology with and for underserved populations requires an understanding of their specific needs, capabilities, and motivations to achieve desired health outcomes. Mobile phone interventions are most likely to be engaging when they are integrated into existing services that people utilize and when technology can be easily integrating into their daily activities and routines. This may require developing a range of technology-based interventions from unsupported standalone interventions to interventions integrating important human relationships (e.g., clinical, social, family, etc.). Furthermore, we need to understand people's preferences. Some people might view mobile mental health interventions as an undesirable alternative to face-to-face care (Rennick-Egglestone et al., 2016).

In the service of creating effective and efficient mHealth mental health interventions that can be responsive to people's needs, it is helpful to consider a continuum of possibilities for such interventions to enter clinical care. Muñoz (2017) presented such a continuum consisting of traditional services augmented by digital tools, guided interventions that could involve low-touch human involvement, and automated interventions that involve no human touch. This continuum of options might exist both within and between interventions;

and ensuring the availability of human support when desired, either remotely or face-to-face, might be an important future direction to tailoring interventions for diverse groups.

Reflecting on our two cases, there are still barriers to developing and implementing mHealth interventions for underserved populations. For example, older and less literate patients have a more difficult time engaging in mobile technology interventions because they tend to use and rely on smartphones less often and because they may have difficulty engaging in concepts that are largely delivered by text. Among homeless youth, some key barriers are lack of technology infrastructure (e.g., although smartphones are pervasive, WiFi and phone service are not), difficulties in promoting their awareness of such services and keeping them connected with them, and ensuring products represent the diversity of this group in terms of ethnic background and sexual orientation. These barriers are not insurmountable but should be viewed as design challenges to be addressed. Although leveraging mobile technology interventions for underserved populations is not always easy, we are confident that the efforts are worthwhile given the high level of need in these vulnerable and stigmatized populations.

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Child Sexual Abuse: Stigmatization of Victims and Suggestions for Clinicians

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CHILD SEXUAL ABUSE (CSA) occurs frequently, with one recent review suggesting that approximately 1 in 10 children will experience sexual abuse before age 18 (Townsend & Rheingold, 2013). Victims of CSA are at risk for developing a range of psychological and behavioral problems, including depression, anxiety, posttraumatic stress disorder (PTSD), suicidal thoughts and behavior, substance abuse, high-risk and inappropriate sexual behavior, and other conduct problems (Maniglio, 2009; Tyler, 2002). However, not all children experience these short- and long-term effects and many factors influence the heterogeneity of response to CSA (Kendall-Tackett, Williams, & Finkelhor, 1993; Putnam, 2003). Stigma, defined as "a mark of disgrace associated with a particular circumstance, quality, or person" (Oxford English Dictionary, 2017), can

play an important role in victims' recovery (Coffey, Leitenberg, Henning, Turner, & Bennett, 1996). As such, the purpose of this paper is to critically review the literature on how survivors of CSA are currently stigmatized, identify the consequences of such stigma, and make suggestions for clinicians working with CSA victims and their families.

Youth who experience sexual abuse often face stigma from others. Due to the stigma around victimization, some youth delay their disclosure and some never tell (Fontes & Plummer, 2010; Gagnier & Collin-Vézina, 2016). Estimates vary, however, as studies show that the majority of children who experience sexual abuse do not tell someone during childhood (London, Bruck, Ceci, & Shuman, 2005; Lyon & Ahren, 2011). Many survivors identify shame and embarrassment as a

primary reason for delayed disclosure (Anderson, Martin, Mullen, Romans, & Herbison, 1993; Fleming, 1997). Stigmatization of sexual abuse victims also discourages open communication between family members about the abuse and discourages open communication about the problem of CSA in the community. Stigma can also influence a youth's own perception of self-blame, shame, and guilt (Finkelhor & Browne, 1985; Karakurt & Silver, 2014) and can lead to feelings of isolation (Finkelhor & Araji, 1986). The effects of stigma may continue into adulthood. Coffey and colleagues (1996) found that stigma mediated the relationship between sexual victimization in childhood and adult psychological distress in women. Another study showed that the relationship between childhood sexual abuse and the use of avoidant coping strategies following an adult sexual assault was mediated by feelings of stigma (Gibson & Leitenberg, 2001). Overall, a review of the limited literature suggests that more research is still needed to better understand the stigma CSA victims experience. Relative to other widely studied topics in the CSA literature, the dearth of studies on stigma likely associates with the complex-